

FflasFpack

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1 FFLAS-FFPACK Documentation.	1
1.1 Introduction	1
1.2 Goals	1
1.3 Design	1
1.4 Using FFLAS-FFPACK.	1
1.5 Contributing to fflas-ffpack, getting assistance.	1
2 Configuring and Installing FFLAS-FFPACK	3
3 Copying and Licence	5
4 Tutorial	7
5 Architecture of the library.	9
6 Bug List	11
7 Bibliography	15
8 Todo List	17
9 Module Index	21
9.1 Modules	21
10 Namespace Index	23
10.1 Namespace List	23
11 Hierarchical Index	25
11.1 Class Hierarchy	25
12 Data Structure Index	33
12.1 Data Structures	33
13 File Index	41
13.1 File List	41
14 Module Documentation	49
14.1 CHECKER	49
14.2 FFLAS-FFPACK	49
14.2.1 Detailed Description	49
14.3 FFLAS	50
14.4 Matrix Multiplication Algorithms	50
14.4.1 Detailed Description	50
14.5 SIMD wrapper	50
14.6 FFPACK	50
14.6.1 Detailed Description	51
14.7 FFLAS-FFPACK fields	51

14.7.1 Detailed Description	51
14.8 RNS	51
14.9 Interfaces	51
15 Namespace Documentation	53
15.1 FFLAS Namespace Reference	53
15.1.1 Typedef Documentation	78
15.1.1.1 Checker_fgemm	78
15.1.1.2 Checker_ftrsm	78
15.1.1.3 ForceCheck_fgemm	78
15.1.1.4 ForceCheck_ftrsm	79
15.1.1.5 ZOSparseMatrix	79
15.1.1.6 NotZOSparseMatrix	79
15.1.1.7 SimdSparseMatrix	79
15.1.1.8 NoSimdSparseMatrix	79
15.1.1.9 MKLSparseMatrixFormat	79
15.1.1.10 NotMKLSparseMatrixFormat	79
15.1.1.11 has_plus	79
15.1.1.12 has_minus	80
15.1.1.13 has_equal	80
15.1.1.14 has_plus_eq	80
15.1.1.15 has_minus_eq	80
15.1.1.16 has_mul	80
15.1.1.17 has_mul_eq	80
15.1.1.18 Timer	80
15.1.1.19 BaseTimer	81
15.1.1.20 UserTimer	81
15.1.1.21 SysTimer	81
15.1.2 Enumeration Type Documentation	81
15.1.2.1 FFLAS_ORDER	81
15.1.2.2 FFLAS_TRANSPOSE	81
15.1.2.3 FFLAS_UPLO	82
15.1.2.4 FFLAS_DIAG	82
15.1.2.5 FFLAS_SIDE	82
15.1.2.6 FFLAS_BASE	82
15.1.2.7 number_kind	83
15.1.2.8 SparseMatrix_t	83
15.1.2.9 FFLAS_FORMAT	83
15.1.3 Function Documentation	84
15.1.3.1 InfNorm()	84
15.1.3.2 min3()	84
15.1.3.3 max3()	84

15.1.3.4 min4()	84
15.1.3.5 max4()	85
15.1.3.6 fadd() [1/8]	85
15.1.3.7 faddin() [1/4]	85
15.1.3.8 fsub() [1/4]	85
15.1.3.9 fsubin() [1/3]	86
15.1.3.10 fadd() [2/8]	86
15.1.3.11 pfadd()	86
15.1.3.12 pfsub()	87
15.1.3.13 pfaddin()	87
15.1.3.14 pfsubin()	87
15.1.3.15 fadd() [3/8]	87
15.1.3.16 fsub() [2/4]	89
15.1.3.17 faddin() [2/4]	89
15.1.3.18 fsubin() [2/3]	90
15.1.3.19 fadd() [4/8]	90
15.1.3.20 fassign() [1/10]	91
15.1.3.21 fassign() [2/10]	91
15.1.3.22 fassign() [3/10]	91
15.1.3.23 fassign() [4/10]	92
15.1.3.24 fassign() [5/10]	92
15.1.3.25 fassign() [6/10]	92
15.1.3.26 fassign() [7/10]	92
15.1.3.27 fassign() [8/10]	93
15.1.3.28 faxpy() [1/6]	93
15.1.3.29 faxpy() [2/6]	94
15.1.3.30 faxpy() [3/6]	94
15.1.3.31 faxpy() [4/6]	94
15.1.3.32 fdot() [1/11]	95
15.1.3.33 fdot() [2/11]	95
15.1.3.34 fdot() [3/11]	95
15.1.3.35 fdot() [4/11]	95
15.1.3.36 fdot() [5/11]	96
15.1.3.37 fdot() [6/11]	96
15.1.3.38 fdot() [7/11]	96
15.1.3.39 fdot() [8/11]	96
15.1.3.40 fgemm() [1/23]	97
15.1.3.41 fgemm() [2/23]	97
15.1.3.42 fgemm() [3/23]	98
15.1.3.43 fgemm() [4/23]	98
15.1.3.44 fgemm() [5/23]	99
15.1.3.45 fgemm() [6/23]	99

15.1.3.46 fsquare() [1/6]	100
15.1.3.47 fsquare() [2/6]	100
15.1.3.48 fsquare() [3/6]	101
15.1.3.49 fsquare() [4/6]	101
15.1.3.50 fsquare() [5/6]	101
15.1.3.51 fgemm() [7/23]	101
15.1.3.52 fgemm() [8/23]	102
15.1.3.53 fgemm() [9/23]	102
15.1.3.54 fgemm() [10/23]	103
15.1.3.55 fgemm() [11/23]	103
15.1.3.56 fgemm() [12/23]	103
15.1.3.57 fgemm() [13/23]	104
15.1.3.58 fgemm() [14/23]	104
15.1.3.59 fgemm() [15/23]	105
15.1.3.60 fgemm() [16/23]	105
15.1.3.61 fgemm() [17/23]	105
15.1.3.62 fgemm() [18/23]	106
15.1.3.63 fgemv() [1/19]	106
15.1.3.64 fgemv() [2/19]	107
15.1.3.65 fgemv() [3/19]	107
15.1.3.66 fgemv() [4/19]	107
15.1.3.67 fgemv() [5/19]	108
15.1.3.68 fgemv() [6/19]	108
15.1.3.69 fgemv() [7/19]	109
15.1.3.70 fgemv() [8/19]	109
15.1.3.71 fgemv() [9/19]	109
15.1.3.72 fgemv() [10/19]	110
15.1.3.73 fgemv() [11/19]	110
15.1.3.74 fgemv() [12/19]	111
15.1.3.75 fgemv() [13/19]	111
15.1.3.76 fgemv() [14/19]	111
15.1.3.77 fgemv() [15/19]	112
15.1.3.78 fgemv() [16/19]	112
15.1.3.79 fger() [1/12]	112
15.1.3.80 fger() [2/12]	113
15.1.3.81 fger() [3/12]	113
15.1.3.82 fger() [4/12]	114
15.1.3.83 fger() [5/12]	114
15.1.3.84 fger() [6/12]	114
15.1.3.85 fger() [7/12]	115
15.1.3.86 fger() [8/12]	115
15.1.3.87 fger() [9/12]	115

15.1.3.88 fger()	[10/12]	116
15.1.3.89 fger()	[11/12]	116
15.1.3.90 freduce()	[1/10]	116
15.1.3.91 freduce()	[2/10]	117
15.1.3.92 freduce_constoverride()	[1/2]	117
15.1.3.93 finit()	[1/8]	117
15.1.3.94 finit()	[2/8]	118
15.1.3.95 freduce()	[3/10]	118
15.1.3.96 pfreduce()		118
15.1.3.97 freduce()	[4/10]	119
15.1.3.98 freduce_constoverride()	[2/2]	119
15.1.3.99 finit()	[3/8]	119
15.1.3.100 finit()	[4/8]	120
15.1.3.101 freduce()	[5/10]	120
15.1.3.102 freduce()	[6/10]	120
15.1.3.103 freivalds()		121
15.1.3.104 fscal()	[1/10]	121
15.1.3.105 fscal()	[1/10]	122
15.1.3.106 fscal()	[2/10]	122
15.1.3.107 fscal()	[3/10]	123
15.1.3.108 fscal()	[2/10]	123
15.1.3.109 fscal()	[3/10]	123
15.1.3.110 fscal()	[4/10]	123
15.1.3.111 fscal()	[4/10]	124
15.1.3.112 fscal()	[5/10]	124
15.1.3.113 fscal()	[5/10]	125
15.1.3.114 fscal()	[6/10]	125
15.1.3.115 fscal()	[6/10]	125
15.1.3.116 fscal()	[7/10]	125
15.1.3.117 fscal()	[7/10]	126
15.1.3.118 fscal()	[8/10]	126
15.1.3.119 fscal()	[8/10]	126
15.1.3.120 fsyr2k()		126
15.1.3.121 fsyrk()	[1/5]	127
15.1.3.122 fsyrk()	[2/5]	128
15.1.3.123 fsyrk()	[3/5]	129
15.1.3.124 fsyrk()	[4/5]	129
15.1.3.125 fsyrk()	[5/5]	129
15.1.3.126 ftrmm()	[1/3]	130
15.1.3.127 ftrmm()	[2/3]	131
15.1.3.128 ftrsm()	[1/9]	132
15.1.3.129 ftrsm()	[2/9]	132

15.1.3.130 ftrsm() [3/9]	133
15.1.3.131 ftrsm() [4/9]	133
15.1.3.132 ftrsm() [5/9]	133
15.1.3.133 cblas_imptrsm()	134
15.1.3.134 ftrsv() [1/2]	134
15.1.3.135 igemm_()	134
15.1.3.136 finit() [5/8]	135
15.1.3.137 fconvert() [1/3]	135
15.1.3.138 fnegin() [1/4]	136
15.1.3.139 fneg() [1/4]	136
15.1.3.140 fzero() [1/4]	137
15.1.3.141 frand() [1/2]	137
15.1.3.142 fiszero() [1/4]	138
15.1.3.143 fequal() [1/4]	138
15.1.3.144 faxpby() [1/2]	138
15.1.3.145 fdot() [9/11]	139
15.1.3.146 fswap() [1/2]	139
15.1.3.147 fzero() [2/4]	140
15.1.3.148 frand() [2/2]	140
15.1.3.149 fequal() [2/4]	141
15.1.3.150 fiszero() [2/4]	141
15.1.3.151 fidentity() [1/4]	142
15.1.3.152 fidentity() [2/4]	142
15.1.3.153 finit() [6/8]	142
15.1.3.154 fconvert() [2/3]	143
15.1.3.155 fnegin() [2/4]	143
15.1.3.156 fneg() [2/4]	144
15.1.3.157 faxpby() [2/2]	144
15.1.3.158 fmove() [1/2]	145
15.1.3.159 bitsize()	145
15.1.3.160 bitsize< Givaro::ZRing< Givaro::Integer > >()	146
15.1.3.161 ftrmv()	146
15.1.3.162 ftrsm() [6/9]	146
15.1.3.163 pfgemm() [1/7]	147
15.1.3.164 pfgemm_1D_rec()	148
15.1.3.165 pfgemm_2D_rec()	148
15.1.3.166 pfgemm_3D_rec()	148
15.1.3.167 pfgemm_3D_rec2()	149
15.1.3.168 fgemm() [19/23]	149
15.1.3.169 ftrsm() [7/9]	150
15.1.3.170 ftrsm() [8/9]	150
15.1.3.171 fspmv() [1/2]	150

15.1.3.172 fspmm()	151
15.1.3.173 sparse_init() [1/16]	151
15.1.3.174 sparse_init() [2/16]	151
15.1.3.175 sparse_delete() [1/12]	151
15.1.3.176 sparse_delete() [2/12]	152
15.1.3.177 sparse_init() [3/16]	152
15.1.3.178 sparse_init() [4/16]	152
15.1.3.179 sparse_delete() [3/12]	152
15.1.3.180 sparse_delete() [4/12]	152
15.1.3.181 sparse_print() [1/3]	153
15.1.3.182 sparse_init() [5/16]	153
15.1.3.183 sparse_init() [6/16]	153
15.1.3.184 sparse_init() [7/16]	153
15.1.3.185 sparse_init() [8/16]	154
15.1.3.186 sparse_delete() [5/12]	154
15.1.3.187 sparse_init() [9/16]	154
15.1.3.188 sparse_init() [10/16]	154
15.1.3.189 sparse_init() [11/16]	155
15.1.3.190 sparse_delete() [6/12]	155
15.1.3.191 sparse_delete() [7/12]	155
15.1.3.192 sparse_init() [12/16]	155
15.1.3.193 sparse_init() [13/16]	155
15.1.3.194 sparse_delete() [8/12]	156
15.1.3.195 sparse_delete() [9/12]	156
15.1.3.196 sparse_print() [2/3]	156
15.1.3.197 sparse_delete() [10/12]	156
15.1.3.198 sparse_init() [14/16]	156
15.1.3.199 operator<<()	156
15.1.3.200 readSmsFormat()	157
15.1.3.201 readSprFormat()	157
15.1.3.202 getDataType() [1/4]	157
15.1.3.203 getDataType() [2/4]	157
15.1.3.204 getDataType() [3/4]	157
15.1.3.205 getDataType() [4/4]	157
15.1.3.206 readMachineType()	158
15.1.3.207 readDnsFormat()	158
15.1.3.208 writeDnsFormat()	158
15.1.3.209 fspmv() [2/2]	158
15.1.3.210 sparse_delete() [11/12]	158
15.1.3.211 sparse_delete() [12/12]	159
15.1.3.212 sparse_print() [3/3]	159
15.1.3.213 sparse_init() [15/16]	159

15.1.3.214 <code>sparse_init()</code> [16/16]	159
15.1.3.215 <code>computeDeviation()</code>	159
15.1.3.216 <code>getStat()</code>	160
15.1.3.217 <code>fflas_delete()</code> [1/4]	160
15.1.3.218 <code>fflas_delete()</code> [2/4]	160
15.1.3.219 <code>fflas_new()</code> [1/7]	160
15.1.3.220 <code>fflas_new()</code> [2/7]	160
15.1.3.221 <code>finit_rns()</code> [1/2]	161
15.1.3.222 <code>finit_trans_rns()</code>	161
15.1.3.223 <code>fconvert_rns()</code> [1/2]	161
15.1.3.224 <code>fconvert_trans_rns()</code>	161
15.1.3.225 <code>fflas_new()</code> [3/7]	162
15.1.3.226 <code>fflas_new()</code> [4/7]	162
15.1.3.227 <code>finit_rns()</code> [2/2]	162
15.1.3.228 <code>fconvert_rns()</code> [2/2]	162
15.1.3.229 <code>freduce()</code> [7/10]	162
15.1.3.230 <code>freduce()</code> [8/10]	163
15.1.3.231 <code>finit()</code> [7/8]	163
15.1.3.232 <code>fconvert()</code> [3/3]	164
15.1.3.233 <code>fnegin()</code> [3/4]	164
15.1.3.234 <code>fneg()</code> [3/4]	165
15.1.3.235 <code>fzero()</code> [3/4]	165
15.1.3.236 <code>fiszero()</code> [3/4]	166
15.1.3.237 <code>fequal()</code> [3/4]	166
15.1.3.238 <code>fassign()</code> [9/10]	167
15.1.3.239 <code>fscalin()</code> [9/10]	167
15.1.3.240 <code>fscal()</code> [9/10]	168
15.1.3.241 <code>faxpy()</code> [5/6]	168
15.1.3.242 <code>fdot()</code> [10/11]	169
15.1.3.243 <code>fswap()</code> [2/2]	169
15.1.3.244 <code>fadd()</code> [5/8]	170
15.1.3.245 <code>fsub()</code> [3/4]	170
15.1.3.246 <code>faddin()</code> [3/4]	171
15.1.3.247 <code>fadd()</code> [6/8]	171
15.1.3.248 <code>fassign()</code> [10/10]	171
15.1.3.249 <code>fzero()</code> [4/4]	172
15.1.3.250 <code>fequal()</code> [4/4]	172
15.1.3.251 <code>fiszero()</code> [4/4]	173
15.1.3.252 <code>fidentity()</code> [3/4]	173
15.1.3.253 <code>fidentity()</code> [4/4]	173
15.1.3.254 <code>freduce()</code> [9/10]	173
15.1.3.255 <code>freduce()</code> [10/10]	174

15.1.3.256 finit() [8/8]	174
15.1.3.257 fnegin() [4/4]	175
15.1.3.258 fneg() [4/4]	175
15.1.3.259 fscaln() [10/10]	176
15.1.3.260 fscal() [10/10]	176
15.1.3.261 faxpy() [6/6]	177
15.1.3.262 fmove() [2/2]	177
15.1.3.263 fadd() [7/8]	178
15.1.3.264 fsub() [4/4]	178
15.1.3.265 fsubin() [3/3]	179
15.1.3.266 fadd() [8/8]	179
15.1.3.267 faddin() [4/4]	180
15.1.3.268 fgemv() [17/19]	180
15.1.3.269 fger() [12/12]	182
15.1.3.270 ftrsv() [2/2]	183
15.1.3.271 ftrsm() [9/9]	183
15.1.3.272 ftrmm() [3/3]	184
15.1.3.273 fgemm() [20/23]	185
15.1.3.274 fgemm() [21/23]	185
15.1.3.275 fgemm() [22/23]	186
15.1.3.276 fgemm() [23/23]	186
15.1.3.277 fsquare() [6/6]	187
15.1.3.278 BlockCuts() [1/2]	187
15.1.3.279 BlockCuts< CuttingStrategy::Single, StrategyParameter::Threads >()	188
15.1.3.280 BlockCuts< CuttingStrategy::Row, StrategyParameter::Fixed >()	188
15.1.3.281 BlockCuts< CuttingStrategy::Row, StrategyParameter::Grain >()	188
15.1.3.282 BlockCuts< CuttingStrategy::Block, StrategyParameter::Grain >()	188
15.1.3.283 BlockCuts< CuttingStrategy::Column, StrategyParameter::Fixed >()	188
15.1.3.284 BlockCuts< CuttingStrategy::Column, StrategyParameter::Grain >()	189
15.1.3.285 BlockCuts< CuttingStrategy::Block, StrategyParameter::Fixed >()	189
15.1.3.286 BlockCuts< CuttingStrategy::Row, StrategyParameter::Threads >()	189
15.1.3.287 BlockCuts< CuttingStrategy::Column, StrategyParameter::Threads >()	189
15.1.3.288 BlockCuts< CuttingStrategy::Block, StrategyParameter::Threads >()	189
15.1.3.289 BlockCuts() [2/2]	190
15.1.3.290 pfzero()	190
15.1.3.291 pfrand()	190
15.1.3.292 fdot() [11/11]	190
15.1.3.293 pfgemm() [2/7]	191
15.1.3.294 pfgemm() [3/7]	191
15.1.3.295 pfgemm() [4/7]	191
15.1.3.296 pfgemm() [5/7]	192
15.1.3.297 pfgemm() [6/7]	192

15.1.3.298 pfgemm() [7/7]	193
15.1.3.299 fgemv() [18/19]	193
15.1.3.300 fgemv() [19/19]	193
15.1.3.301 parseArguments()	194
15.1.3.302 writeCommandString()	194
15.1.3.303 WriteMatrix() [1/2]	194
15.1.3.304 preamble()	195
15.1.3.305 ReadMatrix() [1/2]	195
15.1.3.306 ReadMatrix() [2/2]	195
15.1.3.307 WriteMatrix() [2/2]	196
15.1.3.308 WritePermutation()	196
15.1.3.309 alignable()	196
15.1.3.310 alignable< Givaro::Integer * >()	197
15.1.3.311 fflas_new() [5/7]	197
15.1.3.312 fflas_new() [6/7]	197
15.1.3.313 fflas_new() [7/7]	197
15.1.3.314 fflas_delete() [3/4]	197
15.1.3.315 fflas_delete() [4/4]	197
15.1.3.316 prefetch()	198
15.1.3.317 getTLBSize()	198
15.1.3.318 queryCacheSizes()	198
15.1.3.319 queryL1CacheSize()	198
15.1.3.320 queryTopLevelCacheSize()	198
15.1.3.321 getSeed()	198
15.2 FFLAS::BLAS3 Namespace Reference	199
15.2.1 Function Documentation	200
15.2.1.1 Bini()	200
15.2.1.2 WinoPar()	201
15.2.1.3 Winograd()	201
15.2.1.4 WinogradAcc_3_23()	201
15.2.1.5 WinogradAcc_3_21()	202
15.2.1.6 WinogradAcc_2_24()	202
15.2.1.7 WinogradAcc_2_27()	203
15.2.1.8 WinogradAcc_LR()	203
15.2.1.9 WinogradAcc_R_S()	203
15.2.1.10 WinogradAcc_L_S()	204
15.2.1.11 Winograd_LR_S()	204
15.2.1.12 Winograd_L_S()	205
15.2.1.13 Winograd_R_S()	205
15.3 FFLAS::csr_hyb_details Namespace Reference	205
15.4 FFLAS::CuttingStrategy Namespace Reference	205
15.4.1 Typedef Documentation	206

15.4.1.1 RNSModulus	206
15.5 FFLAS::details Namespace Reference	206
15.5.1 Function Documentation	207
15.5.1.1 fadd() [1/5]	207
15.5.1.2 fadd() [2/5]	208
15.5.1.3 fadd() [3/5]	208
15.5.1.4 fadd() [4/5]	208
15.5.1.5 fadd() [5/5]	209
15.5.1.6 freduce() [1/4]	209
15.5.1.7 freduce() [2/4]	209
15.5.1.8 freduce() [3/4]	209
15.5.1.9 freduce() [4/4]	210
15.5.1.10 fscaln() [1/2]	210
15.5.1.11 fscal() [1/2]	210
15.5.1.12 fscaln() [2/2]	210
15.5.1.13 fscal() [2/2]	211
15.5.1.14 igebb44()	211
15.5.1.15 igebb24()	211
15.5.1.16 igebb14()	211
15.5.1.17 igebb41()	212
15.5.1.18 igebb21()	212
15.5.1.19 igebb11()	212
15.5.1.20 igebp()	213
15.5.1.21 pack_lhs()	213
15.5.1.22 pack_rhs()	213
15.5.1.23 gebp()	214
15.5.1.24 BlockingFactor()	214
15.6 FFLAS::details_spmv Namespace Reference	214
15.7 FFLAS::ElementCategories Namespace Reference	214
15.8 FFLAS::FieldCategories Namespace Reference	215
15.8.1 Detailed Description	215
15.9 FFLAS::MMHelperAlgo Namespace Reference	215
15.10 FFLAS::ModeCategories Namespace Reference	215
15.10.1 Detailed Description	216
15.11 FFLAS::ParSeqHelper Namespace Reference	216
15.11.1 Detailed Description	216
15.12 FFLAS::Protected Namespace Reference	216
15.12.1 Function Documentation	219
15.12.1.1 computeFactorClassic() [1/3]	219
15.12.1.2 computeFactorClassic() [2/3]	219
15.12.1.3 computeFactorClassic() [3/3]	220
15.12.1.4 DotProdBoundClassic()	220

15.12.1.5 TRSMBound() [1/3]	220
15.12.1.6 TRSMBound() [2/3]	220
15.12.1.7 TRSMBound() [3/3]	220
15.12.1.8 fgemm_convert()	221
15.12.1.9 NeedPreAddReduction() [1/2]	221
15.12.1.10 NeedPreAddReduction() [2/2]	221
15.12.1.11 NeedPreSubReduction() [1/2]	221
15.12.1.12 NeedPreSubReduction() [2/2]	222
15.12.1.13 NeedDoublePreAddReduction() [1/2]	222
15.12.1.14 NeedDoublePreAddReduction() [2/2]	222
15.12.1.15 ScalAndReduce() [1/2]	222
15.12.1.16 ScalAndReduce() [2/2]	223
15.12.1.17 fsquareCommon()	223
15.12.1.18 WinogradThreshold() [1/4]	223
15.12.1.19 WinogradThreshold() [2/4]	223
15.12.1.20 WinogradThreshold() [3/4]	224
15.12.1.21 WinogradThreshold() [4/4]	224
15.12.1.22 WinogradSteps()	224
15.12.1.23 DynamicPeeling()	224
15.12.1.24 DynamicPeeling2()	225
15.12.1.25 WinogradCalc()	225
15.12.1.26 fgemv_convert()	226
15.12.1.27 fger_convert()	226
15.12.1.28 min_types() [1/7]	226
15.12.1.29 min_types() [2/7]	226
15.12.1.30 min_types() [3/7]	226
15.12.1.31 min_types() [4/7]	227
15.12.1.32 min_types() [5/7]	227
15.12.1.33 min_types() [6/7]	227
15.12.1.34 min_types() [7/7]	227
15.12.1.35 unfit() [1/4]	227
15.12.1.36 unfit() [2/4]	227
15.12.1.37 unfit() [3/4]	227
15.12.1.38 unfit() [4/4]	228
15.12.1.39 igemm_colmajor() [1/2]	228
15.12.1.40 igemm_colmajor() [2/2]	228
15.12.1.41 igemm()	228
15.12.1.42 MatF2MatD_Triangular()	229
15.12.1.43 MatF2MatFI_Triangular()	229
15.13 FFLAS::sell_details Namespace Reference	229
15.14 FFLAS::sparse_details Namespace Reference	230
15.14.1 Function Documentation	232

15.14.1.1 <code>init_y()</code> [1/2]	233
15.14.1.2 <code>init_y()</code> [2/2]	233
15.14.1.3 <code>fspmv_dispatch()</code> [1/2]	233
15.14.1.4 <code>fspmv_dispatch()</code> [2/2]	233
15.14.1.5 <code>fspmv()</code> [1/12]	234
15.14.1.6 <code>fspmv()</code> [2/12]	234
15.14.1.7 <code>fspmv()</code> [3/12]	234
15.14.1.8 <code>fspmv()</code> [4/12]	234
15.14.1.9 <code>fspmv()</code> [5/12]	235
15.14.1.10 <code>fspmv()</code> [6/12]	235
15.14.1.11 <code>fspmv()</code> [7/12]	235
15.14.1.12 <code>fspmv()</code> [8/12]	235
15.14.1.13 <code>fspmv()</code> [9/12]	236
15.14.1.14 <code>fspmm_dispatch()</code> [1/2]	236
15.14.1.15 <code>fspmm_dispatch()</code> [2/2]	236
15.14.1.16 <code>fspmm()</code> [1/9]	237
15.14.1.17 <code>fspmm()</code> [2/9]	237
15.14.1.18 <code>fspmm()</code> [3/9]	237
15.14.1.19 <code>fspmm()</code> [4/9]	237
15.14.1.20 <code>fspmm()</code> [5/9]	238
15.14.1.21 <code>fspmm()</code> [6/9]	238
15.14.1.22 <code>fspmm()</code> [7/9]	238
15.14.1.23 <code>fspmm()</code> [8/9]	238
15.14.1.24 <code>fspmm()</code> [9/9]	239
15.14.1.25 <code>pfspmm_dispatch()</code> [1/2]	239
15.14.1.26 <code>pfspmm_dispatch()</code> [2/2]	239
15.14.1.27 <code>pfspmm()</code> [1/9]	240
15.14.1.28 <code>pfspmm()</code> [2/9]	240
15.14.1.29 <code>pfspmm()</code> [3/9]	240
15.14.1.30 <code>pfspmm()</code> [4/9]	240
15.14.1.31 <code>pfspmm()</code> [5/9]	241
15.14.1.32 <code>pfspmm()</code> [6/9]	241
15.14.1.33 <code>pfspmm()</code> [7/9]	241
15.14.1.34 <code>pfspmm()</code> [8/9]	241
15.14.1.35 <code>pfspmm()</code> [9/9]	242
15.14.1.36 <code>pfspmv()</code> [1/6]	242
15.14.1.37 <code>pfspmv()</code> [2/6]	242
15.14.1.38 <code>pfspmv()</code> [3/6]	242
15.14.1.39 <code>pfspmv()</code> [4/6]	243
15.14.1.40 <code>pfspmv()</code> [5/6]	243
15.14.1.41 <code>pfspmv()</code> [6/6]	243
15.14.1.42 <code>fspmv()</code> [10/12]	243

15.14.1.43 fspmv() [11/12]	244
15.14.1.44 fspmv() [12/12]	244
15.15 FFLAS::sparse_details_impl Namespace Reference	244
15.15.1 Function Documentation	252
15.15.1.1 fspmm() [1/15]	253
15.15.1.2 fspmm() [2/15]	253
15.15.1.3 fspmm() [3/15]	253
15.15.1.4 fspmm_simd_aligned() [1/2]	253
15.15.1.5 fspmm_simd_unaligned() [1/2]	254
15.15.1.6 fspmm_one() [1/4]	254
15.15.1.7 fspmm_mone() [1/4]	254
15.15.1.8 fspmm_one_simd_aligned() [1/3]	254
15.15.1.9 fspmm_one_simd_unaligned() [1/3]	255
15.15.1.10 fspmm_mone_simd_aligned() [1/3]	255
15.15.1.11 fspmm_mone_simd_unaligned() [1/3]	255
15.15.1.12 fspmv() [1/21]	255
15.15.1.13 fspmv() [2/21]	256
15.15.1.14 fspmv() [3/21]	256
15.15.1.15 fspmv_one() [1/10]	256
15.15.1.16 fspmv_mone() [1/10]	256
15.15.1.17 fspmv_one() [2/10]	256
15.15.1.18 fspmv_mone() [2/10]	257
15.15.1.19 pfspmm() [1/18]	257
15.15.1.20 pfspmm() [2/18]	257
15.15.1.21 pfspmm() [3/18]	257
15.15.1.22 pfspmm_one() [1/2]	258
15.15.1.23 pfspmm_mone() [1/2]	258
15.15.1.24 pfspmm_one() [2/2]	258
15.15.1.25 pfspmm_mone() [2/2]	258
15.15.1.26 pfspmv() [1/18]	259
15.15.1.27 pfspmv_task()	259
15.15.1.28 pfspmv() [2/18]	259
15.15.1.29 pfspmv() [3/18]	259
15.15.1.30 pfspmv_one() [1/8]	259
15.15.1.31 pfspmv_mone() [1/8]	260
15.15.1.32 pfspmv_one() [2/8]	260
15.15.1.33 pfspmv_mone() [2/8]	260
15.15.1.34 fspmm() [4/15]	260
15.15.1.35 fspmm() [5/15]	261
15.15.1.36 fspmm_simd_aligned() [2/2]	261
15.15.1.37 fspmm_simd_unaligned() [2/2]	261
15.15.1.38 fspmm() [6/15]	261

15.15.1.39 fspmm_one() [2/4]	262
15.15.1.40 fspmm_mone() [2/4]	262
15.15.1.41 fspmm_one_simd_aligned() [2/3]	262
15.15.1.42 fspmm_one_simd_unaligned() [2/3]	262
15.15.1.43 fspmm_mone_simd_aligned() [2/3]	263
15.15.1.44 fspmm_mone_simd_unaligned() [2/3]	263
15.15.1.45 fspmv() [4/21]	263
15.15.1.46 fspmv() [5/21]	263
15.15.1.47 fspmv() [6/21]	264
15.15.1.48 fspmv_one() [3/10]	264
15.15.1.49 fspmv_mone() [3/10]	264
15.15.1.50 fspmv_one() [4/10]	264
15.15.1.51 fspmv_mone() [4/10]	264
15.15.1.52 pfspmm() [4/18]	265
15.15.1.53 pfspmm() [5/18]	265
15.15.1.54 pfspmm() [6/18]	265
15.15.1.55 pfspmm() [7/18]	265
15.15.1.56 pfspmm() [8/18]	266
15.15.1.57 pfspmm() [9/18]	266
15.15.1.58 pfspmv() [4/18]	266
15.15.1.59 pfspmv() [5/18]	266
15.15.1.60 pfspmv() [6/18]	267
15.15.1.61 fspmm() [7/15]	267
15.15.1.62 fspmm() [8/15]	267
15.15.1.63 fspmm() [9/15]	267
15.15.1.64 fspmv() [7/21]	268
15.15.1.65 fspmv() [8/21]	268
15.15.1.66 fspmv() [9/21]	268
15.15.1.67 pfspmm() [10/18]	268
15.15.1.68 pfspmm() [11/18]	268
15.15.1.69 pfspmm() [12/18]	269
15.15.1.70 pfspmm() [13/18]	269
15.15.1.71 pfspmm() [14/18]	269
15.15.1.72 pfspmm() [15/18]	269
15.15.1.73 pfspmm_zo() [1/2]	270
15.15.1.74 pfspmm_zo() [2/2]	270
15.15.1.75 pfspmv() [7/18]	270
15.15.1.76 pfspmv() [8/18]	270
15.15.1.77 pfspmv() [9/18]	271
15.15.1.78 pfspmv_one() [3/8]	271
15.15.1.79 pfspmv_mone() [3/8]	271
15.15.1.80 pfspmv_one() [4/8]	271

15.15.1.81 pfspmv_mone()	[4/8]	271
15.15.1.82 fspmm()	[10/15]	272
15.15.1.83 fspmm()	[11/15]	272
15.15.1.84 fspmm()	[12/15]	272
15.15.1.85 fspmm_mone()	[3/4]	272
15.15.1.86 fspmm_one()	[3/4]	273
15.15.1.87 fspmm_mone()	[4/4]	273
15.15.1.88 fspmm_one()	[4/4]	273
15.15.1.89 fspmm_one_simd_aligned()	[3/3]	273
15.15.1.90 fspmm_one_simd_unaligned()	[3/3]	274
15.15.1.91 fspmm_mone_simd_aligned()	[3/3]	274
15.15.1.92 fspmm_mone_simd_unaligned()	[3/3]	274
15.15.1.93 fspmv()	[10/21]	274
15.15.1.94 fspmv()	[11/21]	275
15.15.1.95 fspmv()	[12/21]	275
15.15.1.96 fspmv_one()	[5/10]	275
15.15.1.97 fspmv_mone()	[5/10]	275
15.15.1.98 fspmv_one()	[6/10]	275
15.15.1.99 fspmv_mone()	[6/10]	276
15.15.1.100 pfspmv()	[10/18]	276
15.15.1.101 pfspmv()	[11/18]	276
15.15.1.102 pfspmv()	[12/18]	276
15.15.1.103 pfspmv_one()	[5/8]	276
15.15.1.104 pfspmv_mone()	[5/8]	277
15.15.1.105 pfspmv_one()	[6/8]	277
15.15.1.106 pfspmv_mone()	[6/8]	277
15.15.1.107 fspmv()	[13/21]	277
15.15.1.108 fspmv_simd()	[1/4]	277
15.15.1.109 fspmv()	[14/21]	278
15.15.1.110 fspmv_simd()	[2/4]	278
15.15.1.111 fspmv()	[15/21]	278
15.15.1.112 fspmv_one()	[7/10]	278
15.15.1.113 fspmv_mone()	[7/10]	278
15.15.1.114 fspmv_one()	[8/10]	279
15.15.1.115 fspmv_mone()	[8/10]	279
15.15.1.116 fspmv_one_simd()	[1/2]	279
15.15.1.117 fspmv_mone_simd()	[1/2]	279
15.15.1.118 pfspmmm()	[16/18]	279
15.15.1.119 pfspmmm()	[17/18]	280
15.15.1.120 pfspmmm()	[18/18]	280
15.15.1.121 pfspmv()	[13/18]	280
15.15.1.122 pfspmv()	[14/18]	280

15.15.1.123 pfspmv()	[15/18]	281
15.15.1.124 fspmm()	[13/15]	281
15.15.1.125 fspmm()	[14/15]	281
15.15.1.126 fspmm()	[15/15]	281
15.15.1.127 fspmv()	[16/21]	282
15.15.1.128 fspmv()	[17/21]	282
15.15.1.129 fspmv()	[18/21]	282
15.15.1.130 pfspmv()	[16/18]	282
15.15.1.131 pfspmv()	[17/18]	282
15.15.1.132 pfspmv()	[18/18]	283
15.15.1.133 pfspmv_one()	[7/8]	283
15.15.1.134 pfspmv_mone()	[7/8]	283
15.15.1.135 pfspmv_one()	[8/8]	283
15.15.1.136 pfspmv_mone()	[8/8]	283
15.15.1.137 fspmv()	[19/21]	284
15.15.1.138 fspmv_simd()	[3/4]	284
15.15.1.139 fspmv()	[20/21]	284
15.15.1.140 fspmv_simd()	[4/4]	284
15.15.1.141 fspmv()	[21/21]	284
15.15.1.142 fspmv_one()	[9/10]	285
15.15.1.143 fspmv_mone()	[9/10]	285
15.15.1.144 fspmv_one_simd()	[2/2]	285
15.15.1.145 fspmv_mone_simd()	[2/2]	285
15.15.1.146 fspmv_one()	[10/10]	285
15.15.1.147 fspmv_mone()	[10/10]	286
15.16 FFLAS::StrategyParameter Namespace Reference		286
15.17 FFLAS::StructureHelper Namespace Reference		286
15.17.1 Detailed Description		286
15.18 FFLAS::vectorised Namespace Reference		286
15.18.1 Function Documentation		288
15.18.1.1 VEC_ADD()		288
15.18.1.2 addp()		288
15.18.1.3 VEC_SUB()		288
15.18.1.4 subp()		289
15.18.1.5 add()		289
15.18.1.6 sub()		289
15.18.1.7 reduce()	[1/9]	289
15.18.1.8 reduce()	[2/9]	289
15.18.1.9 reduce()	[3/9]	290
15.18.1.10 reduce()	[4/9]	290
15.18.1.11 reduce()	[5/9]	290
15.18.1.12 reduce()	[6/9]	290

15.18.1.13 <code>reduce()</code> [7/9]	290
15.18.1.14 <code>reduce()</code> [8/9]	291
15.18.1.15 <code>reduce()</code> [9/9]	291
15.18.1.16 <code>modp()</code> [1/2]	291
15.18.1.17 <code>modp()</code> [2/2]	291
15.18.1.18 <code>scalp()</code> [1/2]	291
15.18.1.19 <code>scalp()</code> [2/2]	292
15.19 FFLAS::vectorised::unswitch Namespace Reference	292
15.19.1 Function Documentation	292
15.19.1.1 <code>modp()</code> [1/2]	292
15.19.1.2 <code>modp()</code> [2/2]	293
15.19.1.3 <code>scalp()</code> [1/2]	293
15.19.1.4 <code>scalp()</code> [2/2]	293
15.20 FFPACK Namespace Reference	293
15.20.1 Detailed Description	309
15.20.2 Typedef Documentation	309
15.20.2.1 <code>Checker_PLUQ</code>	309
15.20.2.2 <code>Checker_Det</code>	309
15.20.2.3 <code>Checker_invert</code>	309
15.20.2.4 <code>Checker_charpoly</code>	309
15.20.2.5 <code>ForceCheck_PLUQ</code>	309
15.20.2.6 <code>ForceCheck_Det</code>	309
15.20.2.7 <code>ForceCheck_invert</code>	310
15.20.2.8 <code>ForceCheck_charpoly</code>	310
15.20.3 Function Documentation	310
15.20.3.1 <code>LAPACKPerm2MathPerm()</code>	310
15.20.3.2 <code>MathPerm2LAPACKPerm()</code>	310
15.20.3.3 <code>applyP()</code> [1/4]	310
15.20.3.4 <code>applyP()</code> [2/4]	311
15.20.3.5 <code>applyP()</code> [3/4]	312
15.20.3.6 <code>MonotonicApplyP()</code>	312
15.20.3.7 <code>fgetrs()</code> [1/4]	313
15.20.3.8 <code>fgetrs()</code> [2/4]	313
15.20.3.9 <code>fgesv()</code> [1/4]	314
15.20.3.10 <code>fgesv()</code> [2/4]	315
15.20.3.11 <code>fttrtri()</code> [1/2]	316
15.20.3.12 <code>trinv_left()</code> [1/2]	316
15.20.3.13 <code>fttrtm()</code> [1/2]	316
15.20.3.14 <code>fttrstr()</code>	317
15.20.3.15 <code>ftrssyr2k()</code>	318
15.20.3.16 <code>fsytrf()</code> [1/3]	318
15.20.3.17 <code>fsytrf()</code> [2/3]	319

15.20.3.18 fsytrf() [3/3]	319
15.20.3.19 fsytrf_nonunit() [1/3]	319
15.20.3.20 PLUQ() [1/6]	320
15.20.3.21 pPLUQ()	320
15.20.3.22 PLUQ() [2/6]	321
15.20.3.23 PLUQ() [3/6]	321
15.20.3.24 LUdivine() [1/4]	321
15.20.3.25 ColumnEchelonForm() [1/3]	322
15.20.3.26 pColumnEchelonForm()	323
15.20.3.27 ColumnEchelonForm() [2/3]	323
15.20.3.28 RowEchelonForm() [1/3]	323
15.20.3.29 pRowEchelonForm()	324
15.20.3.30 RowEchelonForm() [2/3]	324
15.20.3.31 ReducedColumnEchelonForm() [1/3]	325
15.20.3.32 pReducedColumnEchelonForm()	325
15.20.3.33 ReducedColumnEchelonForm() [2/3]	326
15.20.3.34 ReducedRowEchelonForm() [1/3]	326
15.20.3.35 pReducedRowEchelonForm()	326
15.20.3.36 ReducedRowEchelonForm() [2/3]	327
15.20.3.37 Invert() [1/4]	327
15.20.3.38 Invert() [2/4]	328
15.20.3.39 Invert2() [1/2]	328
15.20.3.40 CharPoly() [1/8]	329
15.20.3.41 CharPoly() [2/8]	330
15.20.3.42 CharPoly() [3/8]	330
15.20.3.43 MinPoly() [1/4]	331
15.20.3.44 MinPoly() [2/4]	331
15.20.3.45 MatVecMinPoly() [1/2]	332
15.20.3.46 Rank() [1/3]	332
15.20.3.47 pRank()	333
15.20.3.48 Rank() [2/3]	333
15.20.3.49 IsSingular() [1/2]	333
15.20.3.50 Det() [1/6]	334
15.20.3.51 pDet()	334
15.20.3.52 Det() [2/6]	335
15.20.3.53 Solve() [1/3]	335
15.20.3.54 Solve() [2/3]	335
15.20.3.55 pSolve()	336
15.20.3.56 RandomNullSpaceVector() [1/3]	336
15.20.3.57 NullSpaceBasis() [1/2]	337
15.20.3.58 RowRankProfile() [1/3]	337
15.20.3.59 pRowRankProfile()	338

15.20.3.60 RowRankProfile() [2/3]	338
15.20.3.61 ColumnRankProfile() [1/3]	338
15.20.3.62 pColumnRankProfile()	339
15.20.3.63 ColumnRankProfile() [2/3]	339
15.20.3.64 RankProfileFromLU()	339
15.20.3.65 LeadingSubmatrixRankProfiles()	340
15.20.3.66 RowRankProfileSubmatrixIndices() [1/2]	341
15.20.3.67 ColRankProfileSubmatrixIndices() [1/2]	341
15.20.3.68 RowRankProfileSubmatrix() [1/2]	342
15.20.3.69 ColRankProfileSubmatrix() [1/2]	343
15.20.3.70 getTriangular() [1/2]	343
15.20.3.71 getTriangular() [2/2]	344
15.20.3.72 getEchelonForm() [1/2]	345
15.20.3.73 getEchelonForm() [2/2]	345
15.20.3.74 getEchelonTransform()	346
15.20.3.75 getReducedEchelonForm() [1/2]	347
15.20.3.76 getReducedEchelonForm() [2/2]	348
15.20.3.77 getReducedEchelonTransform()	348
15.20.3.78 PLUQtoEchelonPermutation()	349
15.20.3.79 LQUPtoInverseOfFullRankMinor() [1/2]	349
15.20.3.80 RandomNullSpaceVector() [2/3]	350
15.20.3.81 solveLB() [1/2]	351
15.20.3.82 solveLB2() [1/2]	351
15.20.3.83 Danilevski()	351
15.20.3.84 buildMatrix()	352
15.20.3.85 CharPoly() [4/8]	352
15.20.3.86 CharPoly() [5/8]	352
15.20.3.87 Det() [3/6]	352
15.20.3.88 Det() [4/6]	353
15.20.3.89 fsytrf_BC_Crout()	353
15.20.3.90 fsytrf_BC_RL()	353
15.20.3.91 fsytrf_UP_RPM_BC_RL()	353
15.20.3.92 fsytrf_LOW_RPM_BC_Crout()	354
15.20.3.93 fsytrf_UP_RPM_BC_Crout()	354
15.20.3.94 fsytrf_UP_RPM()	354
15.20.3.95 fsytrf_nonunit() [2/3]	354
15.20.3.96 fsytrf_nonunit() [3/3]	355
15.20.3.97 fsytrf_RPM()	355
15.20.3.98 getTridiagonal()	355
15.20.3.99 LUdivine_gauss() [1/2]	355
15.20.3.100 LUdivine_small() [1/2]	356
15.20.3.101 LUdivine() [2/4]	356

15.20.3.102 LUdivine() [3/4]	356
15.20.3.103 MonotonicCompress()	357
15.20.3.104 MonotonicCompressMorePivots()	357
15.20.3.105 MonotonicCompressCycles()	357
15.20.3.106 MonotonicExpand()	358
15.20.3.107 applyP_block()	358
15.20.3.108 doApplyS()	358
15.20.3.109 MatrixApplyS() [1/3]	359
15.20.3.110 MatrixApplyS() [2/3]	359
15.20.3.111 MatrixApplyS() [3/3]	359
15.20.3.112 PermApplyS()	360
15.20.3.113 doApplyT()	360
15.20.3.114 MatrixApplyT() [1/3]	360
15.20.3.115 MatrixApplyT() [2/3]	360
15.20.3.116 MatrixApplyT() [3/3]	361
15.20.3.117 PermApplyT()	361
15.20.3.118 composePermutationsLLL()	361
15.20.3.119 composePermutationsLLM()	362
15.20.3.120 composePermutationsMLM()	362
15.20.3.121 cyclic_shift_mathPerm()	362
15.20.3.122 cyclic_shift_row_col() [1/2]	363
15.20.3.123 cyclic_shift_row() [1/3]	363
15.20.3.124 cyclic_shift_row() [2/3]	363
15.20.3.125 cyclic_shift_col() [1/3]	363
15.20.3.126 cyclic_shift_col() [2/3]	364
15.20.3.127 PLUQ_basecaseV3()	364
15.20.3.128 PLUQ_basecaseV2()	364
15.20.3.129 PLUQ_basecaseCrout()	364
15.20.3.130 _PLUQ()	365
15.20.3.131 PLUQ() [4/6]	365
15.20.3.132 threads_fgemm()	365
15.20.3.133 threads_frsm()	365
15.20.3.134 PLUQ() [5/6]	366
15.20.3.135 fflas_const_cast() [1/3]	366
15.20.3.136 fflas_const_cast() [2/3]	366
15.20.3.137 cyclic_shift_row_col() [2/2]	366
15.20.3.138 cyclic_shift_row() [3/3]	366
15.20.3.139 cyclic_shift_col() [3/3]	367
15.20.3.140 applyP() [4/4]	367
15.20.3.141 fgetrs() [3/4]	367
15.20.3.142 fgetrs() [4/4]	367
15.20.3.143 fgesv() [3/4]	368

15.20.3.144 fgesv() [4/4]	368
15.20.3.145 ftrtri() [2/2]	368
15.20.3.146 trinv_left() [2/2]	369
15.20.3.147 ftrtrm() [2/2]	369
15.20.3.148 PLUQ() [6/6]	369
15.20.3.149 LUdivine() [4/4]	369
15.20.3.150 LUdivine_small() [2/2]	370
15.20.3.151 LUdivine_gauss() [2/2]	370
15.20.3.152 RowEchelonForm() [3/3]	370
15.20.3.153 ReducedRowEchelonForm() [3/3]	371
15.20.3.154 ColumnEchelonForm() [3/3]	371
15.20.3.155 ReducedColumnEchelonForm() [3/3]	371
15.20.3.156 Invert() [3/4]	371
15.20.3.157 Invert() [4/4]	372
15.20.3.158 Invert2() [2/2]	372
15.20.3.159 CharPoly() [6/8]	372
15.20.3.160 CharPoly() [7/8]	372
15.20.3.161 CharPoly() [8/8]	373
15.20.3.162 MinPoly() [3/4]	373
15.20.3.163 MinPoly() [4/4]	373
15.20.3.164 MatVecMinPoly() [2/2]	373
15.20.3.165 KrylovElim()	374
15.20.3.166 SpecRankProfile()	374
15.20.3.167 Rank() [3/3]	374
15.20.3.168 IsSingular() [2/2]	374
15.20.3.169 Det() [5/6]	375
15.20.3.170 Det() [6/6]	375
15.20.3.171 Solve() [3/3]	375
15.20.3.172 solveLB() [2/2]	375
15.20.3.173 solveLB2() [2/2]	376
15.20.3.174 RandomNullSpaceVector() [3/3]	376
15.20.3.175 NullSpaceBasis() [2/2]	376
15.20.3.176 RowRankProfile() [3/3]	376
15.20.3.177 ColumnRankProfile() [3/3]	377
15.20.3.178 RowRankProfileSubmatrixIndices() [2/2]	377
15.20.3.179 ColRankProfileSubmatrixIndices() [2/2]	377
15.20.3.180 RowRankProfileSubmatrix() [2/2]	377
15.20.3.181 ColRankProfileSubmatrix() [2/2]	378
15.20.3.182 getTriangular< FFLAS_FIELD< FFLAS_ELT > >() [1/2]	378
15.20.3.183 getTriangular< FFLAS_FIELD< FFLAS_ELT > >() [2/2]	378
15.20.3.184 getEchelonForm< FFLAS_FIELD< FFLAS_ELT > >() [1/2]	378
15.20.3.185 getEchelonForm< FFLAS_FIELD< FFLAS_ELT > >() [2/2]	379

15.20.3.186 getEchelonTransform< FFLAS_FIELD< FFLAS_ELT > >()	379
15.20.3.187 getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > >() [1/2]	379
15.20.3.188 getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > >() [2/2]	380
15.20.3.189 getReducedEchelonTransform< FFLAS_FIELD< FFLAS_ELT > >()	380
15.20.3.190 LQUPtoInverseOfFullRankMinor() [2/2]	380
15.20.3.191 fflas_const_cast() [3/3]	381
15.20.3.192 failure()	381
15.20.3.193 isOdd() [1/3]	381
15.20.3.194 isOdd() [2/3]	381
15.20.3.195 isOdd() [3/3]	381
15.20.3.196 NonZeroRandomMatrix() [1/2]	381
15.20.3.197 NonZeroRandomMatrix() [2/2]	382
15.20.3.198 RandomMatrix() [1/2]	382
15.20.3.199 RandomMatrix() [2/2]	383
15.20.3.200 RandomTriangularMatrix() [1/2]	384
15.20.3.201 RandomTriangularMatrix() [2/2]	384
15.20.3.202 RandInt()	385
15.20.3.203 RandomSymmetricMatrix()	385
15.20.3.204 RandomMatrixWithRank() [1/2]	386
15.20.3.205 RandomMatrixWithRank() [2/2]	386
15.20.3.206 RandomIndexSubset()	387
15.20.3.207 RandomPermutation()	387
15.20.3.208 RandomRankProfileMatrix()	387
15.20.3.209 swapval()	388
15.20.3.210 RandomSymmetricRankProfileMatrix()	388
15.20.3.211 RandomMatrixWithRankandRPM() [1/2]	388
15.20.3.212 RandomMatrixWithRankandRPM() [2/2]	389
15.20.3.213 RandomSymmetricMatrixWithRankandRPM() [1/2]	390
15.20.3.214 RandomSymmetricMatrixWithRankandRPM() [2/2]	390
15.20.3.215 RandomMatrixWithRankandRandomRPM() [1/2]	391
15.20.3.216 RandomMatrixWithRankandRandomRPM() [2/2]	391
15.20.3.217 RandomSymmetricMatrixWithRankandRandomRPM() [1/2]	392
15.20.3.218 RandomSymmetricMatrixWithRankandRandomRPM() [2/2]	393
15.20.3.219 RandomMatrixWithDet() [1/2]	393
15.20.3.220 RandomMatrixWithDet() [2/2]	394
15.20.3.221 maxFieldElt()	394
15.20.3.222 maxFieldElt< Givaro::ZRing< Givaro::Integer > >()	394
15.20.3.223 chooseField()	394
15.20.3.224 chooseField< Givaro::ZRing< int32_t > >()	395
15.20.3.225 chooseField< Givaro::ZRing< int64_t > >()	395
15.20.3.226 chooseField< Givaro::ZRing< float > >()	395
15.20.3.227 chooseField< Givaro::ZRing< double > >()	395

15.21 FFPACK::Protected Namespace Reference	395
15.21.1 Function Documentation	397
15.21.1.1 LUdivine_construct() [1/2]	397
15.21.1.2 GaussJordan()	397
15.21.1.3 KellerGehrig()	398
15.21.1.4 KGFast()	398
15.21.1.5 KGFast_generalized()	398
15.21.1.6 fgemv_kgf()	398
15.21.1.7 LUKrylov()	399
15.21.1.8 Danilevski()	399
15.21.1.9 RandomKrylovPrecond()	399
15.21.1.10 ArithProg()	400
15.21.1.11 LUKrylov_KGFast()	400
15.21.1.12 MatVecMinPoly()	400
15.21.1.13 Hybrid_KGF_LUK_MinPoly()	400
15.21.1.14 updateD()	400
15.21.1.15 newD()	401
15.21.1.16 CompressRows()	401
15.21.1.17 CompressRowsQK()	401
15.21.1.18 DeCompressRows()	401
15.21.1.19 DeCompressRowsQK()	402
15.21.1.20 CompressRowsQA()	402
15.21.1.21 DeCompressRowsQA()	402
15.21.1.22 LUdivine_construct() [2/2]	402
15.22 Givaro Namespace Reference	403
15.23 MKL_CONFIG Namespace Reference	403
15.24 Reclnt Namespace Reference	403
16 Data Structure Documentation	405
16.1 AlgoChooser< ModeT, ParSeq > Struct Template Reference	405
16.1.1 Member Typedef Documentation	405
16.1.1.1 value	405
16.2 AlgoChooser< ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > Struct Template Reference	405
16.2.1 Member Typedef Documentation	405
16.2.1.1 value	405
16.3 ArbitraryPrecIntTag Struct Reference	405
16.3.1 Detailed Description	406
16.4 AreEqual< X, Y > Class Template Reference	406
16.4.1 Field Documentation	406
16.4.1.1 value	406
16.5 AreEqual< X, X > Class Template Reference	406
16.5.1 Field Documentation	406

16.5.1.1 value	406
16.6 Argument Struct Reference	406
16.6.1 Field Documentation	407
16.6.1.1 c	407
16.6.1.2 example	407
16.6.1.3 helpString	407
16.6.1.4 type	407
16.6.1.5 data	407
16.7 associatedDelayedField< Field > Struct Template Reference	407
16.7.1 Member Typedef Documentation	407
16.7.1.1 field	407
16.7.1.2 type	407
16.8 associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > > Struct Template Reference	407
16.8.1 Member Typedef Documentation	408
16.8.1.1 field	408
16.8.1.2 type	408
16.9 associatedDelayedField< const Givaro::Modular< T, X > > Struct Template Reference	408
16.9.1 Member Typedef Documentation	408
16.9.1.1 field	408
16.9.1.2 type	408
16.10 associatedDelayedField< const Givaro::ModularBalanced< T > > Struct Template Reference	408
16.10.1 Member Typedef Documentation	409
16.10.1.1 field	409
16.10.1.2 type	409
16.11 associatedDelayedField< const Givaro::ZRing< T > > Struct Template Reference	409
16.11.1 Member Typedef Documentation	409
16.11.1.1 field	409
16.11.1.2 type	409
16.12 Auto Struct Reference	409
16.13 Bini Struct Reference	409
16.14 Block Struct Reference	409
16.15 callLUdivine_small< Element > Class Template Reference	410
16.15.1 Member Function Documentation	410
16.15.1.1 operator()()	410
16.16 callLUdivine_small< double > Class Reference	410
16.16.1 Member Function Documentation	410
16.16.1.1 operator()()	410
16.17 callLUdivine_small< float > Class Reference	411
16.17.1 Member Function Documentation	411
16.17.1.1 operator()()	411
16.18 CharpolyFailed Class Reference	411
16.19 Checker_Empty< Field > Struct Template Reference	411

16.19.1 Constructor & Destructor Documentation	411
16.19.1.1 Checker_Empty()	411
16.19.2 Member Function Documentation	412
16.19.2.1 check()	412
16.20 CheckerImplem_charpoly< Field, Polynomial > Class Template Reference	412
16.20.1 Constructor & Destructor Documentation	412
16.20.1.1 CheckerImplem_charpoly() [1/2]	412
16.20.1.2 CheckerImplem_charpoly() [2/2]	412
16.20.1.3 ~CheckerImplem_charpoly()	412
16.20.2 Member Function Documentation	412
16.20.2.1 check()	412
16.21 CheckerImplem_Det< Field > Class Template Reference	413
16.21.1 Constructor & Destructor Documentation	413
16.21.1.1 CheckerImplem_Det() [1/2]	413
16.21.1.2 CheckerImplem_Det() [2/2]	413
16.21.1.3 ~CheckerImplem_Det()	413
16.21.2 Member Function Documentation	413
16.21.2.1 check()	413
16.22 CheckerImplem_fgemm< Field > Class Template Reference	414
16.22.1 Constructor & Destructor Documentation	414
16.22.1.1 CheckerImplem_fgemm() [1/2]	414
16.22.1.2 CheckerImplem_fgemm() [2/2]	414
16.22.1.3 ~CheckerImplem_fgemm()	414
16.22.2 Member Function Documentation	414
16.22.2.1 check()	415
16.23 CheckerImplem_ftdsm< Field > Class Template Reference	415
16.23.1 Constructor & Destructor Documentation	415
16.23.1.1 CheckerImplem_ftdsm() [1/2]	415
16.23.1.2 CheckerImplem_ftdsm() [2/2]	415
16.23.1.3 ~CheckerImplem_ftdsm()	415
16.23.2 Member Function Documentation	416
16.23.2.1 check()	416
16.24 CheckerImplem_invert< Field > Class Template Reference	416
16.24.1 Constructor & Destructor Documentation	416
16.24.1.1 CheckerImplem_invert() [1/2]	416
16.24.1.2 CheckerImplem_invert() [2/2]	416
16.24.1.3 ~CheckerImplem_invert()	416
16.24.2 Member Function Documentation	417
16.24.2.1 check()	417
16.25 CheckerImplem_PLUQ< Field > Class Template Reference	417
16.25.1 Constructor & Destructor Documentation	417
16.25.1.1 CheckerImplem_PLUQ() [1/2]	417

16.25.1.2 CheckerImplem_PLUQ() [2/2]	417
16.25.1.3 ~CheckerImplem_PLUQ()	417
16.25.2 Member Function Documentation	417
16.25.2.1 check()	418
16.26 Classic Struct Reference	418
16.27 Column Struct Reference	418
16.28 CompactElement< Element > Struct Template Reference	418
16.28.1 Member Typedef Documentation	418
16.28.1.1 type	418
16.29 CompactElement< double > Struct Reference	418
16.29.1 Member Typedef Documentation	419
16.29.1.1 type	419
16.30 CompactElement< float > Struct Reference	419
16.30.1 Member Typedef Documentation	419
16.30.1.1 type	419
16.31 CompactElement< int16_t > Struct Reference	419
16.31.1 Member Typedef Documentation	419
16.31.1.1 type	419
16.32 CompactElement< int32_t > Struct Reference	419
16.32.1 Member Typedef Documentation	419
16.32.1.1 type	419
16.33 CompactElement< int64_t > Struct Reference	420
16.33.1 Member Typedef Documentation	420
16.33.1.1 type	420
16.34 compatible_data_type< Field > Struct Template Reference	420
16.34.1 Field Documentation	420
16.34.1.1 value	420
16.35 compatible_data_type< Givaro::ZRing< double > > Struct Reference	420
16.35.1 Field Documentation	420
16.35.1.1 value	420
16.36 compatible_data_type< Givaro::ZRing< float > > Struct Reference	420
16.36.1 Field Documentation	421
16.36.1.1 value	421
16.37 Compose< H1, H2 > Struct Template Reference	421
16.37.1 Constructor & Destructor Documentation	421
16.37.1.1 Compose() [1/5]	421
16.37.1.2 Compose() [2/5]	421
16.37.1.3 Compose() [3/5]	421
16.37.1.4 Compose() [4/5]	421
16.37.1.5 Compose() [5/5]	421
16.37.2 Member Function Documentation	422
16.37.2.1 first_component()	422

16.37.2.2 second_component()	422
16.37.3 Friends And Related Function Documentation	422
16.37.3.1 operator<<	422
16.38 Const_int_t< n > Class Template Reference	422
16.39 Const_uint_t< n > Class Template Reference	422
16.40 Simd128_impl< true, true, false, 2 >::Converter Union Reference	422
16.40.1 Field Documentation	422
16.40.1.1 v	422
16.40.1.2 t	423
16.41 Simd128_impl< true, true, false, 4 >::Converter Union Reference	423
16.41.1 Field Documentation	423
16.41.1.1 v	423
16.41.1.2 t	423
16.42 Simd128_impl< true, true, false, 8 >::Converter Union Reference	423
16.42.1 Field Documentation	423
16.42.1.1 v	423
16.42.1.2 t	423
16.43 Simd128_impl< true, true, true, 2 >::Converter Union Reference	423
16.43.1 Field Documentation	424
16.43.1.1 v	424
16.43.1.2 t	424
16.44 Simd128_impl< true, true, true, 4 >::Converter Union Reference	424
16.44.1 Field Documentation	424
16.44.1.1 v	424
16.44.1.2 t	424
16.45 Simd128_impl< true, true, true, 8 >::Converter Union Reference	424
16.45.1 Field Documentation	424
16.45.1.1 v	424
16.45.1.2 t	424
16.46 Simd256_impl< true, true, false, 2 >::Converter Union Reference	425
16.46.1 Field Documentation	425
16.46.1.1 v	425
16.46.1.2 t	425
16.47 Simd256_impl< true, true, false, 4 >::Converter Union Reference	425
16.47.1 Field Documentation	425
16.47.1.1 v	425
16.47.1.2 t	425
16.48 Simd256_impl< true, true, false, 8 >::Converter Union Reference	425
16.48.1 Field Documentation	425
16.48.1.1 v	426
16.48.1.2 t	426
16.49 Simd256_impl< true, true, true, 2 >::Converter Union Reference	426

16.49.1 Field Documentation	426
16.49.1.1 v	426
16.49.1.2 t	426
16.50 Simd256_impl< true, true, true, 4 >::Converter Union Reference	426
16.50.1 Field Documentation	426
16.50.1.1 v	426
16.50.1.2 t	426
16.51 Simd256_impl< true, true, true, 8 >::Converter Union Reference	427
16.51.1 Field Documentation	427
16.51.1.1 v	427
16.51.1.2 t	427
16.52 Simd512_impl< true, true, false, 8 >::Converter Union Reference	427
16.52.1 Field Documentation	427
16.52.1.1 v	427
16.52.1.2 t	427
16.53 Simd512_impl< true, true, true, 8 >::Converter Union Reference	427
16.53.1 Field Documentation	427
16.53.1.1 v	428
16.53.1.2 t	428
16.54 ConvertTo< T > Struct Template Reference	428
16.54.1 Detailed Description	428
16.55 Coo< ValT, IdxT > Struct Template Reference	428
16.55.1 Member Typedef Documentation	428
16.55.1.1 Self	429
16.55.2 Constructor & Destructor Documentation	429
16.55.2.1 Coo() [1/4]	429
16.55.2.2 Coo() [2/4]	429
16.55.2.3 Coo() [3/4]	429
16.55.2.4 Coo() [4/4]	429
16.55.3 Member Function Documentation	429
16.55.3.1 operator=() [1/2]	429
16.55.3.2 operator=() [2/2]	429
16.55.4 Field Documentation	429
16.55.4.1 val	429
16.55.4.2 row	429
16.55.4.3 col	430
16.56 Coo< Field > Struct Template Reference	430
16.56.1 Constructor & Destructor Documentation	430
16.56.1.1 Coo() [1/4]	430
16.56.1.2 Coo() [2/4]	430
16.56.1.3 Coo() [3/4]	430
16.56.1.4 Coo() [4/4]	430

16.56.2 Member Function Documentation	430
16.56.2.1 operator=() [1/2]	431
16.56.2.2 operator=() [2/2]	431
16.56.3 Field Documentation	431
16.56.3.1 val	431
16.56.3.2 col	431
16.56.3.3 row	431
16.56.3.4 deleted	431
16.57 Coo< ValT, IdxT > Struct Template Reference	431
16.57.1 Member Typedef Documentation	432
16.57.1.1 Self	432
16.57.2 Constructor & Destructor Documentation	432
16.57.2.1 Coo() [1/4]	432
16.57.2.2 Coo() [2/4]	432
16.57.2.3 Coo() [3/4]	432
16.57.2.4 Coo() [4/4]	432
16.57.3 Member Function Documentation	432
16.57.3.1 operator=() [1/2]	432
16.57.3.2 operator=() [2/2]	432
16.57.4 Field Documentation	432
16.57.4.1 val	432
16.57.4.2 row	433
16.57.4.3 col	433
16.58 CooMat< Field > Struct Template Reference	433
16.58.1 Field Documentation	433
16.58.1.1 _coo16	433
16.58.1.2 _coo32	433
16.58.1.3 _coo64	433
16.58.1.4 _coo16_zo	433
16.58.1.5 _coo32_zo	433
16.58.1.6 _coo64_zo	433
16.59 CsrMat< Field > Struct Template Reference	434
16.59.1 Field Documentation	434
16.59.1.1 _csr16	434
16.59.1.2 _csr32	434
16.59.1.3 _csr64	434
16.59.1.4 _csr16_zo	434
16.59.1.5 _csr32_zo	434
16.59.1.6 _csr64_zo	434
16.60 DefaultBoundedTag Struct Reference	434
16.60.1 Detailed Description	434
16.61 DefaultTag Struct Reference	435

16.61.1 Detailed Description	435
16.62 DelayedTag Struct Reference	435
16.62.1 Detailed Description	435
16.63 ElementTraits< Element > Struct Template Reference	435
16.63.1 Detailed Description	435
16.63.2 Member Typedef Documentation	435
16.63.2.1 value	435
16.64 ElementTraits< double > Struct Reference	435
16.64.1 Member Typedef Documentation	436
16.64.1.1 value	436
16.65 ElementTraits< FFPACK::rns_double_elt > Struct Reference	436
16.65.1 Member Typedef Documentation	436
16.65.1.1 value	436
16.66 ElementTraits< float > Struct Reference	436
16.66.1 Member Typedef Documentation	436
16.66.1.1 value	436
16.67 ElementTraits< Givaro::Integer > Struct Reference	436
16.67.1 Member Typedef Documentation	437
16.67.1.1 value	437
16.68 ElementTraits< int16_t > Struct Reference	437
16.68.1 Member Typedef Documentation	437
16.68.1.1 value	437
16.69 ElementTraits< int32_t > Struct Reference	437
16.69.1 Member Typedef Documentation	437
16.69.1.1 value	437
16.70 ElementTraits< int64_t > Struct Reference	437
16.70.1 Member Typedef Documentation	438
16.70.1.1 value	438
16.71 ElementTraits< int8_t > Struct Reference	438
16.71.1 Member Typedef Documentation	438
16.71.1.1 value	438
16.72 ElementTraits< RecInt::rint< K > > Struct Template Reference	438
16.72.1 Member Typedef Documentation	438
16.72.1.1 value	438
16.73 ElementTraits< RecInt::rmint< K, MG > > Struct Template Reference	438
16.73.1 Member Typedef Documentation	439
16.73.1.1 value	439
16.74 ElementTraits< RecInt::ruint< K > > Struct Template Reference	439
16.74.1 Member Typedef Documentation	439
16.74.1.1 value	439
16.75 ElementTraits< uint16_t > Struct Reference	439
16.75.1 Member Typedef Documentation	439

16.75.1.1 value	439
16.76 ElementTraits< uint32_t > Struct Reference	439
16.76.1 Member Typedef Documentation	440
16.76.1.1 value	440
16.77 ElementTraits< uint64_t > Struct Reference	440
16.77.1 Member Typedef Documentation	440
16.77.1.1 value	440
16.78 ElementTraits< uint8_t > Struct Reference	440
16.78.1 Member Typedef Documentation	440
16.78.1.1 value	440
16.79 EllMat< Field > Struct Template Reference	440
16.79.1 Field Documentation	441
16.79.1.1 _ell16	441
16.79.1.2 _ell32	441
16.79.1.3 _ell64	441
16.79.1.4 _ell16_zo	441
16.79.1.5 _ell32_zo	441
16.79.1.6 _ell64_zo	441
16.80 Failure Class Reference	441
16.80.1 Detailed Description	442
16.80.2 Constructor & Destructor Documentation	442
16.80.2.1 Failure()	442
16.80.3 Member Function Documentation	442
16.80.3.1 operator>() [1/2]	442
16.80.3.2 operator>() [2/2]	442
16.80.3.3 setErrorMessage()	443
16.80.3.4 print()	443
16.80.4 Field Documentation	443
16.80.4.1 _errorMessage	443
16.81 FailureCharnpolyCheck Class Reference	443
16.82 FailureDetCheck Class Reference	443
16.83 FailureFgemmCheck Class Reference	443
16.84 FailureInvertCheck Class Reference	443
16.85 FailurePLUQCheck Class Reference	444
16.86 FailureTrsmCheck Class Reference	444
16.87 FieldSimd< _Field > Class Template Reference	444
16.87.1 Member Typedef Documentation	445
16.87.1.1 Field	445
16.87.1.2 Element	445
16.87.1.3 simd	445
16.87.1.4 vect_t	445
16.87.1.5 scalar_t	445

16.87.2 Constructor & Destructor Documentation	445
16.87.2.1 FieldSimd() [1/3]	445
16.87.2.2 FieldSimd() [2/3]	445
16.87.2.3 FieldSimd() [3/3]	445
16.87.3 Member Function Documentation	446
16.87.3.1 operator=() [1/2]	446
16.87.3.2 operator=() [2/2]	446
16.87.3.3 init() [1/2]	446
16.87.3.4 init() [2/2]	446
16.87.3.5 add() [1/2]	446
16.87.3.6 add() [2/2]	446
16.87.3.7 addin()	446
16.87.3.8 add_r() [1/2]	446
16.87.3.9 add_r() [2/2]	447
16.87.3.10 addin_r()	447
16.87.3.11 sub() [1/2]	447
16.87.3.12 sub() [2/2]	447
16.87.3.13 subin()	447
16.87.3.14 sub_r() [1/2]	447
16.87.3.15 sub_r() [2/2]	447
16.87.3.16 subin_r()	447
16.87.3.17 zero() [1/2]	448
16.87.3.18 zero() [2/2]	448
16.87.3.19 mod()	448
16.87.3.20 mul() [1/2]	448
16.87.3.21 mul() [2/2]	448
16.87.3.22 mulin()	448
16.87.3.23 mul_r() [1/2]	448
16.87.3.24 mul_r() [2/2]	448
16.87.3.25 axpy() [1/2]	448
16.87.3.26 axpy() [2/2]	449
16.87.3.27 axpyin()	449
16.87.3.28 axpy_r() [1/2]	449
16.87.3.29 axpy_r() [2/2]	449
16.87.3.30 axpyin_r()	449
16.87.3.31 maxpy() [1/2]	449
16.87.3.32 maxpy() [2/2]	449
16.87.3.33 maxpyin()	450
16.87.4 Field Documentation	450
16.87.4.1 vect_size	450
16.87.4.2 alignment	450
16.88 FieldTraits< Field > Struct Template Reference	450

16.88.1 Detailed Description	450
16.88.2 Member Typedef Documentation	450
16.88.2.1 category	450
16.88.3 Field Documentation	450
16.88.3.1 balanced	451
16.89 FieldTraits< FFPACK::RNSInteger< T > > Struct Template Reference	451
16.89.1 Member Typedef Documentation	451
16.89.1.1 category	451
16.89.2 Field Documentation	451
16.89.2.1 balanced	451
16.90 FieldTraits< FFPACK::RNSIntegerMod< T > > Struct Template Reference	451
16.90.1 Member Typedef Documentation	451
16.90.1.1 category	452
16.90.2 Field Documentation	452
16.90.2.1 balanced	452
16.91 FieldTraits< Givaro::Modular< Element > > Struct Template Reference	452
16.91.1 Member Typedef Documentation	452
16.91.1.1 category	452
16.91.2 Field Documentation	452
16.91.2.1 balanced	452
16.92 FieldTraits< Givaro::ModularBalanced< Element > > Struct Template Reference	452
16.92.1 Member Typedef Documentation	453
16.92.1.1 category	453
16.92.2 Field Documentation	453
16.92.2.1 balanced	453
16.93 FieldTraits< Givaro::ZRing< double > > Struct Reference	453
16.93.1 Member Typedef Documentation	453
16.93.1.1 category	453
16.93.2 Field Documentation	453
16.93.2.1 balanced	453
16.94 FieldTraits< Givaro::ZRing< float > > Struct Reference	453
16.94.1 Member Typedef Documentation	454
16.94.1.1 category	454
16.94.2 Field Documentation	454
16.94.2.1 balanced	454
16.95 FieldTraits< Givaro::ZRing< Givaro::Integer > > Struct Reference	454
16.95.1 Member Typedef Documentation	454
16.95.1.1 category	454
16.95.2 Field Documentation	454
16.95.2.1 balanced	454
16.96 FieldTraits< Givaro::ZRing< int16_t > > Struct Reference	455
16.96.1 Member Typedef Documentation	455

16.96.1.1 category	455
16.96.2 Field Documentation	455
16.96.2.1 balanced	455
16.97 FieldTraits< Givaro::ZRing< int32_t > > Struct Reference	455
16.97.1 Member Typedef Documentation	455
16.97.1.1 category	455
16.97.2 Field Documentation	455
16.97.2.1 balanced	456
16.98 FieldTraits< Givaro::ZRing< int64_t > > Struct Reference	456
16.98.1 Member Typedef Documentation	456
16.98.1.1 category	456
16.98.2 Field Documentation	456
16.98.2.1 balanced	456
16.99 FieldTraits< Givaro::ZRing< RecInt::ruint< K > > > Struct Template Reference	456
16.99.1 Member Typedef Documentation	456
16.99.1.1 category	456
16.99.2 Field Documentation	457
16.99.2.1 balanced	457
16.100 FieldTraits< Givaro::ZRing< uint16_t > > Struct Reference	457
16.100.1 Member Typedef Documentation	457
16.100.1.1 category	457
16.100.2 Field Documentation	457
16.100.2.1 balanced	457
16.101 FieldTraits< Givaro::ZRing< uint32_t > > Struct Reference	457
16.101.1 Member Typedef Documentation	457
16.101.1.1 category	458
16.101.2 Field Documentation	458
16.101.2.1 balanced	458
16.102 FieldTraits< Givaro::ZRing< uint64_t > > Struct Reference	458
16.102.1 Member Typedef Documentation	458
16.102.1.1 category	458
16.102.2 Field Documentation	458
16.102.2.1 balanced	458
16.103 Fixed Struct Reference	458
16.104 FixedPreIntTag Struct Reference	458
16.104.1 Detailed Description	459
16.105 ForStrategy1D< blocksize_t, Cut, Param > Struct Template Reference	459
16.105.1 Constructor & Destructor Documentation	459
16.105.1.1 ForStrategy1D() [1/2]	459
16.105.1.2 ForStrategy1D() [2/2]	459
16.105.2 Member Function Documentation	459
16.105.2.1 build()	460

16.105.2.2 initialize()	460
16.105.2.3 isTerminated()	460
16.105.2.4 begin()	460
16.105.2.5 end()	460
16.105.2.6 numblocks()	460
16.105.2.7 blockindex()	460
16.105.2.8 operator++()	460
16.105.3 Field Documentation	460
16.105.3.1 ibeg	460
16.105.3.2 iend	460
16.105.3.3 current	460
16.105.3.4 firstBlockSize	461
16.105.3.5 lastBlockSize	461
16.105.3.6 changeBS	461
16.105.3.7 numBlock	461
16.106 ForStrategy2D< blocksize_t, Cut, Param > Struct Template Reference	461
16.106.1 Constructor & Destructor Documentation	462
16.106.1.1 ForStrategy2D()	462
16.106.2 Member Function Documentation	462
16.106.2.1 initialize()	462
16.106.2.2 isTerminated()	462
16.106.2.3 ibegin()	462
16.106.2.4 jbegin()	462
16.106.2.5 iend()	462
16.106.2.6 jend()	462
16.106.2.7 operator++()	462
16.106.2.8 rownumblocks()	462
16.106.2.9 colnumblocks()	463
16.106.2.10 blockindex()	463
16.106.2.11 rowblockindex()	463
16.106.2.12 colblockindex()	463
16.106.3 Friends And Related Function Documentation	463
16.106.3.1 operator<<	463
16.106.4 Field Documentation	463
16.106.4.1 _ibeg	463
16.106.4.2 _iend	463
16.106.4.3 _jbeg	463
16.106.4.4 _jend	463
16.106.4.5 rowBlockSize	463
16.106.4.6 colBlockSize	464
16.106.4.7 current	464
16.106.4.8 lastRBS	464

16.106.4.9 lastCBS	464
16.106.4.10 changeRBS	464
16.106.4.11 changeCBS	464
16.106.4.12 numRowsBlock	464
16.106.4.13 numColBlock	464
16.106.4.14 BLOCKS	464
16.107 ftrmmLeftLowerNoTransNonUnit< Element > Class Template Reference	464
16.108 ftrmmLeftLowerNoTransUnit< Element > Class Template Reference	464
16.109 ftrmmLeftLowerTransNonUnit< Element > Class Template Reference	465
16.110 ftrmmLeftLowerTransUnit< Element > Class Template Reference	465
16.111 ftrmmLeftUpperNoTransNonUnit< Element > Class Template Reference	465
16.112 ftrmmLeftUpperNoTransUnit< Element > Class Template Reference	465
16.113 ftrmmLeftUpperTransNonUnit< Element > Class Template Reference	465
16.114 ftrmmLeftUpperTransUnit< Element > Class Template Reference	465
16.115 ftrmmRightLowerNoTransNonUnit< Element > Class Template Reference	465
16.116 ftrmmRightLowerNoTransUnit< Element > Class Template Reference	465
16.117 ftrmmRightLowerTransNonUnit< Element > Class Template Reference	466
16.118 ftrmmRightLowerTransUnit< Element > Class Template Reference	466
16.119 ftrmmRightUpperNoTransNonUnit< Element > Class Template Reference	466
16.120 ftrmmRightUpperNoTransUnit< Element > Class Template Reference	466
16.121 ftrmmRightUpperTransNonUnit< Element > Class Template Reference	466
16.122 ftrmmRightUpperTransUnit< Element > Class Template Reference	466
16.123 ftrsmLeftLowerNoTransNonUnit< Element > Class Template Reference	466
16.124 ftrsmLeftLowerNoTransUnit< Element > Class Template Reference	466
16.125 ftrsmLeftLowerTransNonUnit< Element > Class Template Reference	467
16.126 ftrsmLeftLowerTransUnit< Element > Class Template Reference	467
16.127 ftrsmLeftUpperNoTransNonUnit< Element > Class Template Reference	467
16.127.1 Detailed Description	467
16.128 ftrsmLeftUpperNoTransUnit< Element > Class Template Reference	467
16.129 ftrsmLeftUpperTransNonUnit< Element > Class Template Reference	467
16.130 ftrsmLeftUpperTransUnit< Element > Class Template Reference	467
16.131 ftrsmRightLowerNoTransNonUnit< Element > Class Template Reference	468
16.132 ftrsmRightLowerNoTransUnit< Element > Class Template Reference	468
16.133 ftrsmRightLowerTransNonUnit< Element > Class Template Reference	468
16.134 ftrsmRightLowerTransUnit< Element > Class Template Reference	468
16.135 ftrsmRightUpperNoTransNonUnit< Element > Class Template Reference	468
16.136 ftrsmRightUpperNoTransUnit< Element > Class Template Reference	468
16.137 ftrsmRightUpperTransNonUnit< Element > Class Template Reference	468
16.138 ftrsmRightUpperTransUnit< Element > Class Template Reference	468
16.139 GenericTag Struct Reference	469
16.139.1 Detailed Description	469
16.140 GenericTag Struct Reference	469

16.140.1 Detailed Description	469
16.141 Grain Struct Reference	469
16.142 has_minus_eq_impl< C > Struct Template Reference	469
16.142.1 Field Documentation	469
16.142.1.1 value	469
16.143 has_minus_impl< C > Struct Template Reference	469
16.143.1 Field Documentation	470
16.143.1.1 value	470
16.144 has_mul_eq_impl< C > Struct Template Reference	470
16.144.1 Field Documentation	470
16.144.1.1 value	470
16.145 has_mul_impl< C > Struct Template Reference	470
16.145.1 Field Documentation	470
16.145.1.1 value	470
16.146 has_operation< T > Struct Template Reference	470
16.146.1 Field Documentation	471
16.146.1.1 value	471
16.147 has_plus_eq_impl< C > Struct Template Reference	471
16.147.1 Field Documentation	471
16.147.1.1 value	471
16.148 has_plus_impl< C > Struct Template Reference	471
16.148.1 Field Documentation	471
16.148.1.1 value	471
16.149 HelperFlag Struct Reference	471
16.149.1 Field Documentation	472
16.149.1.1 none	472
16.149.1.2 coo	472
16.149.1.3 csr	472
16.149.1.4 ell	472
16.149.1.5 aut	472
16.149.1.6 pm1	472
16.150 HelperMod< Field, ElementTraits > Struct Template Reference	472
16.151 HelperMod< Field, ElementCategories::MachineIntTag > Struct Template Reference	472
16.151.1 Constructor & Destructor Documentation	473
16.151.1.1 HelperMod() [1/2]	473
16.151.1.2 HelperMod() [2/2]	473
16.151.2 Field Documentation	473
16.151.2.1 p	473
16.151.2.2 invp	473
16.151.2.3 min	473
16.151.2.4 max	473
16.151.2.5 pow50rem	473

16.152 HelperMod< Field, FFLAS::ElementCategories::ArbitraryPreIntTag > Struct Template Reference	474
16.152.1 Constructor & Destructor Documentation	474
16.152.1.1 HelperMod() [1/2]	474
16.152.1.2 HelperMod() [2/2]	474
16.152.2 Field Documentation	474
16.152.2.1 p	474
16.153 HelperMod< Field, FFLAS::ElementCategories::FixedPreIntTag > Struct Template Reference	474
16.153.1 Constructor & Destructor Documentation	474
16.153.1.1 HelperMod() [1/2]	474
16.153.1.2 HelperMod() [2/2]	475
16.153.2 Field Documentation	475
16.153.2.1 p	475
16.154 HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag > Struct Template Reference	475
16.154.1 Constructor & Destructor Documentation	475
16.154.1.1 HelperMod() [1/2]	475
16.154.1.2 HelperMod() [2/2]	475
16.154.2 Field Documentation	475
16.154.2.1 p	475
16.154.2.2 invp	475
16.154.2.3 min	476
16.154.2.4 max	476
16.155 Hybrid Struct Reference	476
16.156 Info Struct Reference	476
16.156.1 Constructor & Destructor Documentation	476
16.156.1.1 Info() [1/4]	476
16.156.1.2 Info() [2/4]	476
16.156.1.3 Info() [3/4]	476
16.156.1.4 Info() [4/4]	477
16.156.2 Member Function Documentation	477
16.156.2.1 operator=() [1/2]	477
16.156.2.2 operator=() [2/2]	477
16.156.3 Field Documentation	477
16.156.3.1 size	477
16.156.3.2 perm	477
16.156.3.3 begin	477
16.157 Info Struct Reference	477
16.157.1 Constructor & Destructor Documentation	478
16.157.1.1 Info() [1/4]	478
16.157.1.2 Info() [2/4]	478
16.157.1.3 Info() [3/4]	478
16.157.1.4 Info() [4/4]	478
16.157.2 Member Function Documentation	478

16.157.2.1 operator=() [1/2]	478
16.157.2.2 operator=() [2/2]	478
16.157.3 Field Documentation	478
16.157.3.1 size	478
16.157.3.2 perm	478
16.157.3.3 begin	479
16.158 is_simd< T > Struct Template Reference	479
16.158.1 Member Typedef Documentation	479
16.158.1.1 type	479
16.158.2 Field Documentation	479
16.158.2.1 value	479
16.159 isSparseMatrix< Field, M > Struct Template Reference	479
16.160 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO > > Struct Template Reference	480
16.161 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > > Struct Template Reference	480
16.162 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR > > Struct Template Reference	480
16.163 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_HYB > > Struct Template Reference	480
16.164 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > > Struct Template Reference	481
16.165 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL > > Struct Template Reference	481
16.166 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd > > Struct Template Reference	481
16.167 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > > Struct Template Reference	482
16.168 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > > Struct Template Reference	482
16.169 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::HYB_ZO > > Struct Template Reference	482
16.170 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL > > Struct Template Reference	483
16.171 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > > Struct Template Reference	483
16.172 isSparseMatrixMKLFormat< F, M > Struct Template Reference	483
16.173 isSparseMatrixSimdFormat< F, M > Struct Template Reference	483
16.174 isZOSparseMatrix< F, M > Struct Template Reference	484
16.175 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > > Struct Template Reference	484
16.176 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > > Struct Template Reference	484
16.177 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > > Struct Template Reference	485
16.178 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > > Struct Template Reference	485
16.179 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > > Struct Template Reference	485
16.180 Iterative Struct Reference	485
16.181 LazyTag Struct Reference	486
16.181.1 Detailed Description	486
16.182 limits< T > Struct Template Reference	486
16.183 limits< char > Struct Reference	486
16.183.1 Member Typedef Documentation	486
16.183.1.1 T	486

16.183.2 Member Function Documentation	486
16.183.2.1 max()	486
16.183.2.2 min()	486
16.183.2.3 digits()	486
16.184 limits< double > Struct Reference	487
16.184.1 Member Typedef Documentation	487
16.184.1.1 T	487
16.184.2 Member Function Documentation	487
16.184.2.1 max()	487
16.184.2.2 min()	487
16.184.2.3 digits()	487
16.185 limits< float > Struct Reference	487
16.185.1 Member Typedef Documentation	488
16.185.1.1 T	488
16.185.2 Member Function Documentation	488
16.185.2.1 max()	488
16.185.2.2 min()	488
16.185.2.3 digits()	488
16.186 limits< Givaro::Integer > Struct Reference	488
16.186.1 Member Typedef Documentation	488
16.186.1.1 T	488
16.186.2 Member Function Documentation	488
16.186.2.1 max()	488
16.186.2.2 min()	489
16.187 limits< int > Struct Reference	489
16.187.1 Member Typedef Documentation	489
16.187.1.1 T	489
16.187.2 Member Function Documentation	489
16.187.2.1 max()	489
16.187.2.2 min()	489
16.187.2.3 digits()	489
16.188 limits< long > Struct Reference	489
16.188.1 Member Typedef Documentation	490
16.188.1.1 T	490
16.188.2 Member Function Documentation	490
16.188.2.1 max()	490
16.188.2.2 min()	490
16.188.2.3 digits()	490
16.189 limits< long long > Struct Reference	490
16.189.1 Member Typedef Documentation	490
16.189.1.1 T	490
16.189.2 Member Function Documentation	491

16.189.2.1 max()	491
16.189.2.2 min()	491
16.189.2.3 digits()	491
16.190 limits< Reclnt::rint< K > > Struct Template Reference	491
16.190.1 Member Typedef Documentation	491
16.190.1.1 T	491
16.190.2 Member Function Documentation	491
16.190.2.1 max()	491
16.190.2.2 min()	491
16.191 limits< Reclnt::ruint< K > > Struct Template Reference	492
16.191.1 Member Typedef Documentation	492
16.191.1.1 T	492
16.191.2 Member Function Documentation	492
16.191.2.1 max()	492
16.191.2.2 min()	492
16.192 limits< short int > Struct Reference	492
16.192.1 Member Typedef Documentation	492
16.192.1.1 T	492
16.192.2 Member Function Documentation	493
16.192.2.1 max()	493
16.192.2.2 min()	493
16.192.2.3 digits()	493
16.193 limits< signed char > Struct Reference	493
16.193.1 Member Typedef Documentation	493
16.193.1.1 T	493
16.193.2 Member Function Documentation	493
16.193.2.1 max()	493
16.193.2.2 min()	493
16.193.2.3 digits()	494
16.194 limits< unsigned char > Struct Reference	494
16.194.1 Member Typedef Documentation	494
16.194.1.1 T	494
16.194.2 Member Function Documentation	494
16.194.2.1 max()	494
16.194.2.2 min()	494
16.194.2.3 digits()	494
16.195 limits< unsigned int > Struct Reference	494
16.195.1 Member Typedef Documentation	495
16.195.1.1 T	495
16.195.2 Member Function Documentation	495
16.195.2.1 max()	495
16.195.2.2 min()	495

16.195.2.3 digits()	495
16.196 limits< unsigned long > Struct Reference	495
16.196.1 Member Typedef Documentation	495
16.196.1.1 T	495
16.196.2 Member Function Documentation	496
16.196.2.1 max()	496
16.196.2.2 min()	496
16.196.2.3 digits()	496
16.197 limits< unsigned long long > Struct Reference	496
16.197.1 Member Typedef Documentation	496
16.197.1.1 T	496
16.197.2 Member Function Documentation	496
16.197.2.1 max()	496
16.197.2.2 min()	496
16.197.2.3 digits()	497
16.198 limits< unsigned short int > Struct Reference	497
16.198.1 Member Typedef Documentation	497
16.198.1.1 T	497
16.198.2 Member Function Documentation	497
16.198.2.1 max()	497
16.198.2.2 min()	497
16.198.2.3 digits()	497
16.199 MachineFloatTag Struct Reference	497
16.199.1 Detailed Description	498
16.200 MachineIntTag Struct Reference	498
16.200.1 Detailed Description	498
16.201 MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait > Struct Template Reference	498
16.201.1 Member Typedef Documentation	499
16.201.1.1 Self_t	499
16.201.1.2 DelayedField_t	499
16.201.1.3 DelayedField	499
16.201.1.4 DFelt	499
16.201.2 Constructor & Destructor Documentation	499
16.201.2.1 MMHelper() [1/5]	499
16.201.2.2 MMHelper() [2/5]	500
16.201.2.3 MMHelper() [3/5]	500
16.201.2.4 MMHelper() [4/5]	500
16.201.2.5 MMHelper() [5/5]	500
16.201.3 Member Function Documentation	500
16.201.3.1 initC()	500
16.201.3.2 initA()	500
16.201.3.3 initB()	500

16.201.3.4	initOut()	500
16.201.3.5	MaxDelayedDim()	501
16.201.3.6	Aunfit()	501
16.201.3.7	Bunfit()	501
16.201.3.8	setOutBounds()	501
16.201.3.9	checkA()	501
16.201.3.10	checkB()	501
16.201.3.11	checkOut()	501
16.201.4	Friends And Related Function Documentation	501
16.201.4.1	operator<<	502
16.201.5	Field Documentation	502
16.201.5.1	recLevel	502
16.201.5.2	FieldMin	502
16.201.5.3	FieldMax	502
16.201.5.4	Amin	502
16.201.5.5	Amax	502
16.201.5.6	Bmin	502
16.201.5.7	Bmax	502
16.201.5.8	Cmin	502
16.201.5.9	Cmax	502
16.201.5.10	Outmin	502
16.201.5.11	Outmax	503
16.201.5.12	MaxStorableValue	503
16.201.5.13	delayedField	503
16.201.5.14	parseq	503
16.202	MMHelper< FFPACK::RNSInteger< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait > Struct Template Reference	503
16.202.1	Member Typedef Documentation	503
16.202.1.1	Self_t	504
16.202.2	Constructor & Destructor Documentation	504
16.202.2.1	MMHelper() [1/5]	504
16.202.2.2	MMHelper() [2/5]	504
16.202.2.3	MMHelper() [3/5]	504
16.202.2.4	MMHelper() [4/5]	504
16.202.2.5	MMHelper() [5/5]	504
16.202.3	Member Function Documentation	504
16.202.3.1	setNorm()	504
16.202.4	Friends And Related Function Documentation	504
16.202.4.1	operator<<	505
16.202.5	Field Documentation	505
16.202.5.1	normA	505
16.202.5.2	normB	505

16.202.5.3 recLevel	505
16.202.5.4 parseq	505
16.203 MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeq← Trait > Struct Template Reference	505
16.203.1 Member Typedef Documentation	506
16.203.1.1 Self_t	506
16.203.2 Constructor & Destructor Documentation	506
16.203.2.1 MMHelper() [1/5]	506
16.203.2.2 MMHelper() [2/5]	506
16.203.2.3 MMHelper() [3/5]	506
16.203.2.4 MMHelper() [4/5]	506
16.203.2.5 MMHelper() [5/5]	506
16.203.3 Member Function Documentation	506
16.203.3.1 setNorm()	506
16.203.4 Friends And Related Function Documentation	507
16.203.4.1 operator<<	507
16.203.5 Field Documentation	507
16.203.5.1 normA	507
16.203.5.2 normB	507
16.203.5.3 recLevel	507
16.203.5.4 parseq	507
16.204 MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< Dest >, ParSeqTrait > Struct Tem- plate Reference	507
16.204.1 Member Typedef Documentation	508
16.204.1.1 Self_t	508
16.204.2 Constructor & Destructor Documentation	508
16.204.2.1 MMHelper() [1/4]	508
16.204.2.2 MMHelper() [2/4]	508
16.204.2.3 MMHelper() [3/4]	508
16.204.2.4 MMHelper() [4/4]	508
16.204.3 Friends And Related Function Documentation	508
16.204.3.1 operator<<	508
16.204.4 Field Documentation	508
16.204.4.1 recLevel	508
16.204.4.2 parseq	509
16.205 MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeqTrait > Struct Template Reference	509
16.205.1 Member Typedef Documentation	509
16.205.1.1 Self_t	509
16.205.2 Constructor & Destructor Documentation	509
16.205.2.1 MMHelper() [1/5]	509
16.205.2.2 MMHelper() [2/5]	510
16.205.2.3 MMHelper() [3/5]	510

16.205.2.4 MMHelper() [4 / 5]	510
16.205.2.5 MMHelper() [5 / 5]	510
16.205.3 Member Function Documentation	510
16.205.3.1 setNorm()	510
16.205.4 Friends And Related Function Documentation	510
16.205.4.1 operator<<	510
16.205.5 Field Documentation	510
16.205.5.1 normA	510
16.205.5.2 normB	511
16.205.5.3 recLevel	511
16.205.5.4 parseq	511
16.206 MMHelper< Field, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait > Struct Template Reference	511
16.206.1 Detailed Description	511
16.206.2 Member Typedef Documentation	511
16.206.2.1 Self_t	511
16.206.3 Constructor & Destructor Documentation	512
16.206.3.1 MMHelper() [1 / 4]	512
16.206.3.2 MMHelper() [2 / 4]	512
16.206.3.3 MMHelper() [3 / 4]	512
16.206.3.4 MMHelper() [4 / 4]	512
16.206.4 Friends And Related Function Documentation	512
16.206.4.1 operator<<	512
16.206.5 Field Documentation	512
16.206.5.1 recLevel	512
16.206.5.2 parseq	512
16.207 ModeTraits< Field > Struct Template Reference	513
16.207.1 Detailed Description	513
16.207.2 Member Typedef Documentation	513
16.207.2.1 value	513
16.208 ModeTraits< Givaro::Modular< Element, Compute > > Struct Template Reference	513
16.208.1 Member Typedef Documentation	513
16.208.1.1 value	513
16.209 ModeTraits< Givaro::Modular< Givaro::Integer, Compute > > Struct Template Reference	513
16.209.1 Member Typedef Documentation	514
16.209.1.1 value	514
16.210 ModeTraits< Givaro::Modular< int16_t, Compute > > Struct Template Reference	514
16.210.1 Member Typedef Documentation	514
16.210.1.1 value	514
16.211 ModeTraits< Givaro::Modular< int32_t, Compute > > Struct Template Reference	514
16.211.1 Member Typedef Documentation	514
16.211.1.1 value	514
16.212 ModeTraits< Givaro::Modular< int8_t, Compute > > Struct Template Reference	514

16.212.1 Member Typedef Documentation	515
16.212.1.1 value	515
16.213 ModeTraits< Givaro::Modular< ReclInt::ruint< K >, Compute > > Struct Template Reference	515
16.213.1 Member Typedef Documentation	515
16.213.1.1 value	515
16.214 ModeTraits< Givaro::Modular< uint16_t, Compute > > Struct Template Reference	515
16.214.1 Member Typedef Documentation	515
16.214.1.1 value	515
16.215 ModeTraits< Givaro::Modular< uint32_t, Compute > > Struct Template Reference	516
16.215.1 Member Typedef Documentation	516
16.215.1.1 value	516
16.216 ModeTraits< Givaro::Modular< uint8_t, Compute > > Struct Template Reference	516
16.216.1 Member Typedef Documentation	516
16.216.1.1 value	516
16.217 ModeTraits< Givaro::ModularBalanced< Element > > Struct Template Reference	516
16.217.1 Member Typedef Documentation	516
16.217.1.1 value	517
16.218 ModeTraits< Givaro::ModularBalanced< Givaro::Integer > > Struct Reference	517
16.218.1 Member Typedef Documentation	517
16.218.1.1 value	517
16.219 ModeTraits< Givaro::ModularBalanced< int16_t > > Struct Reference	517
16.219.1 Member Typedef Documentation	517
16.219.1.1 value	517
16.220 ModeTraits< Givaro::ModularBalanced< int32_t > > Struct Reference	517
16.220.1 Member Typedef Documentation	518
16.220.1.1 value	518
16.221 ModeTraits< Givaro::ModularBalanced< int8_t > > Struct Reference	518
16.221.1 Member Typedef Documentation	518
16.221.1.1 value	518
16.222 ModeTraits< Givaro::Montgomery< T > > Struct Template Reference	518
16.222.1 Member Typedef Documentation	518
16.222.1.1 value	518
16.223 ModeTraits< Givaro::ZRing< double > > Struct Reference	518
16.223.1 Member Typedef Documentation	519
16.223.1.1 value	519
16.224 ModeTraits< Givaro::ZRing< float > > Struct Reference	519
16.224.1 Member Typedef Documentation	519
16.224.1.1 value	519
16.225 ModeTraits< Givaro::ZRing< Givaro::Integer > > Struct Reference	519
16.225.1 Member Typedef Documentation	519
16.225.1.1 value	519
16.226 ModularBalanced< T > Class Template Reference	519

16.227 ModularTag Struct Reference	520
16.227.1 Detailed Description	520
16.228 Montgomery< T > Class Template Reference	520
16.229 need_field_characteristic< Field > Struct Template Reference	520
16.229.1 Field Documentation	520
16.229.1.1 value	520
16.230 need_field_characteristic< Givaro::Modular< Field > > Struct Template Reference	520
16.230.1 Field Documentation	520
16.230.1.1 value	520
16.231 need_field_characteristic< Givaro::ModularBalanced< Field > > Struct Template Reference	520
16.231.1 Field Documentation	521
16.231.1.1 value	521
16.232 NoSimd< T > Struct Template Reference	521
16.232.1 Member Typedef Documentation	521
16.232.1.1 vect_t	521
16.232.1.2 scalar_t	521
16.232.2 Member Function Documentation	521
16.232.2.1 type_string()	521
16.232.2.2 valid()	521
16.232.2.3 compliant()	522
16.232.3 Field Documentation	522
16.232.3.1 vect_size	522
16.233 Parallel< C, P > Struct Template Reference	522
16.233.1 Member Typedef Documentation	522
16.233.1.1 Cut	522
16.233.1.2 Param	522
16.233.2 Constructor & Destructor Documentation	522
16.233.2.1 Parallel()	522
16.233.3 Member Function Documentation	522
16.233.3.1 numthreads()	523
16.233.3.2 set_numthreads()	523
16.233.4 Friends And Related Function Documentation	523
16.233.4.1 operator<<	523
16.234 RNSInteger< RNS >::RandIter Class Reference	523
16.234.1 Constructor & Destructor Documentation	523
16.234.1.1 RandIter()	523
16.234.2 Member Function Documentation	523
16.234.2.1 random() [1/2]	524
16.234.2.2 random() [2/2]	524
16.234.2.3 operator>() [1/2]	524
16.234.2.4 operator>() [2/2]	524
16.234.2.5 ring()	524

16.235 RNSIntegerMod< RNS >::RandIter Class Reference	524
16.235.1 Constructor & Destructor Documentation	524
16.235.1.1 RandIter()	525
16.235.2 Member Function Documentation	525
16.235.2.1 random() [1/2]	525
16.235.2.2 random() [2/2]	525
16.235.2.3 operator>() [1/2]	525
16.235.2.4 operator>() [2/2]	525
16.235.2.5 ring()	525
16.236 readMyMachineType< Field, T > Struct Template Reference	525
16.236.1 Member Typedef Documentation	525
16.236.1.1 Element	526
16.236.1.2 Element_ptr	526
16.236.2 Member Function Documentation	526
16.236.2.1 operator>()	526
16.237 readMyMachineType< Field, mpz_t > Struct Template Reference	526
16.237.1 Member Typedef Documentation	526
16.237.1.1 Element	526
16.237.1.2 Element_ptr	526
16.237.2 Member Function Documentation	526
16.237.2.1 operator>()	527
16.238 Recursive Struct Reference	527
16.239 Recursive Struct Reference	527
16.240 rint< K > Class Template Reference	527
16.241 rns_double Struct Reference	527
16.241.1 Member Typedef Documentation	528
16.241.1.1 integer	528
16.241.1.2 ModField	528
16.241.1.3 BasisElement	528
16.241.1.4 Element	528
16.241.1.5 Element_ptr	529
16.241.1.6 ConstElement_ptr	529
16.241.2 Constructor & Destructor Documentation	529
16.241.2.1 rns_double() [1/4]	529
16.241.2.2 rns_double() [2/4]	529
16.241.2.3 rns_double() [3/4]	529
16.241.2.4 rns_double() [4/4]	529
16.241.3 Member Function Documentation	529
16.241.3.1 precompute_cst()	529
16.241.3.2 init() [1/3]	529
16.241.3.3 init() [2/3]	530
16.241.3.4 init_transpose()	530

16.241.3.5	convert() [1/2]	530
16.241.3.6	convert_transpose()	530
16.241.3.7	reduce()	531
16.241.3.8	init() [3/3]	531
16.241.3.9	convert() [2/2]	531
16.241.4	Field Documentation	531
16.241.4.1	_basis	531
16.241.4.2	_basisMax	531
16.241.4.3	_negbasis	531
16.241.4.4	_invbasis	531
16.241.4.5	_field_rns	532
16.241.4.6	_M	532
16.241.4.7	_Mi	532
16.241.4.8	_MMi	532
16.241.4.9	_crt_in	532
16.241.4.10	_crt_out	532
16.241.4.11	_size	532
16.241.4.12	_pbits	532
16.241.4.13	_ldm	532
16.241.4.14	_mi_sum	532
16.242	rns_double_elt Struct Reference	532
16.242.1	Constructor & Destructor Documentation	533
16.242.1.1	rns_double_elt() [1/3]	533
16.242.1.2	~rns_double_elt()	533
16.242.1.3	rns_double_elt() [2/3]	533
16.242.1.4	rns_double_elt() [3/3]	533
16.242.2	Member Function Documentation	533
16.242.2.1	operator&() [1/2]	533
16.242.2.2	operator&() [2/2]	534
16.242.3	Field Documentation	534
16.242.3.1	_ptr	534
16.242.3.2	_stride	534
16.242.3.3	_alloc	534
16.243	rns_double_elt_cstptr Struct Reference	534
16.243.1	Constructor & Destructor Documentation	535
16.243.1.1	rns_double_elt_cstptr() [1/5]	535
16.243.1.2	rns_double_elt_cstptr() [2/5]	535
16.243.1.3	rns_double_elt_cstptr() [3/5]	535
16.243.1.4	rns_double_elt_cstptr() [4/5]	535
16.243.1.5	rns_double_elt_cstptr() [5/5]	535
16.243.2	Member Function Documentation	535
16.243.2.1	operator&() [1/2]	535

16.243.2.2 operator*()	535
16.243.2.3 operator[]() [1/2]	535
16.243.2.4 operator[]() [2/2]	536
16.243.2.5 operator++()	536
16.243.2.6 operator--()	536
16.243.2.7 operator+()	536
16.243.2.8 operator-()	536
16.243.2.9 operator+=()	536
16.243.2.10 operator-=()	536
16.243.2.11 operator=()	536
16.243.2.12 operator<()	536
16.243.2.13 operator"!=(536
16.243.2.14 operator&() [2/2]	536
16.243.3 Field Documentation	537
16.243.3.1 other	537
16.243.3.2 _ptr	537
16.243.3.3 _stride	537
16.243.3.4 _alloc	537
16.244 rns_double_elt_ptr Struct Reference	537
16.244.1 Constructor & Destructor Documentation	538
16.244.1.1 rns_double_elt_ptr() [1/5]	538
16.244.1.2 rns_double_elt_ptr() [2/5]	538
16.244.1.3 rns_double_elt_ptr() [3/5]	538
16.244.1.4 rns_double_elt_ptr() [4/5]	538
16.244.1.5 rns_double_elt_ptr() [5/5]	538
16.244.2 Member Function Documentation	538
16.244.2.1 operator&() [1/2]	538
16.244.2.2 operator*()	538
16.244.2.3 operator[]() [1/2]	538
16.244.2.4 operator[]() [2/2]	539
16.244.2.5 operator++()	539
16.244.2.6 operator--()	539
16.244.2.7 operator+()	539
16.244.2.8 operator-()	539
16.244.2.9 operator+=()	539
16.244.2.10 operator-=()	539
16.244.2.11 operator=()	539
16.244.2.12 operator<()	539
16.244.2.13 operator"!=(539
16.244.2.14 operator&() [2/2]	539
16.244.3 Field Documentation	540
16.244.3.1 other	540

16.244.3.2 _ptr	540
16.244.3.3 _stride	540
16.244.3.4 _alloc	540
16.245 rns_double_extended Struct Reference	540
16.245.1 Member Typedef Documentation	541
16.245.1.1 integer	541
16.245.1.2 ModField	541
16.245.1.3 BasisElement	541
16.245.1.4 Element	541
16.245.1.5 Element_ptr	541
16.245.1.6 ConstElement_ptr	541
16.245.2 Constructor & Destructor Documentation	541
16.245.2.1 rns_double_extended() [1/3]	542
16.245.2.2 rns_double_extended() [2/3]	542
16.245.2.3 rns_double_extended() [3/3]	542
16.245.3 Member Function Documentation	542
16.245.3.1 precompute_cst()	542
16.245.3.2 init() [1/3]	542
16.245.3.3 init() [2/3]	542
16.245.3.4 convert() [1/2]	543
16.245.3.5 init() [3/3]	543
16.245.3.6 convert() [2/2]	543
16.245.3.7 reduce()	543
16.245.4 Field Documentation	543
16.245.4.1 _basis	543
16.245.4.2 _basisMax	543
16.245.4.3 _negbasis	543
16.245.4.4 _invbasis	544
16.245.4.5 _field_rns	544
16.245.4.6 _M	544
16.245.4.7 _Mi	544
16.245.4.8 _MMi	544
16.245.4.9 _crt_in	544
16.245.4.10 _crt_out	544
16.245.4.11 _size	544
16.245.4.12 _pbits	544
16.245.4.13 _ldm	544
16.246 RNSElementTag Struct Reference	544
16.246.1 Detailed Description	545
16.247 RNSInteger< RNS > Class Template Reference	545
16.247.1 Member Typedef Documentation	546
16.247.1.1 BasisElement	546

16.247.1.2 integer	546
16.247.1.3 Element	546
16.247.1.4 Element_ptr	546
16.247.1.5 ConstElement_ptr	546
16.247.2 Constructor & Destructor Documentation	546
16.247.2.1 RNSInteger() [1/2]	546
16.247.2.2 RNSInteger() [2/2]	546
16.247.3 Member Function Documentation	546
16.247.3.1 rns()	546
16.247.3.2 size()	546
16.247.3.3 isOne()	547
16.247.3.4 isMOne()	547
16.247.3.5 isZero()	547
16.247.3.6 characteristic()	547
16.247.3.7 cardinality()	547
16.247.3.8 init() [1/2]	547
16.247.3.9 init() [2/2]	547
16.247.3.10 reduce() [1/2]	547
16.247.3.11 reduce() [2/2]	547
16.247.3.12 convert()	548
16.247.3.13 assign()	548
16.247.3.14 write() [1/2]	548
16.247.3.15 write() [2/2]	548
16.247.4 Field Documentation	548
16.247.4.1 _rns	548
16.247.4.2 one	548
16.247.4.3 mOne	548
16.247.4.4 zero	548
16.248 RNSIntegerMod< RNS > Class Template Reference	548
16.248.1 Member Typedef Documentation	550
16.248.1.1 Element	550
16.248.1.2 Element_ptr	550
16.248.1.3 ConstElement_ptr	550
16.248.1.4 BasisElement	550
16.248.1.5 ModField	550
16.248.1.6 integer	550
16.248.2 Constructor & Destructor Documentation	550
16.248.2.1 RNSIntegerMod()	550
16.248.3 Member Function Documentation	550
16.248.3.1 rns()	550
16.248.3.2 delayed()	551
16.248.3.3 size()	551

16.248.3.4 isOne()	551
16.248.3.5 isMOne()	551
16.248.3.6 isZero()	551
16.248.3.7 characteristic() [1/2]	551
16.248.3.8 characteristic() [2/2]	551
16.248.3.9 cardinality() [1/2]	551
16.248.3.10 cardinality() [2/2]	551
16.248.3.11 minElement()	551
16.248.3.12 maxElement()	551
16.248.3.13 init() [1/3]	552
16.248.3.14 init() [2/3]	552
16.248.3.15 reduce() [1/2]	552
16.248.3.16 reduce() [2/2]	552
16.248.3.17 init() [3/3]	552
16.248.3.18 convert()	552
16.248.3.19 assign()	552
16.248.3.20 add()	552
16.248.3.21 sub()	552
16.248.3.22 neg()	553
16.248.3.23 mul()	553
16.248.3.24 axpyin()	553
16.248.3.25 inv()	553
16.248.3.26 areEqual()	553
16.248.3.27 write() [1/2]	553
16.248.3.28 write() [2/2]	553
16.248.3.29 reduce_modp() [1/2]	553
16.248.3.30 write_matrix()	554
16.248.3.31 write_matrix_long()	554
16.248.3.32 reduce_modp() [2/2]	554
16.248.3.33 reduce_modp_rnsmajor()	554
16.248.4 Field Documentation	554
16.248.4.1 _p	554
16.248.4.2 _Mi_modp_rns	554
16.248.4.3 _iM_modp_rns	554
16.248.4.4 _rns	554
16.248.4.5 _F	555
16.248.4.6 _RNSdelayed	555
16.248.4.7 one	555
16.248.4.8 mOne	555
16.248.4.9 zero	555
16.249 rnsRandIter< RNS > Class Template Reference	555
16.249.1 Constructor & Destructor Documentation	555

16.249.1.1 rnsRandIter()	555
16.249.2 Member Function Documentation	556
16.249.2.1 random() [1/2]	556
16.249.2.2 operator>() [1/2]	556
16.249.2.3 operator>() [2/2]	556
16.249.2.4 random() [2/2]	556
16.249.2.5 ring()	556
16.250 Row Struct Reference	556
16.251 ruint< K > Class Template Reference	556
16.252 ScalFunctions< Element, Enable > Struct Template Reference	556
16.253 ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type > Struct Template Reference	557
16.253.1 Member Function Documentation	557
16.253.1.1 zero()	557
16.253.1.2 vand()	557
16.253.1.3 vor()	557
16.253.1.4 vxor()	558
16.253.1.5 vandnot()	558
16.253.1.6 ceil()	558
16.253.1.7 floor()	558
16.253.1.8 round()	558
16.253.1.9 add()	558
16.253.1.10 addin()	558
16.253.1.11 sub()	558
16.253.1.12 subin()	558
16.253.1.13 mul()	559
16.253.1.14 mulin()	559
16.253.1.15 div()	559
16.253.1.16 fmadd()	559
16.253.1.17 fmaddin()	559
16.253.1.18 fmsub()	559
16.253.1.19 fmsubin()	559
16.253.1.20 fnmadd()	559
16.253.1.21 fnmaddin()	560
16.253.1.22 lesser()	560
16.253.1.23 lesser_eq()	560
16.253.1.24 greater()	560
16.253.1.25 greater_eq()	560
16.253.1.26 eq()	560
16.254 ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type > Struct Template Reference	560
16.254.1 Member Function Documentation	561
16.254.1.1 zero()	561

16.254.1.2 round()	561
16.254.1.3 vand()	561
16.254.1.4 vor()	562
16.254.1.5 vxor()	562
16.254.1.6 vandnot()	562
16.254.1.7 add()	562
16.254.1.8 addin()	562
16.254.1.9 sub()	562
16.254.1.10 subin()	562
16.254.1.11 mul()	562
16.254.1.12 mullo()	563
16.254.1.13 mulhi()	563
16.254.1.14 mulx()	563
16.254.1.15 fmadd()	563
16.254.1.16 fmaddin()	563
16.254.1.17 fmaddx()	563
16.254.1.18 fmaddxin()	563
16.254.1.19 fmsub()	563
16.254.1.20 fmsubin()	564
16.254.1.21 fmsubx()	564
16.254.1.22 fmsubxin()	564
16.254.1.23 fnmadd()	564
16.254.1.24 fnmaddin()	564
16.254.1.25 fnmaddx()	564
16.254.1.26 fnmaddxin()	564
16.254.1.27 sra() [1/2]	564
16.254.1.28 sra() [2/2]	565
16.254.1.29 srl()	565
16.254.1.30 sll()	565
16.254.1.31 lesser()	565
16.254.1.32 lesser_eq()	565
16.254.1.33 greater()	565
16.254.1.34 greater_eq()	565
16.254.1.35 eq()	565
16.255 Sequential Struct Reference	566
16.255.1 Constructor & Destructor Documentation	566
16.255.1.1 Sequential() [1/3]	566
16.255.1.2 Sequential() [2/3]	566
16.255.1.3 Sequential() [3/3]	566
16.255.2 Member Function Documentation	566
16.255.2.1 numthreads()	566
16.255.3 Friends And Related Function Documentation	566

16.255.3.1 operator<<	566
16.256 Simd128_impl< ArithType, Int, Signed, Size > Struct Template Reference	567
16.257 Simd128_impl< true, false, true, 4 > Struct Reference	567
16.257.1 Member Function Documentation	567
16.257.1.1 type_string()	567
16.258 Simd128_impl< true, false, true, 8 > Struct Reference	567
16.258.1 Member Function Documentation	567
16.258.1.1 type_string()	567
16.259 Simd128_impl< true, true, false, 2 > Struct Reference	568
16.259.1 Member Typedef Documentation	569
16.259.1.1 scalar_t	569
16.259.1.2 vect_t	569
16.259.2 Member Function Documentation	569
16.259.2.1 set1()	570
16.259.2.2 set()	570
16.259.2.3 gather()	570
16.259.2.4 load()	570
16.259.2.5 loadu()	570
16.259.2.6 store()	570
16.259.2.7 storeu()	570
16.259.2.8 stream()	570
16.259.2.9 sra()	571
16.259.2.10 greater()	571
16.259.2.11 lesser()	571
16.259.2.12 greater_eq()	571
16.259.2.13 lesser_eq()	571
16.259.2.14 mulhi()	571
16.259.2.15 mulx()	571
16.259.2.16 fmaddx()	571
16.259.2.17 fmaddxin()	571
16.259.2.18 fnmaddx()	572
16.259.2.19 fnmaddxin()	572
16.259.2.20 fmsubx()	572
16.259.2.21 fmsubxin()	572
16.259.2.22 hadd_to_scal()	572
16.259.2.23 valid()	572
16.259.2.24 compliant()	572
16.259.2.25 sll()	572
16.259.2.26 srl()	573
16.259.2.27 shuffle()	573
16.259.2.28 unpacklo()	573
16.259.2.29 unpackhi()	573

16.259.2.30	blend()	573
16.259.2.31	add()	573
16.259.2.32	addin()	573
16.259.2.33	sub()	573
16.259.2.34	subin()	573
16.259.2.35	mullo()	574
16.259.2.36	mul()	574
16.259.2.37	fmadd()	574
16.259.2.38	fmaddin()	574
16.259.2.39	fnmadd()	574
16.259.2.40	fnmaddin()	574
16.259.2.41	fmsub()	574
16.259.2.42	fmsubin()	574
16.259.2.43	eq()	575
16.259.2.44	round()	575
16.259.2.45	mod()	575
16.259.2.46	type_string()	575
16.259.2.47	zero()	575
16.259.2.48	sll128()	575
16.259.2.49	srl128()	575
16.259.2.50	vand()	575
16.259.2.51	vor()	576
16.259.2.52	vxor()	576
16.259.2.53	vandnot()	576
16.259.3	Field Documentation	576
16.259.3.1	vect_size	576
16.259.3.2	alignment	576
16.260	Simd128_impl< true, true, false, 4 > Struct Reference	576
16.260.1	Member Typedef Documentation	578
16.260.1.1	scalar_t	578
16.260.1.2	vect_t	578
16.260.2	Member Function Documentation	578
16.260.2.1	set1()	578
16.260.2.2	set()	578
16.260.2.3	gather()	578
16.260.2.4	load()	578
16.260.2.5	loadu()	579
16.260.2.6	store()	579
16.260.2.7	storeu()	579
16.260.2.8	stream()	579
16.260.2.9	sra()	579
16.260.2.10	greater()	579

16.260.2.11 lesser()	579
16.260.2.12 greater_eq()	579
16.260.2.13 lesser_eq()	579
16.260.2.14 mulhi()	580
16.260.2.15 mulx()	580
16.260.2.16 fmaddx()	580
16.260.2.17 fmaddxin()	580
16.260.2.18 fnmaddx()	580
16.260.2.19 fnmaddxin()	580
16.260.2.20 fmsubx()	580
16.260.2.21 fmsubxin()	580
16.260.2.22 hadd_to_scal()	581
16.260.2.23 valid()	581
16.260.2.24 compliant()	581
16.260.2.25 sll()	581
16.260.2.26 srl()	581
16.260.2.27 shuffle()	581
16.260.2.28 unpacklo()	581
16.260.2.29 unpackhi()	581
16.260.2.30 blend()	581
16.260.2.31 add()	582
16.260.2.32 addin()	582
16.260.2.33 sub()	582
16.260.2.34 subin()	582
16.260.2.35 mullo()	582
16.260.2.36 mul()	582
16.260.2.37 fmadd()	582
16.260.2.38 fmaddin()	582
16.260.2.39 fnmadd()	583
16.260.2.40 fnmaddin()	583
16.260.2.41 fmsub()	583
16.260.2.42 fmsubin()	583
16.260.2.43 eq()	583
16.260.2.44 round()	583
16.260.2.45 mod()	583
16.260.2.46 type_string()	584
16.260.2.47 zero()	584
16.260.2.48 sll128()	584
16.260.2.49 srl128()	584
16.260.2.50 vand()	584
16.260.2.51 vor()	584
16.260.2.52 vxor()	584

16.260.2.53 vandnot()	584
16.260.3 Field Documentation	584
16.260.3.1 vect_size	584
16.260.3.2 alignment	585
16.261 Simd128_impl< true, true, false, 8 > Struct Reference	585
16.261.1 Member Typedef Documentation	586
16.261.1.1 scalar_t	587
16.261.1.2 vect_t	587
16.261.2 Member Function Documentation	587
16.261.2.1 set1()	587
16.261.2.2 set()	587
16.261.2.3 gather()	587
16.261.2.4 load()	587
16.261.2.5 loadu()	587
16.261.2.6 store()	587
16.261.2.7 storeu()	587
16.261.2.8 stream()	588
16.261.2.9 sra()	588
16.261.2.10 greater()	588
16.261.2.11 lesser()	588
16.261.2.12 greater_eq()	588
16.261.2.13 lesser_eq()	588
16.261.2.14 mullo()	588
16.261.2.15 mulx()	588
16.261.2.16 fmaddx()	588
16.261.2.17 fmaddxin()	589
16.261.2.18 fnmaddx()	589
16.261.2.19 fnmaddxin()	589
16.261.2.20 fmsubx()	589
16.261.2.21 fmsubxin() [1/2]	589
16.261.2.22 hadd_to_scal()	589
16.261.2.23 valid()	589
16.261.2.24 compliant()	590
16.261.2.25 get()	590
16.261.2.26 sll()	590
16.261.2.27 srl()	590
16.261.2.28 shuffle()	590
16.261.2.29 unpacklo()	590
16.261.2.30 unpackhi()	590
16.261.2.31 blend()	590
16.261.2.32 add()	590
16.261.2.33 addin()	591

16.261.2.34	sub()	591
16.261.2.35	subin()	591
16.261.2.36	mul()	591
16.261.2.37	fmadd()	591
16.261.2.38	fmaddin()	591
16.261.2.39	fnmadd()	591
16.261.2.40	fnmaddin()	591
16.261.2.41	fmsub()	592
16.261.2.42	fmsubin()	592
16.261.2.43	fmsubxin() [2/2]	592
16.261.2.44	eq()	592
16.261.2.45	round()	592
16.261.2.46	mask_high()	592
16.261.2.47	mulhi_fast()	592
16.261.2.48	mod()	592
16.261.2.49	signbits()	593
16.261.2.50	type_string()	593
16.261.2.51	zero()	593
16.261.2.52	sll128()	593
16.261.2.53	srl128()	593
16.261.2.54	vand()	593
16.261.2.55	vor()	593
16.261.2.56	vxor()	593
16.261.2.57	vandnot()	593
16.261.3	Field Documentation	594
16.261.3.1	vect_size	594
16.261.3.2	alignment	594
16.262	Simd128_impl< true, true, true, 2 > Struct Reference	594
16.262.1	Member Typedef Documentation	595
16.262.1.1	vect_t	596
16.262.1.2	scalar_t	596
16.262.2	Member Function Documentation	596
16.262.2.1	valid()	596
16.262.2.2	compliant()	596
16.262.2.3	set1()	596
16.262.2.4	set()	596
16.262.2.5	gather()	596
16.262.2.6	load()	596
16.262.2.7	loadu()	597
16.262.2.8	store()	597
16.262.2.9	storeu()	597
16.262.2.10	stream()	597

16.262.2.11 sll()	597
16.262.2.12 srl()	597
16.262.2.13 sra()	597
16.262.2.14 shuffle()	597
16.262.2.15 unpacklo()	597
16.262.2.16 unpackhi()	598
16.262.2.17 blend()	598
16.262.2.18 add()	598
16.262.2.19 addin()	598
16.262.2.20 sub()	598
16.262.2.21 subin()	598
16.262.2.22 mullo()	598
16.262.2.23 mul()	598
16.262.2.24 mulhi()	599
16.262.2.25 mulx()	599
16.262.2.26 fmadd()	599
16.262.2.27 fmaddin()	599
16.262.2.28 fmaddx()	599
16.262.2.29 fmaddxin()	599
16.262.2.30 fnmadd()	599
16.262.2.31 fnmaddin()	599
16.262.2.32 fnmaddx()	600
16.262.2.33 fnmaddxin()	600
16.262.2.34 fmsub()	600
16.262.2.35 fmsubin()	600
16.262.2.36 fmsubx()	600
16.262.2.37 fmsubxin()	600
16.262.2.38 eq()	600
16.262.2.39 greater()	601
16.262.2.40 lesser()	601
16.262.2.41 greater_eq()	601
16.262.2.42 lesser_eq()	601
16.262.2.43 hadd_to_scal()	601
16.262.2.44 round()	601
16.262.2.45 mod()	601
16.262.2.46 type_string()	601
16.262.2.47 zero()	602
16.262.2.48 sll128()	602
16.262.2.49 srl128()	602
16.262.2.50 vand()	602
16.262.2.51 vor()	602
16.262.2.52 vxor()	602

16.262.2.53 vandnot()	602
16.262.3 Field Documentation	602
16.262.3.1 vect_size	602
16.262.3.2 alignment	602
16.263 Simd128_impl< true, true, true, 4 > Struct Reference	603
16.263.1 Member Typedef Documentation	604
16.263.1.1 vect_t	604
16.263.1.2 scalar_t	604
16.263.2 Member Function Documentation	604
16.263.2.1 valid()	605
16.263.2.2 compliant()	605
16.263.2.3 set1()	605
16.263.2.4 set()	605
16.263.2.5 gather()	605
16.263.2.6 load()	605
16.263.2.7 loadu()	605
16.263.2.8 store()	605
16.263.2.9 storeu()	605
16.263.2.10 stream()	606
16.263.2.11 sll()	606
16.263.2.12 srl()	606
16.263.2.13 sra()	606
16.263.2.14 shuffle()	606
16.263.2.15 unpacklo()	606
16.263.2.16 unpackhi()	606
16.263.2.17 blend()	606
16.263.2.18 add()	606
16.263.2.19 addin()	607
16.263.2.20 sub()	607
16.263.2.21 subin()	607
16.263.2.22 mullo()	607
16.263.2.23 mul()	607
16.263.2.24 mulhi()	607
16.263.2.25 mulx()	607
16.263.2.26 fmadd()	607
16.263.2.27 fmaddin()	608
16.263.2.28 fmaddx()	608
16.263.2.29 fmaddxin()	608
16.263.2.30 fnmadd()	608
16.263.2.31 fnmaddin()	608
16.263.2.32 fnmaddx()	608
16.263.2.33 fnmaddxin()	608

16.263.2.34 fmsub()	608
16.263.2.35 fmsubin()	609
16.263.2.36 fmsubx()	609
16.263.2.37 fmsubxin()	609
16.263.2.38 eq()	609
16.263.2.39 greater()	609
16.263.2.40 lesser()	609
16.263.2.41 greater_eq()	609
16.263.2.42 lesser_eq()	610
16.263.2.43 hadd_to_scal()	610
16.263.2.44 round()	610
16.263.2.45 mod()	610
16.263.2.46 type_string()	610
16.263.2.47 zero()	610
16.263.2.48 sll128()	610
16.263.2.49 srl128()	610
16.263.2.50 vand()	610
16.263.2.51 vor()	611
16.263.2.52 vxor()	611
16.263.2.53 vandnot()	611
16.263.3 Field Documentation	611
16.263.3.1 vect_size	611
16.263.3.2 alignment	611
16.264 Simd128_impl< true, true, true, 8 > Struct Reference	611
16.264.1 Member Typedef Documentation	613
16.264.1.1 vect_t	613
16.264.1.2 scalar_t	613
16.264.2 Member Function Documentation	613
16.264.2.1 valid()	613
16.264.2.2 compliant()	613
16.264.2.3 set1()	613
16.264.2.4 set()	614
16.264.2.5 gather()	614
16.264.2.6 get()	614
16.264.2.7 load()	614
16.264.2.8 loadu()	614
16.264.2.9 store()	614
16.264.2.10 storeu()	614
16.264.2.11 stream()	614
16.264.2.12 sll()	614
16.264.2.13 srl()	615
16.264.2.14 sra()	615

16.264.2.15 shuffle()	615
16.264.2.16 unpacklo()	615
16.264.2.17 unpackhi()	615
16.264.2.18 blend()	615
16.264.2.19 add()	615
16.264.2.20 addin()	615
16.264.2.21 sub()	615
16.264.2.22 subin()	616
16.264.2.23 mullo()	616
16.264.2.24 mul()	616
16.264.2.25 mulx()	616
16.264.2.26 fmadd()	616
16.264.2.27 fmaddin()	616
16.264.2.28 fmaddx()	616
16.264.2.29 fmaddxin()	616
16.264.2.30 fnmadd()	617
16.264.2.31 fnmaddin()	617
16.264.2.32 fnmaddx()	617
16.264.2.33 fnmaddxin()	617
16.264.2.34 fmsub()	617
16.264.2.35 fmsubin()	617
16.264.2.36 fmsubx()	617
16.264.2.37 fmsubxin()	617
16.264.2.38 eq()	618
16.264.2.39 greater()	618
16.264.2.40 lesser()	618
16.264.2.41 greater_eq()	618
16.264.2.42 lesser_eq()	618
16.264.2.43 hadd_to_scal()	618
16.264.2.44 round()	618
16.264.2.45 mask_high()	618
16.264.2.46 mulhi_fast()	619
16.264.2.47 mod()	619
16.264.2.48 signbits()	619
16.264.2.49 type_string()	619
16.264.2.50 zero()	619
16.264.2.51 sll128()	619
16.264.2.52 srl128()	619
16.264.2.53 vand()	619
16.264.2.54 vor()	620
16.264.2.55 vxor()	620
16.264.2.56 vandnot()	620

16.264.3 Field Documentation	620
16.264.3.1 vect_size	620
16.264.3.2 alignment	620
16.265 Simd128fp_base Struct Reference	620
16.265.1 Member Function Documentation	620
16.265.1.1 type_string()	620
16.266 Simd128i_base Struct Reference	621
16.266.1 Member Typedef Documentation	621
16.266.1.1 vect_t	621
16.266.2 Member Function Documentation	621
16.266.2.1 type_string()	621
16.266.2.2 zero()	621
16.266.2.3 sll128()	621
16.266.2.4 srl128()	622
16.266.2.5 vand()	622
16.266.2.6 vor()	622
16.266.2.7 vxor()	622
16.266.2.8 vandnot()	622
16.267 Simd256_impl< ArithType, Int, Signed, Size > Struct Template Reference	622
16.268 Simd256_impl< true, false, true, 4 > Struct Reference	622
16.269 Simd256_impl< true, false, true, 8 > Struct Reference	623
16.269.1 Member Typedef Documentation	624
16.269.1.1 vect_t	624
16.269.1.2 scalar_t	624
16.269.2 Member Function Documentation	624
16.269.2.1 valid()	624
16.269.2.2 compliant()	624
16.269.2.3 zero()	624
16.269.2.4 set1()	624
16.269.2.5 set()	625
16.269.2.6 gather()	625
16.269.2.7 load()	625
16.269.2.8 loadu()	625
16.269.2.9 store()	625
16.269.2.10 storeu()	625
16.269.2.11 stream()	625
16.269.2.12 unpacklo_twice()	625
16.269.2.13 unpackhi_twice()	626
16.269.2.14 blend()	626
16.269.2.15 blendv()	626
16.269.2.16 add()	626
16.269.2.17 addin()	626

16.269.2.18 sub()	626
16.269.2.19 subin()	626
16.269.2.20 mul()	626
16.269.2.21 mulin()	627
16.269.2.22 div()	627
16.269.2.23 fmadd()	627
16.269.2.24 fmaddin()	627
16.269.2.25 fnmadd()	627
16.269.2.26 fnmaddin()	627
16.269.2.27 fmsub()	627
16.269.2.28 fmsubin()	627
16.269.2.29 eq()	628
16.269.2.30 lesser()	628
16.269.2.31 lesser_eq()	628
16.269.2.32 greater()	628
16.269.2.33 greater_eq()	628
16.269.2.34 vand()	628
16.269.2.35 vor()	628
16.269.2.36 vxor()	628
16.269.2.37 vandnot()	629
16.269.2.38 floor()	629
16.269.2.39 ceil()	629
16.269.2.40 round()	629
16.269.2.41 hadd()	629
16.269.2.42 hadd_to_scal()	629
16.269.2.43 mod()	629
16.269.3 Field Documentation	629
16.269.3.1 vect_size	629
16.269.3.2 alignment	630
16.270 Simd256_impl< true, true, false, 2 > Struct Reference	630
16.270.1 Member Typedef Documentation	631
16.270.1.1 scalar_t	631
16.270.1.2 simdHalf	631
16.270.1.3 vect_t	632
16.270.1.4 half_t	632
16.270.2 Member Function Documentation	632
16.270.2.1 set1()	632
16.270.2.2 set()	632
16.270.2.3 gather()	632
16.270.2.4 load()	632
16.270.2.5 loadu()	632
16.270.2.6 store()	633

16.270.2.7 storeu()	633
16.270.2.8 stream()	633
16.270.2.9 sra()	633
16.270.2.10 greater()	633
16.270.2.11 lesser()	633
16.270.2.12 greater_eq()	633
16.270.2.13 lesser_eq()	633
16.270.2.14 mulhi()	633
16.270.2.15 mulx()	634
16.270.2.16 fmaddx()	634
16.270.2.17 fmaddxin()	634
16.270.2.18 fnmaddx()	634
16.270.2.19 fnmaddxin()	634
16.270.2.20 fmsubx()	634
16.270.2.21 fmsubxin()	634
16.270.2.22 hadd_to_scal()	635
16.270.2.23 valid()	635
16.270.2.24 compliant()	635
16.270.2.25 sll()	635
16.270.2.26 srl()	635
16.270.2.27 shuffle()	635
16.270.2.28 unpacklo_twice()	635
16.270.2.29 unpackhi_twice()	635
16.270.2.30 unpacklo()	635
16.270.2.31 unpackhi()	636
16.270.2.32 unpacklohi()	636
16.270.2.33 blend_twice()	636
16.270.2.34 add()	636
16.270.2.35 addin()	636
16.270.2.36 sub()	636
16.270.2.37 subin()	636
16.270.2.38 mullo()	636
16.270.2.39 mul()	637
16.270.2.40 fmadd()	637
16.270.2.41 fmaddin()	637
16.270.2.42 fnmadd()	637
16.270.2.43 fnmaddin()	637
16.270.2.44 fmsub()	637
16.270.2.45 fmsubin()	637
16.270.2.46 eq()	637
16.270.2.47 round()	638
16.270.2.48 mod()	638

16.270.2.49 type_string()	638
16.270.2.50 zero()	638
16.270.3 Field Documentation	638
16.270.3.1 vect_size	638
16.270.3.2 alignment	638
16.271 Simd256_impl< true, true, false, 4 > Struct Reference	638
16.271.1 Member Typedef Documentation	641
16.271.1.1 scalar_t [1/2]	641
16.271.1.2 simdHalf [1/2]	641
16.271.1.3 scalar_t [2/2]	641
16.271.1.4 simdHalf [2/2]	641
16.271.1.5 vect_t [1/2]	642
16.271.1.6 vect_t [2/2]	642
16.271.1.7 half_t [1/2]	642
16.271.1.8 half_t [2/2]	642
16.271.2 Member Function Documentation	642
16.271.2.1 set1() [1/2]	642
16.271.2.2 set() [1/3]	642
16.271.2.3 gather() [1/2]	642
16.271.2.4 load() [1/2]	642
16.271.2.5 loadu() [1/2]	642
16.271.2.6 store() [1/2]	643
16.271.2.7 storeu() [1/2]	643
16.271.2.8 stream() [1/2]	643
16.271.2.9 sra() [1/2]	643
16.271.2.10 greater() [1/2]	643
16.271.2.11 lesser() [1/2]	643
16.271.2.12 greater_eq() [1/2]	643
16.271.2.13 lesser_eq() [1/2]	643
16.271.2.14 mulhi() [1/2]	643
16.271.2.15 mulx() [1/2]	644
16.271.2.16 fmaddx() [1/2]	644
16.271.2.17 fmaddxin() [1/2]	644
16.271.2.18 fnmaddx() [1/2]	644
16.271.2.19 fnmaddxin() [1/2]	644
16.271.2.20 fmsubx() [1/2]	644
16.271.2.21 fmsubxin() [1/2]	644
16.271.2.22 hadd_to_scal() [1/2]	645
16.271.2.23 set1() [2/2]	645
16.271.2.24 set() [2/3]	645
16.271.2.25 gather() [2/2]	645
16.271.2.26 load() [2/2]	645

16.271.2.27 loadu() [2/2]	645
16.271.2.28 store() [2/2]	645
16.271.2.29 storeu() [2/2]	645
16.271.2.30 stream() [2/2]	646
16.271.2.31 sra() [2/2]	646
16.271.2.32 greater() [2/2]	646
16.271.2.33 lesser() [2/2]	646
16.271.2.34 greater_eq() [2/2]	646
16.271.2.35 lesser_eq() [2/2]	646
16.271.2.36 mulhi() [2/2]	646
16.271.2.37 mulx() [2/2]	646
16.271.2.38 fmaddx() [2/2]	646
16.271.2.39 fmaddxin() [2/2]	647
16.271.2.40 fnmaddx() [2/2]	647
16.271.2.41 fnmaddxin() [2/2]	647
16.271.2.42 fmsubx() [2/2]	647
16.271.2.43 fmsubxin() [2/2]	647
16.271.2.44 hadd_to_scal() [2/2]	647
16.271.2.45 valid() [1/2]	647
16.271.2.46 valid() [2/2]	648
16.271.2.47 compliant() [1/2]	648
16.271.2.48 compliant() [2/2]	648
16.271.2.49 set() [3/3]	648
16.271.2.50 sll() [1/2]	648
16.271.2.51 sll() [2/2]	648
16.271.2.52 srl() [1/2]	648
16.271.2.53 srl() [2/2]	649
16.271.2.54 shuffle_twice() [1/2]	649
16.271.2.55 shuffle_twice() [2/2]	649
16.271.2.56 shuffle() [1/2]	649
16.271.2.57 shuffle() [2/2]	649
16.271.2.58 unpacklo_twice()	649
16.271.2.59 unpackhi_twice()	649
16.271.2.60 unpacklo()	649
16.271.2.61 unpackhi()	649
16.271.2.62 unpacklohi()	650
16.271.2.63 blend()	650
16.271.2.64 add() [1/2]	650
16.271.2.65 add() [2/2]	650
16.271.2.66 addin() [1/2]	650
16.271.2.67 addin() [2/2]	650
16.271.2.68 sub() [1/2]	650

16.271.2.69 sub()	[2/2]	650
16.271.2.70 subin()	[1/2]	651
16.271.2.71 subin()	[2/2]	651
16.271.2.72 mullo()	[1/2]	651
16.271.2.73 mullo()	[2/2]	651
16.271.2.74 mul()	[1/2]	651
16.271.2.75 mul()	[2/2]	651
16.271.2.76 fmadd()	[1/2]	651
16.271.2.77 fmadd()	[2/2]	651
16.271.2.78 fmaddin()	[1/2]	652
16.271.2.79 fmaddin()	[2/2]	652
16.271.2.80 fnmadd()	[1/2]	652
16.271.2.81 fnmadd()	[2/2]	652
16.271.2.82 fnmaddin()	[1/2]	652
16.271.2.83 fnmaddin()	[2/2]	652
16.271.2.84 fmsub()	[1/2]	652
16.271.2.85 fmsub()	[2/2]	652
16.271.2.86 fmsubin()	[1/2]	653
16.271.2.87 fmsubin()	[2/2]	653
16.271.2.88 eq()	[1/2]	653
16.271.2.89 eq()	[2/2]	653
16.271.2.90 round()	[1/2]	653
16.271.2.91 round()	[2/2]	653
16.271.2.92 mod()	[1/2]	653
16.271.2.93 mod()	[2/2]	654
16.271.2.94 type_string()	[1/2]	654
16.271.2.95 type_string()	[2/2]	654
16.271.2.96 zero()	[1/2]	654
16.271.2.97 zero()	[2/2]	654
16.271.2.98 vor()		654
16.271.2.99 vxor()		654
16.271.2.100 vand()		654
16.271.2.101 vandnot()		654
16.271.3 Field Documentation		655
16.271.3.1 vect_size		655
16.271.3.2 alignment		655
16.272 Simd256_impl< true, true, false, 8 > Struct Reference		655
16.272.1 Member Typedef Documentation		657
16.272.1.1 scalar_t		657
16.272.1.2 simdHalf		657
16.272.1.3 vect_t		657
16.272.1.4 half_t		657

16.272.2 Member Function Documentation	657
16.272.2.1 set1()	657
16.272.2.2 set()	657
16.272.2.3 gather()	657
16.272.2.4 load()	657
16.272.2.5 loadu()	658
16.272.2.6 store()	658
16.272.2.7 storeu()	658
16.272.2.8 stream()	658
16.272.2.9 sra()	658
16.272.2.10 greater()	658
16.272.2.11 lesser()	658
16.272.2.12 greater_eq()	658
16.272.2.13 lesser_eq()	658
16.272.2.14 mullo()	659
16.272.2.15 mulx()	659
16.272.2.16 fmaddx()	659
16.272.2.17 fmaddxin()	659
16.272.2.18 fnmaddx()	659
16.272.2.19 fnmaddxin()	659
16.272.2.20 fmsubx()	659
16.272.2.21 fmsubxin()	659
16.272.2.22 hadd_to_scal()	660
16.272.2.23 valid()	660
16.272.2.24 compliant()	660
16.272.2.25 get()	660
16.272.2.26 sll()	660
16.272.2.27 srl()	660
16.272.2.28 shuffle()	660
16.272.2.29 unpacklo_twice()	660
16.272.2.30 unpackhi_twice()	660
16.272.2.31 unpacklo()	661
16.272.2.32 unpackhi()	661
16.272.2.33 unpacklohi()	661
16.272.2.34 blend()	661
16.272.2.35 add()	661
16.272.2.36 addin()	661
16.272.2.37 sub()	661
16.272.2.38 subin()	661
16.272.2.39 mul()	662
16.272.2.40 fmadd()	662
16.272.2.41 fmaddin()	662

16.272.2.42 fnmadd()	662
16.272.2.43 fnmaddin()	662
16.272.2.44 fmsub()	662
16.272.2.45 fmsubin()	662
16.272.2.46 eq()	662
16.272.2.47 round()	663
16.272.2.48 mask_high()	663
16.272.2.49 mulhi_fast()	663
16.272.2.50 mod()	663
16.272.2.51 signbits()	663
16.272.2.52 type_string()	663
16.272.2.53 zero()	663
16.272.3 Field Documentation	663
16.272.3.1 vect_size	663
16.272.3.2 alignment	664
16.273 Simd256_impl< true, true, true, 2 > Struct Reference	664
16.273.1 Member Typedef Documentation	665
16.273.1.1 vect_t	665
16.273.1.2 half_t	665
16.273.1.3 scalar_t	666
16.273.1.4 simdHalf	666
16.273.2 Member Function Documentation	666
16.273.2.1 valid()	666
16.273.2.2 compliant()	666
16.273.2.3 set1()	666
16.273.2.4 set()	666
16.273.2.5 gather()	666
16.273.2.6 load()	667
16.273.2.7 loadu()	667
16.273.2.8 store()	667
16.273.2.9 storeu()	667
16.273.2.10 stream()	667
16.273.2.11 sll()	667
16.273.2.12 srl()	667
16.273.2.13 sra()	667
16.273.2.14 shuffle()	667
16.273.2.15 unpacklo_twice()	668
16.273.2.16 unpackhi_twice()	668
16.273.2.17 unpacklo()	668
16.273.2.18 unpackhi()	668
16.273.2.19 unpacklohi()	668
16.273.2.20 blend_twice()	668

16.273.2.21	add()	668
16.273.2.22	addin()	668
16.273.2.23	sub()	669
16.273.2.24	subin()	669
16.273.2.25	mullo()	669
16.273.2.26	mul()	669
16.273.2.27	mulhi()	669
16.273.2.28	mulx()	669
16.273.2.29	fmadd()	669
16.273.2.30	fmaddin()	669
16.273.2.31	fmaddx()	670
16.273.2.32	fmaddxin()	670
16.273.2.33	fnmadd()	670
16.273.2.34	fnmaddin()	670
16.273.2.35	fnmaddx()	670
16.273.2.36	fnmaddxin()	670
16.273.2.37	fmsub()	670
16.273.2.38	fmsubin()	670
16.273.2.39	fmsubx()	671
16.273.2.40	fmsubxin()	671
16.273.2.41	eq()	671
16.273.2.42	greater()	671
16.273.2.43	lesser()	671
16.273.2.44	greater_eq()	671
16.273.2.45	lesser_eq()	671
16.273.2.46	hadd_to_scal()	671
16.273.2.47	round()	672
16.273.2.48	mod()	672
16.273.2.49	type_string()	672
16.273.2.50	zero()	672
16.273.3	Field Documentation	672
16.273.3.1	vect_size	672
16.273.3.2	alignment	672
16.274	Simd256_impl< true, true, true, 4 > Struct Reference	672
16.274.1	Member Typedef Documentation	675
16.274.1.1	vect_t [1/2]	675
16.274.1.2	half_t [1/2]	675
16.274.1.3	scalar_t [1/2]	675
16.274.1.4	simdHalf [1/2]	675
16.274.1.5	vect_t [2/2]	676
16.274.1.6	half_t [2/2]	676
16.274.1.7	scalar_t [2/2]	676

16.274.1.8 simdHalf [2/2]	676
16.274.2 Member Function Documentation	676
16.274.2.1 valid() [1/2]	676
16.274.2.2 compliant() [1/2]	676
16.274.2.3 set1() [1/2]	676
16.274.2.4 set() [1/2]	676
16.274.2.5 gather() [1/2]	676
16.274.2.6 load() [1/2]	677
16.274.2.7 loadu() [1/2]	677
16.274.2.8 store() [1/2]	677
16.274.2.9 storeu() [1/2]	677
16.274.2.10 stream() [1/2]	677
16.274.2.11 sll() [1/2]	677
16.274.2.12 srl() [1/2]	677
16.274.2.13 sra() [1/2]	677
16.274.2.14 shuffle_twice() [1/2]	677
16.274.2.15 shuffle() [1/2]	678
16.274.2.16 unpacklo_twice()	678
16.274.2.17 unpackhi_twice()	678
16.274.2.18 unpacklo()	678
16.274.2.19 unpackhi()	678
16.274.2.20 unpacklohi()	678
16.274.2.21 blend()	678
16.274.2.22 add() [1/2]	678
16.274.2.23 addin() [1/2]	679
16.274.2.24 sub() [1/2]	679
16.274.2.25 subin() [1/2]	679
16.274.2.26 mullo() [1/2]	679
16.274.2.27 mul() [1/2]	679
16.274.2.28 mulhi() [1/2]	679
16.274.2.29 mulx() [1/2]	679
16.274.2.30 fmadd() [1/2]	679
16.274.2.31 fmaddin() [1/2]	680
16.274.2.32 fmaddx() [1/2]	680
16.274.2.33 fmaddxin() [1/2]	680
16.274.2.34 fnmadd() [1/2]	680
16.274.2.35 fnmaddin() [1/2]	680
16.274.2.36 fnmaddx() [1/2]	680
16.274.2.37 fnmaddxin() [1/2]	680
16.274.2.38 fmsub() [1/2]	680
16.274.2.39 fmsubin() [1/2]	681
16.274.2.40 fmsubx() [1/2]	681

16.274.2.41 fmsubxin() [1/2]	681
16.274.2.42 eq() [1/2]	681
16.274.2.43 greater() [1/2]	681
16.274.2.44 lesser() [1/2]	681
16.274.2.45 greater_eq() [1/2]	681
16.274.2.46 lesser_eq() [1/2]	682
16.274.2.47 hadd_to_scal() [1/2]	682
16.274.2.48 round() [1/2]	682
16.274.2.49 mod() [1/2]	682
16.274.2.50 valid() [2/2]	682
16.274.2.51 compliant() [2/2]	682
16.274.2.52 set1() [2/2]	682
16.274.2.53 set() [2/2]	682
16.274.2.54 gather() [2/2]	683
16.274.2.55 load() [2/2]	683
16.274.2.56 loadu() [2/2]	683
16.274.2.57 store() [2/2]	683
16.274.2.58 storeu() [2/2]	683
16.274.2.59 stream() [2/2]	683
16.274.2.60 sll() [2/2]	683
16.274.2.61 srl() [2/2]	684
16.274.2.62 sra() [2/2]	684
16.274.2.63 shuffle_twice() [2/2]	684
16.274.2.64 shuffle() [2/2]	684
16.274.2.65 add() [2/2]	684
16.274.2.66 addin() [2/2]	684
16.274.2.67 sub() [2/2]	684
16.274.2.68 subin() [2/2]	684
16.274.2.69 mullo() [2/2]	684
16.274.2.70 mul() [2/2]	685
16.274.2.71 mulhi() [2/2]	685
16.274.2.72 mulx() [2/2]	685
16.274.2.73 fmadd() [2/2]	685
16.274.2.74 fmaddin() [2/2]	685
16.274.2.75 fmaddx() [2/2]	685
16.274.2.76 fmaddxin() [2/2]	685
16.274.2.77 fnmadd() [2/2]	685
16.274.2.78 fnmaddin() [2/2]	686
16.274.2.79 fnmaddx() [2/2]	686
16.274.2.80 fnmaddxin() [2/2]	686
16.274.2.81 fmsub() [2/2]	686
16.274.2.82 fmsubin() [2/2]	686

16.274.2.83 fmsubx() [2/2]	686
16.274.2.84 fmsubxin() [2/2]	686
16.274.2.85 eq() [2/2]	686
16.274.2.86 greater() [2/2]	687
16.274.2.87 lesser() [2/2]	687
16.274.2.88 greater_eq() [2/2]	687
16.274.2.89 lesser_eq() [2/2]	687
16.274.2.90 hadd_to_scal() [2/2]	687
16.274.2.91 round() [2/2]	687
16.274.2.92 mod() [2/2]	687
16.274.2.93 type_string() [1/2]	687
16.274.2.94 zero() [1/2]	688
16.274.2.95 type_string() [2/2]	688
16.274.2.96 zero() [2/2]	688
16.274.2.97 vor()	688
16.274.2.98 vxor()	688
16.274.2.99 vand()	688
16.274.2.100 vandnot()	688
16.274.3 Field Documentation	688
16.274.3.1 vect_size	688
16.274.3.2 alignment	688
16.275 Simd256_impl< true, true, true, 8 > Struct Reference	689
16.275.1 Member Typedef Documentation	690
16.275.1.1 vect_t	690
16.275.1.2 half_t	690
16.275.1.3 scalar_t	691
16.275.1.4 simdHalf	691
16.275.2 Member Function Documentation	691
16.275.2.1 valid()	691
16.275.2.2 compliant()	691
16.275.2.3 set1()	691
16.275.2.4 set()	691
16.275.2.5 gather()	691
16.275.2.6 get()	691
16.275.2.7 load()	691
16.275.2.8 loadu()	692
16.275.2.9 store()	692
16.275.2.10 storeu()	692
16.275.2.11 stream()	692
16.275.2.12 sll()	692
16.275.2.13 srl()	692
16.275.2.14 sra()	692

16.275.2.15 shuffle()	692
16.275.2.16 unpacklo_twice()	692
16.275.2.17 unpackhi_twice()	693
16.275.2.18 unpacklo()	693
16.275.2.19 unpackhi()	693
16.275.2.20 unpacklohi()	693
16.275.2.21 blend()	693
16.275.2.22 add()	693
16.275.2.23 addin()	693
16.275.2.24 sub()	693
16.275.2.25 subin()	694
16.275.2.26 mullo()	694
16.275.2.27 mul()	694
16.275.2.28 mulx()	694
16.275.2.29 fmadd()	694
16.275.2.30 fmaddin()	694
16.275.2.31 fmaddx()	694
16.275.2.32 fmaddxin()	694
16.275.2.33 fnmadd()	695
16.275.2.34 fnmaddin()	695
16.275.2.35 fnmaddx()	695
16.275.2.36 fnmaddxin()	695
16.275.2.37 fmsub()	695
16.275.2.38 fmsubin()	695
16.275.2.39 fmsubx()	695
16.275.2.40 fmsubxin()	695
16.275.2.41 eq()	696
16.275.2.42 greater()	696
16.275.2.43 lesser()	696
16.275.2.44 greater_eq()	696
16.275.2.45 lesser_eq()	696
16.275.2.46 hadd_to_scal()	696
16.275.2.47 round()	696
16.275.2.48 mask_high()	696
16.275.2.49 mulhi_fast()	697
16.275.2.50 mod()	697
16.275.2.51 signbits()	697
16.275.2.52 type_string()	697
16.275.2.53 zero()	697
16.275.3 Field Documentation	697
16.275.3.1 vect_size	697
16.275.3.2 alignment	697

16.276 Simd256fp_base Struct Reference	697
16.277 Simd256i_base Struct Reference	698
16.277.1 Member Typedef Documentation	698
16.277.1.1 vect_t	698
16.277.2 Member Function Documentation	698
16.277.2.1 type_string()	698
16.277.2.2 zero()	698
16.278 Simd512_impl< ArithType, Int, Signed, Size > Struct Template Reference	699
16.279 Simd512_impl< true, false, true, 4 > Struct Reference	699
16.279.1 Member Function Documentation	699
16.279.1.1 type_string()	699
16.280 Simd512_impl< true, false, true, 8 > Struct Reference	699
16.280.1 Member Typedef Documentation	700
16.280.1.1 vect_t	700
16.280.1.2 scalar_t	701
16.280.2 Member Function Documentation	701
16.280.2.1 valid()	701
16.280.2.2 compliant()	701
16.280.2.3 zero()	701
16.280.2.4 set1()	701
16.280.2.5 set()	701
16.280.2.6 gather()	701
16.280.2.7 load()	701
16.280.2.8 loadu()	702
16.280.2.9 store()	702
16.280.2.10 storeu()	702
16.280.2.11 stream()	702
16.280.2.12 shuffle()	702
16.280.2.13 unpacklo_twice()	702
16.280.2.14 unpackhi_twice()	702
16.280.2.15 blend()	702
16.280.2.16 blendv()	702
16.280.2.17 add()	703
16.280.2.18 addin()	703
16.280.2.19 sub()	703
16.280.2.20 subin()	703
16.280.2.21 mul()	703
16.280.2.22 mulin()	703
16.280.2.23 div()	703
16.280.2.24 fmadd()	703
16.280.2.25 fmaddin()	704
16.280.2.26 fnmadd()	704

16.280.2.27 fnmaddin()	704
16.280.2.28 fmsub()	704
16.280.2.29 fmsubin()	704
16.280.2.30 eq()	704
16.280.2.31 lesser()	704
16.280.2.32 lesser_eq()	704
16.280.2.33 greater()	705
16.280.2.34 greater_eq()	705
16.280.2.35 floor()	705
16.280.2.36 ceil()	705
16.280.2.37 round()	705
16.280.2.38 hadd()	705
16.280.2.39 hadd_to_scal()	705
16.280.2.40 type_string()	705
16.280.3 Field Documentation	705
16.280.3.1 vect_size	705
16.280.3.2 alignment	706
16.281 Simd512_impl< true, true, false, 8 > Struct Reference	706
16.281.1 Member Typedef Documentation	708
16.281.1.1 scalar_t	708
16.281.1.2 simdHalf	708
16.281.1.3 vect_t	708
16.281.1.4 half_t	708
16.281.2 Member Function Documentation	708
16.281.2.1 set1()	708
16.281.2.2 set() $[1/2]$	708
16.281.2.3 gather()	708
16.281.2.4 load()	708
16.281.2.5 loadu()	709
16.281.2.6 store()	709
16.281.2.7 maskstore()	709
16.281.2.8 storeu()	709
16.281.2.9 stream()	709
16.281.2.10 sra()	709
16.281.2.11 greater()	709
16.281.2.12 lesser()	709
16.281.2.13 greater_eq()	709
16.281.2.14 lesser_eq()	710
16.281.2.15 mullo()	710
16.281.2.16 mulx()	710
16.281.2.17 fmaddx()	710
16.281.2.18 fmaddxin()	710

16.281.2.19 fnmaddx()	710
16.281.2.20 fnmaddxin()	710
16.281.2.21 fmsubx()	710
16.281.2.22 fmsubxin()	711
16.281.2.23 hadd_to_scal()	711
16.281.2.24 valid()	711
16.281.2.25 compliant()	711
16.281.2.26 set() [2/2]	711
16.281.2.27 sll()	711
16.281.2.28 srl()	711
16.281.2.29 shuffle()	711
16.281.2.30 unpacklo_twice()	711
16.281.2.31 unpackhi_twice()	712
16.281.2.32 unpacklo()	712
16.281.2.33 unpackhi()	712
16.281.2.34 unpacklohi()	712
16.281.2.35 blend()	712
16.281.2.36 add()	712
16.281.2.37 addin()	712
16.281.2.38 sub()	712
16.281.2.39 subin()	713
16.281.2.40 mul()	713
16.281.2.41 fmadd()	713
16.281.2.42 fmaddin()	713
16.281.2.43 fnmadd()	713
16.281.2.44 fnmaddin()	713
16.281.2.45 fmsub()	713
16.281.2.46 fmsubin()	713
16.281.2.47 eq()	714
16.281.2.48 round()	714
16.281.2.49 mask_high()	714
16.281.2.50 mulhi_fast()	714
16.281.2.51 mod()	714
16.281.2.52 signbits()	714
16.281.2.53 type_string()	714
16.281.2.54 zero()	714
16.281.2.55 vor()	715
16.281.2.56 vxor()	715
16.281.2.57 vand()	715
16.281.2.58 vandnot()	715
16.281.3 Field Documentation	715
16.281.3.1 vect_size	715

16.281.3.2 alignment	715
16.282 Simd512_impl< true, true, true, 8 > Struct Reference	715
16.282.1 Member Typedef Documentation	717
16.282.1.1 vect_t	717
16.282.1.2 half_t	717
16.282.1.3 scalar_t	717
16.282.1.4 simdHalf	717
16.282.2 Member Function Documentation	717
16.282.2.1 valid()	718
16.282.2.2 compliant()	718
16.282.2.3 set1()	718
16.282.2.4 set() [1/2]	718
16.282.2.5 set() [2/2]	718
16.282.2.6 gather()	718
16.282.2.7 load()	718
16.282.2.8 loadu()	718
16.282.2.9 store()	719
16.282.2.10 maskstore()	719
16.282.2.11 storeu()	719
16.282.2.12 stream()	719
16.282.2.13 sll()	719
16.282.2.14 srl()	719
16.282.2.15 sra()	719
16.282.2.16 shuffle()	719
16.282.2.17 unpacklo_twice()	719
16.282.2.18 unpackhi_twice()	720
16.282.2.19 unpacklo()	720
16.282.2.20 unpackhi()	720
16.282.2.21 unpacklohi()	720
16.282.2.22 blend()	720
16.282.2.23 add()	720
16.282.2.24 addin()	720
16.282.2.25 sub()	720
16.282.2.26 subin()	721
16.282.2.27 mullo()	721
16.282.2.28 mul()	721
16.282.2.29 mulx()	721
16.282.2.30 fmadd()	721
16.282.2.31 fmaddin()	721
16.282.2.32 fmaddx()	721
16.282.2.33 fmaddxin()	721
16.282.2.34 fnmadd()	722

16.282.2.35 fmaddin()	722
16.282.2.36 fmaddx()	722
16.282.2.37 fmaddxin()	722
16.282.2.38 fmsub()	722
16.282.2.39 fmsubin()	722
16.282.2.40 fmsubx()	722
16.282.2.41 fmsubxin()	722
16.282.2.42 eq()	723
16.282.2.43 greater()	723
16.282.2.44 lesser()	723
16.282.2.45 greater_eq()	723
16.282.2.46 lesser_eq()	723
16.282.2.47 hadd_to_scal()	723
16.282.2.48 round()	723
16.282.2.49 mask_high()	723
16.282.2.50 mulhi_fast()	724
16.282.2.51 mod()	724
16.282.2.52 signbits()	724
16.282.2.53 type_string()	724
16.282.2.54 zero()	724
16.282.2.55 vor()	724
16.282.2.56 vxor()	724
16.282.2.57 vand()	724
16.282.2.58 vandnot()	725
16.282.3 Field Documentation	725
16.282.3.1 vect_size	725
16.282.3.2 alignment	725
16.283 Simd512fp_base Struct Reference	725
16.283.1 Member Function Documentation	725
16.283.1.1 type_string()	725
16.284 Simd512i_base Struct Reference	725
16.284.1 Member Typedef Documentation	726
16.284.1.1 vect_t	726
16.284.2 Member Function Documentation	726
16.284.2.1 type_string()	726
16.284.2.2 zero()	726
16.284.2.3 vor()	726
16.284.2.4 vxor()	726
16.284.2.5 vand()	726
16.284.2.6 vandnot()	727
16.285 SimdChooser< T, bool, bool > Struct Template Reference	727
16.286 SimdChooser< T, false, b > Struct Template Reference	727

16.286.1 Member Typedef Documentation	727
16.286.1.1 value	727
16.287 SimdChooser< T, true, false > Struct Template Reference	727
16.287.1 Member Typedef Documentation	727
16.287.1.1 value	727
16.288 SimdChooser< T, true, true > Struct Template Reference	727
16.288.1 Member Typedef Documentation	728
16.288.1.1 value	728
16.289 simdToType< T > Struct Template Reference	728
16.290 Single Struct Reference	728
16.291 Sparse< Field, SparseMatrix_t, IdxT, PtrT > Struct Template Reference	728
16.292 Sparse< _Field, SparseMatrix_t::COO > Struct Template Reference	728
16.292.1 Member Typedef Documentation	729
16.292.1.1 Field	729
16.292.2 Field Documentation	729
16.292.2.1 col	729
16.292.2.2 row	729
16.292.2.3 dat	729
16.292.2.4 delayed	729
16.292.2.5 kmax	729
16.292.2.6 m	729
16.292.2.7 n	729
16.292.2.8 nnz	729
16.292.2.9 nElements	730
16.292.2.10 maxrow	730
16.293 Sparse< _Field, SparseMatrix_t::COO_ZO > Struct Template Reference	730
16.293.1 Member Typedef Documentation	730
16.293.1.1 Field	730
16.293.2 Field Documentation	730
16.293.2.1 cst	730
16.293.2.2 col	731
16.293.2.3 row	731
16.293.2.4 dat	731
16.293.2.5 delayed	731
16.293.2.6 kmax	731
16.293.2.7 m	731
16.293.2.8 n	731
16.293.2.9 nnz	731
16.293.2.10 nElements	731
16.293.2.11 maxrow	731
16.294 Sparse< _Field, SparseMatrix_t::CSR > Struct Template Reference	731
16.294.1 Member Typedef Documentation	732

16.294.1.1 Field	732
16.294.2 Field Documentation	732
16.294.2.1 delayed	732
16.294.2.2 kmax	732
16.294.2.3 m	732
16.294.2.4 n	732
16.294.2.5 nnz	733
16.294.2.6 nElements	733
16.294.2.7 maxrow	733
16.294.2.8 col	733
16.294.2.9 st	733
16.294.2.10 stend	733
16.294.2.11 dat	733
16.295 Sparse< _Field, SparseMatrix_t::CSR_HYB > Struct Template Reference	733
16.295.1 Member Typedef Documentation	734
16.295.1.1 Field	734
16.295.2 Field Documentation	734
16.295.2.1 delayed	734
16.295.2.2 col	734
16.295.2.3 st	734
16.295.2.4 dat	734
16.295.2.5 kmax	734
16.295.2.6 m	734
16.295.2.7 n	734
16.295.2.8 nnz	734
16.295.2.9 nElements	734
16.295.2.10 maxrow	735
16.295.2.11 nOnes	735
16.295.2.12 nMOnes	735
16.295.2.13 nOthers	735
16.296 Sparse< _Field, SparseMatrix_t::CSR_ZO > Struct Template Reference	735
16.296.1 Member Typedef Documentation	735
16.296.1.1 Field	736
16.296.2 Field Documentation	736
16.296.2.1 cst	736
16.296.2.2 delayed	736
16.296.2.3 kmax	736
16.296.2.4 m	736
16.296.2.5 n	736
16.296.2.6 nnz	736
16.296.2.7 nElements	736
16.296.2.8 maxrow	736

16.296.2.9 col	736
16.296.2.10 st	736
16.296.2.11 stend	737
16.296.2.12 dat	737
16.297 Sparse< _Field, SparseMatrix_t::ELL > Struct Template Reference	737
16.297.1 Member Typedef Documentation	737
16.297.1.1 Field	737
16.297.2 Field Documentation	737
16.297.2.1 delayed	737
16.297.2.2 kmax	738
16.297.2.3 m	738
16.297.2.4 n	738
16.297.2.5 ld	738
16.297.2.6 nnz	738
16.297.2.7 nElements	738
16.297.2.8 maxrow	738
16.297.2.9 col	738
16.297.2.10 dat	738
16.298 Sparse< _Field, SparseMatrix_t::ELL_simd > Struct Template Reference	738
16.298.1 Field Documentation	739
16.298.1.1 delayed	739
16.298.1.2 chunk	739
16.298.1.3 m	739
16.298.1.4 n	739
16.298.1.5 ld	739
16.298.1.6 kmax	739
16.298.1.7 nnz	739
16.298.1.8 nElements	739
16.298.1.9 maxrow	740
16.298.1.10 nChunks	740
16.298.1.11 col	740
16.298.1.12 dat	740
16.299 Sparse< _Field, SparseMatrix_t::ELL_simd_ZO > Struct Template Reference	740
16.299.1 Field Documentation	740
16.299.1.1 cst	740
16.299.1.2 delayed	741
16.299.1.3 chunk	741
16.299.1.4 m	741
16.299.1.5 n	741
16.299.1.6 ld	741
16.299.1.7 kmax	741
16.299.1.8 nnz	741

16.299.1.9 nElements	741
16.299.1.10 maxrow	741
16.299.1.11 nChunks	741
16.299.1.12 col	741
16.299.1.13 dat	741
16.300 Sparse< _Field, SparseMatrix_t::ELL_ZO > Struct Template Reference	742
16.300.1 Member Typedef Documentation	742
16.300.1.1 Field	742
16.300.2 Field Documentation	742
16.300.2.1 cst	742
16.300.2.2 delayed	742
16.300.2.3 kmax	742
16.300.2.4 m	743
16.300.2.5 n	743
16.300.2.6 ld	743
16.300.2.7 nnz	743
16.300.2.8 nElements	743
16.300.2.9 maxrow	743
16.300.2.10 col	743
16.300.2.11 dat	743
16.301 Sparse< _Field, SparseMatrix_t::HYB_ZO > Struct Template Reference	743
16.301.1 Member Typedef Documentation	744
16.301.1.1 Field	744
16.301.1.2 Self_t	744
16.301.2 Field Documentation	744
16.301.2.1 delayed	744
16.301.2.2 kmax	744
16.301.2.3 m	744
16.301.2.4 n	744
16.301.2.5 nnz	744
16.301.2.6 maxrow	744
16.301.2.7 nElements	744
16.301.2.8 dat	745
16.301.2.9 one	745
16.301.2.10 mone	745
16.302 Sparse< _Field, SparseMatrix_t::SELL > Struct Template Reference	745
16.302.1 Member Typedef Documentation	745
16.302.1.1 Field	746
16.302.2 Field Documentation	746
16.302.2.1 delayed	746
16.302.2.2 chunk	746
16.302.2.3 kmax	746

16.302.2.4 m	746
16.302.2.5 n	746
16.302.2.6 maxrow	746
16.302.2.7 sigma	746
16.302.2.8 nChunks	746
16.302.2.9 nnz	746
16.302.2.10 nElements	746
16.302.2.11 perm	747
16.302.2.12 st	747
16.302.2.13 chunkSize	747
16.302.2.14 col	747
16.302.2.15 dat	747
16.303 Sparse< _Field, SparseMatrix_t::SELL_ZO > Struct Template Reference	747
16.303.1 Member Typedef Documentation	748
16.303.1.1 Field	748
16.303.2 Field Documentation	748
16.303.2.1 cst	748
16.303.2.2 delayed	748
16.303.2.3 chunk	748
16.303.2.4 kmax	748
16.303.2.5 m	748
16.303.2.6 n	748
16.303.2.7 maxrow	748
16.303.2.8 sigma	748
16.303.2.9 nChunks	749
16.303.2.10 nnz	749
16.303.2.11 nElements	749
16.303.2.12 perm	749
16.303.2.13 st	749
16.303.2.14 chunkSize	749
16.303.2.15 col	749
16.303.2.16 dat	749
16.304 SpMat< Field, flag > Struct Template Reference	749
16.304.1 Field Documentation	749
16.304.1.1 _coo	749
16.304.1.2 _csr	750
16.304.1.3 _ell	750
16.305 Static_error_check< bool > Class Template Reference	750
16.305.1 Constructor & Destructor Documentation	750
16.305.1.1 Static_error_check()	750
16.306 Static_error_check< false > Class Reference	750
16.307 StatsMatrix Struct Reference	750

16.307.1 Field Documentation	751
16.307.1.1 rowdim	751
16.307.1.2 coldim	751
16.307.1.3 nOnes	751
16.307.1.4 nMOnes	751
16.307.1.5 nOthers	751
16.307.1.6 nnz	751
16.307.1.7 maxRow	751
16.307.1.8 minRow	752
16.307.1.9 averageRow	752
16.307.1.10 deviationRow	752
16.307.1.11 maxCol	752
16.307.1.12 minCol	752
16.307.1.13 averageCol	752
16.307.1.14 deviationCol	752
16.307.1.15 minColDifference	752
16.307.1.16 maxColDifference	752
16.307.1.17 averageColDifference	752
16.307.1.18 deviationColDifference	752
16.307.1.19 minRowDifference	752
16.307.1.20 maxRowDifference	753
16.307.1.21 averageRowDifference	753
16.307.1.22 deviationRowDifference	753
16.307.1.23 nDenseRows	753
16.307.1.24 nDenseCols	753
16.307.1.25 nEmptyRows	753
16.307.1.26 nEmptyCols	753
16.307.1.27 nEmptyColsEnd	753
16.307.1.28 denseRows	753
16.307.1.29 denseCols	753
16.308 support_fast_mod< T > Struct Template Reference	753
16.309 support_fast_mod< double > Struct Reference	754
16.310 support_fast_mod< float > Struct Reference	754
16.311 support_fast_mod< int64_t > Struct Reference	754
16.312 support_simd< T > Struct Template Reference	755
16.313 support_simd_add< T > Struct Template Reference	755
16.314 support_simd_mod< T > Struct Template Reference	755
16.315 tfn_minus Struct Reference	755
16.315.1 Member Function Documentation	756
16.315.1.1 operator>()	756
16.316 tfn_minus_eq Struct Reference	756
16.316.1 Member Function Documentation	756

16.316.1.1 operator>()	756
16.317 tfn_mul Struct Reference	756
16.317.1 Member Function Documentation	756
16.317.1.1 operator>()	756
16.318 tfn_mul_eq Struct Reference	757
16.318.1 Member Function Documentation	757
16.318.1.1 operator>()	757
16.319 tfn_plus Struct Reference	757
16.319.1 Member Function Documentation	757
16.319.1.1 operator>()	757
16.320 tfn_plus_eq Struct Reference	757
16.320.1 Member Function Documentation	757
16.320.1.1 operator>()	758
16.321 Threads Struct Reference	758
16.322 ThreeD Struct Reference	758
16.323 ThreeDAdaptive Struct Reference	758
16.324 ThreeDInPlace Struct Reference	758
16.325 TRSMHelper< RectIterTrait, ParSeqTrait > Struct Template Reference	758
16.325.1 Detailed Description	759
16.325.2 Constructor & Destructor Documentation	759
16.325.2.1 TRSMHelper() [1/3]	759
16.325.2.2 TRSMHelper() [2/3]	759
16.325.2.3 TRSMHelper() [3/3]	759
16.325.3 Member Function Documentation	759
16.325.3.1 pMMH() [1/2]	759
16.325.3.2 pMMH() [2/2]	759
16.325.4 Field Documentation	759
16.325.4.1 parseq	759
16.326 TwoD Struct Reference	760
16.327 TwoDAdaptive Struct Reference	760
16.328 UnparametricTag Struct Reference	760
16.328.1 Detailed Description	760
16.329 Winograd Struct Reference	760
16.330 WinogradPar Struct Reference	760
17 File Documentation	761
17.1 arithprog.C File Reference	761
17.1.1 Macro Definition Documentation	761
17.1.1.1 CUBE	761
17.1.1.2 GFOPS	761
17.1.2 Typedef Documentation	762
17.1.2.1 TTimer	762

17.1.3 Function Documentation	762
17.1.3.1 main()	762
17.2 charpoly.C File Reference	762
17.2.1 Macro Definition Documentation	762
17.2.1.1 CUBE	762
17.2.1.2 GFOPS	762
17.2.2 Typedef Documentation	763
17.2.2.1 TTimer	763
17.2.3 Function Documentation	763
17.2.3.1 main()	763
17.3 charpoly.C File Reference	763
17.3.1 Function Documentation	763
17.3.1.1 main()	763
17.4 fsyrk.C File Reference	763
17.4.1 Macro Definition Documentation	764
17.4.1.1 CUBE	764
17.4.1.2 GFOPS	764
17.4.2 Typedef Documentation	764
17.4.2.1 TTimer	764
17.4.3 Function Documentation	764
17.4.3.1 main()	764
17.5 fsytrf.C File Reference	764
17.5.1 Macro Definition Documentation	765
17.5.1.1 CUBE	765
17.5.1.2 GFOPS	765
17.5.2 Typedef Documentation	765
17.5.2.1 TTimer	765
17.5.3 Function Documentation	765
17.5.3.1 main()	765
17.6 ftrtri.C File Reference	765
17.6.1 Macro Definition Documentation	766
17.6.1.1 CUBE	766
17.6.1.2 GFOPS	766
17.6.2 Typedef Documentation	766
17.6.2.1 TTimer	766
17.6.3 Function Documentation	766
17.6.3.1 main()	766
17.7 pluq.C File Reference	766
17.7.1 Macro Definition Documentation	767
17.7.1.1 CUBE	767
17.7.1.2 GFOPS	767
17.7.2 Typedef Documentation	767

17.7.2.1 TTimer	767
17.7.3 Function Documentation	767
17.7.3.1 main()	767
17.8 pluq.C File Reference	767
17.8.1 Function Documentation	768
17.8.1.1 main()	768
17.9 winograd.C File Reference	768
17.9.1 Macro Definition Documentation	768
17.9.1.1 DOUBLE_TO_FLOAT_CROSSOVER	768
17.9.1.2 GFOPS	768
17.9.2 Typedef Documentation	768
17.9.2.1 TTimer	769
17.9.3 Function Documentation	769
17.9.3.1 balanced() [1/2]	769
17.9.3.2 balanced() [2/2]	769
17.9.3.3 main()	769
17.10 benchmark-charpoly-mp.C File Reference	769
17.10.1 Macro Definition Documentation	769
17.10.1.1 __FFLASFFPACK_FORCE_SEQ	769
17.10.2 Function Documentation	769
17.10.2.1 main()	770
17.11 benchmark-charpoly.C File Reference	770
17.11.1 Macro Definition Documentation	770
17.11.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	770
17.11.2 Function Documentation	770
17.11.2.1 run_with_field()	770
17.11.2.2 main()	770
17.12 benchmark-checkers.C File Reference	771
17.12.1 Macro Definition Documentation	771
17.12.1.1 ENABLE_ALL_CHECKINGS	771
17.12.1.2 _NR_TESTS	771
17.12.1.3 _MAX_SIZE_MATRICES	771
17.12.1.4 CUBE	771
17.12.2 Function Documentation	771
17.12.2.1 main()	771
17.13 benchmark-dgemm.C File Reference	772
17.13.1 Macro Definition Documentation	772
17.13.1.1 CBLAS_GEMM	772
17.13.2 Typedef Documentation	772
17.13.2.1 TTimer	772
17.13.2.2 Floats	772
17.13.3 Function Documentation	772

17.13.3.1 main()	772
17.14 benchmark-dgetrf.C File Reference	773
17.14.1 Macro Definition Documentation	773
17.14.1.1 __FFLASFFPACK_HAVE_DGETRF	773
17.14.2 Typedef Documentation	773
17.14.2.1 TTimer	773
17.14.3 Function Documentation	773
17.14.3.1 main()	773
17.15 benchmark-dgetri.C File Reference	773
17.15.1 Typedef Documentation	774
17.15.1.1 TTimer	774
17.15.2 Function Documentation	774
17.15.2.1 main()	774
17.16 benchmark-dsytrf.C File Reference	774
17.16.1 Macro Definition Documentation	774
17.16.1.1 EFFGFF	775
17.16.2 Typedef Documentation	775
17.16.2.1 TTimer	775
17.16.3 Function Documentation	775
17.16.3.1 main()	775
17.17 benchmark-dtrsm.C File Reference	775
17.17.1 Typedef Documentation	775
17.17.1.1 TTimer	775
17.17.2 Function Documentation	775
17.17.2.1 main()	776
17.18 benchmark-dtrtri.C File Reference	776
17.18.1 Macro Definition Documentation	776
17.18.1.1 __FFLASFFPACK_HAVE_DTRTRI	776
17.18.2 Typedef Documentation	776
17.18.2.1 TTimer	776
17.18.3 Function Documentation	776
17.18.3.1 main()	776
17.19 benchmark-fadd-lvl2.C File Reference	777
17.19.1 Macro Definition Documentation	777
17.19.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	777
17.19.2 Function Documentation	777
17.19.2.1 main()	777
17.20 benchmark-fdot.C File Reference	777
17.20.1 Macro Definition Documentation	778
17.20.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	778
17.20.2 Function Documentation	778
17.20.2.1 run_with_field()	778

17.20.2.2 main()	778
17.21 benchmark-fgemm-mp.C File Reference	778
17.21.1 Macro Definition Documentation	779
17.21.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	779
17.21.1.2 MG_DEFAULT	779
17.21.1.3 STD_RECINT_SIZE	779
17.21.2 Function Documentation	779
17.21.2.1 tmain()	779
17.21.2.2 main()	779
17.22 benchmark-fgemm-rns.C File Reference	779
17.22.1 Macro Definition Documentation	780
17.22.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	780
17.22.2 Typedef Documentation	780
17.22.2.1 RNS	780
17.22.2.2 Field	780
17.22.2.3 Element_ptr	780
17.22.2.4 ConstElement_ptr	780
17.22.2.5 THREADS	780
17.22.2.6 GRAIN	780
17.22.2.7 TWOD	780
17.22.2.8 TWODA	781
17.22.2.9 THREED	781
17.22.2.10 THREEDA	781
17.22.2.11 THREEDIP	781
17.22.2.12 PSeq	781
17.22.3 Function Documentation	781
17.22.3.1 main()	781
17.23 benchmark-fgemm.C File Reference	781
17.23.1 Macro Definition Documentation	781
17.23.1.1 CLASSIC_HYBRID	782
17.23.2 Function Documentation	782
17.23.2.1 main()	782
17.24 benchmark-fgemv-mp.C File Reference	782
17.24.1 Macro Definition Documentation	782
17.24.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	782
17.24.1.2 MG_DEFAULT	782
17.24.1.3 STD_RECINT_SIZE	783
17.24.2 Function Documentation	783
17.24.2.1 write_matrix()	783
17.24.2.2 tmain()	783
17.24.2.3 main()	783
17.25 benchmark-fgemv.C File Reference	783

17.25.1 Macro Definition Documentation	784
17.25.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	784
17.25.2 Function Documentation	784
17.25.2.1 fill_value()	784
17.25.2.2 genData()	784
17.25.2.3 check_result()	785
17.25.2.4 benchmark_with_timer()	785
17.25.2.5 benchmark_disp()	785
17.25.2.6 benchmark_in_Field()	786
17.25.2.7 benchmark_with_field() [1/2]	786
17.25.2.8 benchmark_with_field() [2/2]	786
17.25.2.9 main()	786
17.26 benchmark-fgesv.C File Reference	786
17.26.1 Macro Definition Documentation	787
17.26.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	787
17.26.2 Function Documentation	787
17.26.2.1 main()	787
17.27 benchmark-fsyrk.C File Reference	787
17.27.1 Macro Definition Documentation	787
17.27.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	788
17.27.1.2 CUBE	788
17.27.2 Function Documentation	788
17.27.2.1 main()	788
17.28 benchmark-fsytrf.C File Reference	788
17.28.1 Macro Definition Documentation	788
17.28.1.1 __FFPACK_FSYTRF_BC_CROUT	788
17.28.1.2 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	788
17.28.1.3 CUBE	788
17.28.2 Function Documentation	789
17.28.2.1 main()	789
17.29 benchmark-ftnrm-mp.C File Reference	789
17.29.1 Macro Definition Documentation	789
17.29.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	789
17.29.2 Function Documentation	789
17.29.2.1 main()	789
17.30 benchmark-ftnrm.C File Reference	789
17.30.1 Macro Definition Documentation	790
17.30.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	790
17.30.2 Function Documentation	790
17.30.2.1 main()	790
17.31 benchmark-ftnrmv.C File Reference	790
17.31.1 Macro Definition Documentation	790

17.31.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	790
17.31.2 Function Documentation	790
17.31.2.1 main()	791
17.32 benchmark-ffttri.C File Reference	791
17.32.1 Macro Definition Documentation	791
17.32.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	791
17.32.1.2 CUBE	791
17.32.2 Function Documentation	791
17.32.2.1 main()	791
17.33 benchmark-inverse.C File Reference	791
17.33.1 Macro Definition Documentation	792
17.33.1.1 CUBE	792
17.33.2 Function Documentation	792
17.33.2.1 main()	792
17.34 benchmark-lqup-mp.C File Reference	792
17.34.1 Function Documentation	792
17.34.1.1 main()	792
17.35 benchmark-lqup.C File Reference	793
17.35.1 Macro Definition Documentation	793
17.35.1.1 CUBE	793
17.35.2 Function Documentation	793
17.35.2.1 main()	793
17.36 benchmark-pluq.C File Reference	793
17.36.1 Macro Definition Documentation	794
17.36.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET	794
17.36.1.2 CUBE	794
17.36.2 Typedef Documentation	794
17.36.2.1 Field	794
17.36.3 Function Documentation	794
17.36.3.1 verification_PLUQ()	794
17.36.3.2 Rec_Initialize()	794
17.36.3.3 main()	795
17.37 benchmark-wino.C File Reference	795
17.37.1 Macro Definition Documentation	795
17.37.1.1 CUBE	795
17.37.2 Function Documentation	795
17.37.2.1 launch_wino()	795
17.37.2.2 main()	795
17.38 config.h File Reference	796
17.38.1 Macro Definition Documentation	796
17.38.1.1 HAVE_BLAS	796
17.38.1.2 HAVE_CBLAS	796

17.38.1.3 HAVE_CXX11	797
17.38.1.4 HAVE_DLFCN_H	797
17.38.1.5 HAVE_FLOAT_H	797
17.38.1.6 HAVE_INT128	797
17.38.1.7 HAVE_INTPTR_T	797
17.38.1.8 HAVE_LAPACK	797
17.38.1.9 HAVE_LIMITS_H	797
17.38.1.10 HAVE_LITTLE_ENDIAN	797
17.38.1.11 HAVE_PTHREAD_H	797
17.38.1.12 HAVE_STDDEF_H	797
17.38.1.13 HAVE_STDINT_H	797
17.38.1.14 HAVE_STDIO_H	797
17.38.1.15 HAVE_STDLIB_H	798
17.38.1.16 HAVE_STRINGS_H	798
17.38.1.17 HAVE_STRING_H	798
17.38.1.18 HAVE_SYS_STAT_H	798
17.38.1.19 HAVE_SYS_TIME_H	798
17.38.1.20 HAVE_SYS_TYPES_H	798
17.38.1.21 HAVE_UNISTD_H	798
17.38.1.22 LT_OBJDIR	798
17.38.1.23 OPENBLAS_NUM_THREADS	798
17.38.1.24 PACKAGE	798
17.38.1.25 PACKAGE_BUGREPORT	798
17.38.1.26 PACKAGE_NAME	798
17.38.1.27 PACKAGE_STRING	799
17.38.1.28 PACKAGE_TARNAME	799
17.38.1.29 PACKAGE_URL	799
17.38.1.30 PACKAGE_VERSION	799
17.38.1.31 SIZEOF_CHAR	799
17.38.1.32 SIZEOF_INT	799
17.38.1.33 SIZEOF_LONG	799
17.38.1.34 SIZEOF_LONG_LONG	799
17.38.1.35 SIZEOF_SHORT	799
17.38.1.36 SIZEOF__INT64	799
17.38.1.37 STDC_HEADERS	799
17.38.1.38 USE_OPENMP	799
17.38.1.39 VERSION	800
17.39 config.h File Reference	800
17.39.1 Macro Definition Documentation	800
17.39.1.1 __F77CBLAS__	800
17.39.1.2 __F77CBLAS__	801
17.39.1.3 __F77CBLAS__	801

17.39.1.4	__FFLASFFPACK_HAVE_DLFCN_H	801
17.39.1.5	__FFLASFFPACK_HAVE_FLOAT_H	801
17.39.1.6	__FFLASFFPACK_HAVE_INT128	801
17.39.1.7	__FFLASFFPACK_HAVE_INTPYPES_H	801
17.39.1.8	__FFLASFFPACK_HAVE_LAPACK	801
17.39.1.9	__FFLASFFPACK_HAVE_LIMITS_H	801
17.39.1.10	__FFLASFFPACK_HAVE_LITTLE_ENDIAN	801
17.39.1.11	__FFLASFFPACK_HAVE_PTHREAD_H	801
17.39.1.12	__FFLASFFPACK_HAVE_STDDEF_H	801
17.39.1.13	__FFLASFFPACK_HAVE_STDINT_H	801
17.39.1.14	__FFLASFFPACK_HAVE_STDIO_H	802
17.39.1.15	__FFLASFFPACK_HAVE_STDLIB_H	802
17.39.1.16	__FFLASFFPACK_HAVE_STRINGS_H	802
17.39.1.17	__FFLASFFPACK_HAVE_STRING_H	802
17.39.1.18	__FFLASFFPACK_HAVE_SYS_STAT_H	802
17.39.1.19	__FFLASFFPACK_HAVE_SYS_TIME_H	802
17.39.1.20	__FFLASFFPACK_HAVE_SYS_TYPES_H	802
17.39.1.21	__FFLASFFPACK_HAVE_UNISTD_H	802
17.39.1.22	__FFLASFFPACK_LT_OBJDIR	802
17.39.1.23	__FFLASFFPACK_OPENBLAS_NUM_THREADS	802
17.39.1.24	__FFLASFFPACK_PACKAGE	802
17.39.1.25	__FFLASFFPACK_PACKAGE_BUGREPORT	802
17.39.1.26	__FFLASFFPACK_PACKAGE_NAME	803
17.39.1.27	__FFLASFFPACK_PACKAGE_STRING	803
17.39.1.28	__FFLASFFPACK_PACKAGE_TARNAME	803
17.39.1.29	__FFLASFFPACK_PACKAGE_URL	803
17.39.1.30	__FFLASFFPACK_PACKAGE_VERSION	803
17.39.1.31	__FFLASFFPACK_SIZEOF_CHAR	803
17.39.1.32	__FFLASFFPACK_SIZEOF_INT	803
17.39.1.33	__FFLASFFPACK_SIZEOF_LONG	803
17.39.1.34	__FFLASFFPACK_SIZEOF_LONG_LONG	803
17.39.1.35	__FFLASFFPACK_SIZEOF_SHORT	803
17.39.1.36	__FFLASFFPACK_SIZEOF__INT64	803
17.39.1.37	__FFLASFFPACK_STDC_HEADERS	803
17.39.1.38	__FFLASFFPACK_USE_OPENMP	804
17.39.1.39	__FFLASFFPACK_VERSION	804
17.40	mainpage.doxy File Reference	804
17.41	det.C File Reference	804
17.41.1	Function Documentation	804
17.41.1.1	main()	804
17.42	matmul.C File Reference	804
17.42.1	Function Documentation	804

17.42.1.1 main()	805
17.43 rank.C File Reference	805
17.43.1 Function Documentation	805
17.43.1.1 main()	805
17.44 solve.C File Reference	805
17.44.1 Function Documentation	805
17.44.1.1 main()	805
17.45 checker_charpoly.inl File Reference	805
17.45.1 Macro Definition Documentation	806
17.45.1.1 __FFLASFFPACK_checker_charpoly_INL	806
17.46 checker_det.inl File Reference	806
17.46.1 Macro Definition Documentation	806
17.46.1.1 __FFLASFFPACK_checker_det_INL	806
17.47 checker_empty.h File Reference	806
17.48 checker_fgemm.inl File Reference	807
17.48.1 Macro Definition Documentation	807
17.48.1.1 __FFLASFFPACK_checker_fgemm_INL	807
17.49 checker_ftsm.inl File Reference	807
17.49.1 Macro Definition Documentation	807
17.49.1.1 __FFLASFFPACK_checker_ftsm_INL	807
17.50 checker_invert.inl File Reference	807
17.50.1 Macro Definition Documentation	808
17.50.1.1 __FFLASFFPACK_checker_invert_INL	808
17.51 checker_pluq.inl File Reference	808
17.51.1 Macro Definition Documentation	808
17.51.1.1 __FFLASFFPACK_checker_pluq_INL	808
17.52 checkers.doxy File Reference	808
17.53 checkers_fflas.h File Reference	808
17.54 checkers_fflas.inl File Reference	809
17.54.1 Macro Definition Documentation	809
17.54.1.1 FFLASFFPACK_checkers_fflas_inl_H	809
17.55 checkers_ffpack.h File Reference	809
17.56 checkers_ffpack.inl File Reference	810
17.56.1 Macro Definition Documentation	810
17.56.1.1 FFLASFFPACK_checkers_ffpack_inl_H	810
17.57 config-blas.h File Reference	811
17.57.1 Macro Definition Documentation	811
17.57.1.1 CBLAS_INT	812
17.57.1.2 CBLAS_ENUM_DEFINED_H	812
17.57.1.3 CBLAS_EXTERNALS	812
17.57.1.4 blas_enum	812
17.57.2 Enumeration Type Documentation	812

17.57.2.1 CBLAS_ORDER	812
17.57.2.2 CBLAS_TRANSPOSE	812
17.57.2.3 CBLAS_UPLO	812
17.57.2.4 CBLAS_DIAG	813
17.57.2.5 CBLAS_SIDE	813
17.57.3 Function Documentation	813
17.57.3.1 daxpy_()	813
17.57.3.2 saxpy_()	813
17.57.3.3 ddot_()	813
17.57.3.4 sdot_()	814
17.57.3.5 dasum_()	814
17.57.3.6 idamax_()	814
17.57.3.7 dnrm2_()	814
17.57.3.8 dgemv_()	814
17.57.3.9 sgemv_()	814
17.57.3.10 dger_()	815
17.57.3.11 sger_()	815
17.57.3.12 dcopy_()	815
17.57.3.13 scopy_()	815
17.57.3.14 dscal_()	815
17.57.3.15 sscal_()	816
17.57.3.16 dtrsm_()	816
17.57.3.17 strsm_()	816
17.57.3.18 dtrmm_()	816
17.57.3.19 strmm_()	817
17.57.3.20 sgemm_()	817
17.57.3.21 dgemm_()	817
17.58 fflas-ffpack-config.h File Reference	817
17.58.1 Detailed Description	818
17.58.2 Macro Definition Documentation	818
17.58.2.1 GCC_VERSION	818
17.59 fflas-ffpack-default-thresholds.h File Reference	818
17.59.1 Macro Definition Documentation	818
17.59.1.1 __FFLASFFPACK_WINOTHRESHOLD	818
17.59.1.2 __FFLASFFPACK_WINOTHRESHOLD_FLT	818
17.59.1.3 __FFLASFFPACK_WINOTHRESHOLD_BAL	819
17.59.1.4 __FFLASFFPACK_WINOTHRESHOLD_BAL_FLT	819
17.59.1.5 __FFLASFFPACK_PLUQ_THRESHOLD	819
17.59.1.6 __FFLASFFPACK_CHARPOLY_LUKrylov_ArithProg_THRESHOLD	819
17.59.1.7 __FFLASFFPACK_CHARPOLY_Danilevskii_LUKrylov_THRESHOLD	819
17.59.1.8 __FFLASFFPACK_ARITHPROG_THRESHOLD	819
17.59.1.9 __FFLASFFPACK_FTRTRI_THRESHOLD	819

17.59.1.10	__FFLASFFPACK_FSYTRF_THRESHOLD	819
17.59.1.11	__FFLASFFPACK_FSYRK_THRESHOLD	819
17.60	fflas-ffpack-thresholds.h File Reference	819
17.61	fflas-ffpack.doxy File Reference	819
17.62	fflas-ffpack.h File Reference	819
17.62.1	Detailed Description	819
17.63	fflas.doxy File Reference	820
17.64	fflas.h File Reference	820
17.64.1	Detailed Description	821
17.64.2	Macro Definition Documentation	821
17.64.2.1	WINOTHRESHOLD	821
17.64.2.2	DOUBLE_TO_FLOAT_CROSSOVER	821
17.65	fflas_bounds.inl File Reference	821
17.65.1	Macro Definition Documentation	822
17.65.1.1	__FFLASFFPACK_fflas_bounds_INL	822
17.65.1.2	FFLAS_INT_TYPE	822
17.66	fflas_enum.h File Reference	822
17.67	fflas_fadd.h File Reference	823
17.68	fflas_fadd.inl File Reference	824
17.68.1	Macro Definition Documentation	825
17.68.1.1	__FFLASFFPACK_fadd_INL	825
17.69	fflas_fassign.h File Reference	825
17.70	fflas_fassign.inl File Reference	825
17.70.1	Macro Definition Documentation	826
17.70.1.1	__FFLASFFPACK_fassign_INL	826
17.71	fflas_faxpy.inl File Reference	826
17.71.1	Macro Definition Documentation	826
17.71.1.1	__FFLASFFPACK_faxpy_INL	827
17.72	fflas_fdot.inl File Reference	827
17.72.1	Macro Definition Documentation	827
17.72.1.1	__FFLASFFPACK_fdot_INL	827
17.73	fflas_fgemm.inl File Reference	828
17.73.1	Macro Definition Documentation	830
17.73.1.1	__FFLASFFPACK_fgemm_INL	830
17.74	fgemm_classical.inl File Reference	830
17.74.1	Macro Definition Documentation	830
17.74.1.1	__FFLASFFPACK_fflas_fflas_fgemm_classical_INL	830
17.75	fgemm_classical_mp.inl File Reference	830
17.75.1	Detailed Description	832
17.75.2	Macro Definition Documentation	832
17.75.2.1	__FFPACK_fgemm_classical_INL	832
17.76	fgemm_winograd.inl File Reference	832

17.76.1 Macro Definition Documentation	833
17.76.1.1 __FFLASFFPACK_fflas_fflas_fgemm_winograd_INL	833
17.76.1.2 NEWWINO	833
17.77 matmul.doxy File Reference	833
17.78 schedule_bini.inl File Reference	834
17.78.1 Detailed Description	834
17.78.2 Macro Definition Documentation	834
17.78.2.1 __FFLASFFPACK_fgemm_bini_INL	834
17.79 schedule_winograd.inl File Reference	834
17.79.1 Macro Definition Documentation	835
17.79.1.1 __FFLASFFPACK_fgemm_winograd_INL	835
17.80 schedule_winograd_acc.inl File Reference	835
17.80.1 Macro Definition Documentation	835
17.80.1.1 __FFLASFFPACK_fgemm_winograd_acc_INL	835
17.81 schedule_winograd_acc_ip.inl File Reference	836
17.81.1 Macro Definition Documentation	836
17.81.1.1 __FFLASFFPACK_fgemm_winograd_acc_ip_INL	836
17.82 schedule_winograd_ip.inl File Reference	836
17.82.1 Macro Definition Documentation	837
17.82.1.1 __FFLASFFPACK_fgemm_winograd_ip_INL	837
17.83 fflas_fgemv.inl File Reference	837
17.83.1 Macro Definition Documentation	838
17.83.1.1 __FFLASFFPACK_fgemv_INL	838
17.84 fflas_fgemv_mp.inl File Reference	839
17.84.1 Macro Definition Documentation	839
17.84.1.1 __FFLASFFPACK_fgemv_mp_INL	839
17.85 fflas_fger.inl File Reference	839
17.85.1 Macro Definition Documentation	840
17.85.1.1 __FFLASFFPACK_fger_INL	840
17.86 fflas_fger_mp.inl File Reference	841
17.86.1 Macro Definition Documentation	841
17.86.1.1 __FFPACK_fger_mp_INL	841
17.87 fflas_freduce.h File Reference	841
17.88 fflas_freduce.inl File Reference	842
17.88.1 Macro Definition Documentation	844
17.88.1.1 __FFLASFFPACK_fflas_freduce_INL	844
17.88.1.2 FFLASFFPACK_COPY_REDUCE	844
17.89 fflas_freduce_mp.inl File Reference	844
17.89.1 Macro Definition Documentation	844
17.89.1.1 __FFLASFFPACK_fflas_freduce_mp_INL	844
17.90 fflas_freivalds.inl File Reference	844
17.90.1 Macro Definition Documentation	845

17.90.1.1 __FFLASFFPACK_freivalds_INL	845
17.91 fflas_fscal.h File Reference	845
17.92 fflas_fscal.inl File Reference	845
17.92.1 Macro Definition Documentation	846
17.92.1.1 __FFLASFFPACK_fscal_INL	846
17.93 fflas_fscal_mp.inl File Reference	847
17.93.1 Macro Definition Documentation	847
17.93.1.1 __FFLASFFPACK_fscal_mp_INL	847
17.94 fflas_fsyr2k.inl File Reference	847
17.94.1 Macro Definition Documentation	848
17.94.1.1 __FFLASFFPACK_fflas_fsyr2k_INL	848
17.95 fflas_fsyrk.inl File Reference	848
17.95.1 Macro Definition Documentation	849
17.95.1.1 __FFLASFFPACK_fflas_fsyrk_INL	849
17.96 fflas_ftrmm.inl File Reference	849
17.96.1 Macro Definition Documentation	849
17.96.1.1 __FFLASFFPACK_ftrmm_INL	849
17.97 fflas_ftrsm.inl File Reference	849
17.97.1 Macro Definition Documentation	850
17.97.1.1 __FFLASFFPACK_ftrsm_INL	850
17.98 fflas_ftrsm_mp.inl File Reference	850
17.98.1 Detailed Description	850
17.98.2 Macro Definition Documentation	851
17.98.2.1 __FFPACK_ftrsm_mp_INL	851
17.99 fflas_ftrsv.inl File Reference	851
17.99.1 Macro Definition Documentation	851
17.99.1.1 __FFLASFFPACK_ftrsv_INL	851
17.100 fflas_helpers.inl File Reference	851
17.100.1 Macro Definition Documentation	852
17.100.1.1 __FFLASFFPACK_fflas_fflas_mmhelper_INL	852
17.101 igemm.doxy File Reference	852
17.102 igemm.h File Reference	852
17.103 igemm.inl File Reference	853
17.103.1 Macro Definition Documentation	853
17.103.1.1 __FFLASFFPACK_fflas_igemm_igemm_INL	854
17.104 igemm_kernels.h File Reference	854
17.105 igemm_kernels.inl File Reference	854
17.105.1 Macro Definition Documentation	855
17.105.1.1 __FFLASFFPACK_fflas_igemm_igemm_kernels_INL	855
17.106 igemm_tools.h File Reference	855
17.107 igemm_tools.inl File Reference	855
17.107.1 Macro Definition Documentation	856

17.107.1.1	__FFLASFFPACK_fflas_igemm_igemm_tools_INL	856
17.108	fflas_level1.inl File Reference	856
17.108.1	Macro Definition Documentation	858
17.108.1.1	__FFLASFFPACK_fflas_fflas_level1_INL	858
17.109	fflas_level2.inl File Reference	858
17.109.1	Macro Definition Documentation	861
17.109.1.1	__FFLASFFPACK_fflas_fflas_level2_INL	861
17.110	fflas_level3.inl File Reference	861
17.110.1	Macro Definition Documentation	863
17.110.1.1	__FFLASFFPACK_fflas_fflas_level3_INL	863
17.110.1.2	__FFLAS__TRSM_READONLY	863
17.111	fflas_pfgemm.inl File Reference	863
17.111.1	Macro Definition Documentation	864
17.111.1.1	__FFLASFFPACK_fflas_pfgemm_INL	864
17.111.1.2	__FFLASFFPACK_SEQPARTHRESHOLD	864
17.111.1.3	__FFLASFFPACK_DIMKPENALTY	864
17.112	fflas_pftsm.inl File Reference	864
17.112.1	Macro Definition Documentation	865
17.112.1.1	__FFLASFFPACK_fflas_pftsm_INL	865
17.112.1.2	PTRSM_HYBRID_THRESHOLD	865
17.113	fflas_simd.h File Reference	865
17.113.1	Macro Definition Documentation	866
17.113.1.1	SIMD_INT	866
17.113.1.2	INLINE	866
17.113.1.3	CONST	866
17.113.1.4	PURE	866
17.113.1.5	NORML_MOD	866
17.113.1.6	FLOAT_MOD	866
17.113.2	Typedef Documentation	867
17.113.2.1	Simd	867
17.114	simd.doxy File Reference	867
17.115	simd128.inl File Reference	867
17.115.1	Macro Definition Documentation	867
17.115.1.1	__FFLASFFPACK_fflas_ffpack_utils_simd128_INL	867
17.115.2	Typedef Documentation	867
17.115.2.1	Simd128	867
17.116	simd128_double.inl File Reference	867
17.116.1	Macro Definition Documentation	868
17.116.1.1	__FFLASFFPACK_fflas_ffpack_utils_simd128_double_INL	868
17.117	simd128_float.inl File Reference	868
17.117.1	Macro Definition Documentation	868
17.117.1.1	__FFLASFFPACK_fflas_ffpack_utils_simd128_float_INL	868

17.118 simd128_int16.inl File Reference	868
17.118.1 Macro Definition Documentation	868
17.118.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_int16_INL	868
17.119 simd128_int32.inl File Reference	868
17.119.1 Macro Definition Documentation	869
17.119.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_int32_INL	869
17.120 simd128_int64.inl File Reference	869
17.120.1 Macro Definition Documentation	869
17.120.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_int64_INL	869
17.120.1.2 vect_t	869
17.121 simd256.inl File Reference	869
17.121.1 Macro Definition Documentation	870
17.121.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_INL	870
17.121.2 Typedef Documentation	870
17.121.2.1 Simd256	870
17.122 simd256_double.inl File Reference	870
17.122.1 Macro Definition Documentation	870
17.122.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_double_INL	870
17.123 simd256_float.inl File Reference	870
17.123.1 Macro Definition Documentation	870
17.123.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_float_INL	870
17.124 simd256_int16.inl File Reference	871
17.124.1 Macro Definition Documentation	871
17.124.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_int16_INL	871
17.125 simd256_int32.inl File Reference	871
17.125.1 Macro Definition Documentation	871
17.125.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_int32_INL	871
17.126 simd256_int64.inl File Reference	871
17.126.1 Macro Definition Documentation	872
17.126.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_int64_INL	872
17.126.1.2 vect_t	872
17.127 simd512.inl File Reference	872
17.127.1 Macro Definition Documentation	872
17.127.1.1 __FFLASFFPACK_simd512_INL	872
17.127.2 Typedef Documentation	872
17.127.2.1 Simd512	872
17.128 simd512_double.inl File Reference	872
17.128.1 Macro Definition Documentation	873
17.128.1.1 __FFLASFFPACK_simd512_double_INL	873
17.129 simd512_float.inl File Reference	873
17.129.1 Macro Definition Documentation	873
17.129.1.1 __FFLASFFPACK_simd512_float_INL	873

17.130 simd512_int32.inl File Reference	873
17.130.1 Macro Definition Documentation	873
17.130.1.1 __FFLASFFPACK_simd512_int32_INL	873
17.131 simd512_int64.inl File Reference	874
17.131.1 Macro Definition Documentation	874
17.131.1.1 _simd512_int64_INL	874
17.131.1.2 vect_t	874
17.132 simd_modular.inl File Reference	874
17.133 fflas_sparse.h File Reference	874
17.133.1 Macro Definition Documentation	878
17.133.1.1 index_t	878
17.133.1.2 ROUND_DOWN	878
17.133.1.3 __FFLASFFPACK_CACHE_LINE_SIZE	878
17.133.1.4 assume_aligned	878
17.133.1.5 DENSE_THRESHOLD	879
17.134 fflas_sparse.inl File Reference	879
17.134.1 Macro Definition Documentation	881
17.134.1.1 __FFLASFFPACK_fflas_fflas_sparse_INL	881
17.135 coo.h File Reference	881
17.136 coo_spmv.inl File Reference	881
17.136.1 Macro Definition Documentation	882
17.136.1.1 __FFLASFFPACK_fflas_sparse_coo_spmv_INL	882
17.137 coo_spmv.inl File Reference	882
17.137.1 Macro Definition Documentation	883
17.137.1.1 __FFLASFFPACK_fflas_sparse_coo_spmv_INL	883
17.138 coo_utils.inl File Reference	883
17.138.1 Macro Definition Documentation	883
17.138.1.1 __FFLASFFPACK_fflas_sparse_coo_utils_INL	884
17.139 csr.h File Reference	884
17.140 csr_pspmm.inl File Reference	884
17.140.1 Macro Definition Documentation	885
17.140.1.1 __FFLASFFPACK_fflas_sparse_CSR_pspmm_INL	885
17.141 csr_pspmv.inl File Reference	885
17.141.1 Macro Definition Documentation	886
17.141.1.1 __FFLASFFPACK_fflas_sparse_CSR_pspmv_INL	886
17.142 csr_spmv.inl File Reference	886
17.142.1 Macro Definition Documentation	887
17.142.1.1 __FFLASFFPACK_fflas_sparse_CSR_spmv_INL	887
17.143 csr_spmv.inl File Reference	887
17.143.1 Macro Definition Documentation	888
17.143.1.1 __FFLASFFPACK_fflas_sparse_CSR_spmv_INL	888
17.144 csr_utils.inl File Reference	888

17.145 csr_hyb.h File Reference	888
17.146 csr_hyb_pspmm.inl File Reference	889
17.146.1 Macro Definition Documentation	889
17.146.1.1 __FFLASFFPACK_fflas_sparse_CSR_HYB_pspmm_INL	889
17.147 csr_hyb_pspmv.inl File Reference	890
17.147.1 Macro Definition Documentation	890
17.147.1.1 __FFLASFFPACK_fflas_sparse_CSR_HYB_pspmv_INL	890
17.148 csr_hyb_spm্ম.inl File Reference	890
17.148.1 Macro Definition Documentation	891
17.148.1.1 __FFLASFFPACK_fflas_sparse_CSR_HYB_spm্ম_INL	891
17.149 csr_hyb_spmmv.inl File Reference	891
17.149.1 Macro Definition Documentation	891
17.149.1.1 __FFLASFFPACK_fflas_sparse_CSR_HYB_spmmv_INL	891
17.150 csr_hyb_utils.inl File Reference	891
17.150.1 Macro Definition Documentation	892
17.150.1.1 __FFLASFFPACK_fflas_sparse_CSR_HYB_utils_INL	892
17.151 ell.h File Reference	892
17.152 ell_pspmm.inl File Reference	892
17.152.1 Macro Definition Documentation	893
17.152.1.1 __FFLASFFPACK_fflas_sparse_ELL_pspmm_INL	893
17.153 ell_pspmv.inl File Reference	893
17.153.1 Macro Definition Documentation	894
17.153.1.1 __FFLASFFPACK_fflas_sparse_ELL_pspmv_INL	894
17.154 ell_spm্ম.inl File Reference	894
17.154.1 Macro Definition Documentation	895
17.154.1.1 __FFLASFFPACK_fflas_sparse_ELL_spm্ম_INL	895
17.155 ell_spmmv.inl File Reference	895
17.155.1 Macro Definition Documentation	896
17.155.1.1 __FFLASFFPACK_fflas_sparse_ELL_spmmv_INL	896
17.156 ell_utils.inl File Reference	896
17.156.1 Macro Definition Documentation	896
17.156.1.1 __FFLASFFPACK_fflas_sparse_ELL_utils_INL	896
17.157 ell_simd.h File Reference	896
17.158 ell_simd_pspmv.inl File Reference	897
17.158.1 Macro Definition Documentation	898
17.158.1.1 __FFLASFFPACK_fflas_sparse_ELL_simd_pspmv_INL	898
17.159 ell_simd_spmmv.inl File Reference	898
17.159.1 Macro Definition Documentation	898
17.159.1.1 __FFLASFFPACK_fflas_sparse_ELL_simd_spmmv_INL	899
17.160 ell_simd_utils.inl File Reference	899
17.160.1 Macro Definition Documentation	899
17.160.1.1 __FFLASFFPACK_fflas_sparse_ELL_simd_utils_INL	899

17.161	hyb_zo.h File Reference	899
17.162	hyb_zo_pspmm.inl File Reference	899
17.162.1	Macro Definition Documentation	900
17.162.1.1	__FFLASFFPACK_fflas_sparse_HYB_ZO_pspmm_INL	900
17.163	hyb_zo_pspmv.inl File Reference	900
17.163.1	Macro Definition Documentation	900
17.163.1.1	__FFLASFFPACK_fflas_sparse_HYB_ZO_pspmv_INL	900
17.164	hyb_zo_spm্ম.inl File Reference	901
17.164.1	Macro Definition Documentation	901
17.164.1.1	__FFLASFFPACK_fflas_sparse_HYB_ZO_spm্ম_INL	901
17.165	hyb_zo_spmv.inl File Reference	901
17.165.1	Macro Definition Documentation	901
17.165.1.1	__FFLASFFPACK_fflas_sparse_HYB_ZO_spmv_INL	902
17.166	hyb_zo_utils.inl File Reference	902
17.166.1	Macro Definition Documentation	902
17.166.1.1	__FFLASFFPACK_fflas_sparse_HYB_ZO_utils_INL	902
17.167	read_sparse.h File Reference	902
17.167.1	Macro Definition Documentation	903
17.167.1.1	DNS_BIN_VER	903
17.167.1.2	mask_t	903
17.168	sell.h File Reference	903
17.169	sell_pspmv.inl File Reference	904
17.169.1	Macro Definition Documentation	904
17.169.1.1	__FFLASFFPACK_fflas_sparse_sell_pspmv_INL	904
17.170	sell_spmv.inl File Reference	904
17.170.1	Macro Definition Documentation	905
17.170.1.1	__FFLASFFPACK_fflas_sparse_sell_spmv_INL	905
17.171	sell_utils.inl File Reference	905
17.171.1	Macro Definition Documentation	906
17.171.1.1	__FFLASFFPACK_fflas_sparse_sell_utils_INL	906
17.172	sparse_matrix_traits.h File Reference	906
17.173	utils.h File Reference	907
17.174	ffpack.doxy File Reference	908
17.175	ffpack.h File Reference	908
17.175.1	Detailed Description	916
17.175.2	Macro Definition Documentation	916
17.175.2.1	__FFLASFFPACK_FTRSTR_THRESHOLD	916
17.175.2.2	__FFLASFFPACK_FTRSSYR2K_THRESHOLD	916
17.176	ffpack.inl File Reference	916
17.176.1	Macro Definition Documentation	917
17.176.1.1	__FFLASFFPACK_ffpack_INL	917
17.177	ffpack_charpoly.inl File Reference	917

17.177.1 Macro Definition Documentation	918
17.177.1.1 __FFLASFFPACK_charpoly_INL	918
17.178 fpack_charpoly_danilevski.inl File Reference	918
17.178.1 Macro Definition Documentation	918
17.178.1.1 __FFLASFFPACK_ffpack_charpoly_danilveski_INL	919
17.179 fpack_charpoly_kgfast.inl File Reference	919
17.179.1 Macro Definition Documentation	919
17.179.1.1 __FFLASFFPACK_ffpack_charpoly_kgfast_INL	919
17.180 fpack_charpoly_kgfastgeneralized.inl File Reference	919
17.180.1 Macro Definition Documentation	920
17.180.1.1 __FFLASFFPACK_ffpack_charpoly_kgfastgeneralized_INL	920
17.181 fpack_charpoly_kglu.inl File Reference	920
17.181.1 Macro Definition Documentation	920
17.181.1.1 __FFLASFFPACK_ffpack_charpoly_kglu_INL	920
17.182 fpack_charpoly_mp.inl File Reference	920
17.182.1 Macro Definition Documentation	921
17.182.1.1 __FFPACK_charpoly_mp_INL	921
17.183 fpack_det_mp.inl File Reference	921
17.183.1 Macro Definition Documentation	921
17.183.1.1 __FFPACK_det_mp_INL	921
17.184 fpack_echelonforms.inl File Reference	922
17.184.1 Macro Definition Documentation	923
17.184.1.1 __FFLASFFPACK_ffpack_echelon_forms_INL	923
17.184.1.2 __FFLASFFPACK_GAUSSJORDAN_BASECASE	923
17.185 fpack_fgesv.inl File Reference	923
17.185.1 Macro Definition Documentation	923
17.185.1.1 __FFLASFFPACK_ffpack_fgesv_INL	923
17.186 fpack_fgetrs.inl File Reference	924
17.186.1 Macro Definition Documentation	924
17.186.1.1 __FFLASFFPACK_ffpack_fgetrs_INL	924
17.187 fpack_frobenius.inl File Reference	924
17.188 fpack_fsytrf.inl File Reference	925
17.188.1 Macro Definition Documentation	926
17.188.1.1 __FFLASFFPACK_ffpack_fsytrf_INL	926
17.189 fpack_ftrssyr2k.inl File Reference	926
17.189.1 Macro Definition Documentation	926
17.189.1.1 __FFLASFFPACK_ffpack_ftrssyr2k_INL	927
17.190 fpack_ftrstr.inl File Reference	927
17.190.1 Macro Definition Documentation	927
17.190.1.1 __FFLASFFPACK_ffpack_ftrstr_INL	927
17.191 fpack_ftrtr.inl File Reference	927
17.191.1 Macro Definition Documentation	928

17.191.1.1	ENABLE_ALL_CHECKINGS	928
17.191.1.2	__FFLASFFPACK_ffpack_ftrtr_INL	928
17.192	ffpack_invert.inl File Reference	928
17.192.1	Macro Definition Documentation	928
17.192.1.1	__FFLASFFPACK_ffpack_invert_INL	928
17.193	ffpack_krylovelim.inl File Reference	928
17.193.1	Macro Definition Documentation	929
17.193.1.1	__FFLASFFPACK_ffpack_krylovelim_INL	929
17.194	ffpack_ludivine.inl File Reference	929
17.194.1	Macro Definition Documentation	929
17.194.1.1	__FFLASFFPACK_ffpack_ludivine_INL	929
17.195	ffpack_ludivine_mp.inl File Reference	930
17.195.1	Macro Definition Documentation	930
17.195.1.1	__FFPACK_ludivine_mp_INL	930
17.196	ffpack_minpoly.inl File Reference	930
17.196.1	Macro Definition Documentation	931
17.196.1.1	__FFLASFFPACK_ffpack_minpoly_INL	931
17.197	ffpack_permutation.inl File Reference	931
17.197.1	Macro Definition Documentation	933
17.197.1.1	__FFLASFFPACK_ffpack_permutation_INL	933
17.197.1.2	FFLASFFPACK_PERM_BKSIZE	933
17.198	ffpack_pluq.inl File Reference	933
17.198.1	Macro Definition Documentation	934
17.198.1.1	__FFLASFFPACK_ffpack_pluq_INL	934
17.198.1.2	CROUT	934
17.199	ffpack_pluq_mp.inl File Reference	934
17.199.1	Macro Definition Documentation	935
17.199.1.1	__FFPACK_pluq_mp_INL	935
17.200	ffpack_ppluq.inl File Reference	935
17.200.1	Macro Definition Documentation	935
17.200.1.1	__FFLASFFPACK_ffpack_ppluq_INL	935
17.200.1.2	__FFLAS__TRSM_READONLY	935
17.200.1.3	PBASECASE_K	935
17.201	ffpack_rankprofiles.inl File Reference	936
17.201.1	Macro Definition Documentation	937
17.201.1.1	__FFLASFFPACK_ffpack_rank_profiles_INL	937
17.202	field-traits.h File Reference	937
17.202.1	Detailed Description	939
17.203	field.doxy File Reference	939
17.204	rns-double-elt.h File Reference	939
17.204.1	Detailed Description	939
17.205	rns-double-recint.inl File Reference	940

17.205.1 Macro Definition Documentation	940
17.205.1.1 __FFLASFFPACK_field_rns_double_recint_INL	940
17.206 rns-double.h File Reference	940
17.206.1 Detailed Description	941
17.206.2 Macro Definition Documentation	941
17.206.2.1 ROUND_DOWN	941
17.207 rns-double.inl File Reference	941
17.207.1 Macro Definition Documentation	941
17.207.1.1 __FFLASFFPACK_field_rns_double_INL	941
17.208 rns-integer-mod.h File Reference	941
17.208.1 Detailed Description	942
17.209 rns-integer.h File Reference	942
17.209.1 Detailed Description	943
17.210 rns.h File Reference	943
17.211 rns.inl File Reference	943
17.211.1 Macro Definition Documentation	943
17.211.1.1 __FFLASFFPACK_field_rns_INL	943
17.212 interfaces.doxy File Reference	943
17.213 fflas_c.h File Reference	943
17.213.1 Macro Definition Documentation	945
17.213.1.1 FFLAS_COMPILED	946
17.213.2 Enumeration Type Documentation	946
17.213.2.1 FFLAS_C_ORDER	946
17.213.2.2 FFLAS_C_TRANSPOSE	946
17.213.2.3 FFLAS_C_UPLO	946
17.213.2.4 FFLAS_C_DIAG	946
17.213.2.5 FFLAS_C_SIDE	947
17.213.2.6 FFLAS_C_BASE	947
17.213.3 Function Documentation	947
17.213.3.1 freducein_1_modular_double()	947
17.213.3.2 freduce_1_modular_double()	947
17.213.3.3 fnegin_1_modular_double()	948
17.213.3.4 fneg_1_modular_double()	948
17.213.3.5 fzero_1_modular_double()	948
17.213.3.6 fiszero_1_modular_double()	948
17.213.3.7 fequal_1_modular_double()	948
17.213.3.8 fassign_1_modular_double()	949
17.213.3.9 fscal_1_modular_double()	949
17.213.3.10 fscal_1_modular_double()	949
17.213.3.11 faxpy_1_modular_double()	949
17.213.3.12 fdot_1_modular_double()	949
17.213.3.13 fswap_1_modular_double()	950

17.213.3.14 fadd_1_modular_double()	950
17.213.3.15 fsub_1_modular_double()	950
17.213.3.16 faddin_1_modular_double()	950
17.213.3.17 fsubin_1_modular_double()	950
17.213.3.18 fassign_2_modular_double()	951
17.213.3.19 fzero_2_modular_double()	951
17.213.3.20 fequal_2_modular_double()	951
17.213.3.21 fiszero_2_modular_double()	951
17.213.3.22 fidentity_2_modular_double()	951
17.213.3.23 freducein_2_modular_double()	952
17.213.3.24 freduce_2_modular_double()	952
17.213.3.25 fnegin_2_modular_double()	952
17.213.3.26 fneg_2_modular_double()	952
17.213.3.27 fscaln_2_modular_double()	952
17.213.3.28 fscal_2_modular_double()	953
17.213.3.29 faxpy_2_modular_double()	953
17.213.3.30 fmove_2_modular_double()	953
17.213.3.31 fadd_2_modular_double()	953
17.213.3.32 fsub_2_modular_double()	954
17.213.3.33 fsubin_2_modular_double()	954
17.213.3.34 faddin_2_modular_double()	954
17.213.3.35 fgemv_2_modular_double()	954
17.213.3.36 fger_2_modular_double()	955
17.213.3.37 ftrsv_2_modular_double()	955
17.213.3.38 ftrsm_3_modular_double()	955
17.213.3.39 ftrmm_3_modular_double()	955
17.213.3.40 fgemm_3_modular_double()	956
17.213.3.41 fsquare_3_modular_double()	956
17.214 fflas_L1_inst.C File Reference	956
17.214.1 Macro Definition Documentation	957
17.214.1.1 __FFLAS_L1_INST_C	957
17.214.1.2 INST_OR_DECL	957
17.214.1.3 FFLAS_FIELD [1/2]	957
17.214.1.4 FFLAS_ELT [1/6]	957
17.214.1.5 FFLAS_ELT [2/6]	957
17.214.1.6 FFLAS_ELT [3/6]	957
17.214.1.7 FFLAS_FIELD [2/2]	957
17.214.1.8 FFLAS_ELT [4/6]	957
17.214.1.9 FFLAS_ELT [5/6]	958
17.214.1.10 FFLAS_ELT [6/6]	958
17.215 fflas_L1_inst.h File Reference	958
17.215.1 Macro Definition Documentation	958

17.215.1.1 INST_OR_DECL	958
17.215.1.2 FFLAS_FIELD [1/2]	958
17.215.1.3 FFLAS_ELT [1/6]	958
17.215.1.4 FFLAS_ELT [2/6]	958
17.215.1.5 FFLAS_ELT [3/6]	958
17.215.1.6 FFLAS_FIELD [2/2]	959
17.215.1.7 FFLAS_ELT [4/6]	959
17.215.1.8 FFLAS_ELT [5/6]	959
17.215.1.9 FFLAS_ELT [6/6]	959
17.216 fflas_L1_inst_implem.inl File Reference	959
17.217 fflas_L2_inst.C File Reference	960
17.217.1 Macro Definition Documentation	960
17.217.1.1 __FFLAS_L2_INST_C	961
17.217.1.2 INST_OR_DECL	961
17.217.1.3 FFLAS_FIELD [1/2]	961
17.217.1.4 FFLAS_ELT [1/6]	961
17.217.1.5 FFLAS_ELT [2/6]	961
17.217.1.6 FFLAS_ELT [3/6]	961
17.217.1.7 FFLAS_FIELD [2/2]	961
17.217.1.8 FFLAS_ELT [4/6]	961
17.217.1.9 FFLAS_ELT [5/6]	961
17.217.1.10 FFLAS_ELT [6/6]	961
17.218 fflas_L2_inst.h File Reference	961
17.218.1 Macro Definition Documentation	962
17.218.1.1 INST_OR_DECL	962
17.218.1.2 FFLAS_FIELD [1/2]	962
17.218.1.3 FFLAS_ELT [1/6]	962
17.218.1.4 FFLAS_ELT [2/6]	962
17.218.1.5 FFLAS_ELT [3/6]	962
17.218.1.6 FFLAS_FIELD [2/2]	962
17.218.1.7 FFLAS_ELT [4/6]	962
17.218.1.8 FFLAS_ELT [5/6]	962
17.218.1.9 FFLAS_ELT [6/6]	962
17.219 fflas_L2_inst_implem.inl File Reference	963
17.220 fflas_L3_inst.C File Reference	964
17.220.1 Macro Definition Documentation	965
17.220.1.1 __FFLAS_L3_INST_C	965
17.220.1.2 INST_OR_DECL	965
17.220.1.3 FFLAS_FIELD [1/2]	965
17.220.1.4 FFLAS_ELT [1/6]	965
17.220.1.5 FFLAS_ELT [2/6]	965
17.220.1.6 FFLAS_ELT [3/6]	965

17.220.1.7 FFLAS_FIELD [2/2]	965
17.220.1.8 FFLAS_ELT [4/6]	965
17.220.1.9 FFLAS_ELT [5/6]	965
17.220.1.10 FFLAS_ELT [6/6]	965
17.221 fflas_L3_inst.h File Reference	965
17.221.1 Macro Definition Documentation	966
17.221.1.1 INST_OR_DECL	966
17.221.1.2 FFLAS_FIELD [1/2]	966
17.221.1.3 FFLAS_ELT [1/6]	966
17.221.1.4 FFLAS_ELT [2/6]	966
17.221.1.5 FFLAS_ELT [3/6]	966
17.221.1.6 FFLAS_FIELD [2/2]	966
17.221.1.7 FFLAS_ELT [4/6]	966
17.221.1.8 FFLAS_ELT [5/6]	966
17.221.1.9 FFLAS_ELT [6/6]	967
17.222 fflas_L3_inst_implem.inl File Reference	967
17.222.1 Macro Definition Documentation	967
17.222.1.1 __FFLAS__TRSM_READONLY	967
17.223 fflas_lvl1.C File Reference	968
17.223.1 Detailed Description	968
17.223.2 Function Documentation	968
17.223.2.1 freducein_1_modular_double()	969
17.223.2.2 freduce_1_modular_double()	969
17.223.2.3 fnegin_1_modular_double()	969
17.223.2.4 fneg_1_modular_double()	969
17.223.2.5 fzero_1_modular_double()	969
17.223.2.6 fiszero_1_modular_double()	969
17.223.2.7 fequal_1_modular_double()	970
17.223.2.8 fassign_1_modular_double()	970
17.223.2.9 fscal_1_modular_double()	970
17.223.2.10 fscal_1_modular_double()	970
17.223.2.11 faxpy_1_modular_double()	970
17.223.2.12 fdot_1_modular_double()	971
17.223.2.13 fswap_1_modular_double()	971
17.223.2.14 fadd_1_modular_double()	971
17.223.2.15 fsub_1_modular_double()	971
17.223.2.16 faddin_1_modular_double()	972
17.223.2.17 fsubin_1_modular_double()	972
17.224 fflas_lvl2.C File Reference	972
17.224.1 Detailed Description	973
17.224.2 Function Documentation	973
17.224.2.1 fassign_2_modular_double()	973

17.224.2.2 fzero_2_modular_double()	973
17.224.2.3 fequal_2_modular_double()	974
17.224.2.4 fiszero_2_modular_double()	974
17.224.2.5 fidentity_2_modular_double()	974
17.224.2.6 freducein_2_modular_double()	974
17.224.2.7 freduce_2_modular_double()	974
17.224.2.8 fnegin_2_modular_double()	975
17.224.2.9 fneg_2_modular_double()	975
17.224.2.10 fscaln_2_modular_double()	975
17.224.2.11 fscal_2_modular_double()	975
17.224.2.12 faxpy_2_modular_double()	975
17.224.2.13 fmove_2_modular_double()	976
17.224.2.14 fadd_2_modular_double()	976
17.224.2.15 fsub_2_modular_double()	976
17.224.2.16 fsubin_2_modular_double()	976
17.224.2.17 faddin_2_modular_double()	977
17.224.2.18 fgemv_2_modular_double()	977
17.224.2.19 fger_2_modular_double()	977
17.224.2.20 ftrsv_2_modular_double()	977
17.225 fflas_lvl3.C File Reference	978
17.225.1 Detailed Description	978
17.225.2 Function Documentation	978
17.225.2.1 ftrsm_3_modular_double()	978
17.225.2.2 ftrmm_3_modular_double()	979
17.225.2.3 fgemm_3_modular_double()	979
17.225.2.4 fsquare_3_modular_double()	979
17.226 fflas_sparse.C File Reference	980
17.226.1 Detailed Description	980
17.227 ffpack.C File Reference	980
17.227.1 Detailed Description	983
17.227.2 Function Documentation	983
17.227.2.1 LAPACKPerm2MathPerm()	983
17.227.2.2 MathPerm2LAPACKPerm()	983
17.227.2.3 MatrixApplyS_modular_double()	984
17.227.2.4 PermApplyS_double()	984
17.227.2.5 MatrixApplyT_modular_double()	984
17.227.2.6 PermApplyT_double()	984
17.227.2.7 composePermutationsLLM()	984
17.227.2.8 composePermutationsLLL()	985
17.227.2.9 composePermutationsMLM()	985
17.227.2.10 cyclic_shift_mathPerm()	985
17.227.2.11 cyclic_shift_row_modular_double()	985

17.227.2.12 cyclic_shift_col_modular_double()	985
17.227.2.13 applyP_modular_double()	985
17.227.2.14 fgetrsin_modular_double()	986
17.227.2.15 fgetrsv_modular_double()	986
17.227.2.16 fgesvin_modular_double()	986
17.227.2.17 fgesv_modular_double()	987
17.227.2.18 ftrtri_modular_double()	987
17.227.2.19 trinv_left_modular_double()	987
17.227.2.20 ftrtrm_modular_double()	987
17.227.2.21 PLUQ_modular_double()	988
17.227.2.22 LUdivine_modular_double()	988
17.227.2.23 ColumnEchelonForm_modular_double()	988
17.227.2.24 RowEchelonForm_modular_double()	988
17.227.2.25 ReducedColumnEchelonForm_modular_double()	989
17.227.2.26 ReducedRowEchelonForm_modular_double()	989
17.227.2.27 ColumnEchelonForm_modular_float()	989
17.227.2.28 RowEchelonForm_modular_float()	989
17.227.2.29 ReducedColumnEchelonForm_modular_float()	990
17.227.2.30 ReducedRowEchelonForm_modular_float()	990
17.227.2.31 ColumnEchelonForm_modular_int32_t()	990
17.227.2.32 RowEchelonForm_modular_int32_t()	990
17.227.2.33 ReducedColumnEchelonForm_modular_int32_t()	991
17.227.2.34 ReducedRowEchelonForm_modular_int32_t()	991
17.227.2.35 pColumnEchelonForm_modular_double()	991
17.227.2.36 pRowEchelonForm_modular_double()	991
17.227.2.37 pReducedColumnEchelonForm_modular_double()	992
17.227.2.38 pReducedRowEchelonForm_modular_double()	992
17.227.2.39 pColumnEchelonForm_modular_float()	992
17.227.2.40 pRowEchelonForm_modular_float()	992
17.227.2.41 pReducedColumnEchelonForm_modular_float()	993
17.227.2.42 pReducedRowEchelonForm_modular_float()	993
17.227.2.43 pColumnEchelonForm_modular_int32_t()	993
17.227.2.44 pRowEchelonForm_modular_int32_t()	993
17.227.2.45 pReducedColumnEchelonForm_modular_int32_t()	994
17.227.2.46 pReducedRowEchelonForm_modular_int32_t()	994
17.227.2.47 Invertin_modular_double()	994
17.227.2.48 Invert_modular_double()	994
17.227.2.49 Invert2_modular_double()	995
17.227.2.50 KrylovElim_modular_double()	995
17.227.2.51 SpecRankProfile_modular_double()	995
17.227.2.52 Rank_modular_double()	995
17.227.2.53 IsSingular_modular_double()	996

17.227.2.54	Det_modular_double()	996
17.227.2.55	Solve_modular_double()	996
17.227.2.56	solveLB_modular_double()	996
17.227.2.57	solveLB2_modular_double()	996
17.227.2.58	RandomNullSpaceVector_modular_double()	997
17.227.2.59	NullSpaceBasis_modular_double()	997
17.227.2.60	RowRankProfile_modular_double()	997
17.227.2.61	ColumnRankProfile_modular_double()	997
17.227.2.62	RankProfileFromLU()	998
17.227.2.63	LeadingSubmatrixRankProfiles()	998
17.227.2.64	RowRankProfileSubmatrixIndices_modular_double()	998
17.227.2.65	ColRankProfileSubmatrixIndices_modular_double()	998
17.227.2.66	RowRankProfileSubmatrix_modular_double()	998
17.227.2.67	ColRankProfileSubmatrix_modular_double()	999
17.227.2.68	getTriangular_modular_double()	999
17.227.2.69	getTriangularin_modular_double()	999
17.227.2.70	getEchelonForm_modular_double()	999
17.227.2.71	getEchelonFormin_modular_double()	1000
17.227.2.72	getEchelonTransform_modular_double()	1000
17.227.2.73	getReducedEchelonForm_modular_double()	1000
17.227.2.74	getReducedEchelonFormin_modular_double()	1001
17.227.2.75	getReducedEchelonTransform_modular_double()	1001
17.227.2.76	PLUQtoEchelonPermutation()	1001
17.228	ffpack_c.h File Reference	1001
17.228.1	Macro Definition Documentation	1005
17.228.1.1	FFPACK_COMPILED	1005
17.228.2	Enumeration Type Documentation	1005
17.228.2.1	FFLAS_C_ORDER	1005
17.228.2.2	FFLAS_C_TRANSPOSE	1005
17.228.2.3	FFLAS_C_UPLO	1005
17.228.2.4	FFLAS_C_DIAG	1005
17.228.2.5	FFLAS_C_SIDE	1006
17.228.2.6	FFPACK_C_LU_TAG	1006
17.228.2.7	FFPACK_C_CHARPOLY_TAG	1006
17.228.2.8	FFPACK_C_MINPOLY_TAG	1006
17.228.3	Function Documentation	1007
17.228.3.1	LAPACKPerm2MathPerm()	1007
17.228.3.2	MathPerm2LAPACKPerm()	1007
17.228.3.3	MatrixApplyS_modular_double()	1007
17.228.3.4	PermApplyS_double()	1007
17.228.3.5	MatrixApplyT_modular_double()	1007
17.228.3.6	PermApplyT_double()	1008

17.228.3.7 composePermutationsLLM()	1008
17.228.3.8 composePermutationsLLL()	1008
17.228.3.9 composePermutationsMLM()	1008
17.228.3.10 cyclic_shift_mathPerm()	1008
17.228.3.11 cyclic_shift_row_modular_double()	1009
17.228.3.12 cyclic_shift_col_modular_double()	1009
17.228.3.13 applyP_modular_double()	1009
17.228.3.14 fgetrsin_modular_double()	1009
17.228.3.15 fgetrs_modular_double()	1009
17.228.3.16 fgesvin_modular_double()	1010
17.228.3.17 fgesv_modular_double()	1010
17.228.3.18 ftrtri_modular_double()	1010
17.228.3.19 trinv_left_modular_double()	1011
17.228.3.20 ftrtrm_modular_double()	1011
17.228.3.21 PLUQ_modular_double()	1011
17.228.3.22 LUdivine_modular_double()	1011
17.228.3.23 LUdivine_small_modular_double()	1011
17.228.3.24 LUdivine_gauss_modular_double()	1012
17.228.3.25 ColumnEchelonForm_modular_double()	1012
17.228.3.26 RowEchelonForm_modular_double()	1012
17.228.3.27 ColumnEchelonForm_modular_float()	1013
17.228.3.28 RowEchelonForm_modular_float()	1013
17.228.3.29 ColumnEchelonForm_modular_int32_t()	1013
17.228.3.30 RowEchelonForm_modular_int32_t()	1013
17.228.3.31 ReducedColumnEchelonForm_modular_double()	1014
17.228.3.32 ReducedRowEchelonForm_modular_double()	1014
17.228.3.33 ReducedColumnEchelonForm_modular_float()	1014
17.228.3.34 ReducedRowEchelonForm_modular_float()	1014
17.228.3.35 ReducedColumnEchelonForm_modular_int32_t()	1015
17.228.3.36 ReducedRowEchelonForm_modular_int32_t()	1015
17.228.3.37 ReducedRowEchelonForm2_modular_double()	1015
17.228.3.38 REF_modular_double()	1015
17.228.3.39 Invertin_modular_double()	1016
17.228.3.40 Invert_modular_double()	1016
17.228.3.41 Invert2_modular_double()	1016
17.228.3.42 KrylovElim_modular_double()	1016
17.228.3.43 SpecRankProfile_modular_double()	1016
17.228.3.44 Rank_modular_double()	1017
17.228.3.45 IsSingular_modular_double()	1017
17.228.3.46 Det_modular_double()	1017
17.228.3.47 Solve_modular_double()	1017
17.228.3.48 solveLB_modular_double()	1017

17.228.3.49 solveLB2_modular_double()	1018
17.228.3.50 RandomNullSpaceVector_modular_double()	1018
17.228.3.51 NullSpaceBasis_modular_double()	1018
17.228.3.52 RowRankProfile_modular_double()	1018
17.228.3.53 ColumnRankProfile_modular_double()	1019
17.228.3.54 RankProfileFromLU()	1019
17.228.3.55 LeadingSubmatrixRankProfiles()	1019
17.228.3.56 RowRankProfileSubmatrixIndices_modular_double()	1019
17.228.3.57 ColRankProfileSubmatrixIndices_modular_double()	1020
17.228.3.58 RowRankProfileSubmatrix_modular_double()	1020
17.228.3.59 ColRankProfileSubmatrix_modular_double()	1020
17.228.3.60 getTriangular_modular_double()	1020
17.228.3.61 getTriangularin_modular_double()	1021
17.228.3.62 getEchelonForm_modular_double()	1021
17.228.3.63 getEchelonFormin_modular_double()	1021
17.228.3.64 getEchelonTransform_modular_double()	1021
17.228.3.65 getReducedEchelonForm_modular_double()	1022
17.228.3.66 getReducedEchelonFormin_modular_double()	1022
17.228.3.67 getReducedEchelonTransform_modular_double()	1022
17.228.3.68 PLUQtoEchelonPermutation()	1023
17.229 fpack_inst.C File Reference	1023
17.229.1 Macro Definition Documentation	1023
17.229.1.1 __FFPACK_INST_C	1023
17.229.1.2 FFLAS_COMPILED	1023
17.229.1.3 INST_OR_DECL	1023
17.229.1.4 FFLAS_FIELD [1/2]	1023
17.229.1.5 FFLAS_ELT [1/6]	1023
17.229.1.6 FFLAS_ELT [2/6]	1024
17.229.1.7 FFLAS_ELT [3/6]	1024
17.229.1.8 FFLAS_FIELD [2/2]	1024
17.229.1.9 FFLAS_ELT [4/6]	1024
17.229.1.10 FFLAS_ELT [5/6]	1024
17.229.1.11 FFLAS_ELT [6/6]	1024
17.230 fpack_inst.h File Reference	1024
17.230.1 Macro Definition Documentation	1024
17.230.1.1 FFLAS_COMPILED	1024
17.230.1.2 INST_OR_DECL	1025
17.230.1.3 FFLAS_FIELD [1/2]	1025
17.230.1.4 FFLAS_ELT [1/6]	1025
17.230.1.5 FFLAS_ELT [2/6]	1025
17.230.1.6 FFLAS_ELT [3/6]	1025
17.230.1.7 FFLAS_FIELD [2/2]	1025

17.230.1.8 FFLAS_ELT [4/6]	1025
17.230.1.9 FFLAS_ELT [5/6]	1025
17.230.1.10 FFLAS_ELT [6/6]	1025
17.231 ffpack_inst_implem.inl File Reference	1025
17.232 blockcuts.inl File Reference	1029
17.232.1 Macro Definition Documentation	1030
17.232.1.1 __FFLASFFPACK_fflas_blockcuts_INL	1030
17.232.1.2 __FFLASFFPACK_MINBLOCKCUTS	1030
17.233 fflas_plevel1.h File Reference	1030
17.234 kaapi_routines.inl File Reference	1031
17.234.1 Macro Definition Documentation	1031
17.234.1.1 __FFLASFFPACK_KAAPI_ROUTINES_INL	1031
17.235 parallel.h File Reference	1031
17.235.1 Macro Definition Documentation	1032
17.235.1.1 __FFLASFFPACK_SEQUENTIAL	1032
17.235.1.2 index_t	1032
17.235.1.3 TASK	1032
17.235.1.4 WAIT	1032
17.235.1.5 CHECK_DEPENDENCIES	1032
17.235.1.6 BARRIER	1032
17.235.1.7 PAR_BLOCK	1032
17.235.1.8 SYNCH_GROUP	1032
17.235.1.9 NUM_THREADS	1032
17.235.1.10 MAX_THREADS	1033
17.235.1.11 READ	1033
17.235.1.12 WRITE	1033
17.235.1.13 READWRITE	1033
17.235.1.14 CONSTREFERENCE	1033
17.235.1.15 VALUE	1033
17.235.1.16 BEGIN_PARALLEL_MAIN	1033
17.235.1.17 END_PARALLEL_MAIN	1033
17.235.1.18 FORBLOCK1D	1033
17.235.1.19 FOR1D	1034
17.235.1.20 PARFORBLOCK1D	1034
17.235.1.21 PARFOR1D	1034
17.235.1.22 FORBLOCK2D	1034
17.235.1.23 FOR2D	1034
17.235.1.24 PARFORBLOCK2D	1035
17.235.1.25 PARFOR2D	1035
17.235.1.26 COMMA	1035
17.235.1.27 MODE	1035
17.235.1.28 RETURNPARAM	1035

17.235.1.29 NUMARGS	1035
17.235.1.30 PP_NARG_	1035
17.235.1.31 PP_ARG_N	1035
17.235.1.32 PP_RSEQ_N	1037
17.235.1.33 NOSPLIT	1037
17.235.1.34 splitting_0	1037
17.235.1.35 splitting_1	1037
17.235.1.36 splitting_2	1037
17.235.1.37 splitting_3	1037
17.235.1.38 splitt	1037
17.235.1.39 SPLITTER	1038
17.236 pfgemm_variants.inl File Reference	1038
17.237 pfgemv.inl File Reference	1039
17.238 align-allocator.h File Reference	1039
17.239 args-parser.h File Reference	1039
17.239.1 Macro Definition Documentation	1040
17.239.1.1 TYPE_BOOL	1040
17.239.1.2 END_OF_ARGUMENTS	1040
17.239.1.3 type_integer	1040
17.239.2 Enumeration Type Documentation	1040
17.239.2.1 ArgumentType	1040
17.239.3 Function Documentation	1040
17.239.3.1 printHelpMessage()	1041
17.239.3.2 findArgument()	1041
17.239.3.3 getListArgs()	1041
17.240 bit_manipulation.h File Reference	1041
17.240.1 Macro Definition Documentation	1041
17.240.1.1 __has_builtin	1041
17.240.2 Function Documentation	1042
17.240.2.1 clz() [1/2]	1042
17.240.2.2 clz() [2/2]	1042
17.240.2.3 ctz() [1/2]	1042
17.240.2.4 ctz() [2/2]	1042
17.241 cast.h File Reference	1042
17.242 debug.h File Reference	1042
17.242.1 Detailed Description	1043
17.242.2 Macro Definition Documentation	1043
17.242.2.1 FFLASFFPACK_check	1043
17.242.2.2 FFLASFFPACK_abort	1043
17.243 fflas_intrinsic.h File Reference	1043
17.244 fflas_io.h File Reference	1043
17.245 fflas_memory.h File Reference	1044

17.246 fflas_randommatrix.h File Reference	1045
17.247 flimits.h File Reference	1047
17.247.1 Function Documentation	1047
17.247.1.1 in_range() [1/3]	1047
17.247.1.2 in_range() [2/3]	1048
17.247.1.3 in_range() [3/3]	1048
17.248 Matio.h File Reference	1048
17.248.1 Function Documentation	1048
17.248.1.1 read_field()	1048
17.248.1.2 write_field()	1048
17.249 test-utils.h File Reference	1048
17.250 timer.h File Reference	1049
17.251 cblas.C File Reference	1049
17.251.1 Macro Definition Documentation	1050
17.251.1.1 __FFLASFFPACK_CONFIGURATION	1050
17.251.1.2 __FFLASFFPACK_HAVE_CBLAS	1050
17.251.2 Function Documentation	1050
17.251.2.1 main()	1050
17.252 clapack.C File Reference	1050
17.252.1 Macro Definition Documentation	1050
17.252.1.1 __FFLASFFPACK_CONFIGURATION	1050
17.252.1.2 __FFLASFFPACK_HAVE_LAPACK	1050
17.252.1.3 __FFLASFFPACK_HAVE_CLAPACK	1051
17.252.2 Function Documentation	1051
17.252.2.1 main()	1051
17.253 cuda.C File Reference	1051
17.253.1 Function Documentation	1051
17.253.1.1 main()	1051
17.254 fblas.C File Reference	1051
17.254.1 Macro Definition Documentation	1051
17.254.1.1 __FFLASFFPACK_CONFIGURATION	1051
17.254.2 Function Documentation	1052
17.254.2.1 dgemm_()	1052
17.254.2.2 main()	1052
17.255 gmp.C File Reference	1052
17.255.1 Function Documentation	1052
17.255.1.1 main()	1052
17.256 instrset.h File Reference	1052
17.256.1 Macro Definition Documentation	1053
17.256.1.1 INSTRSET_H	1053
17.256.1.2 INSTRSET	1053
17.256.1.3 const_int	1053

17.256.1.4 const_uint	1053
17.256.2 Typedef Documentation	1053
17.256.2.1 int8_t	1054
17.256.2.2 uint8_t	1054
17.256.2.3 int16_t	1054
17.256.2.4 uint16_t	1054
17.256.2.5 int32_t	1054
17.256.2.6 uint32_t	1054
17.256.2.7 int64_t	1054
17.256.2.8 uint64_t	1054
17.256.2.9 intptr_t	1054
17.256.3 Function Documentation	1054
17.256.3.1 instrset_detect()	1054
17.256.3.2 hasFMA3()	1054
17.256.3.3 hasFMA4()	1055
17.256.3.4 hasXOP()	1055
17.256.3.5 hasAVX512ER()	1055
17.257 instrset_detect.cpp File Reference	1055
17.257.1 Function Documentation	1055
17.257.1.1 instrset_detect()	1055
17.257.1.2 hasFMA3()	1055
17.257.1.3 hasFMA4()	1055
17.257.1.4 hasXOP()	1055
17.257.1.5 hasF16C()	1056
17.257.1.6 hasAVX512ER()	1056
17.258 lapack.C File Reference	1056
17.258.1 Macro Definition Documentation	1056
17.258.1.1 __FFLASFFPACK_CONFIGURATION	1056
17.258.1.2 __FFLASFFPACK_HAVE_LAPACK	1056
17.258.2 Function Documentation	1056
17.258.2.1 main()	1056
17.259 regression-check.C File Reference	1056
17.259.1 Function Documentation	1057
17.259.1.1 check1()	1057
17.259.1.2 check2()	1057
17.259.1.3 check3()	1057
17.259.1.4 check4()	1057
17.259.1.5 checkZeroDimCharpoly()	1057
17.259.1.6 checkZeroDimMinPoly()	1057
17.259.1.7 gf2ModularBalanced()	1057
17.259.1.8 main()	1057
17.260 test-charpoly-check.C File Reference	1058

17.260.1 Macro Definition Documentation	1058
17.260.1.1 ENABLE_CHECKER_charpoly	1058
17.260.1.2 TIME_CHECKER_CHARPOLY	1058
17.260.2 Function Documentation	1058
17.260.2.1 printPolynomial()	1058
17.260.2.2 main()	1058
17.261 test-charpoly.C File Reference	1058
17.261.1 Function Documentation	1059
17.261.1.1 launch_test()	1059
17.261.1.2 run_with_field()	1059
17.261.1.3 main()	1059
17.262 test-compressQ.C File Reference	1059
17.262.1 Typedef Documentation	1060
17.262.1.1 Field	1060
17.262.2 Function Documentation	1060
17.262.2.1 printvect()	1060
17.262.2.2 main()	1060
17.263 test-det-check.C File Reference	1060
17.263.1 Macro Definition Documentation	1061
17.263.1.1 ENABLE_CHECKER_Det	1061
17.263.1.2 TIME_CHECKER_Det	1061
17.263.2 Function Documentation	1061
17.263.2.1 main()	1061
17.264 test-det.C File Reference	1061
17.264.1 Function Documentation	1061
17.264.1.1 test_det()	1062
17.264.1.2 main()	1062
17.265 test-echelon.C File Reference	1062
17.265.1 Macro Definition Documentation	1063
17.265.1.1 __FFLASFFPACK_SEQUENTIAL	1063
17.265.1.2 __FFLASFFPACK_GAUSSJORDAN_BASECASE	1063
17.265.1.3 __FFLASFFPACK_PLUQ_THRESHOLD	1063
17.265.2 Function Documentation	1063
17.265.2.1 test_colechelon()	1063
17.265.2.2 test_rowechelon()	1063
17.265.2.3 test_redcolechelon()	1063
17.265.2.4 test_redrowechelon()	1064
17.265.2.5 run_with_field()	1064
17.265.2.6 main()	1064
17.266 test-fadd.C File Reference	1064
17.266.1 Function Documentation	1065
17.266.1.1 test_fadd()	1065

17.266.1.2 test_faddin()	1065
17.266.1.3 test_fsub()	1065
17.266.1.4 test_fsubin()	1065
17.266.1.5 main()	1066
17.267 test-fdot.C File Reference	1066
17.267.1 Macro Definition Documentation	1066
17.267.1.1 ENABLE_ALL_CHECKINGS	1066
17.267.2 Function Documentation	1066
17.267.2.1 check_fdot()	1066
17.267.2.2 run_with_field()	1067
17.267.2.3 run_with_Integer()	1067
17.267.2.4 main()	1067
17.268 test-fgemm-check.C File Reference	1067
17.268.1 Macro Definition Documentation	1067
17.268.1.1 ENABLE_ALL_CHECKINGS	1067
17.268.2 Function Documentation	1067
17.268.2.1 launch_MM_dispatch()	1068
17.268.2.2 run_with_field()	1068
17.268.2.3 main()	1068
17.269 test-fgemm.C File Reference	1068
17.269.1 Macro Definition Documentation	1069
17.269.1.1 ENABLE_CHECKER_fgemm	1069
17.269.2 Function Documentation	1069
17.269.2.1 check_MM()	1069
17.269.2.2 launch_MM()	1069
17.269.2.3 launch_MM_dispatch()	1070
17.269.2.4 run_with_field()	1070
17.269.2.5 main()	1070
17.270 test-fgemv.C File Reference	1071
17.270.1 Function Documentation	1071
17.270.1.1 check_MV()	1071
17.270.1.2 launch_MV()	1071
17.270.1.3 launch_MV_dispatch()	1072
17.270.1.4 run_with_field()	1072
17.270.1.5 main()	1072
17.271 test-fger.C File Reference	1072
17.271.1 Macro Definition Documentation	1073
17.271.1.1 TIME	1073
17.271.2 Function Documentation	1073
17.271.2.1 check_fger()	1073
17.271.2.2 launch_fger()	1073
17.271.2.3 launch_fger_dispatch()	1074

17.271.2.4 run_with_field()	1074
17.271.2.5 main()	1074
17.272 test-fgesv.C File Reference	1074
17.272.1 Function Documentation	1075
17.272.1.1 test_square_fgesv()	1075
17.272.1.2 test_rect_fgesv()	1075
17.272.1.3 run_with_field()	1075
17.272.1.4 main()	1075
17.273 test-finit.C File Reference	1076
17.273.1 Function Documentation	1076
17.273.1.1 test_freduce()	1076
17.273.1.2 run_with_field()	1076
17.273.1.3 main()	1076
17.274 test-fscal.C File Reference	1077
17.274.1 Function Documentation	1077
17.274.1.1 test_fscal() [1/2]	1077
17.274.1.2 test_fscal() [2/2]	1077
17.274.1.3 test_fscaln() [1/2]	1077
17.274.1.4 test_fscaln() [2/2]	1078
17.274.1.5 main()	1078
17.275 test-fsyr2k.C File Reference	1078
17.275.1 Macro Definition Documentation	1078
17.275.1.1 ENABLE_ALL_CHECKINGS	1078
17.275.2 Function Documentation	1079
17.275.2.1 check_fsyr2k()	1079
17.275.2.2 run_with_field()	1079
17.275.2.3 main()	1079
17.276 test-fsyrk.C File Reference	1079
17.276.1 Macro Definition Documentation	1080
17.276.1.1 ENABLE_ALL_CHECKINGS	1080
17.276.2 Function Documentation	1080
17.276.2.1 check_fsyrk()	1080
17.276.2.2 check_fsyrk_diag()	1080
17.276.2.3 check_fsyrk_bkdiag()	1080
17.276.2.4 run_with_field()	1081
17.276.2.5 main()	1081
17.277 test-fsytrf.C File Reference	1081
17.277.1 Function Documentation	1081
17.277.1.1 operator<<()	1082
17.277.1.2 test_RPM_fsytrf()	1082
17.277.1.3 test_generic_fsytrf()	1082
17.277.1.4 run_with_field()	1082

17.277.1.5 main()	1082
17.278 test-frm.C File Reference	1082
17.278.1 Macro Definition Documentation	1083
17.278.1.1 __FFLASFFPACK_SEQUENTIAL	1083
17.278.2 Function Documentation	1083
17.278.2.1 check_frm()	1083
17.278.2.2 run_with_field()	1083
17.278.2.3 main()	1084
17.279 test-frm.C File Reference	1084
17.279.1 Macro Definition Documentation	1084
17.279.1.1 __FFLASFFPACK_SEQUENTIAL	1084
17.279.1.2 ENABLE_ALL_CHECKINGS	1084
17.279.2 Function Documentation	1084
17.279.2.1 check_frm()	1084
17.279.2.2 run_with_field()	1085
17.279.2.3 main()	1085
17.280 test-frm-check.C File Reference	1085
17.280.1 Macro Definition Documentation	1085
17.280.1.1 ENABLE_ALL_CHECKINGS	1085
17.280.2 Function Documentation	1085
17.280.2.1 main()	1085
17.281 test-frm.C File Reference	1086
17.281.1 Macro Definition Documentation	1086
17.281.1.1 __FFLASFFPACK_SEQUENTIAL	1086
17.281.1.2 ENABLE_ALL_CHECKINGS	1086
17.281.2 Function Documentation	1086
17.281.2.1 check_frm()	1086
17.281.2.2 run_with_field()	1087
17.281.2.3 main()	1087
17.282 test-frmssyr2k.C File Reference	1087
17.282.1 Macro Definition Documentation	1087
17.282.1.1 ENABLE_ALL_CHECKINGS	1087
17.282.2 Function Documentation	1088
17.282.2.1 check_frmssyr2k()	1088
17.282.2.2 run_with_field()	1088
17.282.2.3 main()	1088
17.283 test-frmstr.C File Reference	1088
17.283.1 Macro Definition Documentation	1089
17.283.1.1 ENABLE_ALL_CHECKINGS	1089
17.283.2 Function Documentation	1089
17.283.2.1 check_frmstr()	1089
17.283.2.2 run_with_field()	1089

17.283.2.3 main()	1089
17.284 test-ftsv.C File Reference	1089
17.284.1 Macro Definition Documentation	1090
17.284.1.1 __FFLASFFPACK_SEQUENTIAL	1090
17.284.1.2 ENABLE_ALL_CHECKINGS	1090
17.284.2 Function Documentation	1090
17.284.2.1 check_ftsv()	1090
17.284.2.2 run_with_field()	1090
17.284.2.3 main()	1090
17.285 test-fty.C File Reference	1090
17.285.1 Macro Definition Documentation	1091
17.285.1.1 __FFLASFFPACK_SEQUENTIAL	1091
17.285.1.2 ENABLE_ALL_CHECKINGS	1091
17.285.2 Function Documentation	1091
17.285.2.1 check_fty()	1091
17.285.2.2 run_with_field()	1091
17.285.2.3 main()	1092
17.286 test-interfaces-c.c File Reference	1092
17.286.1 Function Documentation	1092
17.286.1.1 main()	1092
17.287 test-invert-check.C File Reference	1092
17.287.1 Macro Definition Documentation	1092
17.287.1.1 ENABLE_ALL_CHECKINGS	1092
17.287.2 Function Documentation	1092
17.287.2.1 main()	1093
17.288 test-io.C File Reference	1093
17.288.1 Function Documentation	1093
17.288.1.1 run_with_field()	1093
17.288.1.2 main()	1093
17.289 test-lu.C File Reference	1094
17.289.1 Macro Definition Documentation	1094
17.289.1.1 BASECASE_K	1094
17.289.1.2 __FFLASFFPACK_SEQUENTIAL	1095
17.289.1.3 __LUDIVINE_CUTOFF	1095
17.289.2 Function Documentation	1095
17.289.2.1 test_LUdivine()	1095
17.289.2.2 verifPLUQ()	1095
17.289.2.3 test_pluq()	1096
17.289.2.4 launch_test()	1097
17.289.2.5 run_with_field()	1097
17.289.2.6 main()	1097
17.289.3 Variable Documentation	1097

17.289.3.1 tperm	1097
17.289.3.2 tgemm	1097
17.289.3.3 tBC	1097
17.289.3.4 ttrsm	1097
17.289.3.5 trest	1097
17.289.3.6 timtot	1098
17.289.3.7 mvcnt	1098
17.290 test-maxdelayeddim.C File Reference	1098
17.290.1 Macro Definition Documentation	1098
17.290.1.1 MAX_WITH_SIZE_T	1098
17.290.2 Function Documentation	1098
17.290.2.1 test()	1098
17.290.2.2 main()	1098
17.291 test-minpoly.C File Reference	1099
17.291.1 Function Documentation	1099
17.291.1.1 check_minpoly()	1099
17.291.1.2 run_with_field()	1099
17.291.1.3 main()	1099
17.292 test-multifile1.C File Reference	1100
17.293 test-multifile2.C File Reference	1100
17.293.1 Function Documentation	1100
17.293.1.1 main()	1100
17.294 test-nullspace.C File Reference	1100
17.294.1 Function Documentation	1100
17.294.1.1 checkingMessage()	1101
17.294.1.2 readOrRandomMatrixWithRankAndRandomRPM()	1101
17.294.1.3 test_nullspace()	1101
17.294.1.4 run_with_field()	1101
17.294.1.5 main()	1101
17.295 test-permutations.C File Reference	1101
17.295.1 Function Documentation	1102
17.295.1.1 checkMonotonicApplyP()	1102
17.295.1.2 main()	1102
17.295.2 Variable Documentation	1102
17.295.2.1 tperm	1102
17.295.2.2 tgemm	1102
17.295.2.3 tBC	1102
17.295.2.4 ttrsm	1102
17.295.2.5 trest	1103
17.295.2.6 timtot	1103
17.296 test-pluq-check.C File Reference	1103
17.296.1 Macro Definition Documentation	1103

17.296.1.1	ENABLE_ALL_CHECKINGS	1103
17.296.2	Function Documentation	1103
17.296.2.1	main()	1103
17.297	test-rankprofiles.C File Reference	1103
17.297.1	Macro Definition Documentation	1104
17.297.1.1	__FFLASFFPACK_SEQUENTIAL	1104
17.297.2	Function Documentation	1104
17.297.2.1	run_with_field()	1104
17.297.2.2	main()	1104
17.298	test-rpm.C File Reference	1104
17.298.1	Function Documentation	1105
17.298.1.1	checkRPM()	1105
17.298.1.2	checkSymmetricRPM()	1105
17.298.1.3	main()	1105
17.299	test-simd.C File Reference	1105
17.299.1	Macro Definition Documentation	1106
17.299.1.1	REGISTER_TYPE_NAME	1106
17.299.1.2	TEST_ONE_OP	1106
17.299.2	Typedef Documentation	1106
17.299.2.1	integer	1107
17.299.3	Function Documentation	1107
17.299.3.1	TypeName()	1107
17.299.3.2	REGISTER_TYPE_NAME() [1/8]	1107
17.299.3.3	REGISTER_TYPE_NAME() [2/8]	1107
17.299.3.4	REGISTER_TYPE_NAME() [3/8]	1107
17.299.3.5	REGISTER_TYPE_NAME() [4/8]	1107
17.299.3.6	REGISTER_TYPE_NAME() [5/8]	1107
17.299.3.7	REGISTER_TYPE_NAME() [6/8]	1107
17.299.3.8	REGISTER_TYPE_NAME() [7/8]	1107
17.299.3.9	REGISTER_TYPE_NAME() [8/8]	1107
17.299.3.10	generate_random_vector() [1/2]	1108
17.299.3.11	generate_random_vector() [2/2]	1108
17.299.3.12	check_eq() [1/2]	1108
17.299.3.13	check_eq() [2/2]	1108
17.299.3.14	eval_func_on_array() [1/2]	1108
17.299.3.15	eval_func_on_array() [2/2]	1108
17.299.3.16	test_op()	1108
17.299.3.17	test_impl() [1/2]	1108
17.299.3.18	test_impl() [2/2]	1108
17.299.3.19	test() [1/2]	1109
17.299.3.20	test() [2/2]	1109
17.299.3.21	main()	1109

17.300 test-solve.C File Reference	1109
17.300.1 Function Documentation	1109
17.300.1.1 check_solve()	1109
17.300.1.2 run_with_field()	1109
17.300.1.3 main()	1110
17.301 101-fgemv.C File Reference	1110
17.301.1 Function Documentation	1110
17.301.1.1 main()	1110
17.302 2x2-fgemv.C File Reference	1110
17.302.1 Function Documentation	1110
17.302.1.1 main()	1110
17.303 2x2-ftsrv.C File Reference	1111
17.303.1 Function Documentation	1111
17.303.1.1 main()	1111
17.304 2x2-pluq.C File Reference	1111
17.304.1 Function Documentation	1111
17.304.1.1 main()	1111
17.305 fflas-101_1.C File Reference	1111
17.305.1 Function Documentation	1112
17.305.1.1 main()	1112
17.306 fflas-101_3.C File Reference	1112
17.306.1 Function Documentation	1112
17.306.1.1 main()	1112
17.307 fflas_101.C File Reference	1112
17.307.1 Function Documentation	1112
17.307.1.1 main()	1113
17.308 fflas_101_lvl1.C File Reference	1113
17.308.1 Function Documentation	1113
17.308.1.1 main()	1113
17.309 ffpack-fgesv.C File Reference	1113
17.309.1 Function Documentation	1113
17.309.1.1 main()	1113
17.310 ffpack-solve.C File Reference	1113
17.310.1 Function Documentation	1114
17.310.1.1 main()	1114

Chapter 1

FFLAS-FFPACK Documentation.

1.1 Introduction

FFLAS-FFPACK is a LGPL-2.1+ source code library for basic linear algebra operations over a finite field. It is inspired by BLAS interface (Basic Linear Algebra Subprograms) and the LAPACK library for numerical linear algebra, and shares part of their design. Yet it differs in many aspects due to the specificities of computing over a finite field:

- it is generic with respect to the finite field, so as to accomodate a large variety of field sizes and implementations;
- it is a pure source code library, to be included and compiled in the user's software. Its build system is only used for tests and benchmarks.

1.2 Goals

1.3 Design

1.4 Using FFLAS-FFPACK.

- [Copying and Licence](#).
- [Tutorial](#). This is a brief introduction to FFLAS-FFPACK capabilities.
- [Configuring and Installing FFLAS-FFPACK](#). Explains how to configure/install from sources or from the latest svn version.
- [Architecture of the library](#).. Describes how FFLAS-FFPACK is organized
- [Documentation for Users](#). If everything around is blue, then you are reading the lighter, user-oriented, documentation.
- [Documentation for Developers](#). If everything around is green, then you can get to everything (not necessarily yet) documented.

1.5 Contributing to fflas-ffpack, getting assistance.

Version

2.3.0

Chapter 2

Configuring and Installing FFLAS-FFPACK

FFLAS-FFPACK is a header-only package.

Howver configuration process can be tweaked a lot. Configure looks for BLAS routines and [Givaro](#) library which are both mandatory dependencies. See the output of `./configure -help` for information about the LAPACK/↵ BLAS discovering strategies.

Chapter 3

Copying and Licence

The FFLAS-FFPACK library is licensed under the terms of the GNU LGPL v2.1 or later.

See <https://www.gnu.org/licenses/lgpl-2.1.html>

Chapter 4

Tutorial

no doc.

Chapter 5

Architecture of the library.

no doc.

Chapter 6

Bug List

Global **DOUBLE_TO_FLOAT_CROSSOVER**

to be benchmarked.

Global **FFLAS::details::pack_lhs** (int64_t *XX, const int64_t *X, size_t ldx, size_t rows, size_t cols)

this is fassign

this is fassign

Global **FFLAS::details::pack_rhs** (int64_t *XX, const int64_t *X, size_t ldx, size_t rows, size_t cols)

this is fassign

this is fassign

Global **FFLAS::fconvert** (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, FFLAS_ELT *X, const size_t incX, const FFLAS_ELT *Y, const size_t incY)

use cblas_(d)scal when possible

Global **FFLAS::fconvert** (const Field &F, const size_t n, OtherElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY)

use cblas_(d)scal when possible

Global **FFLAS::finit** (const Field &F, const size_t n, const OtherElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)

use cblas_(d)scal when possible

Global **FFLAS::finit** (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT *Y, const size_t incY, FFLAS_ELT *X, const size_t incX)

use cblas_(d)scal when possible

Global **FFLAS::fneg** (const Field &F, const size_t n, typename Field::ConstElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)

use cblas_(d)scal when possible

Global **FFLAS::fneg** (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT *Y, const size_t incY, FFLAS_ELT *X, const size_t incX)

use cblas_(d)scal when possible

Global **FFLAS::fnegin** (const Field &F, const size_t n, typename Field::Element_ptr X, const size_t incX)

use cblas_(d)scal when possible

Global **FFLAS::fnegin** (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, FFLAS_ELT *X, const size_t incX)

use cblas_(d)scal when possible

Global **FFLAS::freduce** (const Field &F, const size_t n, typename Field::ConstElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)

use cblas_(d)scal when possible

- Global **FFLAS::reduce** (const Field &F, const size_t n, typename **Field::Element_ptr** X, const size_t incX)
use cblas_(d)scal when possible
- Global **FFLAS::reduce** (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, FFLAS_ELT *X, const size_t incX)
use cblas_(d)scal when possible
- Global **FFLAS::reduce** (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT *Y, const size_t incY, FFLAS_ELT *X, const size_t incX)
use cblas_(d)scal when possible
- Global **FFLAS::fscal** (const Field &F, const size_t n, const typename **Field::Element** alpha, typename **Field::ConstElement_ptr** X, const size_t incX, typename **Field::Element_ptr** Y, const size_t incY)
use cblas_(d)scal when possible
- Global **FFLAS::fscal** (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT alpha, const FFLAS_ELT *X, const size_t incX, FFLAS_ELT *Y, const size_t incY)
use cblas_(d)scal when possible
- Global **FFLAS::fscaln** (const Field &F, const size_t n, const typename **Field::Element** alpha, typename **Field::Element_ptr** X, const size_t incX)
use cblas_(d)scal when possible
- Global **FFLAS::fscaln** (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT alpha, FFLAS_ELT *X, const size_t incX)
use cblas_(d)scal when possible
- Global **FFLAS::fsquare** (const Field &F, const FFLAS_TRANSPOSE ta, const size_t n, const typename **Field::Element** alpha, typename **Field::ConstElement_ptr** A, const size_t lda, const typename **Field::Element** beta, typename **Field::Element_ptr** C, const size_t ldc)
why double ?
- Global **FFLAS::fswap** (const Field &F, const size_t N, typename **Field::Element_ptr** X, const size_t incX, typename **Field::Element_ptr** Y, const size_t incY)
use cblas_dswap when double
- Global **FFLAS::fswap** (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t N, FFLAS_ELT *X, const size_t incX, FFLAS_ELT *Y, const size_t incY)
use cblas_dswap when double
- Global **FFLAS::ftrsm** (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename **Field::Element** alpha, typename **Field::ConstElement_ptr** A, const size_t lda, typename **Field::Element_ptr** B, const size_t ldb)
 α must be non zero.
- Global **FFLAS::ftrsm** (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const FFLAS_ELT alpha, const FFLAS_ELT *A, const size_t lda, FFLAS_ELT *B, const size_t ldb)
 α must be non zero.
- Global **FFPACK::buildMatrix** (const Field &F, typename **Field::ConstElement_ptr** E, typename **Field::ConstElement_ptr** C, const size_t lda, const size_t *B, const size_t *T, const size_t me, const size_t mc, const size_t lambda, const size_t mu)
is this :
- Global **FFPACK::invert2** (const Field &F, const size_t M, typename **Field::Element_ptr** A, const size_t lda, typename **Field::Element_ptr** X, const size_t idx, int &nullity)
not tested.
- Global **launch_fger_dispatch** (const Field &F, const size_t nn, const typename **Field::Element** alpha, const size_t iters, RandIter &G)
test for transpo
test for incx equal

Global `launch_MM_dispatch` (const Field &F, const int mm, const int nn, const int kk, const typename `Field::Element` alpha, const typename `Field::Element` beta, const size_t iters, RandIter &G)

Global `launch_MM_dispatch` (const Field &F, const int mm, const int nn, const int kk, const typename `Field::Element` alpha, const typename `Field::Element` beta, const size_t iters, const int nbw, const bool par, RandIter &G)

test for IdX equal

test for transpo

Global `launch_MM_dispatch` (const Field &F, const int mm, const int nn, const int kk, const typename `Field::Element` alpha, const typename `Field::Element` beta, const size_t iters, RandIter &G)

test for transpo

test for IdX equal

Global `printvect` (std::ostream &o, vector< T > &vect)

does not belong here

Chapter 7

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- Global **FFPACK::LUdivine** (const Field &F, const **FFLAS::FFLAS_DIAG** Diag, const **FFLAS::FFLAS_TRANSPOSE** trans, const size_t M, const size_t N, typename **Field::Element_ptr** A, const size_t lda, size_t *P, size_t *Qt, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive, const size_t cutoff=__FFLASFFPACK_LUDIVINE_THRESHOLD) .
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- Global **FFPACK::PLUQ** (const Field &F, const **FFLAS::FFLAS_DIAG** Diag, const size_t M, const size_t N, typename **Field::Element_ptr** A, const size_t lda, size_t *P, size_t *Q) .
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- Global **FFPACK::Protected::GaussJordan** (const Field &F, const size_t M, const size_t N, typename **Field::Element_ptr** A, const size_t lda, const size_t colbeg, const size_t rowbeg, const size_t colsize, size_t *P, size_t *Q, const FFPACK::FFPACK_LU_TAG LuTag) .
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• Algorithm 11 of Jeannerod C-P., Pernet, C. and Storjohann, A. *Rank-profile revealing Gaussian elimination and the CUP matrix decomposition*, J. of Symbolic Comp., 2013
- Class **ftsmLeftUpperNoTransNonUnit**< Element > .
Dumas, Giorgi, Pernet 06, arXiv:cs/0601133.

Chapter 8

Todo List

File `debug.h`

we should put vector printing elsewhere.

Global `FFLAS::fadd` (const Field &F, const size_t N, typename `Field::ConstElement_ptr` A, const size_t incA, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` B, const size_t incB, typename `Field::Element_ptr` C, const size_t incC)

optimise here

Global `FFLAS::fassign` (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t N, const FFLAS_ELT *Y, const size_t incY, FFLAS_ELT *X, const size_t incX)

variant for triangular matrix

Global `FFLAS::fassign` (const Field &F, const size_t N, typename `Field::ConstElement_ptr` Y, const size_t incY, typename `Field::Element_ptr` X, const size_t incX)

variant for triangular matrix

Global `FFLAS::fconvert` (const Field &F, const size_t m, const size_t n, OtherElement_ptr A, const size_t lda, typename `Field::ConstElement_ptr` B, const size_t ldb)

check if n == lda

Global `FFLAS::fneg` (const Field &F, const size_t m, const size_t n, typename `Field::ConstElement_ptr` B, const size_t ldb, typename `Field::Element_ptr` A, const size_t lda)

check if n == lda

Global `FFLAS::fnegin` (const Field &F, const size_t m, const size_t n, typename `Field::Element_ptr` A, const size_t lda)

check if n == lda

Global `FFLAS::fscal` (const Field &F, const size_t n, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` X, const size_t incX, typename `Field::Element_ptr` Y, const size_t incY)

check if comparison with +/-1,0 is necessary.

Global `FFLAS::fscal` (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT alpha, const FFLAS_ELT *X, const size_t incX, FFLAS_ELT *Y, const size_t incY)

check if comparison with +/-1,0 is necessary.

Global `FFLAS::fscaln` (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT alpha, FFLAS_ELT *X, const size_t incX)

check if comparison with +/-1,0 is necessary.

Global `FFLAS::fscaln` (const Field &F, const size_t n, const typename `Field::Element` alpha, typename `Field::Element_ptr` X, const size_t incX)

check if comparison with +/-1,0 is necessary.

Global **FFLAS::Protected::igemm** (const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_TRANSPOSE TransB, size_t rows, size_t cols, size_t depth, const int64_t alpha, const int64_t *A, size_t lda, const int64_t *B, size_t ldb, const int64_t beta, int64_t *C, size_t ldc)

use primitive (no [Field\(\)](#)) and specialise for int64.

Global **FFLAS::Protected::MatF2MatFI_Triangular** (const Field &F, Givaro::FloatDomain::Element_ptr S, const size_t lds, typename [Field::ConstElement_ptr](#) const E, const size_t lde, const size_t m, const size_t n)

do finit(...,FFLAS_TRANS,FFLAS_DIAG)

do fconvert(...,FFLAS_TRANS,FFLAS_DIAG)

Global **FFPACK::getTriangular** (const Field &F, const **FFLAS::FFLAS_UPLO** Uplo, const **FFLAS::FFLAS_DIAG** diag, const size_t M, const size_t N, const size_t R, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) T, const size_t ldt, const bool OnlyNonZeroVectors=false)

just one triangular fzero+fassign ?

Global **FFPACK::getTriangular** (const Field &F, const **FFLAS::FFLAS_UPLO** Uplo, const **FFLAS::FFLAS_DIAG** diag, const size_t M, const size_t N, const size_t R, typename [Field::Element_ptr](#) A, const size_t lda)

just one triangular fzero+fassign ?

Global **FFPACK::invert2** (const Field &F, const size_t M, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) X, const size_t ldx, int &>nullity)

this init is not all necessary (done after ftrtri)

Global **FFPACK::LUdivine** (const Field &F, const **FFLAS::FFLAS_DIAG** Diag, const **FFLAS::FFLAS_TRANSPOSE** trans, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *P, size_t *Q, const **FFPACK::FFPACK_LU_TAG** LuTag, const size_t cutoff)

std::swap ?

Global **FFPACK::Protected::RandomKrylovPrecond** (const PolRing &PR, std::list< typename PolRing::Element > &completedFactors, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, size_t &Nb, typename PolRing::Domain_t::Element_ptr &B, size_t &ldb, typename PolRing::Domain_t::RandIter &g, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)

don't assing K2 c*noc x N but only mas (c,noc) x N and store each one after the other

swap to save space ??

Module [field](#)

biblio

Global **launch_fger_dispatch** (const Field &F, const size_t nn, const typename [Field::Element](#) alpha, const size_t iters, RandIter &G)

does nbw actually do nbw recursive calls and then call blas (check ?) ?

Global **launch_MM_dispatch** (const Field &F, const int mm, const int nn, const int kk, const typename [Field::Element](#) alpha, const typename [Field::Element](#) beta, const size_t iters, RandIter &G)

does nbw actually do nbw recursive calls and then call blas (check ?) ?

Global **launch_MM_dispatch** (const Field &F, const int mm, const int nn, const int kk, const typename [Field::Element](#) alpha, const typename [Field::Element](#) beta, const size_t iters, const int nbw, const bool par, RandIter &G)

does nbw actually do nbw recursive calls and then call blas (check ?) ?

Module [MMalgos](#)

biblio

Module [simd](#)

biblio

Global **test_colechelon** (Field &F, size_t m, size_t n, size_t r, size_t iters, **FFPACK::FFPACK_LU_TAG** LuTag, RandIter &G, bool par)

check lda

Global **test_det** (Field &F, size_t n, int iter, RandIter &G)

test with stride

Global **test_redcochelon** (Field &F, size_t m, size_t n, size_t r, size_t iters, FFPACK::FFPACK_LU_TAG LuTag, RandIter &G, bool par)

check Ida

Global **test_redrowechelon** (Field &F, size_t m, size_t n, size_t r, size_t iters, FFPACK::FFPACK_LU_TAG LuTag, RandIter &G, bool par)

check Ida

Global **test_rowechelon** (Field &F, size_t m, size_t n, size_t r, size_t iters, FFPACK::FFPACK_LU_TAG LuTag, RandIter &G, bool par)

check Ida

Chapter 9

Module Index

9.1 Modules

Here is a list of all modules:

CHECKER	49
FFLAS-FFPACK	49
FFLAS	50
Interfaces	51
Matrix Multiplication Algorithms	50
SIMD wrapper	50
FFPACK	50
FFLAS-FFPACK fields	51
RNS	51

Chapter 10

Namespace Index

10.1 Namespace List

Here is a list of all namespaces with brief descriptions:

FFLAS	53
FFLAS::BLAS3	199
FFLAS::csr_hyb_details	205
FFLAS::CuttingStrategy	205
FFLAS::details	206
FFLAS::details_spmv	214
FFLAS::ElementCategories	214
FFLAS::FieldCategories	
Traits and categories will need to be placed in a proper file later	215
FFLAS::MMHelperAlgo	215
FFLAS::ModeCategories	
Specifies the mode of action for an algorithm w.r.t	215
FFLAS::ParSeqHelper	
ParSeqHelper for both fgemm and ftrsm	216
FFLAS::Protected	216
FFLAS::sell_details	229
FFLAS::sparse_details	230
FFLAS::sparse_details_impl	244
FFLAS::StrategyParameter	286
FFLAS::StructureHelper	
StructureHelper for ftrsm	286
FFLAS::vectorised	286
FFLAS::vectorised::unswitch	292
FFPACK	
Finite Field PACK Set of elimination based routines for dense linear algebra	293
FFPACK::Protected	395
Givaro	403
MKL_CONFIG	403
RecInt	403

Chapter 11

Hierarchical Index

11.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

AlgoChooser< ModeT, ParSeq >	405
AlgoChooser< ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq >	405
ArbitraryPrecIntTag	405
AreEqual< X, Y >	406
AreEqual< X, X >	406
Argument	406
associatedDelayedField< Field >	407
associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > >	407
associatedDelayedField< const Givaro::Modular< T, X > >	408
associatedDelayedField< const Givaro::ModularBalanced< T > >	408
associatedDelayedField< const Givaro::ZRing< T > >	409
Auto	409
Bini	409
Block	409
callLUdivine_small< Element >	410
callLUdivine_small< double >	410
callLUdivine_small< float >	411
CharpolyFailed	411
Checker_Empty< Field >	411
CheckerImplem_charpoly< Field, Polynomial >	412
CheckerImplem_Det< Field >	413
CheckerImplem_fgemm< Field >	414
CheckerImplem_ftdsm< Field >	415
CheckerImplem_invert< Field >	416
CheckerImplem_PLUQ< Field >	417
Classic	418
Column	418
CompactElement< Element >	418
CompactElement< double >	418
CompactElement< float >	419
CompactElement< int16_t >	419
CompactElement< int32_t >	419
CompactElement< int64_t >	420
compatible_data_type< Field >	420
compatible_data_type< Givaro::ZRing< double > >	420

<code>compatible_data_type< Givaro::ZRing< float > ></code>	420
<code>Compose< H1, H2 ></code>	421
<code>Const_int_t< n ></code>	422
<code>Const_uint_t< n ></code>	422
<code>Simd128_impl< true, true, false, 2 >::Converter</code>	422
<code>Simd128_impl< true, true, false, 4 >::Converter</code>	423
<code>Simd128_impl< true, true, false, 8 >::Converter</code>	423
<code>Simd128_impl< true, true, true, 2 >::Converter</code>	423
<code>Simd128_impl< true, true, true, 4 >::Converter</code>	424
<code>Simd128_impl< true, true, true, 8 >::Converter</code>	424
<code>Simd256_impl< true, true, false, 2 >::Converter</code>	425
<code>Simd256_impl< true, true, false, 4 >::Converter</code>	425
<code>Simd256_impl< true, true, false, 8 >::Converter</code>	425
<code>Simd256_impl< true, true, true, 2 >::Converter</code>	426
<code>Simd256_impl< true, true, true, 4 >::Converter</code>	426
<code>Simd256_impl< true, true, true, 8 >::Converter</code>	427
<code>Simd512_impl< true, true, false, 8 >::Converter</code>	427
<code>Simd512_impl< true, true, true, 8 >::Converter</code>	427
<code>ConvertTo< T ></code>	428
<code>Coo< ValT, IdxT ></code>	428
<code>Coo< Field ></code>	430
<code>Coo< ValT, IdxT ></code>	431
<code>CooMat< Field ></code>	433
<code>CooMat< FFPACK::RNSInteger ></code>	433
<code>CsrMat< Field ></code>	434
<code>CsrMat< FFPACK::RNSInteger ></code>	434
<code>DefaultBoundedTag</code>	434
<code>DefaultTag</code>	435
<code>DelayedTag</code>	435
<code>ElementTraits< Element ></code>	435
<code>ElementTraits< double ></code>	435
<code>ElementTraits< FFPACK::rns_double_elt ></code>	436
<code>ElementTraits< float ></code>	436
<code>ElementTraits< Givaro::Integer ></code>	436
<code>ElementTraits< int16_t ></code>	437
<code>ElementTraits< int32_t ></code>	437
<code>ElementTraits< int64_t ></code>	437
<code>ElementTraits< int8_t ></code>	438
<code>ElementTraits< Reclnt::rint< K > ></code>	438
<code>ElementTraits< Reclnt::rmint< K, MG > ></code>	438
<code>ElementTraits< Reclnt::ruint< K > ></code>	439
<code>ElementTraits< uint16_t ></code>	439
<code>ElementTraits< uint32_t ></code>	439
<code>ElementTraits< uint64_t ></code>	440
<code>ElementTraits< uint8_t ></code>	440
<code>EllMat< Field ></code>	440
<code>EllMat< FFPACK::RNSInteger ></code>	440
<code>Failure</code>	441
<code>FailureCharpolyCheck</code>	443
<code>FailureDetCheck</code>	443
<code>FailureFgemmCheck</code>	443
<code>FailureInvertCheck</code>	443
<code>FailurePLUQCheck</code>	444
<code>FailureTrsmCheck</code>	444
<code>false_type</code>	
<code>isSparseMatrix< Field, M ></code>	479
<code>isSparseMatrixMKLFormat< F, M ></code>	483
<code>isSparseMatrixSimdFormat< F, M ></code>	483

isZOSparseMatrix< F, M >	484
support_fast_mod< T >	753
support_simd< T >	755
support_simd_add< T >	755
support_simd_mod< T >	755
FieldSimd< _Field >	444
FieldTraits< Field >	450
FieldTraits< FFPACK::RNSInteger< T > >	451
FieldTraits< FFPACK::RNSIntegerMod< T > >	451
FieldTraits< Givaro::Modular< Element > >	452
FieldTraits< Givaro::ModularBalanced< Element > >	452
FieldTraits< Givaro::ZRing< double > >	453
FieldTraits< Givaro::ZRing< float > >	453
FieldTraits< Givaro::ZRing< Givaro::Integer > >	454
FieldTraits< Givaro::ZRing< int16_t > >	455
FieldTraits< Givaro::ZRing< int32_t > >	455
FieldTraits< Givaro::ZRing< int64_t > >	456
FieldTraits< Givaro::ZRing< Reclnt::ruint< K > > >	456
FieldTraits< Givaro::ZRing< uint16_t > >	457
FieldTraits< Givaro::ZRing< uint32_t > >	457
FieldTraits< Givaro::ZRing< uint64_t > >	458
Fixed	458
FixedPrecIntTag	458
ForStrategy1D< blocksize_t, Cut, Param >	459
ForStrategy2D< blocksize_t, Cut, Param >	461
ftmmLeftLowerNoTransNonUnit< Element >	464
ftmmLeftLowerNoTransUnit< Element >	464
ftmmLeftLowerTransNonUnit< Element >	465
ftmmLeftLowerTransUnit< Element >	465
ftmmLeftUpperNoTransNonUnit< Element >	465
ftmmLeftUpperNoTransUnit< Element >	465
ftmmLeftUpperTransNonUnit< Element >	465
ftmmLeftUpperTransUnit< Element >	465
ftmmRightLowerNoTransNonUnit< Element >	465
ftmmRightLowerNoTransUnit< Element >	465
ftmmRightLowerTransNonUnit< Element >	466
ftmmRightLowerTransUnit< Element >	466
ftmmRightUpperNoTransNonUnit< Element >	466
ftmmRightUpperNoTransUnit< Element >	466
ftmmRightUpperTransNonUnit< Element >	466
ftmmRightUpperTransUnit< Element >	466
ftsmLeftLowerNoTransNonUnit< Element >	466
ftsmLeftLowerNoTransUnit< Element >	466
ftsmLeftLowerTransNonUnit< Element >	467
ftsmLeftLowerTransUnit< Element >	467
ftsmLeftUpperNoTransNonUnit< Element >	467
ftsmLeftUpperNoTransUnit< Element >	467
ftsmLeftUpperTransNonUnit< Element >	467
ftsmLeftUpperTransUnit< Element >	467
ftsmRightLowerNoTransNonUnit< Element >	468
ftsmRightLowerNoTransUnit< Element >	468
ftsmRightLowerTransNonUnit< Element >	468
ftsmRightLowerTransUnit< Element >	468
ftsmRightUpperNoTransNonUnit< Element >	468
ftsmRightUpperNoTransUnit< Element >	468
ftsmRightUpperTransNonUnit< Element >	468
ftsmRightUpperTransUnit< Element >	468
GenericTag	469

GenericTag	469
Grain	469
has_minus_eq_impl< C >	469
has_minus_impl< C >	469
has_mul_eq_impl< C >	470
has_mul_impl< C >	470
has_operation< T >	470
has_plus_eq_impl< C >	471
has_plus_impl< C >	471
HelperFlag	471
HelperMod< Field, ElementTraits >	472
HelperMod< Field, ElementCategories::MachineIntTag >	472
HelperMod< Field, FFLAS::ElementCategories::ArbitraryPrecIntTag >	474
HelperMod< Field, FFLAS::ElementCategories::FixedPrecIntTag >	474
HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag >	475
Hybrid	476
Info	476
Info	477
is_simd< T >	479
Iterative	485
LazyTag	486
limits< T >	486
limits< char >	486
limits< double >	487
limits< float >	487
limits< Givaro::Integer >	488
limits< int >	489
limits< long >	489
limits< long long >	490
limits< Reclnt::rint< K > >	491
limits< Reclnt::ruint< K > >	492
limits< short int >	492
limits< signed char >	493
limits< unsigned char >	494
limits< unsigned int >	494
limits< unsigned long >	495
limits< unsigned long long >	496
limits< unsigned short int >	497
MachineFloatTag	497
MachineIntTag	498
MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >	498
MMHelper< FFPACK::RNSInteger< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >	503
MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >	505
MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< Dest >, ParSeqTrait >	507
MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeqTrait >	509
MMHelper< Field, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >	511
ModeTraits< Field >	513
ModeTraits< Givaro::Modular< Element, Compute > >	513
ModeTraits< Givaro::Modular< Givaro::Integer, Compute > >	513
ModeTraits< Givaro::Modular< int16_t, Compute > >	514
ModeTraits< Givaro::Modular< int32_t, Compute > >	514
ModeTraits< Givaro::Modular< int8_t, Compute > >	514
ModeTraits< Givaro::Modular< Reclnt::ruint< K >, Compute > >	515
ModeTraits< Givaro::Modular< uint16_t, Compute > >	515
ModeTraits< Givaro::Modular< uint32_t, Compute > >	516
ModeTraits< Givaro::Modular< uint8_t, Compute > >	516
ModeTraits< Givaro::ModularBalanced< Element > >	516

ModeTraits< Givaro::ModularBalanced< Givaro::Integer > >	517
ModeTraits< Givaro::ModularBalanced< int16_t > >	517
ModeTraits< Givaro::ModularBalanced< int32_t > >	517
ModeTraits< Givaro::ModularBalanced< int8_t > >	518
ModeTraits< Givaro::Montgomery< T > >	518
ModeTraits< Givaro::ZRing< double > >	518
ModeTraits< Givaro::ZRing< float > >	519
ModeTraits< Givaro::ZRing< Givaro::Integer > >	519
ModularBalanced< T >	519
ModularTag	520
Montgomery< T >	520
need_field_characteristic< Field >	520
need_field_characteristic< Givaro::Modular< Field > >	520
need_field_characteristic< Givaro::ModularBalanced< Field > >	520
NoSimd< T >	521
Parallel< C, P >	522
readMyMachineType< Field, T >	525
readMyMachineType< Field, mpz_t >	526
Recursive	527
Recursive	527
rint< K >	527
rns_double	527
rns_double_elt	532
rns_double_elt_cstptr	534
rns_double_elt_ptr	537
rns_double_extended	540
RNSElementTag	544
RNSInteger< RNS >	545
RNSInteger< FFPACK::rns_double >	545
RNSIntegerMod< RNS >	548
RNSIntegerMod< FFPACK::rns_double >	548
rnsRandIter< RNS >	555
RNSInteger< RNS >::RandIter	523
RNSIntegerMod< RNS >::RandIter	524
Row	556
ruint< K >	556
ScalFunctions< Element, Enable >	556
ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >	557
ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >	560
Sequential	566
Simd128_impl< ArithType, Int, Signed, Size >	567
Simd128fp_base	620
Simd128_impl< true, false, true, 4 >	567
Simd128_impl< true, false, true, 8 >	567
Simd128i_base	621
Simd128_impl< true, true, true, 2 >	594
Simd128_impl< true, true, false, 2 >	568
Simd128_impl< true, true, true, 4 >	603
Simd128_impl< true, true, false, 4 >	576
Simd128_impl< true, true, true, 8 >	611
Simd128_impl< true, true, false, 8 >	585
Simd256_impl< ArithType, Int, Signed, Size >	622
Simd256fp_base	697
Simd256_impl< true, false, true, 4 >	622
Simd256_impl< true, false, true, 8 >	623
Simd256i_base	698

Simd256_impl< true, true, true, 2 >	664
Simd256_impl< true, true, false, 2 >	630
Simd256_impl< true, true, true, 4 >	672
Simd256_impl< true, true, false, 4 >	638
Simd256_impl< true, true, false, 4 >	638
Simd256_impl< true, true, true, 8 >	689
Simd256_impl< true, true, false, 8 >	655
Simd512_impl< ArithType, Int, Signed, Size >	699
Simd512fp_base	725
Simd512_impl< true, false, true, 4 >	699
Simd512_impl< true, false, true, 8 >	699
Simd512i_base	725
Simd256_impl< true, true, true, 4 >	672
Simd512_impl< true, true, true, 8 >	715
Simd512_impl< true, true, false, 8 >	706
SimdChooser< T, bool, bool >	727
SimdChooser< T, false, b >	727
SimdChooser< T, true, false >	727
SimdChooser< T, true, true >	727
simdToType< T >	728
Single	728
Sparse< Field, SparseMatrix_t, IdxT, PtrT >	728
Sparse< _Field, SparseMatrix_t::COO >	728
Sparse< _Field, SparseMatrix_t::COO_ZO >	730
Sparse< _Field, SparseMatrix_t::CSR >	731
Sparse< _Field, SparseMatrix_t::CSR_ZO >	735
Sparse< _Field, SparseMatrix_t::CSR_HYB >	733
Sparse< _Field, SparseMatrix_t::ELL >	737
Sparse< _Field, SparseMatrix_t::ELL_ZO >	742
Sparse< _Field, SparseMatrix_t::ELL_simd >	738
Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >	740
Sparse< _Field, SparseMatrix_t::HYB_ZO >	743
Sparse< _Field, SparseMatrix_t::SELL >	745
Sparse< _Field, SparseMatrix_t::SELL_ZO >	747
Sparse< FFPACK::RNSInteger, SparseMatrix_t::COO, int16_t >	728
Sparse< FFPACK::RNSInteger, SparseMatrix_t::COO, int32_t >	728
Sparse< FFPACK::RNSInteger, SparseMatrix_t::COO, int64_t >	728
Sparse< FFPACK::RNSInteger, SparseMatrix_t::COO_ZO, int16_t >	728
Sparse< FFPACK::RNSInteger, SparseMatrix_t::COO_ZO, int32_t >	728
Sparse< FFPACK::RNSInteger, SparseMatrix_t::COO_ZO, int64_t >	728
Sparse< FFPACK::RNSInteger, SparseMatrix_t::CSR, int16_t >	728
Sparse< FFPACK::RNSInteger, SparseMatrix_t::CSR, int32_t >	728
Sparse< FFPACK::RNSInteger, SparseMatrix_t::CSR, int64_t >	728
Sparse< FFPACK::RNSInteger, SparseMatrix_t::CSR_ZO, int16_t >	728
Sparse< FFPACK::RNSInteger, SparseMatrix_t::CSR_ZO, int32_t >	728
Sparse< FFPACK::RNSInteger, SparseMatrix_t::CSR_ZO, int64_t >	728
Sparse< FFPACK::RNSInteger, SparseMatrix_t::ELL, int16_t >	728
Sparse< FFPACK::RNSInteger, SparseMatrix_t::ELL, int32_t >	728
Sparse< FFPACK::RNSInteger, SparseMatrix_t::ELL, int64_t >	728
Sparse< FFPACK::RNSInteger, SparseMatrix_t::ELL_ZO, int16_t >	728
Sparse< FFPACK::RNSInteger, SparseMatrix_t::ELL_ZO, int32_t >	728
Sparse< FFPACK::RNSInteger, SparseMatrix_t::ELL_ZO, int64_t >	728
SpMat< Field, flag >	749
Static_error_check< bool >	750
Static_error_check< false >	750
StatsMatrix	750

tfn_minus	755
tfn_minus_eq	756
tfn_mul	756
tfn_mul_eq	757
tfn_plus	757
tfn_plus_eq	757
Threads	758
ThreeD	758
ThreeDAdaptive	758
ThreeDInPlace	758
TRSMHelper< ReclterTrait, ParSeqTrait >	758
true_type	
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO > >	480
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >	480
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR > >	480
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_HYB > >	480
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >	481
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL > >	481
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >	482
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd > >	481
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >	482
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::HYB_ZO > >	482
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL > >	483
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >	483
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >	484
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >	484
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >	485
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >	485
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >	485
support_fast_mod< double >	754
support_fast_mod< float >	754
support_fast_mod< int64_t >	754
TwoD	760
TwoDAdaptive	760
UnparametricTag	760
Winograd	760
WinogradPar	760

Chapter 12

Data Structure Index

12.1 Data Structures

Here are the data structures with brief descriptions:

AlgoChooser< ModeT, ParSeq >	405
AlgoChooser< ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq >	405
ArbitraryPrecIntTag	
Arbitrary precision integers: GMP	405
AreEqual< X, Y >	406
AreEqual< X, X >	406
Argument	406
associatedDelayedField< Field >	407
associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > >	407
associatedDelayedField< const Givaro::Modular< T, X > >	408
associatedDelayedField< const Givaro::ModularBalanced< T > >	408
associatedDelayedField< const Givaro::ZRing< T > >	409
Auto	409
Bini	409
Block	409
callLUdivine_small< Element >	410
callLUdivine_small< double >	410
callLUdivine_small< float >	411
CharpolyFailed	411
Checker_Empty< Field >	411
CheckerImplem_charpoly< Field, Polynomial >	412
CheckerImplem_Det< Field >	413
CheckerImplem_fgemm< Field >	414
CheckerImplem_ftdsm< Field >	415
CheckerImplem_invert< Field >	416
CheckerImplem_PLUQ< Field >	417
Classic	418
Column	418
CompactElement< Element >	418
CompactElement< double >	418
CompactElement< float >	419
CompactElement< int16_t >	419
CompactElement< int32_t >	419
CompactElement< int64_t >	420
compatible_data_type< Field >	420

compatible_data_type< Givaro::ZRing< double > >	420
compatible_data_type< Givaro::ZRing< float > >	420
Compose< H1, H2 >	421
Const_int_t< n >	422
Const_uint_t< n >	422
Simd128_impl< true, true, false, 2 >::Converter	422
Simd128_impl< true, true, false, 4 >::Converter	423
Simd128_impl< true, true, false, 8 >::Converter	423
Simd128_impl< true, true, true, 2 >::Converter	423
Simd128_impl< true, true, true, 4 >::Converter	424
Simd128_impl< true, true, true, 8 >::Converter	424
Simd256_impl< true, true, false, 2 >::Converter	425
Simd256_impl< true, true, false, 4 >::Converter	425
Simd256_impl< true, true, false, 8 >::Converter	425
Simd256_impl< true, true, true, 2 >::Converter	426
Simd256_impl< true, true, true, 4 >::Converter	426
Simd256_impl< true, true, true, 8 >::Converter	427
Simd512_impl< true, true, false, 8 >::Converter	427
Simd512_impl< true, true, true, 8 >::Converter	427
ConvertTo< T >	
Force conversion to appropriate element type of ElementCategory T	428
Coo< ValT, IdxT >	428
Coo< Field >	430
Coo< ValT, IdxT >	431
CooMat< Field >	433
CsrMat< Field >	434
DefaultBoundedTag	
Use standard field operations, but keeps track of bounds on input and output	434
DefaultTag	
No specific mode of action: use standard field operations	435
DelayedTag	
Performs field operations with delayed mod reductions. Ensures result is reduced	435
ElementTraits< Element >	
ElementTraits	435
ElementTraits< double >	435
ElementTraits< FFPACK::rns_double_elt >	436
ElementTraits< float >	436
ElementTraits< Givaro::Integer >	436
ElementTraits< int16_t >	437
ElementTraits< int32_t >	437
ElementTraits< int64_t >	437
ElementTraits< int8_t >	438
ElementTraits< Reclnt::rint< K > >	438
ElementTraits< Reclnt::rmint< K, MG > >	438
ElementTraits< Reclnt::ruint< K > >	439
ElementTraits< uint16_t >	439
ElementTraits< uint32_t >	439
ElementTraits< uint64_t >	440
ElementTraits< uint8_t >	440
EllMat< Field >	440
Failure	
A precondition failed	441
FailureCharpolyCheck	443
FailureDetCheck	443
FailureFgemmCheck	443
FailureInvertCheck	443
FailurePLUQCheck	444
FailureTrsmCheck	444

FieldSimd< _Field >	444
FieldTraits< Field >	
FieldTrait	450
FieldTraits< FFPACK::RNSInteger< T > >	451
FieldTraits< FFPACK::RNSIntegerMod< T > >	451
FieldTraits< Givaro::Modular< Element > >	452
FieldTraits< Givaro::ModularBalanced< Element > >	452
FieldTraits< Givaro::ZRing< double > >	453
FieldTraits< Givaro::ZRing< float > >	453
FieldTraits< Givaro::ZRing< Givaro::Integer > >	454
FieldTraits< Givaro::ZRing< int16_t > >	455
FieldTraits< Givaro::ZRing< int32_t > >	455
FieldTraits< Givaro::ZRing< int64_t > >	456
FieldTraits< Givaro::ZRing< Reclnt::ruint< K > > >	456
FieldTraits< Givaro::ZRing< uint16_t > >	457
FieldTraits< Givaro::ZRing< uint32_t > >	457
FieldTraits< Givaro::ZRing< uint64_t > >	458
Fixed	458
FixedPrecIntTag	
Fixed precision integers above machine precision: Givaro::reclnt	458
ForStrategy1D< blocksize_t, Cut, Param >	459
ForStrategy2D< blocksize_t, Cut, Param >	461
ftmmLeftLowerNoTransNonUnit< Element >	464
ftmmLeftLowerNoTransUnit< Element >	464
ftmmLeftLowerTransNonUnit< Element >	465
ftmmLeftLowerTransUnit< Element >	465
ftmmLeftUpperNoTransNonUnit< Element >	465
ftmmLeftUpperNoTransUnit< Element >	465
ftmmLeftUpperTransNonUnit< Element >	465
ftmmLeftUpperTransUnit< Element >	465
ftmmRightLowerNoTransNonUnit< Element >	465
ftmmRightLowerNoTransUnit< Element >	465
ftmmRightLowerTransNonUnit< Element >	466
ftmmRightLowerTransUnit< Element >	466
ftmmRightUpperNoTransNonUnit< Element >	466
ftmmRightUpperNoTransUnit< Element >	466
ftmmRightUpperTransNonUnit< Element >	466
ftmmRightUpperTransUnit< Element >	466
ftsmLeftLowerNoTransNonUnit< Element >	466
ftsmLeftLowerNoTransUnit< Element >	466
ftsmLeftLowerTransNonUnit< Element >	467
ftsmLeftLowerTransUnit< Element >	467
ftsmLeftUpperNoTransNonUnit< Element >	
Computes the maximal size for delaying the modular reduction in a triangular system resolution	467
ftsmLeftUpperNoTransUnit< Element >	467
ftsmLeftUpperTransNonUnit< Element >	467
ftsmLeftUpperTransUnit< Element >	467
ftsmRightLowerNoTransNonUnit< Element >	468
ftsmRightLowerNoTransUnit< Element >	468
ftsmRightLowerTransNonUnit< Element >	468
ftsmRightLowerTransUnit< Element >	468
ftsmRightUpperNoTransNonUnit< Element >	468
ftsmRightUpperNoTransUnit< Element >	468
ftsmRightUpperTransNonUnit< Element >	468
ftsmRightUpperTransUnit< Element >	468
GenericTag	
Default is generic	469

GenericTag	
Generic ring	469
Grain	469
has_minus_eq_impl< C >	469
has_minus_impl< C >	469
has_mul_eq_impl< C >	470
has_mul_impl< C >	470
has_operation< T >	470
has_plus_eq_impl< C >	471
has_plus_impl< C >	471
HelperFlag	471
HelperMod< Field, ElementTraits >	472
HelperMod< Field, ElementCategories::MachineIntTag >	472
HelperMod< Field, FFLAS::ElementCategories::ArbitraryPrecIntTag >	474
HelperMod< Field, FFLAS::ElementCategories::FixedPrecIntTag >	474
HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag >	475
Hybrid	476
Info	476
Info	477
is_simd< T >	479
isSparseMatrix< Field, M >	479
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO > >	480
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >	480
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR > >	480
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_HYB > >	480
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >	481
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL > >	481
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd > >	481
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >	482
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >	482
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::HYB_ZO > >	482
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL > >	483
isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >	483
isSparseMatrixMKLFormat< F, M >	483
isSparseMatrixSimdFormat< F, M >	483
isZOSparseMatrix< F, M >	484
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >	484
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >	484
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >	485
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >	485
isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >	485
Iterative	485
LazyTag	
Performs field operations with delayed mod only when necessary. Result may not be reduced	486
limits< T >	486
limits< char >	486
limits< double >	487
limits< float >	487
limits< Givaro::Integer >	488
limits< int >	489
limits< long >	489
limits< long long >	490
limits< Reclnt::rint< K > >	491
limits< Reclnt::ruint< K > >	492
limits< short int >	492
limits< signed char >	493
limits< unsigned char >	494
limits< unsigned int >	494

limits< unsigned long >	495
limits< unsigned long long >	496
limits< unsigned short int >	497
MachineFloatTag	
Float or double	497
MachineIntTag	
Short, int, long, long long, and unsigned variants	498
MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >	498
MMHelper< FFPACK::RNSInteger< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >	503
MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >	505
MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< Dest >, ParSeqTrait >	507
MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeqTrait >	509
MMHelper< Field, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >	
FGEMM Helper for Default and ConvertTo modes of operation	511
ModeTraits< Field >	
ModeTraits	513
ModeTraits< Givaro::Modular< Element, Compute > >	513
ModeTraits< Givaro::Modular< Givaro::Integer, Compute > >	513
ModeTraits< Givaro::Modular< int16_t, Compute > >	514
ModeTraits< Givaro::Modular< int32_t, Compute > >	514
ModeTraits< Givaro::Modular< int8_t, Compute > >	514
ModeTraits< Givaro::Modular< Reclnt::ruint< K >, Compute > >	515
ModeTraits< Givaro::Modular< uint16_t, Compute > >	515
ModeTraits< Givaro::Modular< uint32_t, Compute > >	516
ModeTraits< Givaro::Modular< uint8_t, Compute > >	516
ModeTraits< Givaro::ModularBalanced< Element > >	516
ModeTraits< Givaro::ModularBalanced< Givaro::Integer > >	517
ModeTraits< Givaro::ModularBalanced< int16_t > >	517
ModeTraits< Givaro::ModularBalanced< int32_t > >	517
ModeTraits< Givaro::ModularBalanced< int8_t > >	518
ModeTraits< Givaro::Montgomery< T > >	518
ModeTraits< Givaro::ZRing< double > >	518
ModeTraits< Givaro::ZRing< float > >	519
ModeTraits< Givaro::ZRing< Givaro::Integer > >	519
ModularBalanced< T >	519
ModularTag	
This is a modular field like e.g. Modular<T> or ModularBalanced<T>	520
Montgomery< T >	520
need_field_characteristic< Field >	520
need_field_characteristic< Givaro::Modular< Field > >	520
need_field_characteristic< Givaro::ModularBalanced< Field > >	520
NoSimd< T >	521
Parallel< C, P >	522
RNSInteger< RNS >::RandIter	523
RNSIntegerMod< RNS >::RandIter	524
readMyMachineType< Field, T >	525
readMyMachineType< Field, mpz_t >	526
Recursive	527
Recursive	527
rint< K >	527
rns_double	527
rns_double_elt	532
rns_double_elt_cstptr	534
rns_double_elt_ptr	537
rns_double_extended	540
RNSElementTag	
Representation in a Residue Number System	544

RNSInteger< RNS >	545
RNSIntegerMod< RNS >	548
rnsRandIter< RNS >	555
Row	556
ruInt< K >	556
ScalFunctions< Element, Enable >	556
ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >	557
ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >	560
Sequential	566
Simd128_impl< ArithType, Int, Signed, Size >	567
Simd128_impl< true, false, true, 4 >	567
Simd128_impl< true, false, true, 8 >	567
Simd128_impl< true, true, false, 2 >	568
Simd128_impl< true, true, false, 4 >	576
Simd128_impl< true, true, false, 8 >	585
Simd128_impl< true, true, true, 2 >	594
Simd128_impl< true, true, true, 4 >	603
Simd128_impl< true, true, true, 8 >	611
Simd128fp_base	620
Simd128i_base	621
Simd256_impl< ArithType, Int, Signed, Size >	622
Simd256_impl< true, false, true, 4 >	622
Simd256_impl< true, false, true, 8 >	623
Simd256_impl< true, true, false, 2 >	630
Simd256_impl< true, true, false, 4 >	638
Simd256_impl< true, true, false, 8 >	655
Simd256_impl< true, true, true, 2 >	664
Simd256_impl< true, true, true, 4 >	672
Simd256_impl< true, true, true, 8 >	689
Simd256fp_base	697
Simd256i_base	698
Simd512_impl< ArithType, Int, Signed, Size >	699
Simd512_impl< true, false, true, 4 >	699
Simd512_impl< true, false, true, 8 >	699
Simd512_impl< true, true, false, 8 >	706
Simd512_impl< true, true, true, 8 >	715
Simd512fp_base	725
Simd512i_base	725
SimdChooser< T, bool, bool >	727
SimdChooser< T, false, b >	727
SimdChooser< T, true, false >	727
SimdChooser< T, true, true >	727
simdToType< T >	728
Single	728
Sparse< Field, SparseMatrix_t, IdxT, PtrT >	728
Sparse< _Field, SparseMatrix_t::COO >	728
Sparse< _Field, SparseMatrix_t::COO_ZO >	730
Sparse< _Field, SparseMatrix_t::CSR >	731
Sparse< _Field, SparseMatrix_t::CSR_HYB >	733
Sparse< _Field, SparseMatrix_t::CSR_ZO >	735
Sparse< _Field, SparseMatrix_t::ELL >	737
Sparse< _Field, SparseMatrix_t::ELL_simd >	738
Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >	740
Sparse< _Field, SparseMatrix_t::ELL_ZO >	742
Sparse< _Field, SparseMatrix_t::HYB_ZO >	743
Sparse< _Field, SparseMatrix_t::SELL >	745
Sparse< _Field, SparseMatrix_t::SELL_ZO >	747
SpMat< Field, flag >	749

Static_error_check< bool >	750
Static_error_check< false >	750
StatsMatrix	750
support_fast_mod< T >	753
support_fast_mod< double >	754
support_fast_mod< float >	754
support_fast_mod< int64_t >	754
support_simd< T >	755
support_simd_add< T >	755
support_simd_mod< T >	755
tfn_minus	755
tfn_minus_eq	756
tfn_mul	756
tfn_mul_eq	757
tfn_plus	757
tfn_plus_eq	757
Threads	758
ThreeD	758
ThreeDAdaptive	758
ThreeDInPlace	758
TRSMHelper< ReclterTrait, ParSeqTrait > TRSM Helper	758
TwoD	760
TwoDAdaptive	760
UnparametricTag If the field uses a representation with infix operators	760
Winograd	760
WinogradPar	760

Chapter 13

File Index

13.1 File List

Here is a list of all files with brief descriptions:

arithprog.C	761
autotune/charpoly.C	762
examples/charpoly.C	763
fsyrk.C	763
fsytrf.C	764
ftrtri.C	765
autotune/pluq.C	766
examples/pluq.C	767
winograd.C	768
benchmark-charpoly-mp.C	769
benchmark-charpoly.C	770
benchmark-checkers.C	771
benchmark-dgemm.C	772
benchmark-dgetrf.C	773
benchmark-dgetri.C	773
benchmark-dsytrf.C	774
benchmark-dtrsm.C	775
benchmark-dtrtri.C	776
benchmark-fadd-lvl2.C	777
benchmark-fdot.C	777
benchmark-fgemm-mp.C	778
benchmark-fgemm-rns.C	779
benchmark-fgemm.C	781
benchmark-fgemv-mp.C	782
benchmark-fgemv.C	783
benchmark-fgesv.C	786
benchmark-fsyrk.C	787
benchmark-fsytrf.C	788
benchmark-ftrsm-mp.C	789
benchmark-ftrsm.C	789
benchmark-ftrsv.C	790
benchmark-ftrtri.C	791
benchmark-inverse.C	791
benchmark-lqup-mp.C	792
benchmark-lqup.C	793

benchmark-pluq.C	793
benchmark-wino.C	795
config.h	796
fflas-ffpack/config.h	800
mainpage.doxy	804
det.C	804
matmul.C	804
rank.C	805
solve.C	805
checker_charpoly.inl	805
checker_det.inl	806
checker_empty.h	806
checker_fgemm.inl	807
checker_ftrsm.inl	807
checker_invert.inl	807
checker_pluq.inl	808
checkers.doxy	808
checkers_fflas.h	808
checkers_fflas.inl	809
checkers_ffpack.h	809
checkers_ffpack.inl	810
config-blas.h	811
fflas-ffpack-config.h	
Defaults for optimised values	817
fflas-ffpack-default-thresholds.h	818
fflas-ffpack-thresholds.h	819
fflas-ffpack.doxy	819
fflas-ffpack.h	
Includes FFLAS and FFPACK	819
fflas.doxy	820
fflas.h	
Finite Field Linear Algebra Subroutines	820
fflas_bounds.inl	821
fflas_enum.h	822
fflas_fadd.h	823
fflas_fadd.inl	824
fflas_fassign.h	825
fflas_fassign.inl	825
fflas_faxpy.inl	826
fflas_fdot.inl	827
fflas_fgemm.inl	828
fgemm_classical.inl	830
fgemm_classical_mp.inl	
Matrix multiplication with multiprecision input (either over \mathbb{Z} or over $\mathbb{Z}/p\mathbb{Z}$)	830
fgemm_winograd.inl	832
matmul.doxy	833
schedule_bini.inl	
Bini implementation	834
schedule_winograd.inl	834
schedule_winograd_acc.inl	835
schedule_winograd_acc_ip.inl	836
schedule_winograd_ip.inl	836
fflas_fgenv.inl	837
fflas_fgenv_mp.inl	839
fflas_fger.inl	839
fflas_fger_mp.inl	841
fflas_freduce.h	841
fflas_freduce.inl	842

fflas_freduce_mp.inl	844
fflas_freivalds.inl	844
fflas_fscal.h	845
fflas_fscal.inl	845
fflas_fscal_mp.inl	847
fflas_fsyr2k.inl	847
fflas_fsyrk.inl	848
fflas_ftpmm.inl	849
fflas_ftrsm.inl	849
fflas_ftrsm_mp.inl	
Triangular system with matrix right hand side over multiprecision domain (either over \mathbb{Z} or over $\mathbb{Z}/p\mathbb{Z}$)	850
fflas_ftrsv.inl	851
fflas_helpers.inl	851
igemm.doxy	852
igemm.h	852
igemm.inl	853
igemm_kernels.h	854
igemm_kernels.inl	854
igemm_tools.h	855
igemm_tools.inl	855
fflas_level1.inl	856
fflas_level2.inl	858
fflas_level3.inl	861
fflas_pfgemm.inl	863
fflas_pftsm.inl	864
fflas_simd.h	865
simd.doxy	867
simd128.inl	867
simd128_double.inl	867
simd128_float.inl	868
simd128_int16.inl	868
simd128_int32.inl	868
simd128_int64.inl	869
simd256.inl	869
simd256_double.inl	870
simd256_float.inl	870
simd256_int16.inl	871
simd256_int32.inl	871
simd256_int64.inl	871
simd512.inl	872
simd512_double.inl	872
simd512_float.inl	873
simd512_int32.inl	873
simd512_int64.inl	874
simd_modular.inl	874
fflas_sparse.h	874
fflas_sparse.inl	879
coo.h	881
coo_spmv.inl	881
coo_spmv.inl	882
coo_utils.inl	883
csr.h	884
csr_pspmm.inl	884
csr_pspmv.inl	885
csr_spmv.inl	886
csr_spmv.inl	887
csr_utils.inl	888

csr_hyb.h	888
csr_hyb_pspmm.inl	889
csr_hyb_pspmv.inl	890
csr_hyb_spmmm.inl	890
csr_hyb_spmv.inl	891
csr_hyb_utils.inl	891
ell.h	892
ell_pspmm.inl	892
ell_pspmv.inl	893
ell_spmmm.inl	894
ell_spmv.inl	895
ell_utils.inl	896
ell_simd.h	896
ell_simd_pspmv.inl	897
ell_simd_spmv.inl	898
ell_simd_utils.inl	899
hyb_zo.h	899
hyb_zo_pspmm.inl	899
hyb_zo_pspmv.inl	900
hyb_zo_spmmm.inl	901
hyb_zo_spmv.inl	901
hyb_zo_utils.inl	902
read_sparse.h	902
sell.h	903
sell_pspmv.inl	904
sell_spmv.inl	904
sell_utils.inl	905
sparse_matrix_traits.h	906
utils.h	907
ffpack.dox	908
ffpack.h	908
Set of elimination based routines for dense linear algebra	908
ffpack.inl	916
ffpack_charpoly.inl	917
ffpack_charpoly_danilevski.inl	918
ffpack_charpoly_kgfast.inl	919
ffpack_charpoly_kgfastgeneralized.inl	919
ffpack_charpoly_kglu.inl	920
ffpack_charpoly_mp.inl	920
ffpack_det_mp.inl	921
ffpack_echelonforms.inl	922
ffpack_fgesv.inl	923
ffpack_fgetrs.inl	924
ffpack_frobenius.inl	924
ffpack_fsytrf.inl	925
ffpack_ftrssyr2k.inl	926
ffpack_ftrstr.inl	927
ffpack_fttr.inl	927
ffpack_invert.inl	928
ffpack_krylovelim.inl	928
ffpack_ludivine.inl	929
ffpack_ludivine_mp.inl	930
ffpack_minpoly.inl	930
ffpack_permutation.inl	931
ffpack_pluq.inl	933
ffpack_pluq_mp.inl	934
ffpack_ppluq.inl	935
ffpack_rankprofiles.inl	936

field-traits.h	
Field Traits	937
field.doxy	939
rns-double-elt.h	
Rns elt structure with double support	939
rns-double-recint.inl	940
rns-double.h	
Rns structure with double support	940
rns-double.inl	941
rns-integer-mod.h	
Representation of $\mathbb{Z}/p\mathbb{Z}$ using RNS representation (note: fixed precision)	941
rns-integer.h	
Representation of \mathbb{Z} using RNS representation (note: fixed precision)	942
rns.h	943
rns.inl	943
interfaces.doxy	943
fflas_c.h	943
fflas_L1_inst.C	956
fflas_L1_inst.h	958
fflas_L1_inst_implem.inl	959
fflas_L2_inst.C	960
fflas_L2_inst.h	961
fflas_L2_inst_implem.inl	963
fflas_L3_inst.C	964
fflas_L3_inst.h	965
fflas_L3_inst_implem.inl	967
fflas_lv1.C	
C functions calls for level 1 FFLAS in fflas-c.h	968
fflas_lv2.C	
C functions calls for level 2 FFLAS in fflas-c.h	972
fflas_lv3.C	
C functions calls for level 3 FFLAS in fflas-c.h	978
fflas_sparse.C	
C functions calls for level 1.5 and 2.5 FFLAS in fflas-c.h	980
ffpack.C	
C functions calls for FFPACK in ffpack-c.h	980
ffpack_c.h	1001
ffpack_inst.C	1023
ffpack_inst.h	1024
ffpack_inst_implem.inl	1025
blockcuts.inl	1029
fflas_plevel1.h	1030
kaapi_routines.inl	1031
parallel.h	1031
pfgemm_variants.inl	1038
pfgemv.inl	1039
align-allocator.h	1039
args-parser.h	1039
bit_manipulation.h	1041
cast.h	1042
debug.h	
Various utilities for debugging	1042
fflas_intrinsic.h	1043
fflas_io.h	1043
fflas_memory.h	1044
fflas_randommatrix.h	1045
flimits.h	1047
Matio.h	1048

test-utils.h	1048
timer.h	1049
cblas.C	1049
clapack.C	1050
cuda.C	1051
fblas.C	1051
gmp.C	1052
instrset.h	1052
instrset_detect.cpp	1055
lapack.C	1056
regression-check.C	1056
test-charpoly-check.C	1058
test-charpoly.C	1058
test-compressQ.C	1059
test-det-check.C	1060
test-det.C	1061
test-echelon.C	1062
test-fadd.C	1064
test-fdot.C	1066
test-fgemm-check.C	1067
test-fgemm.C	1068
test-fgemv.C	1071
test-fger.C	1072
test-fgesv.C	1074
test-finit.C	1076
test-fscal.C	1077
test-fsyr2k.C	1078
test-fsyrrk.C	1079
test-fsytrf.C	1081
test-ftrmm.C	1082
test-ftrmv.C	1084
test-ftrsm-check.C	1085
test-ftrsm.C	1086
test-ftrssyr2k.C	1087
test-ftrstr.C	1088
test-ftrsv.C	1089
test-ftrtri.C	1090
test-interfaces-c.c	1092
test-invert-check.C	1092
test-io.C	1093
test-lu.C	1094
test-maxdelayeddim.C	1098
test-minpoly.C	1099
test-multifile1.C	1100
test-multifile2.C	1100
test-nullspace.C	1100
test-permutations.C	1101
test-pluq-check.C	1103
test-rankprofiles.C	1103
test-rpm.C	1104
test-simd.C	1105
test-solve.C	1109
101-fgemm.C	1110
2x2-fgemm.C	1110
2x2-ftrsv.C	1111
2x2-pluq.C	1111
fflas-101_1.C	1111
fflas-101_3.C	1112

fflas_101.C	1112
fflas_101_lvl1.C	1113
ffpack-fgesv.C	1113
ffpack-solve.C	1113

Chapter 14

Module Documentation

14.1 CHECKER

Class CHECKER provides functions to verify computations in [FFLAS](#) and [FFPACK](#).

Class CHECKER provides functions to verify computations in [FFLAS](#) and [FFPACK](#).

14.2 FFLAS-FFPACK

the [FFLAS FFPACK](#) library

Modules

- [FFLAS](#)
The C-style wrapper of BLAS for finite field linear algebra.
- [Interfaces](#)
Interfaces for FFLAS-FFPACK.

14.2.1 Detailed Description

the [FFLAS FFPACK](#) library

C++ header library for fast exact dense linear algebra

See also

[FFLAS](#)
[FFPACK](#)

14.3 FFLAS

The C-style wrapper of BLAS for finite field linear algebra.

The C-style wrapper of BLAS for finite field linear algebra.

[FFLAS](#), Finite Field Linear Algebra Subroutines, provide basic linear algebra subroutines based on the BLAS interface. Therefore, the specifications are in C style; only the field given as a template parameter requires C++.

As much as possible, these routines use `ATLAS/BLAS` computations and achieve therefore high efficiency.

14.4 Matrix Multiplication Algorithms

Matrix Multiplication (level 3) algorithms.

Files

- file [schedule_bini.inl](#)
Bini implementation.

14.4.1 Detailed Description

Matrix Multiplication (level 3) algorithms.

Todo biblio

14.5 SIMD wrapper

wraps SIMD functions Supportst SSE4.1, AVX, AVX2.

wraps SIMD functions Supportst SSE4.1, AVX, AVX2.

Todo biblio

14.6 FFPACK

Class [FFPACK](#) provides functions using fflas much as Lapack uses BLAS.

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

14.6.1 Detailed Description

Class [FFPACK](#) provides functions using fflas much as Lapack uses BLAS.

14.7 FFLAS-FFPACK fields

fields in the FFLAS-FFPACK library

Files

- file [rns-double-elt.h](#)
rns elt structure with double support
- file [rns-double.h](#)
rns structure with double support
- file [rns-integer-mod.h](#)
representation of $\mathbb{Z}/p\mathbb{Z}$ using RNS representation (note: fixed precision)
- file [rns-integer.h](#)
representation of \mathbb{Z} using RNS representation (note: fixed precision)
- file [rns.h](#)

14.7.1 Detailed Description

fields in the FFLAS-FFPACK library

Unparametric/Random elements

[Todo](#) biblio

14.8 RNS

just include them all

just include them all

14.9 Interfaces

Intefaces for FFLAS-FFPACK.

Intefaces for FFLAS-FFPACK.

C interface in folder

See also

libs

Chapter 15

Namespace Documentation

15.1 FFLAS Namespace Reference

Namespaces

- namespace [BLAS3](#)
- namespace [csr_hyb_details](#)
- namespace [CuttingStrategy](#)
- namespace [details](#)
- namespace [details_spmv](#)
- namespace [ElementCategories](#)
- namespace [FieldCategories](#)

Traits and categories will need to be placed in a proper file later.

- namespace [MMHelperAlgo](#)
- namespace [ModeCategories](#)

Specifies the mode of action for an algorithm w.r.t.

- namespace [ParSeqHelper](#)

ParSeqHelper for both fgemm and ftrsm.

- namespace [Protected](#)
- namespace [sell_details](#)
- namespace [sparse_details](#)
- namespace [sparse_details_impl](#)
- namespace [StrategyParameter](#)
- namespace [StructureHelper](#)

StructureHelper for ftrsm.

- namespace [vectorised](#)

Data Structures

- struct [AlgoChooser](#)
- struct [AlgoChooser< ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq >](#)
- struct [associatedDelayedField](#)
- struct [associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > >](#)
- struct [associatedDelayedField< const Givaro::Modular< T, X > >](#)
- struct [associatedDelayedField< const Givaro::ModularBalanced< T > >](#)
- struct [associatedDelayedField< const Givaro::ZRing< T > >](#)

- struct [Checker_Empty](#)
- class [CheckerImplem_fgemm](#)
- class [CheckerImplem_ftsm](#)
- struct [CooMat](#)
- struct [CsrMat](#)
- struct [ElementTraits](#)
 - ElementTraits.*
- struct [ElementTraits< double >](#)
- struct [ElementTraits< FFPACK::rns_double_elt >](#)
- struct [ElementTraits< float >](#)
- struct [ElementTraits< Givaro::Integer >](#)
- struct [ElementTraits< int16_t >](#)
- struct [ElementTraits< int32_t >](#)
- struct [ElementTraits< int64_t >](#)
- struct [ElementTraits< int8_t >](#)
- struct [ElementTraits< Reclnt::rint< K > >](#)
- struct [ElementTraits< Reclnt::rmint< K, MG > >](#)
- struct [ElementTraits< Reclnt::ruint< K > >](#)
- struct [ElementTraits< uint16_t >](#)
- struct [ElementTraits< uint32_t >](#)
- struct [ElementTraits< uint64_t >](#)
- struct [ElementTraits< uint8_t >](#)
- struct [ElIMat](#)
- struct [FieldTraits](#)
 - FieldTrait.*
- struct [FieldTraits< FFPACK::RNSInteger< T > >](#)
- struct [FieldTraits< FFPACK::RNSIntegerMod< T > >](#)
- struct [FieldTraits< Givaro::Modular< Element > >](#)
- struct [FieldTraits< Givaro::ModularBalanced< Element > >](#)
- struct [FieldTraits< Givaro::ZRing< double > >](#)
- struct [FieldTraits< Givaro::ZRing< float > >](#)
- struct [FieldTraits< Givaro::ZRing< Givaro::Integer > >](#)
- struct [FieldTraits< Givaro::ZRing< int16_t > >](#)
- struct [FieldTraits< Givaro::ZRing< int32_t > >](#)
- struct [FieldTraits< Givaro::ZRing< int64_t > >](#)
- struct [FieldTraits< Givaro::ZRing< Reclnt::ruint< K > > >](#)
- struct [FieldTraits< Givaro::ZRing< uint16_t > >](#)
- struct [FieldTraits< Givaro::ZRing< uint32_t > >](#)
- struct [FieldTraits< Givaro::ZRing< uint64_t > >](#)
- struct [ForStrategy1D](#)
- struct [ForStrategy2D](#)
- struct [has_minus_eq_impl](#)
- struct [has_minus_impl](#)
- struct [has_mul_eq_impl](#)
- struct [has_mul_impl](#)
- struct [has_operation](#)
- struct [has_plus_eq_impl](#)
- struct [has_plus_impl](#)
- struct [HelperFlag](#)
- struct [isSparseMatrix](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO > >](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR > >](#)
- struct [isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_HYB > >](#)

- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::ELL > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::ELL_simd > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::HYB_ZO > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::SELL > >
- struct [isSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >
- struct [isSparseMatrixMKLFormat](#)
- struct [isSparseMatrixSimdFormat](#)
- struct [isZOSparseMatrix](#)
- struct [isZOSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >
- struct [isZOSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >
- struct [isZOSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >
- struct [isZOSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >
- struct [isZOSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >
- struct [MMHelper](#)
- struct [MMHelper](#)< FFPACK::RNSInteger< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >
- struct [MMHelper](#)< FFPACK::RNSIntegerMod< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >
- struct [MMHelper](#)< Field, AlgoTrait, ModeCategories::ConvertTo< Dest >, ParSeqTrait >
- struct [MMHelper](#)< Field, AlgoTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeqTrait >
- struct [MMHelper](#)< Field, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >

FGEMM Helper for Default and ConvertTo modes of operation.

- struct [ModeTraits](#)
 - ModeTraits.*
 - struct [ModeTraits](#)< Givaro::Modular< Element, Compute > >
 - struct [ModeTraits](#)< Givaro::Modular< Givaro::Integer, Compute > >
 - struct [ModeTraits](#)< Givaro::Modular< int16_t, Compute > >
 - struct [ModeTraits](#)< Givaro::Modular< int32_t, Compute > >
 - struct [ModeTraits](#)< Givaro::Modular< int8_t, Compute > >
 - struct [ModeTraits](#)< Givaro::Modular< Reclnt::ruint< K >, Compute > >
 - struct [ModeTraits](#)< Givaro::Modular< uint16_t, Compute > >
 - struct [ModeTraits](#)< Givaro::Modular< uint32_t, Compute > >
 - struct [ModeTraits](#)< Givaro::Modular< uint8_t, Compute > >
 - struct [ModeTraits](#)< Givaro::ModularBalanced< Element > >
 - struct [ModeTraits](#)< Givaro::ModularBalanced< Givaro::Integer > >
 - struct [ModeTraits](#)< Givaro::ModularBalanced< int16_t > >
 - struct [ModeTraits](#)< Givaro::ModularBalanced< int32_t > >
 - struct [ModeTraits](#)< Givaro::ModularBalanced< int8_t > >
 - struct [ModeTraits](#)< Givaro::Montgomery< T > >
 - struct [ModeTraits](#)< Givaro::ZRing< double > >
 - struct [ModeTraits](#)< Givaro::ZRing< float > >
 - struct [ModeTraits](#)< Givaro::ZRing< Givaro::Integer > >
 - struct [readMyMachineType](#)
 - struct [readMyMachineType](#)< Field, mpz_t >
 - struct [Sparse](#)
 - struct [Sparse](#)< _Field, SparseMatrix_t::COO >
 - struct [Sparse](#)< _Field, SparseMatrix_t::COO_ZO >
 - struct [Sparse](#)< _Field, SparseMatrix_t::CSR >
 - struct [Sparse](#)< _Field, SparseMatrix_t::CSR_HYB >
 - struct [Sparse](#)< _Field, SparseMatrix_t::CSR_ZO >
 - struct [Sparse](#)< _Field, SparseMatrix_t::ELL >
 - struct [Sparse](#)< _Field, SparseMatrix_t::ELL_simd >
 - struct [Sparse](#)< _Field, SparseMatrix_t::ELL_simd_ZO >

- struct [Sparse<_Field, SparseMatrix_t::ELL_ZO>](#)
- struct [Sparse<_Field, SparseMatrix_t::HYB_ZO>](#)
- struct [Sparse<_Field, SparseMatrix_t::SELL>](#)
- struct [Sparse<_Field, SparseMatrix_t::SELL_ZO>](#)
- struct [SpMat](#)
- struct [StatsMatrix](#)
- struct [support_fast_mod](#)
- struct [support_fast_mod<double>](#)
- struct [support_fast_mod<float>](#)
- struct [support_fast_mod<int64_t>](#)
- struct [support_simd](#)
- struct [support_simd_add](#)
- struct [support_simd_mod](#)
- struct [tfn_minus](#)
- struct [tfn_minus_eq](#)
- struct [tfn_mul](#)
- struct [tfn_mul_eq](#)
- struct [tfn_plus](#)
- struct [tfn_plus_eq](#)
- struct [TRSMHelper](#)

TRSM Helper.

Typedefs

- `template<class Field>`
using [Checker_fgemm](#) = [FFLAS::Checker_Empty<Field>](#)
- `template<class Field>`
using [Checker_ftrsm](#) = [FFLAS::Checker_Empty<Field>](#)
- `template<class Field>`
using [ForceCheck_fgemm](#) = [CheckerImplem_fgemm<Field>](#)
- `template<class Field>`
using [ForceCheck_ftrsm](#) = [CheckerImplem_ftrsm<Field>](#)
- using [ZOSparseMatrix](#) = `std::true_type`
- using [NotZOSparseMatrix](#) = `std::false_type`
- using [SimdSparseMatrix](#) = `std::true_type`
- using [NoSimdSparseMatrix](#) = `std::false_type`
- using [MKLSparseMatrixFormat](#) = `std::true_type`
- using [NotMKLSparseMatrixFormat](#) = `std::false_type`
- `template<class T>`
using [has_plus](#) = `typename std::conditional<std::is_arithmetic<T>::value, std::true_type, has_plus_impl<T>>::type`
- `template<class T>`
using [has_minus](#) = `typename std::conditional<std::is_arithmetic<T>::value, std::true_type, has_minus_impl<T>>::type`
- `template<class T>`
using [has_equal](#) = `typename std::conditional<std::is_arithmetic<T>::value, std::true_type, std::is_copyable_↵_assignable<T>>::type`
- `template<class T>`
using [has_plus_eq](#) = `typename std::conditional<std::is_arithmetic<T>::value, std::true_type, has_plus_eq_impl<T>>::type`
- `template<class T>`
using [has_minus_eq](#) = `typename std::conditional<std::is_arithmetic<T>::value, std::true_type, has_minus_eq_impl<T>>::type`

- `template<class T >`
using `has_mul` = `typename std::conditional< std::is_arithmetic< T >::value, std::true_type, has_mul_impl< T > >::type`
- `template<class T >`
using `has_mul_eq` = `typename std::conditional< std::is_arithmetic< T >::value, std::true_type, has_mul_eq_impl< T > >::type`
- `typedef Givaro::Timer` `Timer`
- `typedef Givaro::BaseTimer` `BaseTimer`
- `typedef Givaro::UserTimer` `UserTimer`
- `typedef Givaro::SysTimer` `SysTimer`

Enumerations

- enum `FFLAS_ORDER` { `FflasRowMajor` = 101 , `FflasColMajor` = 102 }
Storage by row or col ?
- enum `FFLAS_TRANSPOSE` { `FflasNoTrans` = 111 , `FflasTrans` = 112 }
Is matrix transposed ?
- enum `FFLAS_UPLO` { `FflasUpper` = 121 , `FflasLower` = 122 }
Is triangular matrix's shape upper ?
- enum `FFLAS_DIAG` { `FflasNonUnit` = 131 , `FflasUnit` = 132 }
Is the triangular matrix implicitly unit diagonal ?
- enum `FFLAS_SIDE` { `FflasLeft` = 141 , `FflasRight` = 142 }
On what side ?
- enum `FFLAS_BASE` { `FflasDouble` = 151 , `FflasFloat` = 152 , `FflasGeneric` = 153 }
FFLAS_BASE determines the type of the element representation for Matrix Mult kernel.
- enum `number_kind` { `zero` = 0 , `one` = 1 , `mone` = -1 , `other` = 2 }
- enum class `SparseMatrix_t` {
 `CSR` , `CSR_ZO` , `CSC` , `CSC_ZO` ,
 `COO` , `COO_ZO` , `ELL` , `ELL_ZO` ,
 `SELL` , `SELL_ZO` , `ELL_simd` , `ELL_simd_ZO` ,
 `CSR_HYB` , `HYB_ZO` }
- enum `FFLAS_FORMAT` {
 `FflasAuto` = 0 , `FflasDense` = 1 , `FflasSMS` = 2 , `FflasBinary` = 3 ,
 `FflasMath` = 4 , `FflasMaple` = 5 , `FflasSageMath` = 6 }

Functions

- `Givaro::Integer` `InfNorm` (const `size_t` M, const `size_t` N, const `Givaro::Integer` *A, const `size_t` lda)
- `template<class T >`
const `T` & `min3` (const `T` &m, const `T` &n, const `T` &k)
- `template<class T >`
const `T` & `max3` (const `T` &m, const `T` &n, const `T` &k)
- `template<class T >`
const `T` & `min4` (const `T` &m, const `T` &n, const `T` &k, const `T` &l)
- `template<class T >`
const `T` & `max4` (const `T` &m, const `T` &n, const `T` &k, const `T` &l)
- `template<class Field >`
void `fadd` (const `Field` &F, const `size_t` N, `typename Field::ConstElement_ptr` A, const `size_t` inca, `typename Field::ConstElement_ptr` B, const `size_t` incb, `typename Field::Element_ptr` C, const `size_t` incc)
- `template<class Field >`
void `faddin` (const `Field` &F, const `size_t` N, `typename Field::ConstElement_ptr` B, const `size_t` incb, `typename Field::Element_ptr` C, const `size_t` incc)

- `template<class Field >`
`void fsub (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void fsubin (const Field &F, const size_t N, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, const typename Field::Element alpha, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void pfadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, const size_t numths)`
- `template<class Field >`
`void pfsub (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, const size_t numths)`
- `template<class Field >`
`void pfaddin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`
- `template<class Field >`
`void pfsubin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`
- `template<class Field >`
`void fadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`
fadd : matrix addition.
- `template<class Field >`
`void fsub (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`
fsub : matrix subtraction.
- `template<class Field >`
`void faddin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`
faddin
- `template<class Field >`
`void fsubin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`
fsubin $C = C - B$
- `template<class Field >`
`void fadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element alpha, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`
fadd : matrix addition with scaling.
- `template<class Field >`
`void fassign (const Field &F, const size_t N, typename Field::ConstElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)`
fassign : $x \leftarrow y$.
- `template<> void fassign (const Givaro::Modular< float > &F, const size_t N, const float *Y, const size_t incY, float *X, const size_t incX)`
- `template<> void fassign (const Givaro::ModularBalanced< float > &F, const size_t N, const float *Y, const size_t incY, float *X, const size_t incX)`
- `template<> void fassign (const Givaro::ZRing< float > &F, const size_t N, const float *Y, const size_t incY, float *X, const size_t incX)`

- `template<> void fassign (const Givaro::Modular< double > &F, const size_t N, const double *Y, const size_t incY, double *X, const size_t incX)`
- `template<> void fassign (const Givaro::ModularBalanced< double > &F, const size_t N, const double *Y, const size_t incY, double *X, const size_t incX)`
- `template<> void fassign (const Givaro::ZRing< double > &F, const size_t N, const double *Y, const size_t incY, double *X, const size_t incX)`
- `template<class Field >`
`void fassign (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr A, const size_t lda)`

$$fassign : A \leftarrow B.$$
- `template<class Field >`
`void faxpy (const Field &F, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY)`

$$faxpy : y \leftarrow \alpha \cdot x + y.$$
- `template<> void faxpy (const Givaro::DoubleDomain &, const size_t N, const Givaro::DoubleDomain::Element a, Givaro::DoubleDomain::ConstElement_ptr x, const size_t incx, Givaro::DoubleDomain::Element_ptr y, const size_t incy)`
- `template<> void faxpy (const Givaro::FloatDomain &, const size_t N, const Givaro::FloatDomain::Element a, Givaro::FloatDomain::ConstElement_ptr x, const size_t incx, Givaro::FloatDomain::Element_ptr y, const size_t incy)`
- `template<class Field >`
`void faxpy (const Field &F, const size_t m, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t ldx, typename Field::Element_ptr Y, const size_t ldy)`

$$faxpy : y \leftarrow \alpha \cdot x + y.$$
- `template<class Field >`
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, ModeCategories::DefaultTag &MT)`
- `template<class Field >`
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, ModeCategories::DelayedTag &MT)`
- `template<> Givaro::DoubleDomain::Element fdot (const Givaro::DoubleDomain &, const size_t N, Givaro::DoubleDomain::ConstElement_ptr x, const size_t incx, Givaro::DoubleDomain::ConstElement_ptr y, const size_t incy, ModeCategories::DefaultTag &MT)`
- `template<> Givaro::FloatDomain::Element fdot (const Givaro::FloatDomain &, const size_t N, Givaro::FloatDomain::ConstElement_ptr x, const size_t incx, Givaro::FloatDomain::ConstElement_ptr y, const size_t incy, ModeCategories::DefaultTag &MT)`
- `template<class Field, class T >`
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, ModeCategories::ConvertTo< T > &MT)`
- `template<class Field >`
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, ModeCategories::DefaultBoundedTag &dbt)`
- `template<class Field >`
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, const ParSeqHelper::Sequential seq)`
- `template<class Field >`
`Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY)`

$$fdot: \text{dot product } x^T y.$$
- `template<class Field >`
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >, ParSeqHelper::Sequential > &H)`

- `template<typename Field >`
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const ParSeqHelper::Sequential seq)`
- `template<typename Field , class Cut , class Param >`
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const ParSeqHelper::Parallel< Cut, Param > par)`
- `template<typename Field >`
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`
fgemm: Field GENERAL Matrix Multiply.
- `template<typename Field , class ModeT , class ParSeq >`
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Auto, ModeT, ParSeq > &H)`
- `template<class Field >`
`Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, ModeCategories::DelayedTag, ParSeqHelper::Sequential > &H)`
- `template<class Field >`
`Field::Element_ptr fsquare (const Field &F, const FFLAS_TRANSPOSE ta, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`
fsquare: Squares a matrix.
- `template<> double * fsquare (const Givaro::ModularBalanced< double > &F, const FFLAS_TRANSPOSE ta, const size_t n, const double alpha, const double *A, const size_t lda, const double beta, double *C, const size_t ldc)`
- `template<> float * fsquare (const Givaro::ModularBalanced< float > &F, const FFLAS_TRANSPOSE ta, const size_t n, const float alpha, const float *A, const size_t lda, const float beta, float *C, const size_t ldc)`
- `template<> double * fsquare (const Givaro::Modular< double > &F, const FFLAS_TRANSPOSE ta, const size_t n, const double alpha, const double *A, const size_t lda, const double beta, double *C, const size_t ldc)`
- `template<> float * fsquare (const Givaro::Modular< float > &F, const FFLAS_TRANSPOSE ta, const size_t n, const float alpha, const float *A, const size_t lda, const float beta, float *C, const size_t ldc)`
- `template<typename RNS , typename ParSeqTrait >`
`FFPACK::RNSInteger< RNS >::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Compose< ParSeqHelper::Sequential, ParSeqTrait > > &H)`
- `template<typename RNS >`
`FFPACK::RNSInteger< RNS >::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k,`

- const typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element alpha, typename [FFPACK::RNSInteger](#)< [RNS](#) >::ConstElement_ptr Ad, const size_t lda, typename [FFPACK::RNSInteger](#)< [RNS](#) >::ConstElement_ptr Bd, const size_t ldb, const typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element beta, typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element_ptr Cd, const size_t ldc, [MMHelper](#)< [FFPACK::RNSInteger](#)< [RNS](#) >, [MMHelperAlgo::Classic](#), [ModeCategories::DefaultTag](#), [ParSeqHelper::Sequential](#) > &H)
- [template](#)<typename [RNS](#) , typename [ParSeqTrait](#) >
[FFPACK::RNSInteger](#)< [RNS](#) >::Element_ptr [fgemm](#) (const [FFPACK::RNSInteger](#)< [RNS](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const [FFLAS_TRANSPOSE](#) tb, const size_t m, const size_t n, const size_t k, const typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element alpha, typename [FFPACK::RNSInteger](#)< [RNS](#) >::ConstElement_ptr Ad, const size_t lda, typename [FFPACK::RNSInteger](#)< [RNS](#) >::ConstElement_ptr Bd, const size_t ldb, const typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element beta, typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element_ptr Cd, const size_t ldc, [MMHelper](#)< [FFPACK::RNSInteger](#)< [RNS](#) >, [MMHelperAlgo::Classic](#), [ModeCategories::DefaultTag](#), [ParSeqHelper::Compose](#)< [ParSeqHelper::Parallel](#)< [CuttingStrategy::RNSModulus](#), [StrategyParameter::Threads](#) >, [ParSeqTrait](#) > > &H)
 - [template](#)<typename [RNS](#) , typename [Cut](#) , typename [Param](#) >
[FFPACK::RNSInteger](#)< [RNS](#) >::Element_ptr [fgemm](#) (const [FFPACK::RNSInteger](#)< [RNS](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const [FFLAS_TRANSPOSE](#) tb, const size_t m, const size_t n, const size_t k, const typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element alpha, typename [FFPACK::RNSInteger](#)< [RNS](#) >::ConstElement_ptr Ad, const size_t lda, typename [FFPACK::RNSInteger](#)< [RNS](#) >::ConstElement_ptr Bd, const size_t ldb, const typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element beta, typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element_ptr Cd, const size_t ldc, [MMHelper](#)< [FFPACK::RNSInteger](#)< [RNS](#) >, [MMHelperAlgo::Classic](#), [ModeCategories::DefaultTag](#), [ParSeqHelper::Parallel](#)< [Cut](#), [Param](#) > > &H)
 - [template](#)<class [ParSeq](#) >
[Givaro::Integer](#) * [fgemm](#) (const [Givaro::ZRing](#)< [Givaro::Integer](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const [FFLAS_TRANSPOSE](#) tb, const size_t m, const size_t n, const size_t k, const [Givaro::Integer](#) alpha, const [Givaro::Integer](#) *A, const size_t lda, const [Givaro::Integer](#) *B, const size_t ldb, [Givaro::Integer](#) beta, [Givaro::Integer](#) *C, const size_t ldc, [MMHelper](#)< [Givaro::ZRing](#)< [Givaro::Integer](#) >, [MMHelperAlgo::Classic](#), [ModeCategories::ConvertTo](#)< [ElementCategories::RNSElementTag](#) >, [ParSeq](#) > &H)
 - [template](#)<typename [RNS](#) , class [ModeT](#) >
[RNS::Element_ptr](#) [fgemm](#) (const [FFPACK::RNSInteger](#)< [RNS](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const [FFLAS_TRANSPOSE](#) tb, const size_t m, const size_t n, const size_t k, const typename [RNS::Element](#) alpha, typename [RNS::ConstElement_ptr](#) Ad, const size_t lda, typename [RNS::ConstElement_ptr](#) Bd, const size_t ldb, const typename [RNS::Element](#) beta, typename [RNS::Element_ptr](#) Cd, const size_t ldc, [MMHelper](#)< [FFPACK::RNSInteger](#)< [RNS](#) >, [MMHelperAlgo::Winograd](#), [ModeT](#), [ParSeqHelper::Sequential](#) > &H)
 - [template](#)<typename [RNS](#) >
[RNS::Element_ptr](#) [fgemm](#) (const [FFPACK::RNSIntegerMod](#)< [RNS](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const [FFLAS_TRANSPOSE](#) tb, const size_t m, const size_t n, const size_t k, const typename [RNS::Element](#) alpha, typename [RNS::ConstElement_ptr](#) Ad, const size_t lda, typename [RNS::ConstElement_ptr](#) Bd, const size_t ldb, const typename [RNS::Element](#) beta, typename [RNS::Element_ptr](#) Cd, const size_t ldc, [MMHelper](#)< [FFPACK::RNSIntegerMod](#)< [RNS](#) >, [MMHelperAlgo::Winograd](#) > &H)
 - [Givaro::Integer](#) * [fgemm](#) (const [Givaro::Modular](#)< [Givaro::Integer](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const [FFLAS_TRANSPOSE](#) tb, const size_t m, const size_t n, const size_t k, const [Givaro::Integer](#) alpha, const [Givaro::Integer](#) *A, const size_t lda, const [Givaro::Integer](#) *B, const size_t ldb, const [Givaro::Integer](#) beta, [Givaro::Integer](#) *C, const size_t ldc, [MMHelper](#)< [Givaro::Modular](#)< [Givaro::Integer](#) >, [MMHelperAlgo::Classic](#), [ModeCategories::ConvertTo](#)< [ElementCategories::RNSElementTag](#) > > &H)
 - [template](#)<class [ParSeq](#) >
[Givaro::Integer](#) * [fgemm](#) (const [Givaro::Modular](#)< [Givaro::Integer](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const [FFLAS_TRANSPOSE](#) tb, const size_t m, const size_t n, const size_t k, const [Givaro::Integer](#) alpha, const [Givaro::Integer](#) *A, const size_t lda, const [Givaro::Integer](#) *B, const size_t ldb, const [Givaro::Integer](#) beta, [Givaro::Integer](#) *C, const size_t ldc, [MMHelper](#)< [Givaro::Modular](#)< [Givaro::Integer](#) >, [MMHelperAlgo::Auto](#), [ModeCategories::ConvertTo](#)< [ElementCategories::RNSElementTag](#) >, [ParSeq](#) > &H)
 - [template](#)<size_t K1, size_t K2, class [ParSeq](#) >
[Reclnt::ruint](#)< K1 > * [fgemm](#) (const [Givaro::Modular](#)< [Reclnt::ruint](#)< K1 >, [Reclnt::ruint](#)< K2 > > &F, const [FFLAS_TRANSPOSE](#) ta, const [FFLAS_TRANSPOSE](#) tb, const size_t m, const size_t n, const size_t k, const [Reclnt::ruint](#)< K1 > alpha, const [Reclnt::ruint](#)< K1 > *A, const size_t lda, const [Reclnt::ruint](#)< K1 > *B, const size_t ldb, [Reclnt::ruint](#)< K1 > beta, [Reclnt::ruint](#)< K1 > *C, const size_t

- ldc, MMHelper< Givaro::Modular< RecInt::ruint< K1 >, RecInt::ruint< K2 > >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > &H)
- template<class Field, class ModeT >
Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, ModeT > &H)
 - template<class Field, class ModeT, class Cut, class Param >
Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::WinogradPar, ModeT, ParSeqHelper::Parallel< Cut, Param > > &H)
 - template<class Field >
Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > > &H)
 - template<class Field >
Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DelayedTag > &H)
 - template<class Field >
Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)
 - template<class Field >
Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::LazyTag > &H)
 - template<class Field >
Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE TransA, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY)
- finite prime Field GEneral Matrix Vector multiplication.*
- Givaro::ZRing< int64_t >::Element_ptr fgemv (const Givaro::ZRing< int64_t > &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const int64_t alpha, const int64_t *A, const size_t lda, const int64_t *X, const size_t incX, const int64_t beta, const int64_t *Y, const size_t incY, MMHelper< Givaro::ZRing< int64_t >, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)
 - Givaro::DoubleDomain::Element_ptr fgemv (const Givaro::DoubleDomain &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const Givaro::DoubleDomain::Element alpha, const Givaro::DoubleDomain::ConstElement_ptr A, const size_t lda, const Givaro::DoubleDomain::ConstElement_ptr X, const size_t incX, const Givaro::DoubleDomain::Element beta, const Givaro::DoubleDomain::Element_ptr Y, const size_t incY, MMHelper< Givaro::DoubleDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)
 - template<class Field >
Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element

- beta, typename [Field::Element_ptr](#) Y, const size_t incY, [MMHelper](#)< [Field](#), [MMHelperAlgo::Classic](#), [ModeCategories::DefaultBoundedTag](#) > &H)
- [Givaro::FloatDomain::Element_ptr fgemv](#) (const [Givaro::FloatDomain](#) &F, const [FFLAS_TRANSPOSE](#) ta, const size_t M, const size_t N, const [Givaro::FloatDomain::Element](#) alpha, const [Givaro::FloatDomain::ConstElement_ptr](#) A, const size_t lda, const [Givaro::FloatDomain::ConstElement_ptr](#) X, const size_t incX, const [Givaro::FloatDomain::Element](#) beta, [Givaro::FloatDomain::Element_ptr](#) Y, const size_t incY, [MMHelper](#)< [Givaro::FloatDomain](#), [MMHelperAlgo::Classic](#), [ModeCategories::DefaultTag](#) > &H)
- template<class [Field](#) , class [Cut](#) , class [Param](#) >
[Field::Element_ptr fgemv](#) (const [Field](#) &F, const [FFLAS_TRANSPOSE](#) ta, const size_t m, const size_t n, const typename [Field::Element](#) alpha, const typename [Field::ConstElement_ptr](#) A, const size_t lda, const typename [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t incY, [ParSeqHelper::Parallel](#)< [Cut](#), [Param](#) > &parH)
- template<class [Field](#) >
[Field::Element_ptr fgemv](#) (const [Field](#) &F, const [FFLAS_TRANSPOSE](#) ta, const size_t m, const size_t n, const typename [Field::Element](#) alpha, const typename [Field::ConstElement_ptr](#) A, const size_t lda, const typename [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t incY, [ParSeqHelper::Sequential](#) &seqH)
- [FFPACK::rns_double::Element_ptr fgemv](#) (const [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const size_t M, const size_t N, const [FFPACK::rns_double::Element](#) alpha, [FFPACK::rns_double::ConstElement_ptr](#) A, const size_t lda, [FFPACK::rns_double::ConstElement_ptr](#) X, const size_t incX, const [FFPACK::rns_double::Element](#) beta, [FFPACK::rns_double::Element_ptr](#) Y, const size_t incY, [MMHelper](#)< [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) >, [MMHelperAlgo::Classic](#), [ModeCategories::DefaultTag](#) > &H)
- [FFPACK::rns_double::Element_ptr fgemv](#) (const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const size_t M, const size_t N, const [FFPACK::rns_double::Element](#) alpha, [FFPACK::rns_double::ConstElement_ptr](#) A, const size_t lda, [FFPACK::rns_double::ConstElement_ptr](#) X, const size_t incX, const [FFPACK::rns_double::Element](#) beta, [FFPACK::rns_double::Element_ptr](#) Y, const size_t incY, [MMHelper](#)< [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) >, [MMHelperAlgo::Classic](#), [ModeCategories::DefaultTag](#) > &H)
- [Givaro::Integer * fgemv](#) (const [Givaro::ZRing](#)< [Givaro::Integer](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const size_t m, const size_t n, const [Givaro::Integer](#) alpha, [Givaro::Integer *A](#), const size_t lda, [Givaro::Integer *X](#), const size_t ldx, [Givaro::Integer](#) beta, [Givaro::Integer *Y](#), const size_t ldy, [MMHelper](#)< [Givaro::ZRing](#)< [Givaro::Integer](#) >, [MMHelperAlgo::Classic](#), [ModeCategories::ConvertTo<ElementCategories::RNSElementTag>](#) > > &H)
- [Givaro::Integer * fgemv](#) (const [Givaro::Modular](#)< [Givaro::Integer](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const size_t m, const size_t n, const [Givaro::Integer](#) alpha, [Givaro::Integer *A](#), const size_t lda, [Givaro::Integer *X](#), const size_t ldx, [Givaro::Integer](#) beta, [Givaro::Integer *Y](#), const size_t ldy, [MMHelper](#)< [Givaro::Modular](#)< [Givaro::Integer](#) >, [MMHelperAlgo::Classic](#), [ModeCategories::ConvertTo<ElementCategories::RNSElementTag>](#) > > &H)
- template<size_t K1, size_t K2, class [ParSeq](#) >
[RecInt::ruint](#)< K1 > * [fgemv](#) (const [Givaro::Modular](#)< [RecInt::ruint](#)< K1 >, [RecInt::ruint](#)< K2 > > &F, const [FFLAS_TRANSPOSE](#) ta, const size_t m, const size_t n, const [RecInt::ruint](#)< K1 > alpha, const [RecInt::ruint](#)< K1 > *A, const size_t lda, const [RecInt::ruint](#)< K1 > *X, const size_t incx, [RecInt::ruint](#)< K1 > beta, [RecInt::ruint](#)< K1 > *Y, const size_t incy, [MMHelper](#)< [Givaro::Modular](#)< [RecInt::ruint](#)< K1 >, [RecInt::ruint](#)< K2 > >, [MMHelperAlgo::Classic](#), [ModeCategories::ConvertTo<ElementCategories::RNSElementTag>](#) >, [ParSeq](#) > &H)
- template<class [Field](#) >
void [fger](#) (const [Field](#) &F, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, typename [Field::Element_ptr](#) A, const size_t lda)
fger: rank one update of a general matrix
- template<class [Field](#) >
void [fger](#) (const [Field](#) &F, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, typename [Field::Element_ptr](#) A, const size_t lda, [MMHelper](#)< [Field](#), [MMHelperAlgo::Classic](#), [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag>](#) > > &H)
- template<class [Field](#) , class [AnyTag](#) >
void [fger](#) (const [Field](#) &F, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename

- `Field::ConstElement_ptr x`, `const size_t incx`, `typename Field::ConstElement_ptr y`, `const size_t incy`, `typename Field::Element_ptr A`, `const size_t lda`, `MMHelper< Field, MMHelperAlgo::Classic, AnyTag > &H`)
- `void fger` (`const Givaro::DoubleDomain &F`, `const size_t M`, `const size_t N`, `const Givaro::DoubleDomain::Element alpha`, `const Givaro::DoubleDomain::ConstElement_ptr x`, `const size_t incx`, `const Givaro::DoubleDomain::ConstElement_ptr y`, `const size_t incy`, `Givaro::DoubleDomain::Element_ptr A`, `const size_t lda`, `MMHelper< Givaro::DoubleDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H`)
 - `template<class Field >`
`void fger` (`const Field &F`, `const size_t M`, `const size_t N`, `const typename Field::Element alpha`, `const typename Field::ConstElement_ptr x`, `const size_t incx`, `const typename Field::ConstElement_ptr y`, `const size_t incy`, `typename Field::Element_ptr A`, `const size_t lda`, `MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultBoundedTag > &H`)
 - `void fger` (`const Givaro::FloatDomain &F`, `const size_t M`, `const size_t N`, `const Givaro::FloatDomain::Element alpha`, `const Givaro::FloatDomain::ConstElement_ptr x`, `const size_t incx`, `const Givaro::FloatDomain::ConstElement_ptr y`, `const size_t incy`, `Givaro::FloatDomain::Element_ptr A`, `const size_t lda`, `MMHelper< Givaro::FloatDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H`)
 - `template<class Field >`
`void fger` (`const Field &F`, `const size_t M`, `const size_t N`, `const typename Field::Element alpha`, `typename Field::ConstElement_ptr x`, `const size_t incx`, `typename Field::ConstElement_ptr y`, `const size_t incy`, `typename Field::Element_ptr A`, `const size_t lda`, `MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::LazyTag > &H`)
 - `template<class Field >`
`void fger` (`const Field &F`, `const size_t M`, `const size_t N`, `const typename Field::Element alpha`, `typename Field::ConstElement_ptr x`, `const size_t incx`, `typename Field::ConstElement_ptr y`, `const size_t incy`, `typename Field::Element_ptr A`, `const size_t lda`, `MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DelayedTag > &H`)
 - `void fger` (`const Givaro::Modular< Givaro::Integer > &F`, `const size_t M`, `const size_t N`, `const typename Givaro::Integer alpha`, `typename Givaro::Integer *x`, `const size_t incx`, `typename Givaro::Integer *y`, `const size_t incy`, `typename Givaro::Integer *A`, `const size_t lda`, `MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag > > &H`)
 - `template<typename RNS >`
`void fger` (`const FFPACK::RNSInteger< RNS > &F`, `const size_t M`, `const size_t N`, `const typename FFPACK::RNSInteger< RNS >::Element alpha`, `typename FFPACK::RNSInteger< RNS >::Element_ptr x`, `const size_t incx`, `typename FFPACK::RNSInteger< RNS >::Element_ptr y`, `const size_t incy`, `typename FFPACK::RNSInteger< RNS >::Element_ptr A`, `const size_t lda`, `MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H`)
 - `template<typename RNS >`
`void fger` (`const FFPACK::RNSIntegerMod< RNS > &F`, `const size_t M`, `const size_t N`, `const typename FFPACK::RNSIntegerMod< RNS >::Element alpha`, `typename FFPACK::RNSIntegerMod< RNS >::Element_ptr x`, `const size_t incx`, `typename FFPACK::RNSIntegerMod< RNS >::Element_ptr y`, `const size_t incy`, `typename FFPACK::RNSIntegerMod< RNS >::Element_ptr A`, `const size_t lda`, `MMHelper< FFPACK::RNSIntegerMod< RNS >, MMHelperAlgo::Classic > &H`)
 - `template<class Field >`
`void freduce` (`const Field &F`, `const size_t n`, `typename Field::ConstElement_ptr Y`, `const size_t incY`, `typename Field::Element_ptr X`, `const size_t incX`)

$$\text{freduce } x \leftarrow y \bmod F.$$
 - `template<class Field >`
`void freduce` (`const Field &F`, `const size_t n`, `typename Field::Element_ptr X`, `const size_t incX`)

$$\text{freduce } x \leftarrow x \bmod F.$$
 - `template<class Field >`
`void freduce_constoverride` (`const Field &F`, `const size_t m`, `typename Field::ConstElement_ptr A`, `const size_t incX`)
 - `template<class Field, class ConstOtherElement_ptr >`
`void finit` (`const Field &F`, `const size_t n`, `ConstOtherElement_ptr Y`, `const size_t incY`, `typename Field::Element_ptr X`, `const size_t incX`)
 - `template<class Field >`
`void finit` (`const Field &F`, `const size_t n`, `typename Field::Element_ptr X`, `const size_t incX`)

$$\text{finit Initializes } X \text{ in } F^{\$}.$$

- template<class [Field](#) >
void [freduce](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda)
 $freduce\ A \leftarrow A mod F.$
- template<class [Field](#) >
void [pfreduce](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda, const size_t numths)
- template<class [Field](#) >
void [freduce](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::ConstElement_ptr](#) B, const size_t ldb, typename [Field::Element_ptr](#) A, const size_t lda)
 $freduce\ A \leftarrow B mod F.$
- template<class [Field](#) >
void [freduce_constoverride](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::ConstElement_ptr](#) A, const size_t lda)
- template<class [Field](#), class OtherElement_ptr >
void [finit](#) (const [Field](#) &F, const size_t m, const size_t n, const OtherElement_ptr B, const size_t ldb, typename [Field::Element_ptr](#) A, const size_t lda)
 $finit\ A \leftarrow B mod F.$
- template<class [Field](#) >
void [finit](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda)
- template<> void [freduce](#) (const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) > &F, const size_t n, [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) >::Element_ptr A, size_t inc)
- template<> void [freduce](#) (const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) > &F, const size_t m, const size_t n, [FFPACK::rns_double::Element_ptr](#) A, size_t lda)
- template<class [Field](#) >
bool [freivalds](#) (const [Field](#) &F, const [FFLAS_TRANSPOSE](#) ta, const [FFLAS_TRANSPOSE](#) tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, typename [Field::ConstElement_ptr](#) C, const size_t ldc)
*freivalds: Freivalds **GE**neral **M**atrix **M**ultiply **R**andom **C**heck.*
- template<class [Field](#) >
void [fscal](#) (const [Field](#) &F, const size_t n, const typename [Field::Element](#) alpha, typename [Field::Element_ptr](#) X, const size_t incX)
 $fscal\ x \leftarrow \alpha \cdot x.$
- template<class [Field](#) >
void [fscal](#) (const [Field](#) &F, const size_t n, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) X, const size_t incX, typename [Field::Element_ptr](#) Y, const size_t incY)
 $fscal\ y \leftarrow \alpha \cdot x.$
- template<> void [fscal](#) (const Givaro::DoubleDomain &, const size_t N, const Givaro::DoubleDomain::Element a, [Givaro::DoubleDomain::ConstElement_ptr](#) x, const size_t incx, [Givaro::DoubleDomain::Element_ptr](#) y, const size_t incy)
- template<> void [fscal](#) (const Givaro::FloatDomain &, const size_t N, const Givaro::FloatDomain::Element a, [Givaro::FloatDomain::ConstElement_ptr](#) x, const size_t incx, [Givaro::FloatDomain::Element_ptr](#) y, const size_t incy)
- template<> void [fscal](#) (const Givaro::DoubleDomain &, const size_t N, const Givaro::DoubleDomain::Element a, [Givaro::DoubleDomain::Element_ptr](#) y, const size_t incy)
- template<> void [fscal](#) (const Givaro::FloatDomain &, const size_t N, const Givaro::FloatDomain::Element a, [Givaro::FloatDomain::Element_ptr](#) y, const size_t incy)
- template<class [Field](#) >
void [fscal](#) (const [Field](#) &F, const size_t m, const size_t n, const typename [Field::Element](#) alpha, typename [Field::Element_ptr](#) A, const size_t lda)
 $fscal\ A \leftarrow a \cdot A.$
- template<class [Field](#) >
void [fscal](#) (const [Field](#) &F, const size_t m, const size_t n, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb)
 $fscal\ B \leftarrow a \cdot A.$

- `template<> void fscaln (const FFPACK::RNSInteger< FFPACK::rns_double > &F, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::Element_ptr A, const size_t inc)`
- `template<> void fscal (const FFPACK::RNSInteger< FFPACK::rns_double > &F, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t Ainc, FFPACK::rns_double::Element_ptr B, const size_t Binc)`
- `template<> void fscaln (const FFPACK::RNSInteger< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::Element_ptr A, const size_t lda)`
- `template<> void fscal (const FFPACK::RNSInteger< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t lda, FFPACK::rns_double::Element_ptr B, const size_t ldb)`
- `template<> void fscaln (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t n, const typename FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element alpha, typename FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element_ptr A, const size_t inc)`
- `template<> void fscal (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t Ainc, FFPACK::rns_double::Element_ptr B, const size_t Binc)`
- `template<> void fscaln (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::Element_ptr A, const size_t lda)`
- `template<> void fscal (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t m, const size_t n, const FFPACK::rns_double::Element alpha, FFPACK::rns_double::ConstElement_ptr A, const size_t lda, FFPACK::rns_double::Element_ptr B, const size_t ldb)`
- `template<class Field >`
`Field::Element_ptr fsyr2k (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`
fsyr2k: Symmetric Rank 2K update
- `template<class Field >`
`Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`
fsyrk: Symmetric Rank K update
- `template<class Field >`
`Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::ConstElement_ptr D, const size_t incD, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const size_t threshold=__FFLASFFPACK_FSYRK_THRESHOLD)`
fsyrk: Symmetric Rank K update with diagonal scaling
- `template<class Field , class Cut , class Param >`
`Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t N, const size_t K, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::ConstElement_ptr D, const size_t incD, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const ParSeqHelper::Parallel< Cut, Param > par, const size_t threshold)`
- `template<class Field >`
`Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::ConstElement_ptr D, const size_t incD, const std::vector< bool > &twoBlock, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const size_t threshold=__FFLASFFPACK_FSYRK_THRESHOLD)`
fsyrk: Symmetric Rank K update with diagonal scaling

- `template<class Field >`
`void ftrmm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)`
ftrmm: TRIangular Matrix Multiply.
- `template<class Field >`
`void ftrmm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`
ftrmm: TRIangular Matrix Multiply with 3 operands Computes $C \leftarrow \alpha \text{op}(A)B + \text{beta}C$ or $C \leftarrow \alpha \text{Bop}(A) + \text{beta}C$.
- `template<class Field >`
`void ftrsm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)`
- `template<class Field >`
`void ftrsm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const ParSeqHelper::Sequential &PSH)`
- `template<class Field, class Cut, class Param >`
`void ftrsm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const ParSeqHelper::Parallel< Cut, Param > &PSH)`
- `template<class Field, class ParSeqTrait = ParSeqHelper::Sequential>`
`void ftrsm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, TRSMHelper< StructureHelper::Recursive, ParSeqTrait > &H)`
- `void ftrsm (const Givaro::Modular< Givaro::Integer > &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const Givaro::Integer alpha, const Givaro::Integer *A, const size_t lda, Givaro::Integer *B, const size_t ldb)`
- `void cblas_imptrsm (const enum FFLAS_ORDER Order, const enum FFLAS_SIDE Side, const enum FFLAS_UPLO Uplo, const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_DIAG Diag, const int M, const int N, const FFPACK::rns_double_elt alpha, FFPACK::rns_double_elt_cstptr A, const int lda, FFPACK::rns_double_elt_ptr B, const int ldb)`
- `template<class Field >`
`void ftrsv (const Field &F, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr X, int incX)`
ftrsv: TRIangular System solve with Vector Computes $X \leftarrow \text{op}(A^{-1})X$
- `void igemm_ (const enum FFLAS_ORDER Order, const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_TRANSPOSE TransB, const size_t M, const size_t N, const size_t K, const int64_t alpha, const int64_t *A, const size_t lda, const int64_t *B, const size_t ldb, const int64_t beta, int64_t *C, const size_t ldc)`
- `template<class Field, class OtherElement_ptr >`
`void finit (const Field &F, const size_t n, const OtherElement_ptr Y, const size_t incY, typename Field::Element_ptr X, const size_t incX)`
finit $x \leftarrow y \bmod F$.
- `template<class Field, class OtherElement_ptr >`
`void fconvert (const Field &F, const size_t n, OtherElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY)`
fconvert $x \leftarrow y \bmod F$.
- `template<class Field >`
`void fnegin (const Field &F, const size_t n, typename Field::Element_ptr X, const size_t incX)`
fnegin $x \leftarrow -x$.

- template<class [Field](#) >
void [fneg](#) (const [Field](#) &F, const size_t n, typename [Field::ConstElement_ptr](#) Y, const size_t incY, typename [Field::Element_ptr](#) X, const size_t incX)

$$fneg\ x \leftarrow -y.$$
- template<class [Field](#) >
void [fzero](#) (const [Field](#) &F, const size_t n, typename [Field::Element_ptr](#) X, const size_t incX)

$$fzero : A \leftarrow 0.$$
- template<class [Field](#) , class RandIter >
void [frand](#) (const [Field](#) &F, RandIter &G, const size_t n, typename [Field::Element_ptr](#) X, const size_t incX)

$$frand : A \leftarrow random.$$
- template<class [Field](#) >
bool [fiszero](#) (const [Field](#) &F, const size_t n, typename [Field::ConstElement_ptr](#) X, const size_t incX)

$$fiszero : test\ X = 0.$$
- template<class [Field](#) >
bool [fequal](#) (const [Field](#) &F, const size_t n, typename [Field::ConstElement_ptr](#) X, const size_t incX, typename [Field::ConstElement_ptr](#) Y, const size_t incY)

$$fequal : test\ X = Y.$$
- template<class [Field](#) >
void [faxpby](#) (const [Field](#) &F, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t incY)

$$faxpby : y \leftarrow \alpha \cdot x + \beta \cdot y.$$
- template<typename [Field](#) , class Cut , class Param >
[Field::Element](#) [fdot](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) X, const size_t incX, typename [Field::ConstElement_ptr](#) Y, const size_t incY, const [ParSeqHelper::Parallel](#)< Cut, Param > par)
- template<class [Field](#) >
void [fswap](#) (const [Field](#) &F, const size_t N, typename [Field::Element_ptr](#) X, const size_t incX, typename [Field::Element_ptr](#) Y, const size_t incY)

$$fswap : X \leftrightarrow Y.$$
- template<class [Field](#) >
void [fzero](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda)

$$fzero : A \leftarrow 0.$$
- template<class [Field](#) , class RandIter >
void [frand](#) (const [Field](#) &F, RandIter &G, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda)

$$frand : A \leftarrow random.$$
- template<class [Field](#) >
bool [fequal](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb)

$$fequal : test\ A = B.$$
- template<class [Field](#) >
bool [fiszero](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::ConstElement_ptr](#) A, const size_t lda)

$$fiszero : test\ A = 0.$$
- template<class [Field](#) >
void [fidentity](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda, const typename [Field::Element](#) &d)

$$creates\ a\ diagonal\ matrix$$
- template<class [Field](#) >
void [fidentity](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda)

$$creates\ a\ diagonal\ matrix$$
- template<class [Field](#) , class OtherElement_ptr >
void [finit](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda)

$$finit\ Initializes\ A\ in\ F^{\$}.$$

- template<class [Field](#) , class OtherElement_ptr >
void [fconvert](#) (const [Field](#) &F, const size_t m, const size_t n, OtherElement_ptr A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb)
 $fconvert\ A \leftarrow B \bmod F.$
- template<class [Field](#) >
void [fnegin](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda)
 $fnegin\ A \leftarrow -A.$
- template<class [Field](#) >
void [fneg](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::ConstElement_ptr](#) B, const size_t ldb, typename [Field::Element_ptr](#) A, const size_t lda)
 $fneg\ A \leftarrow -B.$
- template<class [Field](#) >
void [faxpby](#) (const [Field](#) &F, const size_t m, const size_t n, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) X, const size_t ldx, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t ldy)
 $faxpby : y \leftarrow \alpha \cdot x + \beta \cdot y.$
- template<class [Field](#) >
void [fmove](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb)
 $fmove : A \leftarrow B\ and\ B \leftarrow 0.$
- template<class [Field](#) >
size_t [bitsize](#) (const [Field](#) &F, size_t M, size_t N, const typename [Field::ConstElement_ptr](#) A, size_t lda)
bitsize: Computes the largest bitsize of the matrix' coefficients.
- template<> size_t [bitsize](#)< [Givaro::ZRing](#)< [Givaro::Integer](#) > > (const [Givaro::ZRing](#)< [Givaro::Integer](#) > &F, size_t M, size_t N, const [Givaro::Integer](#) *A, size_t lda)
- template<class [Field](#) >
void [ftmrv](#) (const [Field](#) &F, const [FFLAS_UPLO](#) Uplo, const [FFLAS_TRANSPOSE](#) TransA, const [FFLAS_DIAG](#) Diag, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) X, int incX)
ftsm: TRIangular Matrix Vector prodcut Computes $X \leftarrow op(A)X$
- template<class [Field](#) >
void [ftrsm](#) (const [Field](#) &F, const [FFLAS_SIDE](#) Side, const [FFLAS_UPLO](#) Uplo, const [FFLAS_TRANSPOSE](#) TransA, const [FFLAS_DIAG](#) Diag, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb)
ftrsm: TRIangular System solve with Matrix.
- template<typename [Field](#) >
[Field::Element_ptr](#) [pfgemm](#) (const [Field](#) &F, const [FFLAS_TRANSPOSE](#) ta, const [FFLAS_TRANSPOSE](#) tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, size_t numthreads=0)
- template<class [Field](#) >
[Field::Element](#) * [pfgemm_1D_rec](#) (const [Field](#) &F, const [FFLAS_TRANSPOSE](#) ta, const [FFLAS_TRANSPOSE](#) tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, const typename [Field::Element_ptr](#) A, const size_t lda, const typename [Field::Element_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element](#) *C, const size_t ldc, size_t seuil)
- template<class [Field](#) >
[Field::Element](#) * [pfgemm_2D_rec](#) (const [Field](#) &F, const [FFLAS_TRANSPOSE](#) ta, const [FFLAS_TRANSPOSE](#) tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, const typename [Field::Element_ptr](#) A, const size_t lda, const typename [Field::Element_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element](#) *C, const size_t ldc, size_t seuil)
- template<class [Field](#) >
[Field::Element](#) * [pfgemm_3D_rec](#) (const [Field](#) &F, const [FFLAS_TRANSPOSE](#) ta, const [FFLAS_TRANSPOSE](#) tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, const typename [Field::Element_ptr](#) A, const size_t lda, const typename [Field::Element_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, size_t seuil, size_t *x)

- `template<class Field >`
`Field::Element_ptr pfgemm_3D_rec2` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const `typename Field::Element` alpha, const `typename Field::Element_ptr` A, const `size_t` lda, const `typename Field::Element_ptr` B, const `size_t` ldb, const `typename Field::Element` beta, `typename Field::Element_ptr` C, const `size_t` ldc, `size_t` seuil, `size_t` *x)
- `template<class Field , class ModeTrait , class Strat , class Param >`
`std::enable_if<!std::is_same< ModeTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag > >::value, typename Field::Element_ptr >::type` `fgemm` (const `Field` &F, const `FFLAS::FFLAS_TRANSPOSE` ta, const `FFLAS::FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const `typename Field::Element` alpha, `typename Field::ConstElement_ptr` A, const `size_t` lda, `typename Field::ConstElement_ptr` B, const `size_t` ldb, const `typename Field::Element` beta, `typename Field::Element_ptr` C, const `size_t` ldc, `MMHelper< Field, MMHelperAlgo::Winograd, ModeTrait, ParSeqHelper::Parallel< Strat, Param > >` &H)
- `template<class Field , class Cut , class Param >`
`Field::Element_ptr ftrsm` (const `Field` &F, const `FFLAS::FFLAS_SIDE` Side, const `FFLAS::FFLAS_UPLO` UpLo, const `FFLAS::FFLAS_TRANSPOSE` TA, const `FFLAS::FFLAS_DIAG` Diag, const `size_t` m, const `size_t` n, const `typename Field::Element` alpha, `typename Field::Element_ptr` A, const `size_t` lda, `typename Field::Element_ptr` B, const `size_t` ldb, `TRSMHelper< StructureHelper::Iterative, ParSeqHelper::Parallel< Cut, Param > >` &H)
- `template<class Field , class Cut , class Param >`
`Field::Element_ptr ftrsm` (const `Field` &F, const `FFLAS::FFLAS_SIDE` Side, const `FFLAS::FFLAS_UPLO` UpLo, const `FFLAS::FFLAS_TRANSPOSE` TA, const `FFLAS::FFLAS_DIAG` Diag, const `size_t` m, const `size_t` n, const `typename Field::Element` alpha, `typename Field::Element_ptr` A, const `size_t` lda, `typename Field::Element_ptr` B, const `size_t` ldb, `TRSMHelper< StructureHelper::Hybrid, ParSeqHelper::Parallel< Cut, Param > >` &H)
- `template<class Field , class SM >`
`void fspmv` (const `Field` &F, const `SM` &A, `typename Field::ConstElement_ptr` x, const `typename Field::Element` &beta, `typename Field::Element_ptr` y)
- `template<class Field , class SM >`
`void fspmm` (const `Field` &F, const `SM` &A, `size_t` blockSize, `typename Field::ConstElement_ptr` x, `int` ldx, const `typename Field::Element` &beta, `typename Field::Element_ptr` y, `int` ldy)
- `template<class Field , class IndexT >`
`void sparse_init` (const `Field` &F, `Sparse< Field, SparseMatrix_t::COO >` &A, const `IndexT` *row, const `IndexT` *col, `typename Field::ConstElement_ptr` dat, `uint64_t` rowdim, `uint64_t` coldim, `uint64_t` nnz)
- `template<class Field , class IndexT >`
`void sparse_init` (const `Field` &F, `Sparse< Field, SparseMatrix_t::COO_ZO >` &A, const `IndexT` *row, const `IndexT` *col, `typename Field::ConstElement_ptr` dat, `uint64_t` rowdim, `uint64_t` coldim, `uint64_t` nnz)
- `template<class Field >`
`void sparse_delete` (const `Sparse< Field, SparseMatrix_t::COO >` &A)
- `template<class Field >`
`void sparse_delete` (const `Sparse< Field, SparseMatrix_t::COO_ZO >` &A)
- `template<class Field , class IndexT >`
`void sparse_init` (const `Field` &F, `Sparse< Field, SparseMatrix_t::CSR >` &A, const `IndexT` *row, const `IndexT` *col, `typename Field::ConstElement_ptr` dat, `uint64_t` rowdim, `uint64_t` coldim, `uint64_t` nnz)
- `template<class Field , class IndexT >`
`void sparse_init` (const `Field` &F, `Sparse< Field, SparseMatrix_t::CSR_ZO >` &A, const `IndexT` *row, const `IndexT` *col, `typename Field::ConstElement_ptr` dat, `uint64_t` rowdim, `uint64_t` coldim, `uint64_t` nnz)
- `template<class Field >`
`void sparse_delete` (const `Sparse< Field, SparseMatrix_t::CSR >` &A)
- `template<class Field >`
`void sparse_delete` (const `Sparse< Field, SparseMatrix_t::CSR_ZO >` &A)
- `template<class Field >`
`std::ostream & sparse_print` (std::ostream &os, const `Sparse< Field, SparseMatrix_t::CSR >` &A)
- `template<class IndexT >`
`void sparse_init` (const `Givaro::Modular< Givaro::Integer >` &F, `Sparse< Givaro::Modular< Givaro::Integer >, SparseMatrix_t::CSR >` &A, const `IndexT` *row, const `IndexT` *col, `Givaro::Integer` *dat, `uint64_t` rowdim, `uint64_t` coldim, `uint64_t` nnz)

- `template<class IndexT >`
`void sparse_init (const Givaro::ZRing< Givaro::Integer > &F, Sparse< Givaro::ZRing< Givaro::Integer >, SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col, Givaro::Integer *dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class IndexT, size_t RECINT_SIZE>`
`void sparse_init (const Givaro::ZRing< RecInt::rmint< RECINT_SIZE > > &F, Sparse< Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >, SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col, typename Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >::Element_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class IndexT, size_t RECINT_SIZE>`
`void sparse_init (const Givaro::ZRing< RecInt::rmint< RECINT_SIZE > > &F, Sparse< Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >, SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT *col, typename Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >::Element_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::CSR_HYB > &A)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::CSR_HYB > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL_ZO > &A)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL_simd > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL_simd > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > &A)`
- `template<class Field >`
`void sparse_print (const Sparse< Field, SparseMatrix_t::ELL_simd > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::HYB_ZO > &A)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::HYB_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<typename _Field >`
`std::ostream & operator<< (std::ostream &os, const Sparse< _Field, SparseMatrix_t::HYB_ZO > &A)`
- `template<class Field, bool sorted = true, bool read_integer = false>`
`void readSmsFormat (const std::string &path, const Field &f, index_t *&row, index_t *&col, typename Field::Element_ptr &val, index_t &rowdim, index_t &coldim, uint64_t &nnz)`
- `template<class Field >`
`void readSprFormat (const std::string &path, const Field &f, index_t *&row, index_t *&col, typename Field::Element_ptr &val, index_t &rowdim, index_t &coldim, uint64_t &nnz)`
- `template<class T >`
`std::enable_if< std::is_integral< T >::value, int > getDataTypes ()`

- `template<class T >`
`std::enable_if< std::is_floating_point< T >::value, int > getDataType ()`
- `template<class T >`
`std::enable_if< std::is_same< T, mpz_t >::value, int > getDataType ()`
- `template<class T >`
`int getDataType ()`
- `template<class Field >`
`void readMachineType (const Field &F, typename Field::Element &modulo, typename Field::Element_ptr val, std::ifstream &file, const uint64_t dims, const mask_t data_type, const mask_t field_desc)`
- `template<class Field >`
`void readDnsFormat (const std::string &path, const Field &F, index_t &rowdim, index_t &coldim, typename Field::Element_ptr &val)`
- `template<class Field >`
`void writeDnsFormat (const std::string &path, const Field &F, const index_t &rowdim, const index_t &coldim, typename Field::Element_ptr A, index_t lIdA)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::SELL > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::SELL_ZO > &A)`
- `template<class Field >`
`void sparse_print (const Sparse< Field, SparseMatrix_t::SELL > &A)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::SELL > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz, uint64_t sigma=0)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::SELL_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class It >`
`double computeDeviation (It begin, It end)`
- `template<class Field >`
`StatsMatrix getStat (const Field &F, const index_t *row, const index_t *col, typename Field::ConstElement_ptr val, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<> void fflas_delete (FFPACK::rns_double_elt_ptr A)`
- `template<> void fflas_delete (FFPACK::rns_double_elt_cstptr A)`
- `template<> FFPACK::rns_double_elt_ptr fflas_new (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t m, const Alignment align)`
- `template<> FFPACK::rns_double_elt_ptr fflas_new (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t m, const size_t n, const Alignment align)`
- `template<typename RNS >`
`void finit_rns (const FFPACK::RNSIntegerMod< RNS > &F, const size_t m, const size_t n, size_t k, const Givaro::Integer *B, const size_t ldb, typename RNS::Element_ptr A)`
- `template<typename RNS >`
`void finit_trans_rns (const FFPACK::RNSIntegerMod< RNS > &F, const size_t m, const size_t n, size_t k, const Givaro::Integer *B, const size_t ldb, typename RNS::Element_ptr A)`
- `template<typename RNS >`
`void fconvert_rns (const FFPACK::RNSIntegerMod< RNS > &F, const size_t m, const size_t n, Givaro::Integer alpha, Givaro::Integer *B, const size_t ldb, typename RNS::ConstElement_ptr A)`
- `template<typename RNS >`
`void fconvert_trans_rns (const FFPACK::RNSIntegerMod< RNS > &F, const size_t m, const size_t n, Givaro::Integer alpha, Givaro::Integer *B, const size_t ldb, typename RNS::ConstElement_ptr A)`
- `template<> FFPACK::rns_double_elt_ptr fflas_new (const FFPACK::RNSInteger< FFPACK::rns_double > &F, const size_t m, const Alignment align)`

- `template<> FFPACK::rns_double_elt_ptr fflas_new (const FFPACK::RNSInteger< FFPACK::rns_double > &F, const size_t m, const size_t n, const Alignment align)`
- `template<typename RNS > void finit_rns (const FFPACK::RNSInteger< RNS > &F, const size_t m, const size_t n, size_t k, const Givaro::Integer *B, const size_t ldb, typename FFPACK::RNSInteger< RNS >::Element_ptr A)`
- `template<typename RNS > void fconvert_rns (const FFPACK::RNSInteger< RNS > &F, const size_t m, const size_t n, Givaro::Integer alpha, Givaro::Integer *B, const size_t ldb, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr A)`
- `template INST_OR_DECL void freduce (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, FFLAS_ELT *X, const size_t incX)`

$$\text{freduce } x \leftarrow x \bmod F.$$
- `template INST_OR_DECL void freduce (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT *Y, const size_t incY, FFLAS_ELT *X, const size_t incX)`

$$\text{freduce } x \leftarrow y \bmod F.$$
- `template INST_OR_DECL void finit (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT *Y, const size_t incY, FFLAS_ELT *X, const size_t incX)`

$$\text{finit } x \leftarrow y \bmod F.$$
- `template INST_OR_DECL void fconvert (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, FFLAS_ELT *X, const size_t incX, const FFLAS_ELT *Y, const size_t incY)`

$$\text{fconvert } x \leftarrow y \bmod F.$$
- `template INST_OR_DECL void fnegin (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, FFLAS_ELT *X, const size_t incX)`

$$\text{fnegin } x \leftarrow -x.$$
- `template INST_OR_DECL void fneg (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT *Y, const size_t incY, FFLAS_ELT *X, const size_t incX)`

$$\text{fneg } x \leftarrow -y.$$
- `template INST_OR_DECL void fzero (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, FFLAS_ELT *X, const size_t incX)`

$$\text{fzero} : A \leftarrow 0.$$
- `template INST_OR_DECL bool fiszero (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT *X, const size_t incX)`

$$\text{fiszero} : \text{test } X = 0.$$
- `template INST_OR_DECL bool fequal (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT *X, const size_t incX, const FFLAS_ELT *Y, const size_t incY)`

$$\text{fequal} : \text{test } X = Y.$$
- `template INST_OR_DECL void fassign (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t N, const FFLAS_ELT *Y, const size_t incY, FFLAS_ELT *X, const size_t incX)`

$$\text{fassign} : x \leftarrow y.$$
- `template INST_OR_DECL void fscaln (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT alpha, FFLAS_ELT *X, const size_t incX)`

$$\text{fscaln } x \leftarrow \alpha \cdot x.$$
- `template INST_OR_DECL void fscal (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t n, const FFLAS_ELT alpha, const FFLAS_ELT *X, const size_t incX, FFLAS_ELT *Y, const size_t incY)`

$$\text{fscal } y \leftarrow \alpha \cdot x.$$
- `template INST_OR_DECL void faxpy (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t N, const FFLAS_ELT alpha, const FFLAS_ELT *X, const size_t incX, FFLAS_ELT *Y, const size_t incY)`

$$\text{faxpy} : y \leftarrow \alpha \cdot x + y.$$
- `template INST_OR_DECL FFLAS_ELT fdot (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t N, const FFLAS_ELT *X, const size_t incX, const FFLAS_ELT *Y, const size_t incY)`

$$\text{faxpby} : y \leftarrow \alpha \cdot x + \beta \cdot y.$$
- `template INST_OR_DECL void fswap (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t N, FFLAS_ELT *X, const size_t incX, FFLAS_ELT *Y, const size_t incY)`

$$\text{fswap} : X \leftrightarrow Y.$$

- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t N, const `FFLAS_ELT` *A, const size_t inca, const `FFLAS_ELT` *B, const size_t incb, `FFLAS_ELT` *C, const size_t incc)
- template `INST_OR_DECL` void `fsub` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t N, const `FFLAS_ELT` *A, const size_t inca, const `FFLAS_ELT` *B, const size_t incb, `FFLAS_ELT` *C, const size_t incc)
- template `INST_OR_DECL` void `faddin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t N, const `FFLAS_ELT` *B, const size_t incb, `FFLAS_ELT` *C, const size_t incc)
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t N, const `FFLAS_ELT` *A, const size_t inca, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *B, const size_t incb, `FFLAS_ELT` *C, const size_t incc)
- template `INST_OR_DECL` void `fassign` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *A, const size_t lda)
 $fassign : A \leftarrow B.$
- template `INST_OR_DECL` void `fzero` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, `FFLAS_ELT` *A, const size_t lda)
 $fzero : A \leftarrow 0.$
- template `INST_OR_DECL` bool `fequal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *B, const size_t ldb)
 $fequal : test A = B.$
- template `INST_OR_DECL` bool `fiszero` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` *A, const size_t lda)
 $fiszero : test A = 0.$
- template `INST_OR_DECL` void `fidentity` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` &d)
creates a diagonal matrix
- template `INST_OR_DECL` void `fidentity` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, `FFLAS_ELT` *A, const size_t lda)
creates a diagonal matrix
- template `INST_OR_DECL` void `freduce` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, `FFLAS_ELT` *A, const size_t lda)
 $freduce A \leftarrow A \bmod F.$
- template `INST_OR_DECL` void `freduce` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *A, const size_t lda)
 $freduce A \leftarrow B \bmod F.$
- template `INST_OR_DECL` void `finit` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *A, const size_t lda)
 $finit A \leftarrow B \bmod F.$
- template `INST_OR_DECL` void `fnegin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, `FFLAS_ELT` *A, const size_t lda)
 $fnegin A \leftarrow -A.$
- template `INST_OR_DECL` void `fneg` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *A, const size_t lda)
 $fneg A \leftarrow -B.$
- template `INST_OR_DECL` void `fscaln` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` alpha, `FFLAS_ELT` *A, const size_t lda)
 $fscaln A \leftarrow a \cdot A.$
- template `INST_OR_DECL` void `fscal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const size_t lda, `FFLAS_ELT` *B, const size_t ldb)
 $fscal B \leftarrow a \cdot A.$
- template `INST_OR_DECL` void `faxpy` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t m, const size_t n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *X, const size_t idx, `FFLAS_ELT` *Y, const size_t ldy)
 $faxpy : y \leftarrow \alpha \cdot x + y.$

- template `INST_OR_DECL` void `fmove` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t m, const size_t n, `FFLAS_ELT` *A, const size_t lda, `FFLAS_ELT` *B, const size_t ldb)

$$faxpby : y \leftarrow \alpha \cdot x + \beta \cdot y.$$
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t M, const size_t N, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)

$$fadd : \text{matrix addition.}$$
- template `INST_OR_DECL` void `fsub` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t M, const size_t N, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)

$$fsub : \text{matrix subtraction.}$$
- template `INST_OR_DECL` void `fsubin` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t M, const size_t N, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)

$$fsubin : C = C - B$$
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t M, const size_t N, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)

$$fadd : \text{matrix addition with scaling.}$$
- template `INST_OR_DECL` void `faddin` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t M, const size_t N, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)

$$faddin$$
- template `INST_OR_DECL` `FFLAS_ELT` * `fgemv` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS_TRANSPOSE` TransA, const size_t M, const size_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *X, const size_t incX, const `FFLAS_ELT` beta, `FFLAS_ELT` *Y, const size_t incY)

$$\text{finite prime } FFLAS_FIELD<FFLAS_ELT> \text{ G}eneral \text{ M}atrix \text{ V}ector \text{ m}ultiplication.$$
- template `INST_OR_DECL` void `fger` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const size_t M, const size_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *x, const size_t incx, const `FFLAS_ELT` *y, const size_t incy, `FFLAS_ELT` *A, const size_t lda)

$$fger : \text{rank one update of a general matrix}$$
- template `INST_OR_DECL` void `ftsv` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS_UPLO` Uplo, const `FFLAS_TRANSPOSE` TransA, const `FFLAS_DIAG` Diag, const size_t N, const `FFLAS_ELT` *A, const size_t lda, `FFLAS_ELT` *X, int incX)

$$ftsv : \text{TRIangular System solve with Vector Computes } X \leftarrow \text{op}(A^{-1})X$$
- template `INST_OR_DECL` void `ftsm` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS_SIDE` Side, const `FFLAS_UPLO` Uplo, const `FFLAS_TRANSPOSE` TransA, const `FFLAS_DIAG` Diag, const size_t M, const size_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const size_t lda, `FFLAS_ELT` *B, const size_t ldb)

$$ftsm : \text{TRIangular System solve with Matrix.}$$
- template `INST_OR_DECL` void `ftmm` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS_SIDE` Side, const `FFLAS_UPLO` Uplo, const `FFLAS_TRANSPOSE` TransA, const `FFLAS_DIAG` Diag, const size_t M, const size_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const size_t lda, `FFLAS_ELT` *B, const size_t ldb)

$$ftmm : \text{TRIangular Matrix Multiply.}$$
- template `INST_OR_DECL` `FFLAS_ELT` * `fgemm` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const size_t m, const size_t n, const size_t k, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *B, const size_t ldb, const `FFLAS_ELT` beta, `FFLAS_ELT` *C, const size_t ldc)

$$fgemm : \text{Field G}eneral \text{ M}atrix \text{ M}ultiply.$$
- template `INST_OR_DECL` `FFLAS_ELT` * `fgemm` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const size_t m, const size_t n, const size_t k, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *B, const size_t ldb, const `FFLAS_ELT` beta, `FFLAS_ELT` *C, const size_t ldc, const `ParSeqHelper::Sequential` seq)

- template INST_OR_DECL FFLAS_ELT * fgemm (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const FFLAS_ELT alpha, const FFLAS_ELT *A, const size_t lda, const FFLAS_ELT *B, const size_t ldb, const FFLAS_ELT beta, FFLAS_ELT *C, const size_t ldc, const ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoDAdaptive > par)
 - template INST_OR_DECL FFLAS_ELT * fgemm (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const FFLAS_ELT alpha, const FFLAS_ELT *A, const size_t lda, const FFLAS_ELT *B, const size_t ldb, const FFLAS_ELT beta, FFLAS_ELT *C, const size_t ldc, const ParSeqHelper::Parallel< CuttingStrategy::Block, StrategyParameter::Threads > par)
 - template INST_OR_DECL FFLAS_ELT * fsquare (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS_TRANSPOSE ta, const size_t n, const FFLAS_ELT alpha, const FFLAS_ELT *A, const size_t lda, const FFLAS_ELT beta, FFLAS_ELT *C, const size_t ldc)
- fsquare: Squares a matrix.*
- template<class Cut = CuttingStrategy::Block, class Strat = StrategyParameter::Threads>
void BlockCuts (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)
 - template<> void BlockCuts< CuttingStrategy::Single, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)
 - template<> void BlockCuts< CuttingStrategy::Row, StrategyParameter::Fixed > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)
 - template<> void BlockCuts< CuttingStrategy::Row, StrategyParameter::Grain > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t grainsize)
 - template<> void BlockCuts< CuttingStrategy::Block, StrategyParameter::Grain > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t grainsize)
 - template<> void BlockCuts< CuttingStrategy::Column, StrategyParameter::Fixed > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)
 - template<> void BlockCuts< CuttingStrategy::Column, StrategyParameter::Grain > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t grainsize)
 - template<> void BlockCuts< CuttingStrategy::Block, StrategyParameter::Fixed > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)
 - template<> void BlockCuts< CuttingStrategy::Row, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)
 - template<> void BlockCuts< CuttingStrategy::Column, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)
 - template<> void BlockCuts< CuttingStrategy::Block, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)
 - template<class Cut = CuttingStrategy::Block, class Param = StrategyParameter::Threads>
void BlockCuts (size_t &rowBlockSize, size_t &colBlockSize, size_t &lastRBS, size_t &lastCBS, size_t &changeRBS, size_t &changeCBS, size_t &numRowBlock, size_t &numColBlock, size_t m, size_t n, const size_t numthreads)
 - template<class Field >
void pfzero (const Field &F, size_t m, size_t n, typename Field::Element_ptr C, size_t BS=0)
 - template<class Field, class RandIter >
void pfrand (const Field &F, RandIter &G, size_t m, size_t n, typename Field::Element_ptr C, size_t BS=0)
 - template<class Field, class Cut, class Param >
Field::Element & fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element &d, const ParSeqHelper::Parallel< Cut, Param > par)
 - template<class Field, class AlgoT, class FieldTrait >
Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Block, StrategyParameter::Threads > > &H)

- `template<class Field, class AlgoT, class FieldTrait >`
`Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb,`
`const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename`
`Field::ConstElement_ptr AA, const size_t lda, const typename Field::ConstElement_ptr BB, const size_t`
`ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, MMHelper< Field,`
`AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::ThreeDAdaptive`
`> > &H)`
- `template<class Field, class AlgoT, class FieldTrait >`
`Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb,`
`const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename`
`Field::ConstElement_ptr AA, const size_t lda, const typename Field::ConstElement_ptr BB, const size_t`
`ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, MMHelper< Field,`
`AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoDAdaptive`
`> > &H)`
- `template<class Field, class AlgoT, class FieldTrait >`
`Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb,`
`const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename`
`Field::ConstElement_ptr AA, const size_t lda, const typename Field::ConstElement_ptr BB, const size_t`
`ldb, const typename Field::Element beta, typename Field::Element *C, const size_t ldc, MMHelper< Field,`
`AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoD`
`> > &H)`
- `template<class Field, class AlgoT, class FieldTrait >`
`Field::Element_ptr pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`
`tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename`
`Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t`
`ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field,`
`AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::ThreeD`
`> > &H)`
- `template<class Field, class AlgoT, class FieldTrait >`
`Field::Element * pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb,`
`const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, const typename`
`Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t`
`ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field,`
`AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::ThreeDInPlace`
`> > &H)`
- `template<class Field, class AlgoT, class FieldTrait >`
`Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t m, const size_t`
`n, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t`
`lda, const typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta,`
`typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel<`
`CuttingStrategy::Recursive, StrategyParameter::Threads`
`> > &H)`
- `template<class Field, class AlgoT, class FieldTrait, class Cut >`
`Field::Element_ptr fgemv (const Field &F, const FFLAS_TRANSPOSE ta, const size_t m, const size_t`
`n, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t`
`lda, const typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta,`
`typename Field::Element_ptr Y, const size_t incY, MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel<`
`CuttingStrategy::Row, Cut`
`> > &H)`
- `void parseArguments (int argc, char **argv, Argument *args, bool printDefaults=true)`
- `std::ostream & writeCommandString (std::ostream &os, Argument *args, const char *programName=nullptr)`
writes the values of all arguments, preceded by the programName
- `template<class Field >`
`std::ostream & WriteMatrix (std::ostream &c, const Field &F, size_t m, size_t n, typename Field::ConstElement_ptr`
`A, size_t lda, FFLAS_FORMAT format, bool column_major)`
WriteMatrix: write a matrix to an output stream.
- `void preamble (std::ifstream &if, FFLAS_FORMAT &format)`
- `template<class Field >`
`Field::Element_ptr ReadMatrix (std::ifstream &if, Field &F, size_t &m, size_t &n, typename Field::Element_ptr`
`&A, FFLAS_FORMAT format=FflasAuto)`
ReadMatrix: read a matrix from an input stream.

- `template<class Field >`
`Field::Element_ptr ReadMatrix` (const std::string &matrix_file, Field &F, size_t &m, size_t &n, typename Field::Element_ptr &A, FFLAS_FORMAT format=FflasAuto)
ReadMatrix: read a matrix from a file.
- `template<class Field >`
`void WriteMatrix` (std::string &matrix_file, const Field &F, int m, int n, typename Field::ConstElement_ptr A, size_t lda, FFLAS_FORMAT format=FflasDense, bool column_major=false)
WriteMatrix: write a matrix to a file.
- `std::ostream & WritePermutation` (std::ostream &c, const size_t *P, size_t N)
WritePermutation: write a permutation matrix to an output stream.
- `template<class Element >`
`bool alignable` ()
- `template<> bool alignable< Givaro::Integer * > ()`
- `template<class Field >`
`Field::Element_ptr fflas_new` (const Field &F, const size_t m, const Alignment align=Alignment::DEFAULT)
- `template<class Field >`
`Field::Element_ptr fflas_new` (const Field &F, const size_t m, const size_t n, const Alignment align=Alignment::DEFAULT)
- `template<class Element >`
`Element * fflas_new` (const size_t m, const Alignment align=Alignment::DEFAULT)
- `template<class Element_ptr >`
`void fflas_delete` (Element_ptr A)
- `template<class Ptr , class ... Args>`
`void fflas_delete` (Ptr p, Args ... args)
- `void prefetch` (const int64_t *)
- `void getTLBSize` (int &tlb)
- `void queryCacheSizes` (int &l1, int &l2, int &l3)
- `int queryL1CacheSize` ()
- `int queryTopLevelCacheSize` ()
- `uint64_t getSeed` ()

15.1.1 Typedef Documentation

15.1.1.1 Checker_fgemm

```
using Checker_fgemm = FFLAS::Checker_Empty<Field>
```

15.1.1.2 Checker_ftrsm

```
using Checker_ftrsm = FFLAS::Checker_Empty<Field>
```

15.1.1.3 ForceCheck_fgemm

```
using ForceCheck_fgemm = CheckerImplem_fgemm<Field>
```

15.1.1.4 ForceCheck_ftrsm

```
using ForceCheck_ftrsm = CheckerImplem_ftrsm<Field>
```

15.1.1.5 ZOSparseMatrix

```
using ZOSparseMatrix = std::true_type
```

15.1.1.6 NotZOSparseMatrix

```
using NotZOSparseMatrix = std::false_type
```

15.1.1.7 SimdSparseMatrix

```
using SimdSparseMatrix = std::true_type
```

15.1.1.8 NoSimdSparseMatrix

```
using NoSimdSparseMatrix = std::false_type
```

15.1.1.9 MKLSparseMatrixFormat

```
using MKLSparseMatrixFormat = std::true_type
```

15.1.1.10 NotMKLSparseMatrixFormat

```
using NotMKLSparseMatrixFormat = std::false_type
```

15.1.1.11 has_plus

```
using has_plus = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,  
has_plus_impl<T> >::type
```

15.1.1.12 has_minus

```
using has_minus = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,  
has_minus_impl<T> >::type
```

15.1.1.13 has_equal

```
using has_equal = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,  
std::is_copy_assignable<T> >::type
```

15.1.1.14 has_plus_eq

```
using has_plus_eq = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,  
has_plus_eq_impl<T> >::type
```

15.1.1.15 has_minus_eq

```
using has_minus_eq = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,  
has_minus_eq_impl<T> >::type
```

15.1.1.16 has_mul

```
using has_mul = typename std::conditional<std::is_arithmetic<T>::value, std::true_type, has_mul_impl<T>  
>::type
```

15.1.1.17 has_mul_eq

```
using has_mul_eq = typename std::conditional<std::is_arithmetic<T>::value, std::true_type,  
has_mul_eq_impl<T> >::type
```

15.1.1.18 Timer

```
typedef Givaro::Timer Timer
```

15.1.1.19 BaseTimer

```
typedef Givaro::BaseTimer BaseTimer
```

15.1.1.20 UserTimer

```
typedef Givaro::UserTimer UserTimer
```

15.1.1.21 SysTimer

```
typedef Givaro::SysTimer SysTimer
```

15.1.2 Enumeration Type Documentation

15.1.2.1 FFLAS_ORDER

```
enum FFLAS_ORDER
```

Storage by row or col ?

Enumerator

FflasRowMajor	row major
FflasColMajor	col major

15.1.2.2 FFLAS_TRANSPOSE

```
enum FFLAS_TRANSPOSE
```

Is matrix transposed ?

Enumerator

FflasNoTrans	Matrix is not transposed.
FflasTrans	Matrix is transposed.

15.1.2.3 FFLAS_UPLO

enum [FFLAS_UPLO](#)

Is triangular matrix's shape upper ?

Enumerator

FflasUpper	Triangular matrix is Upper triangular (if $i > j$ then $T_{i,j} = 0$)
FflasLower	Triangular matrix is Lower triangular (if $i < j$ then $T_{i,j} = 0$)

15.1.2.4 FFLAS_DIAG

enum [FFLAS_DIAG](#)

Is the triangular matrix implicitly unit diagonal ?

Enumerator

FflasNonUnit	Triangular matrix has an explicit arbitrary diagonal.
FflasUnit	Triangular matrix has an implicit unit diagonal ($T_{i,i} = 1$)

15.1.2.5 FFLAS_SIDE

enum [FFLAS_SIDE](#)

On what side ?

Enumerator

FflasLeft	Operator applied on the left.
FflasRight	Operator applied on the righth.

15.1.2.6 FFLAS_BASE

enum [FFLAS_BASE](#)

FFLAS_BASE determines the type of the element representation for Matrix Mult kernel.

(deprecated, should not be used)

Enumerator

FflasDouble	to use the double precision BLAS
FflasFloat	to use the single precison BLAS
FflasGeneric	for any other domain, that can not be converted to floating point integers

15.1.2.7 number_kind

```
enum number_kind
```

Enumerator

zero	
one	
mone	
other	

15.1.2.8 SparseMatrix_t

```
enum class SparseMatrix_t [strong]
```

Enumerator

CSR	
CSR_ZO	
CSC	
CSC_ZO	
COO	
COO_ZO	
ELL	
ELL_ZO	
SELL	
SELL_ZO	
ELL_simd	
ELL_simd_ZO	
CSR_HYB	
HYB_ZO	

15.1.2.9 FFLAS_FORMAT

```
enum FFLAS_FORMAT
```

Enumerator

FflasAuto	
FflasDense	
FflasSMS	
FflasBinary	
FflasMath	
FflasMaple	
FflasSageMath	

15.1.3 Function Documentation

15.1.3.1 InfNorm()

```
Givaro::Integer InfNorm (
    const size_t M,
    const size_t N,
    const Givaro::Integer * A,
    const size_t lda ) [inline]
```

15.1.3.2 min3()

```
const T & min3 (
    const T & m,
    const T & n,
    const T & k )
```

15.1.3.3 max3()

```
const T & max3 (
    const T & m,
    const T & n,
    const T & k )
```

15.1.3.4 min4()

```
const T & min4 (
    const T & m,
    const T & n,
    const T & k,
    const T & l )
```

15.1.3.5 max4()

```
const T & max4 (
    const T & m,
    const T & n,
    const T & k,
    const T & l )
```

15.1.3.6 fadd() [1/8]

```
void fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc )
```

15.1.3.7 faddin() [1/4]

```
void faddin (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc )
```

15.1.3.8 fsub() [1/4]

```
void fsub (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc )
```

15.1.3.9 fsubin() [1/3]

```
void fsubin (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc )
```

15.1.3.10 fadd() [2/8]

```
void fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc )
```

Todo optimise here

15.1.3.11 pfadd()

```
void pfadd (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc,
    const size_t numths )
```

15.1.3.12 pfsub()

```
void pfsub (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc,
    const size_t numths )
```

15.1.3.13 pfaddin()

```
void pfaddin (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc,
    size_t numths )
```

15.1.3.14 pfsubin()

```
void pfsubin (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc,
    size_t numths )
```

15.1.3.15 fadd() [3/8]

```
void fadd (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
```

```
const size_t ldb,  
typename Field::Element_ptr C,  
const size_t ldc )
```

fadd : matrix addition.

Computes $C = A + B$.

Parameters

<i>F</i>	field
<i>M</i>	rows
<i>N</i>	cols
<i>A</i>	dense matrix of size $M \times N$
<i>lda</i>	leading dimension of A
<i>B</i>	dense matrix of size $M \times N$
<i>ldb</i>	leading dimension of B
<i>C</i>	dense matrix of size $M \times N$
<i>ldc</i>	leading dimension of C

15.1.3.16 fsub() [2/4]

```
void fsub (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc )
```

fsub : matrix subtraction.

Computes $C = A - B$.

Parameters

<i>F</i>	field
<i>M</i>	rows
<i>N</i>	cols
<i>A</i>	dense matrix of size $M \times N$
<i>lda</i>	leading dimension of A
<i>B</i>	dense matrix of size $M \times N$
<i>ldb</i>	leading dimension of B
<i>C</i>	dense matrix of size $M \times N$
<i>ldc</i>	leading dimension of C

15.1.3.17 faddin() [2/4]

```
void faddin (
    const Field & F,
```

```

    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc )

```

faddin

15.1.3.18 fsubin() [2/3]

```

void fsubin (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc )

```

fsubin $C = C - B$

15.1.3.19 fadd() [4/8]

```

void fadd (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr C,
    const size_t ldc )

```

fadd : matrix addition with scaling.

Computes $C = A + \text{alpha } B$.

Parameters

<i>F</i>	field
<i>M</i>	rows
<i>N</i>	cols
<i>A</i>	dense matrix of size MxN
<i>lda</i>	leading dimension of A
<i>alpha</i>	some scalar
<i>B</i>	dense matrix of size MxN
<i>ldb</i>	leading dimension of B
<i>C</i>	dense matrix of size MxN
<i>ldc</i>	leading dimension of C

15.1.3.20 fassign() [1/10]

```

void fassign (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr Y,
    const size_t incY,
    typename Field::Element_ptr X,
    const size_t incX ) [inline]

```

$\text{fassign} : x \leftarrow y.$

X is preallocated

Todo variant for triangular matrix

Parameters

	F	field
	N	size of the vectors
out	X	vector in F
	$incX$	stride of X
in	Y	vector in F
	$incY$	stride of Y

15.1.3.21 fassign() [2/10]

```

void fassign (
    const Givaro::Modular< float > & F,
    const size_t N,
    const float * Y,
    const size_t incY,
    float * X,
    const size_t incX ) [inline]

```

15.1.3.22 fassign() [3/10]

```

void fassign (
    const Givaro::ModularBalanced< float > & F,
    const size_t N,
    const float * Y,
    const size_t incY,
    float * X,
    const size_t incX ) [inline]

```

15.1.3.23 fassign() [4/10]

```
void fassign (
    const Givaro::ZRing< float > & F,
    const size_t N,
    const float * Y,
    const size_t incY,
    float * X,
    const size_t incX ) [inline]
```

15.1.3.24 fassign() [5/10]

```
void fassign (
    const Givaro::Modular< double > & F,
    const size_t N,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX ) [inline]
```

15.1.3.25 fassign() [6/10]

```
void fassign (
    const Givaro::ModularBalanced< double > & F,
    const size_t N,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX ) [inline]
```

15.1.3.26 fassign() [7/10]

```
void fassign (
    const Givaro::ZRing< double > & F,
    const size_t N,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX ) [inline]
```

15.1.3.27 fassign() [8/10]

```

void fassign (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr A,
    const size_t lda )

```

$\text{fassign} : A \leftarrow B.$

Parameters

F	field
m	number of rows to copy
n	number of cols to copy
A	matrix in F
lda	stride of A
B	vector in F
ldb	stride of B

15.1.3.28 faxpy() [1/6]

```

void faxpy (
    const Field & F,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY ) [inline]

```

$\text{faxpy} : y \leftarrow \alpha \cdot x + y.$

Parameters

	F	field
	N	size of the vectors
	$alpha$	scalar
in	X	vector in F
	$incX$	stride of X
in, out	Y	vector in F
	$incY$	stride of Y

15.1.3.29 faxpy() [2/6]

```

void faxpy (
    const Givaro::DoubleDomain & ,
    const size_t N,
    const Givaro::DoubleDomain::Element a,
    Givaro::DoubleDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::DoubleDomain::Element_ptr y,
    const size_t incy ) [inline]

```

15.1.3.30 faxpy() [3/6]

```

void faxpy (
    const Givaro::FloatDomain & ,
    const size_t N,
    const Givaro::FloatDomain::Element a,
    Givaro::FloatDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::FloatDomain::Element_ptr y,
    const size_t incy ) [inline]

```

15.1.3.31 faxpy() [4/6]

```

void faxpy (
    const Field & F,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr X,
    const size_t ldx,
    typename Field::Element_ptr Y,
    const size_t ldy ) [inline]

```

$\text{faxpy} : y \leftarrow \alpha \cdot x + y.$

Parameters

	F	field
	m	row dimension
	n	column dimension
	α	scalar
in	X	vector in F
	ldx	leading dimension of X
in, out	Y	vector in F
	ldy	leading dimension of Y

15.1.3.32 fdot() [1/11]

```
Field::Element fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::DefaultTag & MT ) [inline]
```

15.1.3.33 fdot() [2/11]

```
Field::Element fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::DelayedTag & MT ) [inline]
```

15.1.3.34 fdot() [3/11]

```
Givaro::DoubleDomain::Element fdot (
    const Givaro::DoubleDomain & ,
    const size_t N,
    Givaro::DoubleDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::DoubleDomain::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::DefaultTag & MT ) [inline]
```

15.1.3.35 fdot() [4/11]

```
Givaro::FloatDomain::Element fdot (
    const Givaro::FloatDomain & ,
    const size_t N,
    Givaro::FloatDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::FloatDomain::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::DefaultTag & MT ) [inline]
```

15.1.3.36 fdot() [5/11]

```
Field::Element fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::ConvertTo< T > & MT ) [inline]
```

15.1.3.37 fdot() [6/11]

```
Field::Element fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    ModeCategories::DefaultBoundedTag & dbt ) [inline]
```

15.1.3.38 fdot() [7/11]

```
Field::Element fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    const ParSeqHelper::Sequential seq ) [inline]
```

15.1.3.39 fdot() [8/11]

```
Field::Element fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::ConstElement_ptr Y,
    const size_t incY ) [inline]
```

fdot: dot product $x^T y$.

Parameters

<i>F</i>	field
<i>N</i>	size of the vectors
<i>X</i>	vector in <i>F</i>
<i>incX</i>	stride of <i>X</i>
<i>Y</i>	vector in <i>F</i>
<i>incY</i>	stride of <i>Y</i>

15.1.3.40 fgemm() [1/23]

```
Field::Element_ptr fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, ModeCategories::ConvertTo< ElementCategories::MachineF1
>, ParSeqHelper::Sequential > & H ) [inline]
```

15.1.3.41 fgemm() [2/23]

```
Field::Element_ptr fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const ParSeqHelper::Sequential seq ) [inline]
```

15.1.3.42 fgemm() [3/23]

```
Field::Element_ptr fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const ParSeqHelper::Parallel< Cut, Param > par ) [inline]
```

15.1.3.43 fgemm() [4/23]

```
Field::Element_ptr fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc ) [inline]
```

fgemm: **Field GENERAL Matrix Multiply**.

Computes $C = \alpha \text{op}(A) \times \text{op}(B) + \beta C$ Automatically set Winograd recursion level

Parameters

<i>F</i>	field.
<i>ta</i>	if $ta == \text{FflasTrans}$ then $\text{op}(A) = A^t$, else $\text{op}(A) = A$,
<i>tb</i>	same for matrix B
<i>m</i>	see A
<i>n</i>	see B
<i>k</i>	see A
<i>alpha</i>	scalar
<i>beta</i>	scalar
<i>A</i>	$\text{op}(A)$ is $m \times k$
<i>B</i>	$\text{op}(B)$ is $k \times n$

Parameters

C	C is $m \times n$
lda	leading dimension of A
ldb	leading dimension of B
ldc	leading dimension of C
w	recursive levels of Winograd's algorithm are used. No argument (or -1) does auto computation of w .

Warning

α must be invertible

15.1.3.44 fgemm() [5/23]

```
Field::Element_ptr fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Auto, ModeT, ParSeq > & H ) [inline]
```

15.1.3.45 fgemm() [6/23]

```
Field::Element_ptr fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, ModeCategories::DelayedTag, ParSeqHelper::Sequential
> & H ) [inline]
```

15.1.3.46 fsquare() [1/6]

```
Field::Element_ptr fsquare (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc ) [inline]
```

fsquare: Squares a matrix.

compute $C \leftarrow \alpha \text{op}(A) \text{op}(A) + \beta C$ over a Field F Avoid the conversion of B

Parameters

<i>ta</i>	if $ta == \text{FflasTrans}$, $\text{op}(A) = A^T$.
<i>F</i>	field
<i>n</i>	size of A
<i>alpha</i>	scalar
<i>beta</i>	scalar
<i>A</i>	dense matrix of size $n \times n$
<i>lda</i>	leading dimension of A
<i>C</i>	dense matrix of size $n \times n$
<i>ldc</i>	leading dimension of C

Bug why double ?

15.1.3.47 fsquare() [2/6]

```
double * fsquare (
    const Givaro::ModularBalanced< double > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t lda,
    const double beta,
    double * C,
    const size_t ldc ) [inline]
```

15.1.3.48 fsquare() [3/6]

```
float * fsquare (
    const Givaro::ModularBalanced< float > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const float alpha,
    const float * A,
    const size_t lda,
    const float beta,
    float * C,
    const size_t ldc ) [inline]
```

15.1.3.49 fsquare() [4/6]

```
double * fsquare (
    const Givaro::Modular< double > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t lda,
    const double beta,
    double * C,
    const size_t ldc ) [inline]
```

15.1.3.50 fsquare() [5/6]

```
float * fsquare (
    const Givaro::Modular< float > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const float alpha,
    const float * A,
    const size_t lda,
    const float beta,
    float * C,
    const size_t ldc ) [inline]
```

15.1.3.51 fgemm() [7/23]

```
FFPACK::RNSInteger< RNS >::Element_ptr fgemm (
    const FFPACK::RNSInteger< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
```

```

    const size_t k,
    const typename FFPACK::RNSInteger< RNS >::Element alpha,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad,
    const size_t lda,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd,
    const size_t ldb,
    const typename FFPACK::RNSInteger< RNS >::Element beta,
    typename FFPACK::RNSInteger< RNS >::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag,
    ParSeqHelper::Compose< ParSeqHelper::Sequential, ParSeqTrait > > & H ) [inline]

```

15.1.3.52 fgemm() [8/23]

```

FFPACK::RNSInteger< RNS >::Element_ptr fgemm (
    const FFPACK::RNSInteger< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename FFPACK::RNSInteger< RNS >::Element alpha,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad,
    const size_t lda,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd,
    const size_t ldb,
    const typename FFPACK::RNSInteger< RNS >::Element beta,
    typename FFPACK::RNSInteger< RNS >::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag,
    ParSeqHelper::Sequential > & H ) [inline]

```

15.1.3.53 fgemm() [9/23]

```

FFPACK::RNSInteger< RNS >::Element_ptr fgemm (
    const FFPACK::RNSInteger< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename FFPACK::RNSInteger< RNS >::Element alpha,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad,
    const size_t lda,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd,
    const size_t ldb,
    const typename FFPACK::RNSInteger< RNS >::Element beta,
    typename FFPACK::RNSInteger< RNS >::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag,
    ParSeqHelper::Compose< ParSeqHelper::Parallel< CuttingStrategy::RNSModulus, StrategyParameter::Threads
    >, ParSeqTrait > > & H ) [inline]

```

15.1.3.54 fgemm() [10/23]

```
FFPACK::RNSInteger< RNS >::Element_ptr fgemm (
    const FFPACK::RNSInteger< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename FFPACK::RNSInteger< RNS >::Element alpha,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad,
    const size_t lda,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd,
    const size_t ldb,
    const typename FFPACK::RNSInteger< RNS >::Element beta,
    typename FFPACK::RNSInteger< RNS >::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag,
    ParSeqHelper::Parallel< Cut, Param > > & H ) [inline]
```

15.1.3.55 fgemm() [11/23]

```
Givaro::Integer * fgemm (
    const Givaro::ZRing< Givaro::Integer > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const Givaro::Integer alpha,
    const Givaro::Integer * A,
    const size_t lda,
    const Givaro::Integer * B,
    const size_t ldb,
    Givaro::Integer beta,
    Givaro::Integer * C,
    const size_t ldc,
    MMHelper< Givaro::ZRing< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo<
    ElementCategories::RNSElementTag >, ParSeq > & H ) [inline]
```

15.1.3.56 fgemm() [12/23]

```
RNS::Element_ptr fgemm (
    const FFPACK::RNSInteger< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename RNS::Element alpha,
```

```

    typename RNS::ConstElement_ptr Ad,
    const size_t lda,
    typename RNS::ConstElement_ptr Bd,
    const size_t ldb,
    const typename RNS::Element beta,
    typename RNS::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Winograd, ModeT, ParSeqHelper::Sequential
> & H ) [inline]

```

15.1.3.57 fgemm() [13/23]

```

RNS::Element_ptr fgemm (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename RNS::Element alpha,
    typename RNS::ConstElement_ptr Ad,
    const size_t lda,
    typename RNS::ConstElement_ptr Bd,
    const size_t ldb,
    const typename RNS::Element beta,
    typename RNS::Element_ptr Cd,
    const size_t ldc,
    MMHelper< FFPACK::RNSIntegerMod< RNS >, MMHelperAlgo::Winograd > & H ) [inline]

```

15.1.3.58 fgemm() [14/23]

```

Givaro::Integer * fgemm (
    const Givaro::Modular< Givaro::Integer > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const Givaro::Integer alpha,
    const Givaro::Integer * A,
    const size_t lda,
    const Givaro::Integer * B,
    const size_t ldb,
    const Givaro::Integer beta,
    Givaro::Integer * C,
    const size_t ldc,
    MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo<
ElementCategories::RNSElementTag > > & H ) [inline]

```

15.1.3.59 fgemm() [15/23]

```
Givaro::Integer * fgemm (
    const Givaro::Modular< Givaro::Integer > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const Givaro::Integer alpha,
    const Givaro::Integer * A,
    const size_t lda,
    const Givaro::Integer * B,
    const size_t ldb,
    const Givaro::Integer beta,
    Givaro::Integer * C,
    const size_t ldc,
    MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Auto, ModeCategories::ConvertTo<
ElementCategories::RNSElementTag >, ParSeq > & H ) [inline]
```

15.1.3.60 fgemm() [16/23]

```
RecInt::ruint< K1 > * fgemm (
    const Givaro::Modular< RecInt::ruint< K1 >, RecInt::ruint< K2 > > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const RecInt::ruint< K1 > alpha,
    const RecInt::ruint< K1 > * A,
    const size_t lda,
    const RecInt::ruint< K1 > * B,
    const size_t ldb,
    RecInt::ruint< K1 > beta,
    RecInt::ruint< K1 > * C,
    const size_t ldc,
    MMHelper< Givaro::Modular< RecInt::ruint< K1 >, RecInt::ruint< K2 > >, MMHelperAlgo::Classic,
ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > & H ) [inline]
```

15.1.3.61 fgemm() [17/23]

```
Field::Element_ptr fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
```

```

typename Field::ConstElement_ptr A,
const size_t lda,
typename Field::ConstElement_ptr B,
const size_t ldb,
const typename Field::Element beta,
typename Field::Element_ptr C,
const size_t ldc,
MMHelper< Field, MMHelperAlgo::Winograd, ModeT > & H ) [inline]

```

15.1.3.62 fgemm() [18/23]

```

Field::Element_ptr fgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::WinogradPar, ModeT, ParSeqHelper::Parallel< Cut,
Param > > & H ) [inline]

```

15.1.3.63 fgemv() [1/19]

```

Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::MachineFlo
> > & H ) [inline]

```


15.1.3.64 fgemv() [2/19]

```
Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DelayedTag > & H ) [inline]
```

15.1.3.65 fgemv() [3/19]

```
Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultTag > & H ) [inline]
```

15.1.3.66 fgemv() [4/19]

```
Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::LazyTag > & H ) [inline]
```

15.1.3.67 fgemv() [5/19]

```
Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE TransA,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY ) [inline]
```

finite prime Field GEneral Matrix Vector multiplication.

Computes $Y \leftarrow \alpha \text{op}(A)X + \beta Y$.

Parameters

	F	field
	$TransA$	if $TransA == FflasTrans$ then $\text{op}(A) = A^t$.
	M	rows
	N	cols
	$alpha$	scalar
	A	dense matrix of size $M \times N$
	lda	leading dimension of A
	X	dense vector of size N
	$incX$	stride of X
	$beta$	scalar
out	Y	dense vector of size M
	$incY$	stride of Y

15.1.3.68 fgemv() [6/19]

```
Givaro::ZRing< int64_t >::Element_ptr fgemv (
    const Givaro::ZRing< int64_t > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const int64_t alpha,
    const int64_t * A,
    const size_t lda,
    const int64_t * X,
    const size_t incX,
    const int64_t beta,
    int64_t * Y,
    const size_t incY,
```

```

    MMHelper< Givaro::ZRing< int64_t >, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H ) [inline]

```

15.1.3.69 fgemv() [7/19]

```

Givaro::DoubleDomain::Element_ptr fgemv (
    const Givaro::DoubleDomain & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const Givaro::DoubleDomain::Element alpha,
    const Givaro::DoubleDomain::ConstElement_ptr A,
    const size_t lda,
    const Givaro::DoubleDomain::ConstElement_ptr X,
    const size_t incX,
    const Givaro::DoubleDomain::Element beta,
    Givaro::DoubleDomain::Element_ptr Y,
    const size_t incY,
    MMHelper< Givaro::DoubleDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H ) [inline]

```

15.1.3.70 fgemv() [8/19]

```

Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultBoundedTag > & H )
[inline]

```

15.1.3.71 fgemv() [9/19]

```

Givaro::FloatDomain::Element_ptr fgemv (
    const Givaro::FloatDomain & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const Givaro::FloatDomain::Element alpha,

```

```

    const Givaro::FloatDomain::ConstElement_ptr A,
    const size_t lda,
    const Givaro::FloatDomain::ConstElement_ptr X,
    const size_t incX,
    const Givaro::FloatDomain::Element beta,
    Givaro::FloatDomain::Element_ptr Y,
    const size_t incY,
    MMHelper< Givaro::FloatDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H ) [inline]

```

15.1.3.72 fgemv() [10/19]

```

Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    ParSeqHelper::Parallel< Cut, Param > & parH )

```

15.1.3.73 fgemv() [11/19]

```

Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    ParSeqHelper::Sequential & seqH )

```

15.1.3.74 fgemv() [12/19]

```
FFPACK::rns_double::Element_ptr fgemv (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t lda,
    FFPACK::rns_double::ConstElement_ptr X,
    const size_t incX,
    const FFPACK::rns_double::Element beta,
    FFPACK::rns_double::Element_ptr Y,
    const size_t incY,
    MMHelper< FFPACK::RNSInteger< FFPACK::rns_double >, MMHelperAlgo::Classic, ModeCategories::Default
> & H ) [inline]
```

15.1.3.75 fgemv() [13/19]

```
FFPACK::rns_double::Element_ptr fgemv (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t lda,
    FFPACK::rns_double::ConstElement_ptr X,
    const size_t incX,
    const FFPACK::rns_double::Element beta,
    FFPACK::rns_double::Element_ptr Y,
    const size_t incY,
    MMHelper< FFPACK::RNSIntegerMod< FFPACK::rns_double >, MMHelperAlgo::Classic,
ModeCategories::DefaultTag > & H ) [inline]
```

15.1.3.76 fgemv() [14/19]

```
Givaro::Integer * fgemv (
    const Givaro::ZRing< Givaro::Integer > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const Givaro::Integer alpha,
    Givaro::Integer * A,
    const size_t lda,
    Givaro::Integer * X,
    const size_t ldX,
    Givaro::Integer beta,
    Givaro::Integer * Y,
    const size_t ldY,
    MMHelper< Givaro::ZRing< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo<
ElementCategories::RNSElementTag > > & H ) [inline]
```

15.1.3.77 fgemv() [15/19]

```
Givaro::Integer * fgemv (
    const Givaro::Modular< Givaro::Integer > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const Givaro::Integer alpha,
    Givaro::Integer * A,
    const size_t lda,
    Givaro::Integer * X,
    const size_t ldx,
    Givaro::Integer beta,
    Givaro::Integer * Y,
    const size_t ldy,
    MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo<
ElementCategories::RNSElementTag > > & H ) [inline]
```

15.1.3.78 fgemv() [16/19]

```
RecInt::ruint< K1 > * fgemv (
    const Givaro::Modular< RecInt::ruint< K1 >, RecInt::ruint< K2 > > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const RecInt::ruint< K1 > alpha,
    const RecInt::ruint< K1 > * A,
    const size_t lda,
    const RecInt::ruint< K1 > * X,
    const size_t incx,
    RecInt::ruint< K1 > beta,
    RecInt::ruint< K1 > * Y,
    const size_t incy,
    MMHelper< Givaro::Modular< RecInt::ruint< K1 >, RecInt::ruint< K2 > >, MMHelperAlgo::Classic,
ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > & H ) [inline]
```

15.1.3.79 fger() [1/12]

```
void fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda ) [inline]
```

fger: rank one update of a general matrix

Computes $A \leftarrow \alpha x y^T + A$

Parameters

	F	field
	M	rows
	N	cols
	α	scalar
in, out	A	dense matrix of size $M \times N$ and leading dimension lda
	lda	leading dimension of A
	x	dense vector of size M
	$incx$	stride of x
	y	dense vector of size N
	$incy$	stride of y

15.1.3.80 fger() [2/12]

```

void fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::MachineFlo
> > & H ) [inline]

```

15.1.3.81 fger() [3/12]

```

void fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda,
    MMHelper< Field, MMHelperAlgo::Classic, AnyTag > & H ) [inline]

```

15.1.3.82 fger() [4/12]

```

void fger (
    const Givaro::DoubleDomain & F,
    const size_t M,
    const size_t N,
    const Givaro::DoubleDomain::Element alpha,
    const Givaro::DoubleDomain::ConstElement_ptr x,
    const size_t incx,
    const Givaro::DoubleDomain::ConstElement_ptr y,
    const size_t incy,
    Givaro::DoubleDomain::Element_ptr A,
    const size_t lda,
    MMHelper< Givaro::DoubleDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H ) [inline]

```

15.1.3.83 fger() [5/12]

```

void fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr x,
    const size_t incx,
    const typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultBoundedTag > & H )
[inline]

```

15.1.3.84 fger() [6/12]

```

void fger (
    const Givaro::FloatDomain & F,
    const size_t M,
    const size_t N,
    const Givaro::FloatDomain::Element alpha,
    const Givaro::FloatDomain::ConstElement_ptr x,
    const size_t incx,
    const Givaro::FloatDomain::ConstElement_ptr y,
    const size_t incy,
    Givaro::FloatDomain::Element_ptr A,
    const size_t lda,
    MMHelper< Givaro::FloatDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H ) [inline]

```


15.1.3.85 fger() [7/12]

```

void fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::LazyTag > & H ) [inline]

```

15.1.3.86 fger() [8/12]

```

void fger (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda,
    MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DelayedTag > & H ) [inline]

```

15.1.3.87 fger() [9/12]

```

void fger (
    const Givaro::Modular< Givaro::Integer > & F,
    const size_t M,
    const size_t N,
    const typename Givaro::Integer alpha,
    typename Givaro::Integer * x,
    const size_t incx,
    typename Givaro::Integer * y,
    const size_t incy,
    typename Givaro::Integer * A,
    const size_t lda,
    MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo<
ElementCategories::RNSElementTag > > & H ) [inline]

```

15.1.3.88 fger() [10/12]

```

void fger (
    const FFPACK::RNSInteger< RNS > & F,
    const size_t M,
    const size_t N,
    const typename FFPACK::RNSInteger< RNS >::Element alpha,
    typename FFPACK::RNSInteger< RNS >::Element_ptr x,
    const size_t incx,
    typename FFPACK::RNSInteger< RNS >::Element_ptr y,
    const size_t incy,
    typename FFPACK::RNSInteger< RNS >::Element_ptr A,
    const size_t lda,
    MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag
> & H ) [inline]

```

15.1.3.89 fger() [11/12]

```

void fger (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const size_t M,
    const size_t N,
    const typename FFPACK::RNSIntegerMod< RNS >::Element alpha,
    typename FFPACK::RNSIntegerMod< RNS >::Element_ptr x,
    const size_t incx,
    typename FFPACK::RNSIntegerMod< RNS >::Element_ptr y,
    const size_t incy,
    typename FFPACK::RNSIntegerMod< RNS >::Element_ptr A,
    const size_t lda,
    MMHelper< FFPACK::RNSIntegerMod< RNS >, MMHelperAlgo::Classic > & H ) [inline]

```

15.1.3.90 freduce() [1/10]

```

void freduce (
    const Field & F,
    const size_t n,
    typename Field::ConstElement_ptr Y,
    const size_t incY,
    typename Field::Element_ptr X,
    const size_t incX )

```

freduce $x \leftarrow y \bmod F$.

Parameters

F	field
n	size of the vectors
Y	vector of Element
$incY$	stride of Y
X	vector in F
$incX$	stride of X

Bug use cblas_(d)scal when possible

15.1.3.91 freduce() [2/10]

```
void freduce (
    const Field & F,
    const size_t n,
    typename Field::Element_ptr X,
    const size_t incX )
```

$\text{freduce } x \leftarrow x \bmod F.$

Parameters

F	field
n	size of the vectors
X	vector in F
$incX$	stride of X

Bug use cblas_(d)scal when possible

15.1.3.92 freduce_constoverride() [1/2]

```
void freduce_constoverride (
    const Field & F,
    const size_t m,
    typename Field::ConstElement_ptr A,
    const size_t incX )
```

15.1.3.93 finit() [1/8]

```
void finit (
    const Field & F,
    const size_t n,
    ConstOtherElement_ptr Y,
    const size_t incY,
    typename Field::Element_ptr X,
    const size_t incX )
```

15.1.3.94 finit() [2/8]

```
void finit (
    const Field & F,
    const size_t n,
    typename Field::Element_ptr X,
    const size_t incX )
```

finit Initializes X in F .

Parameters

F	field
n	size of the vectors
X	vector in F
$incX$	stride of X

15.1.3.95 freduce() [3/10]

```
void freduce (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda )
```

freduce $A \leftarrow A \bmod F$.

Parameters

F	field
m	number of rows
n	number of cols
A	matrix in F
lda	stride of A

15.1.3.96 pfreduce()

```
void pfreduce (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t numths )
```

15.1.3.97 freduce() [4/10]

```

void freduce (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr A,
    const size_t lda )

```

$\text{freduce } A \leftarrow B \bmod F.$

Parameters

F	field
m	number of rows
n	number of cols
A	matrix in F
lda	stride of A
B	matrix in Element
ldb	stride of B

15.1.3.98 freduce_constoverride() [2/2]

```

void freduce_constoverride (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr A,
    const size_t lda )

```

15.1.3.99 finit() [3/8]

```

void finit (
    const Field & F,
    const size_t m,
    const size_t n,
    const OtherElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr A,
    const size_t lda )

```

$\text{finit } A \leftarrow B \bmod F.$

Parameters

F	field
m	number of rows

Parameters

<i>n</i>	number of cols
<i>A</i>	matrix in F
<i>lda</i>	stride of A
<i>B</i>	matrix in OtherElement
<i>ldb</i>	stride of B

15.1.3.100 finit() [4/8]

```
void finit (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda )
```

15.1.3.101 freduce() [5/10]

```
void freduce (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t n,
    FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element_ptr A,
    size_t inc ) [inline]
```

15.1.3.102 freduce() [6/10]

```
void freduce (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    FFPACK::rns_double::Element_ptr A,
    size_t lda ) [inline]
```

15.1.3.103 freivalds()

```

bool freivalds (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::ConstElement_ptr C,
    const size_t ldc ) [inline]

```

freivalds: Freivalds **GE**neral **M**atrix **M**ultiply **R**andom **C**heck.

Randomly Checks $C = \alpha \text{op}(A) \times \text{op}(B)$

Parameters

F	field.
ta	if $ta == \text{FflasTrans}$ then $\text{op}(A) = A^t$, else $\text{op}(A) = A$,
tb	same for matrix B
m	see A
n	see B
k	see A
α	scalar
A	$\text{op}(A)$ is $m \times k$
B	$\text{op}(B)$ is $k \times n$
C	C is $m \times n$
lda	leading dimension of A
ldb	leading dimension of B
ldc	leading dimension of C

15.1.3.104 fscaln() [1/10]

```

void fscaln (
    const Field & F,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::Element_ptr X,
    const size_t incX ) [inline]

```

fscaln $x \leftarrow \alpha \cdot x$.

Parameters

F	field
-----	-------

Parameters

n	size of the vectors
α	scalar
X	vector in \mathbb{F}
$incX$	stride of X

Bug use `cblas_(d)scal` when possible

Todo check if comparison with $\pm 1, 0$ is necessary.

15.1.3.105 `fscal()` [1/10]

```
void fscal (
    const Field & F,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY ) [inline]
```

`fscal` $y \leftarrow \alpha \cdot x$.

Parameters

	F	field
	n	size of the vectors
	α	scalar
in	X	vector in \mathbb{F}
	$incX$	stride of X
out	Y	vector in \mathbb{F}
	$incY$	stride of Y

Bug use `cblas_(d)scal` when possible

Todo check if comparison with $\pm 1, 0$ is necessary.

15.1.3.106 `fscal()` [2/10]

```
void fscal (
    const Givaro::DoubleDomain & ,
```



```

    const size_t N,
    const Givaro::DoubleDomain::Element a,
    Givaro::DoubleDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::DoubleDomain::Element_ptr y,
    const size_t incy ) [inline]

```

15.1.3.107 fscal() [3/10]

```

void fscal (
    const Givaro::FloatDomain & ,
    const size_t N,
    const Givaro::FloatDomain::Element a,
    Givaro::FloatDomain::ConstElement_ptr x,
    const size_t incx,
    Givaro::FloatDomain::Element_ptr y,
    const size_t incy ) [inline]

```

15.1.3.108 fscaln() [2/10]

```

void fscaln (
    const Givaro::DoubleDomain & ,
    const size_t N,
    const Givaro::DoubleDomain::Element a,
    Givaro::DoubleDomain::Element_ptr y,
    const size_t incy ) [inline]

```

15.1.3.109 fscaln() [3/10]

```

void fscaln (
    const Givaro::FloatDomain & ,
    const size_t N,
    const Givaro::FloatDomain::Element a,
    Givaro::FloatDomain::Element_ptr y,
    const size_t incy ) [inline]

```

15.1.3.110 fscaln() [4/10]

```

void fscaln (
    const Field & F,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda ) [inline]

```

$\text{fscaln } A \leftarrow a \cdot A.$

Parameters

F	field
m	number of rows
n	number of cols
α	homotecie scalar
A	matrix in F
lda	stride of A

15.1.3.111 **fscal()** [4/10]

```

void fscal (
    const Field & F,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb ) [inline]

```

$\text{fscal } B \leftarrow a \cdot A.$

Parameters

	F	field
	m	number of rows
	n	number of cols
	α	homotecie scalar
in	A	matrix in F
	lda	stride of A
out	B	matrix in F
	ldb	stride of B

15.1.3.112 **fscaln()** [5/10]

```

void fscaln (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::Element_ptr A,
    const size_t inc ) [inline]

```

15.1.3.113 fscal() [5/10]

```

void fscal (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t Ainc,
    FFPACK::rns_double::Element_ptr B,
    const size_t Binc ) [inline]

```

15.1.3.114 fscaln() [6/10]

```

void fscaln (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::Element_ptr A,
    const size_t lda ) [inline]

```

15.1.3.115 fscal() [6/10]

```

void fscal (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t lda,
    FFPACK::rns_double::Element_ptr B,
    const size_t ldb ) [inline]

```

15.1.3.116 fscaln() [7/10]

```

void fscaln (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t n,
    const typename FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element alpha,
    typename FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element_ptr A,
    const size_t inc ) [inline]

```

15.1.3.117 fscal() [7/10]

```
void fscal (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t Ainc,
    FFPACK::rns_double::Element_ptr B,
    const size_t Binc ) [inline]
```

15.1.3.118 fscaln() [8/10]

```
void fscaln (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::Element_ptr A,
    const size_t lda ) [inline]
```

15.1.3.119 fscal() [8/10]

```
void fscal (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const FFPACK::rns_double::Element alpha,
    FFPACK::rns_double::ConstElement_ptr A,
    const size_t lda,
    FFPACK::rns_double::Element_ptr B,
    const size_t ldb ) [inline]
```

15.1.3.120 fsyr2k()

```
Field::Element_ptr fsyr2k (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc ) [inline]
```

fsyr2k: Symmetric Rank 2K update

Computes the Lower or Upper triangular part of $C = \alpha(A \times B^T + B \times A^T) + \beta C$ or $C = \alpha(A^T \times B + B^T \times A) + \beta C$

Parameters

<i>F</i>	field.
<i>UpLo</i>	whether to compute the upper or the lower triangular part of the symmetric matrix C
<i>trans</i>	if <code>ta==FflasNoTrans</code> then compute $C = \alpha(A \times B^T + B \times A^T) + \beta C$, else $C = \alpha(A^T \times B + B^T \times A) + \beta C$
<i>n</i>	order of matrix C
<i>k</i>	see A
<i>alpha</i>	scalar
<i>A</i>	<i>A</i> is $n \times k$ (FflasNoTrans) or <i>A</i> is $k \times n$ (FflasTrans)
<i>lda</i>	leading dimension of A
<i>beta</i>	scalar
<i>C</i>	<i>C</i> is $n \times n$
<i>ldc</i>	leading dimension of C

Warning

α must be invertible

15.1.3.121 fsyrk() [1/5]

```
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc ) [inline]
```

fsyrk: Symmetric Rank K update

Computes the Lower or Upper triangular part of $C = \alpha A \times A^T + \beta C$ or $C = \alpha A^T \times A + \beta C$

Parameters

<i>F</i>	field.
<i>UpLo</i>	whether to compute the upper or the lower triangular part of the symmetric matrix C
<i>trans</i>	if <code>ta==FflasNoTrans</code> then compute $C = \alpha A \times A^T + \beta C$, else $C = \alpha A^T \times A + \beta C$
<i>n</i>	order of matrix C
<i>k</i>	see A
<i>alpha</i>	scalar
<i>A</i>	<i>A</i> is $n \times k$ or <i>A</i> is $k \times n$
<i>lda</i>	leading dimension of A
<i>beta</i>	scalar
<i>C</i>	<i>C</i> is $n \times n$
<i>ldc</i>	leading dimension of C

Warning

α must be invertible

15.1.3.122 fsyrk() [2/5]

```
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr D,
    const size_t incD,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const size_t threshold = __FFLASFFPACK_FSYRK_THRESHOLD ) [inline]
```

fsyrk: Symmetric Rank K update with diagonal scaling

Computes the Lower or Upper triangular part of $C = \alpha A \times D \times A^T + \beta C$ or $C = \alpha A^T \times D \times A + \beta C$ where D is a diagonal matrix. Matrix A is updated into $D \times A$ (if trans = FflasTrans) or $A \times D$ (if trans = FflasNoTrans).

Parameters

F	field.
$UpLo$	whether to compute the upper or the lower triangular part of the symmetric matrix C
$trans$	if $trans == FflasNoTrans$ then compute $C = \alpha A \times A^T + \beta C$, else $C = \alpha A^T \times A + \beta C$
n	order of matrix C
k	see A
$alpha$	scalar
A	A is $n \times k$ or A is $k \times n$
lda	leading dimension of A
D	D is $k \times k$ diagonal matrix, stored as a vector of k coefficients
lda	leading dimension of A
$beta$	scalar
C	C is $n \times n$
ldc	leading dimension of C

Warning

α must be invertible

15.1.3.123 fsyrk() [3/5]

```
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr D,
    const size_t incD,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const ParSeqHelper::Sequential seq,
    const size_t threshold ) [inline]
```

15.1.3.124 fsyrk() [4/5]

```
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t N,
    const size_t K,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr D,
    const size_t incD,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const ParSeqHelper::Parallel< Cut, Param > par,
    const size_t threshold ) [inline]
```

15.1.3.125 fsyrk() [5/5]

```
Field::Element_ptr fsyrk (
    const Field & F,
    const FFLAS_UPLO UpLo,
    const FFLAS_TRANSPOSE trans,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr D,
```

```

const size_t incD,
const std::vector< bool > & twoBlock,
const typename Field::Element beta,
typename Field::Element_ptr C,
const size_t ldc,
const size_t threshold = __FFLASFFPACK_FSYRK_THRESHOLD ) [inline]

```

fsyrk: Symmetric Rank K update with diagonal scaling

Computes the Lower or Upper triangular part of $C = \alpha A \times \text{Delta} D \times A^T + \beta C$ or $C = \alpha A^T \times \text{Delta} D \times A + \beta C$ where D is a diagonal matrix and Delta is a block diagonal with either 1 on the diagonal or 2x2 swap blocks Matrix A is updated into $D \times A$ (if trans = FflasTrans) or $A \times D$ (if trans = FflasNoTrans).

Parameters

<i>F</i>	field.
<i>UpLo</i>	whether to compute the upper or the lower triangular part of the symmetric matrix C
<i>trans</i>	if ta==FflasNoTrans then compute $C = \alpha A \text{Delta} D \times A^T + \beta C$, else $C = \alpha A^T \text{Delta} D \times A + \beta C$
<i>n</i>	see B
<i>k</i>	see A
<i>alpha</i>	scalar
<i>A</i>	A is $n \times k$ or A is $k \times n$
<i>lda</i>	leading dimension of A
<i>D</i>	D is $k \times k$ diagonal matrix, stored as a vector of k coefficients
<i>twoBlocks</i>	a vector boolean indicating the beginning of each 2x2 blocs in Delta
<i>lda</i>	leading dimension of A
<i>beta</i>	scalar
<i>C</i>	C is $n \times n$
<i>ldc</i>	leading dimension of C

Warning

α must be invertible

15.1.3.126 ftrmm() [1/3]

```

void ftrmm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb ) [inline]

```

ftrmm: **TR**iangular **M**atrix **M**ultiply.

Computes $B \leftarrow \alpha \text{op}(A)B$ or $B \leftarrow \alpha B \text{op}(A)$.

Parameters

<i>F</i>	field
<i>Side</i>	if <code>Side==FflasLeft</code> then $B \leftarrow \alpha \text{op}(A)B$ is computed.
<i>Uplo</i>	if <code>Uplo==FflasUpper</code> then A is upper triangular
<i>TransA</i>	if <code>TransA==FflasTrans</code> then $\text{op}(A) = A^t$.
<i>Diag</i>	if <code>Diag==FflasUnit</code> then A is implicitly unit.
<i>M</i>	rows of B
<i>N</i>	cols of B
<i>alpha</i>	scalar
<i>A</i>	triangular matrix. If <code>Side==FflasLeft</code> then A is $N \times N$, otherwise A is $M \times M$
<i>lda</i>	leading dim of A
<i>B</i>	matrix of size MxN
<i>ldb</i>	leading dim of B

15.1.3.127 ftrmm() [2/3]

```

void ftrmm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc ) [inline]

```

ftrmm: **TR**angular **M**atrix **M**ultiply with 3 operands Computes $C \leftarrow \alpha \text{op}(A)B + \beta C$ or $C \leftarrow \alpha B \text{op}(A) + \beta C$.

Parameters

<i>F</i>	field
<i>Side</i>	if <code>Side==FflasLeft</code> then $B \leftarrow \alpha \text{op}(A)B$ is computed.
<i>Uplo</i>	if <code>Uplo==FflasUpper</code> then A is upper triangular
<i>TransA</i>	if <code>TransA==FflasTrans</code> then $\text{op}(A) = A^t$.
<i>Diag</i>	if <code>Diag==FflasUnit</code> then A is implicitly unit.
<i>M</i>	rows of B
<i>N</i>	cols of B
<i>alpha</i>	scalar
<i>A</i>	triangular matrix. If <code>Side==FflasLeft</code> then A is $N \times N$, otherwise A is $M \times M$
<i>lda</i>	leading dim of A
<i>B</i>	matrix of size MxN

Parameters

<i>ldb</i>	leading dim of B
<i>beta</i>	scalar
<i>C</i>	matrix of size MxN
<i>ldc</i>	leading dim of C

15.1.3.128 ftrsm() [1/9]

```

void ftrsm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb ) [inline]

```

15.1.3.129 ftrsm() [2/9]

```

void ftrsm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const ParSeqHelper::Sequential & PSH ) [inline]

```

15.1.3.130 ftrsm() [3/9]

```

void ftrsm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const ParSeqHelper::Parallel< Cut, Param > & PSH ) [inline]

```

15.1.3.131 ftrsm() [4/9]

```

void ftrsm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    TRSMHelper< StructureHelper::Recursive, ParSeqTrait > & H ) [inline]

```

15.1.3.132 ftrsm() [5/9]

```

void ftrsm (
    const Givaro::Modular< Givaro::Integer > & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const Givaro::Integer alpha,
    const Givaro::Integer * A,
    const size_t lda,
    Givaro::Integer * B,
    const size_t ldb ) [inline]

```

15.1.3.133 cblas_impstrsm()

```

void cblas_impstrsm (
    const enum FFLAS_ORDER Order,
    const enum FFLAS_SIDE Side,
    const enum FFLAS_UPLO Uplo,
    const enum FFLAS_TRANSPOSE TransA,
    const enum FFLAS_DIAG Diag,
    const int M,
    const int N,
    const FFPACK::rns_double_elt alpha,
    FFPACK::rns_double_elt_cstptr A,
    const int lda,
    FFPACK::rns_double_elt_ptr B,
    const int ldb ) [inline]

```

15.1.3.134 ftrsv() [1/2]

```

void ftrsv (
    const Field & F,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    int incX ) [inline]

```

ftrsv: TRIangular System solve with Vector Computes $X \leftarrow \text{op}(A^{-1})X$

Parameters

<i>F</i>	field
<i>X</i>	vector of size N on a field F
<i>incX</i>	stride of X
<i>A</i>	a matrix of leading dimension lda and size N
<i>lda</i>	leading dimension of A
<i>N</i>	number of rows or columns of A according to TransA
<i>TransA</i>	if TransA==FflasTrans then $\text{op}(A) = A^t$.
<i>Diag</i>	if Diag==FflasUnit then A is unit.
<i>Uplo</i>	if Uplo==FflasUpper then A is upper triangular

15.1.3.135 igemm_()

```

void igemm_ (
    const enum FFLAS_ORDER Order,

```

```

const enum FFLAS_TRANSPOSE TransA,
const enum FFLAS_TRANSPOSE TransB,
const size_t M,
const size_t N,
const size_t K,
const int64_t alpha,
const int64_t * A,
const size_t lda,
const int64_t * B,
const size_t ldb,
const int64_t beta,
int64_t * C,
const size_t ldc ) [inline]

```

15.1.3.136 finit() [5/8]

```

void finit (
    const Field & F,
    const size_t n,
    const OtherElement_ptr Y,
    const size_t incY,
    typename Field::Element_ptr X,
    const size_t incX )

```

$\text{finit } x \leftarrow y \bmod F.$

Parameters

F	field
n	size of the vectors
Y	vector of OtherElement
$incY$	stride of Y
X	vector in F
$incX$	stride of X

Bug use `cblas_(d)scal` when possible

15.1.3.137 fconvert() [1/3]

```

void fconvert (
    const Field & F,
    const size_t n,
    OtherElement_ptr X,
    const size_t incX,
    typename Field::ConstElement_ptr Y,
    const size_t incY )

```

$\text{fconvert } x \leftarrow y \bmod F.$

Parameters

F	field
n	size of the vectors
Y	vector of F
$incY$	stride of Y
X	vector in <code>OtherElement</code>
$incX$	stride of X

Bug use `cblas_(d)scal` when possible

15.1.3.138 `fnegin()` [1/4]

```
void fnegin (
    const Field & F,
    const size_t n,
    typename Field::Element_ptr X,
    const size_t incX )
```

`fnegin` $x \leftarrow -x$.

Parameters

F	field
n	size of the vectors
X	vector in F
$incX$	stride of X

Bug use `cblas_(d)scal` when possible

15.1.3.139 `fneg()` [1/4]

```
void fneg (
    const Field & F,
    const size_t n,
    typename Field::ConstElement_ptr Y,
    const size_t incY,
    typename Field::Element_ptr X,
    const size_t incX )
```

`fneg` $x \leftarrow -y$.

Parameters

F	field
n	size of the vectors
X	vector in F
$incX$	stride of X
Y	vector in F
$incY$	stride of Y

Bug use `cblas_(d)scal` when possible

15.1.3.140 fzero() [1/4]

```
void fzero (
    const Field & F,
    const size_t n,
    typename Field::Element_ptr X,
    const size_t incX )
```

$fzero : A \leftarrow 0$.

Parameters

F	field
n	number of elements to zero
X	vector in F
$incX$	stride of X

15.1.3.141 frand() [1/2]

```
void frand (
    const Field & F,
    RandIter & G,
    const size_t n,
    typename Field::Element_ptr X,
    const size_t incX )
```

$frand : A \leftarrow random$.

Parameters

F	field
G	randomiterator
n	number of elements to randomize
X	vector in F
$incX$	stride of X

15.1.3.142 fiszero() [1/4]

```
bool fiszero (
    const Field & F,
    const size_t n,
    typename Field::ConstElement_ptr X,
    const size_t incX )
```

fiszero : test $X = 0$.

Parameters

F	field
n	vector dimension
X	vector in F
$incX$	increment of X

15.1.3.143 fequal() [1/4]

```
bool fequal (
    const Field & F,
    const size_t n,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::ConstElement_ptr Y,
    const size_t incY )
```

fequal : test $X = Y$.

Parameters

F	field
n	vector dimension
X	vector in F
$incX$	increment of X
Y	vector in F
$incY$	increment of Y

15.1.3.144 faxpby() [1/2]

```
void faxpby (
    const Field & F,
    const size_t N,
```



```

const typename Field::Element alpha,
typename Field::ConstElement_ptr X,
const size_t incX,
const typename Field::Element beta,
typename Field::Element_ptr Y,
const size_t incY )

```

$\text{faxpby} : y \leftarrow \alpha \cdot x + \beta \cdot y.$

Parameters

	F	field
	N	size of the vectors
	α	scalar
in	X	vector in F
	incX	stride of X
	β	scalar
in, out	Y	vector in F
	incY	stride of Y

Note

this is a catlas function

15.1.3.145 fdot() [9/11]

```

Field::Element fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::ConstElement_ptr Y,
    const size_t incY,
    const ParSeqHelper::Parallel< Cut, Param > par ) [inline]

```

15.1.3.146 fswap() [1/2]

```

void fswap (
    const Field & F,
    const size_t N,
    typename Field::Element_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY )

```

$\text{fswap} : X \leftrightarrow Y.$

Bug use `cblas_dswap` when double

Parameters

F	field
N	size of the vectors
X	vector in F
$incX$	stride of X
Y	vector in F
$incY$	stride of Y

15.1.3.147 fzero() [2/4]

```
void fzero (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda )
```

$fzero : A \leftarrow 0.$

Parameters

F	field
m	number of rows to zero
n	number of cols to zero
A	matrix in F
lda	stride of A

Warning

may be buggy if Element is larger than int

15.1.3.148 frand() [2/2]

```
void frand (
    const Field & F,
    RandIter & G,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda )
```

$frand : A \leftarrow random.$

Parameters

<i>F</i>	field
<i>G</i>	randomiterator
<i>m</i>	number of rows to randomize
<i>n</i>	number of cols to randomize
<i>A</i>	matrix in F
<i>lda</i>	stride of A

15.1.3.149 fequal() [2/4]

```
bool fequal (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb )
```

fequal : test $A = B$.

Parameters

<i>F</i>	field
<i>m</i>	row dimension
<i>n</i>	column dimension
<i>A</i>	m x n matrix in F
<i>lda</i>	leading dimension of A
<i>B</i>	m x n matrix in F
<i>ldb</i>	leading dimension of B

15.1.3.150 fiszero() [2/4]

```
bool fiszero (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr A,
    const size_t lda )
```

fiszero : test $A = 0$.

Parameters

<i>F</i>	field
<i>m</i>	row dimension

Parameters

n	column dimension
A	m x n matrix in F
lda	leading dimension of A

15.1.3.151 fidentity() [1/4]

```
void fidentity (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element & d )
```

creates a diagonal matrix

15.1.3.152 fidentity() [2/4]

```
void fidentity (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda )
```

creates a diagonal matrix

15.1.3.153 finit() [6/8]

```
void finit (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda )
```

finit Initializes A in $F^{\$}$.

Parameters

F	field
m	number of rows
n	number of cols
A	matrix in F
lda	stride of A

15.1.3.154 fconvert() [2/3]

```

void fconvert (
    const Field & F,
    const size_t m,
    const size_t n,
    OtherElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb )

```

$\text{fconvert } A \leftarrow B \bmod F.$

Parameters

F	field
m	number of rows
n	number of cols
A	matrix in OtherElement
lda	stride of A
B	matrix in F
ldb	stride of B

Todo check if $n == lda$

15.1.3.155 fnegin() [2/4]

```

void fnegin (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda )

```

$\text{fnegin } A \leftarrow -A.$

Parameters

F	field
m	number of rows
n	number of cols
A	matrix in F
lda	stride of A

Todo check if $n == lda$

15.1.3.156 fneg() [2/4]

```

void fneg (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::Element_ptr A,
    const size_t lda )

```

$\text{fneg } A \leftarrow -B.$

Parameters

F	field
m	number of rows
n	number of cols
A	matrix in F
lda	stride of A

Todo check if $n == lda$

15.1.3.157 faxpby() [2/2]

```

void faxpby (
    const Field & F,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr X,
    const size_t ldx,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t ldy )

```

$\text{faxpby} : y \leftarrow \alpha \cdot x + \beta \cdot y.$

Parameters

	F	field
	m	row dimension
	n	column dimension
	α	scalar
in	X	vector in F
	ldx	leading dimension of X
	β	scalar
in, out	Y	vector in F
	ldy	leading dimension of Y

Note

this is a catlas function

15.1.3.158 fmove() [1/2]

```
void fmove (
    const Field & F,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb )
```

fmove : $A \leftarrow B$ and $B \leftarrow 0$.

Parameters

F	field
m	number of rows to copy
n	number of cols to copy
A	matrix in F
lda	stride of A
B	matrix in F
ldb	stride of B

15.1.3.159 bitsize()

```
size_t bitsize (
    const Field & F,
    size_t M,
    size_t N,
    const typename Field::ConstElement_ptr A,
    size_t lda ) [inline]
```

bitsize: Computes the largest bitsize of the matrix' coefficients.

If the matrix is over a modular prime field, it returns the bitsize of the largest element (in a bsolute value)

Parameters

F	field
M	rows
N	cols
$incX$	stride of X
A	a matrix of leading dimension lda and size $M \times N$
lda	leading dimension of A

15.1.3.160 bitsize< Givaro::ZRing< Givaro::Integer > >()

```
size_t bitsize< Givaro::ZRing< Givaro::Integer > > (
    const Givaro::ZRing< Givaro::Integer > & F,
    size_t M,
    size_t N,
    const Givaro::Integer * A,
    size_t lda ) [inline]
```

15.1.3.161 ftrmv()

```
void ftrmv (
    const Field & F,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    int incX )
```

ftrsm: TRIangular Matrix Vector prodcut Computes $X \leftarrow \text{op}(A)X$

Parameters

<i>F</i>	field
<i>X</i>	vector of size N on a field F
<i>incX</i>	stride of X
<i>A</i>	a matrix of leading dimension lda and size N
<i>lda</i>	leading dimension of A
<i>N</i>	number of rows and columns of A
<i>TransA</i>	if TransA==FflasTrans then $\text{op}(A) = A^T$.
<i>Diag</i>	if Diag==FflasUnit then A is unit diagonal.
<i>Uplo</i>	if Uplo==FflasUpper then A is upper triangular

15.1.3.162 ftrsm() [6/9]

```
void ftrsm (
    const Field & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
```



```

const FFLAS_DIAG Diag,
const size_t M,
const size_t N,
const typename Field::Element alpha,
typename Field::ConstElement_ptr A,
const size_t lda,
typename Field::Element_ptr B,
const size_t ldb )

```

ftsm: **T**riangular **S**ystem solve with **M**atrix.

Computes $B \leftarrow \alpha \text{op}(A^{-1})B$ or $B \leftarrow \alpha B \text{op}(A^{-1})$.

Parameters

<i>F</i>	field
<i>Side</i>	if Side==FflasLeft then $B \leftarrow \alpha \text{op}(A^{-1})B$ is computed.
<i>Uplo</i>	if Uplo==FflasUpper then A is upper triangular
<i>TransA</i>	if TransA==FflasTrans then $\text{op}(A) = A^t$.
<i>Diag</i>	if Diag==FflasUnit then A is unit.
<i>M</i>	rows of B
<i>N</i>	cols of B
<i>alpha</i>	scalar
<i>A</i>	triangular invertible matrix. If Side==FflasLeft then A is $N \times N$, otherwise A is $M \times M$
<i>lda</i>	leading dim of A
<i>B</i>	matrix of size MxN
<i>ldb</i>	leading dim of B

Bug α must be non zero.

15.1.3.163 pfgemm() [1/7]

```

Field::Element_ptr pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    size_t numthreads = 0 )

```

15.1.3.164 pfgemm_1D_rec()

```
Field::Element * pfgemm_1D_rec (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element * C,
    const size_t ldc,
    size_t seuil )
```

15.1.3.165 pfgemm_2D_rec()

```
Field::Element * pfgemm_2D_rec (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element * C,
    const size_t ldc,
    size_t seuil )
```

15.1.3.166 pfgemm_3D_rec()

```
Field::Element * pfgemm_3D_rec (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
```

```

const typename Field::Element_ptr B,
const size_t ldb,
const typename Field::Element beta,
typename Field::Element_ptr C,
const size_t ldc,
size_t seuil,
size_t * x )

```

15.1.3.167 pfgemm_3D_rec2()

```

Field::Element_ptr pfgemm_3D_rec2 (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    size_t seuil,
    size_t * x )

```

15.1.3.168 fgemm() [19/23]

```

std::enable_if<!std::is_same< ModeTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag
> >::value, typename Field::Element_ptr >::type fgemm (
    const Field & F,
    const FFLAS::FFLAS_TRANSPOSE ta,
    const FFLAS::FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, ModeTrait, ParSeqHelper::Parallel< Strat,
Param > > & H ) [inline]

```

15.1.3.169 ftrsm() [7/9]

```
Field::Element_ptr ftrsm (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_UPLO UpLo,
    const FFLAS::FFLAS_TRANSPOSE TA,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    TRSMHelper< StructureHelper::Iterative, ParSeqHelper::Parallel< Cut, Param > > &
    H ) [inline]
```

15.1.3.170 ftrsm() [8/9]

```
Field::Element_ptr ftrsm (
    const Field & F,
    const FFLAS::FFLAS_SIDE Side,
    const FFLAS::FFLAS_UPLO UpLo,
    const FFLAS::FFLAS_TRANSPOSE TA,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    TRSMHelper< StructureHelper::Hybrid, ParSeqHelper::Parallel< Cut, Param > > & H
) [inline]
```

15.1.3.171 fspmv() [1/2]

```
void fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    const typename Field::Element & beta,
    typename Field::Element_ptr y ) [inline]
```

15.1.3.172 fspmm()

```
void fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    const typename Field::Element & beta,
    typename Field::Element_ptr y,
    int ldy ) [inline]
```

15.1.3.173 sparse_init() [1/16]

```
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::COO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.174 sparse_init() [2/16]

```
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::COO_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.175 sparse_delete() [1/12]

```
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::COO > & A ) [inline]
```

15.1.3.176 sparse_delete() [2/12]

```
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::COO_ZO > & A ) [inline]
```

15.1.3.177 sparse_init() [3/16]

```
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::CSR > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.178 sparse_init() [4/16]

```
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.179 sparse_delete() [3/12]

```
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::CSR > & A ) [inline]
```

15.1.3.180 sparse_delete() [4/12]

```
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::CSR_ZO > & A ) [inline]
```

15.1.3.181 sparse_print() [1/3]

```
std::ostream & sparse_print (
    std::ostream & os,
    const Sparse< Field, SparseMatrix_t::CSR > & A ) [inline]
```

15.1.3.182 sparse_init() [5/16]

```
void sparse_init (
    const Givaro::Modular< Givaro::Integer > & F,
    Sparse< Givaro::Modular< Givaro::Integer >, SparseMatrix_t::CSR > & A,
    const IndexT * row,
    const IndexT * col,
    Givaro::Integer * dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.183 sparse_init() [6/16]

```
void sparse_init (
    const Givaro::ZRing< Givaro::Integer > & F,
    Sparse< Givaro::ZRing< Givaro::Integer >, SparseMatrix_t::CSR_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    Givaro::Integer * dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.184 sparse_init() [7/16]

```
void sparse_init (
    const Givaro::ZRing< RecInt::rmint< RECINT_SIZE > > & F,
    Sparse< Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >, SparseMatrix_t::CSR_ZO >
& A,
    const IndexT * row,
    const IndexT * col,
    typename Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >::Element_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.185 sparse_init() [8/16]

```

void sparse_init (
    const Givaro::ZRing< RecInt::rmint< RECINT_SIZE > > & F,
    Sparse< Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >, SparseMatrix_t::CSR > &
A,

    const IndexT * row,
    const IndexT * col,
    typename Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >::Element_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]

```

15.1.3.186 sparse_delete() [5/12]

```

void sparse_delete (
    const Sparse< Field, SparseMatrix_t::CSR_HYB > & A ) [inline]

```

15.1.3.187 sparse_init() [9/16]

```

void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]

```

15.1.3.188 sparse_init() [10/16]

```

void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::ELL > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]

```


15.1.3.189 sparse_init() [11/16]

```
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.190 sparse_delete() [6/12]

```
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::ELL > & A ) [inline]
```

15.1.3.191 sparse_delete() [7/12]

```
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::ELL_ZO > & A ) [inline]
```

15.1.3.192 sparse_init() [12/16]

```
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::ELL_simd > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.193 sparse_init() [13/16]

```
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.194 sparse_delete() [8/12]

```
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A ) [inline]
```

15.1.3.195 sparse_delete() [9/12]

```
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A ) [inline]
```

15.1.3.196 sparse_print() [2/3]

```
void sparse_print (
    const Sparse< Field, SparseMatrix_t::ELL_simd > & A ) [inline]
```

15.1.3.197 sparse_delete() [10/12]

```
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::HYB_ZO > & A ) [inline]
```

15.1.3.198 sparse_init() [14/16]

```
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.199 operator<<()

```
std::ostream & operator<< (
    std::ostream & os,
    const Sparse< _Field, SparseMatrix_t::HYB_ZO > & A )
```

15.1.3.200 readSmsFormat()

```
void readSmsFormat (
    const std::string & path,
    const Field & f,
    index_t *& row,
    index_t *& col,
    typename Field::Element_ptr & val,
    index_t & rowdim,
    index_t & coldim,
    uint64_t & nnz )
```

15.1.3.201 readSprFormat()

```
void readSprFormat (
    const std::string & path,
    const Field & f,
    index_t *& row,
    index_t *& col,
    typename Field::Element_ptr & val,
    index_t & rowdim,
    index_t & coldim,
    uint64_t & nnz )
```

15.1.3.202 getDataType() [1/4]

```
std::enable_if< std::is_integral< T >::value, int > getDataType ( )
```

15.1.3.203 getDataType() [2/4]

```
std::enable_if< std::is_floating_point< T >::value, int > getDataType ( )
```

15.1.3.204 getDataType() [3/4]

```
std::enable_if< std::is_same< T, mpz_t >::value, int > getDataType ( )
```

15.1.3.205 getDataType() [4/4]

```
int getDataType ( )
```

15.1.3.206 readMachineType()

```
void readMachineType (
    const Field & F,
    typename Field::Element & modulo,
    typename Field::Element_ptr val,
    std::ifstream & file,
    const uint64_t dims,
    const mask_t data_type,
    const mask_t field_desc )
```

15.1.3.207 readDnsFormat()

```
void readDnsFormat (
    const std::string & path,
    const Field & F,
    index_t & rowdim,
    index_t & coldim,
    typename Field::Element_ptr & val )
```

15.1.3.208 writeDnsFormat()

```
void writeDnsFormat (
    const std::string & path,
    const Field & F,
    const index_t & rowdim,
    const index_t & coldim,
    typename Field::Element_ptr A,
    index_t ldA )
```

15.1.3.209 fspmv() [2/2]

```
void fspmv (
    const Field & F,
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ) [inline]
```

15.1.3.210 sparse_delete() [11/12]

```
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::SELL > & A ) [inline]
```

15.1.3.211 sparse_delete() [12/12]

```
void sparse_delete (
    const Sparse< Field, SparseMatrix_t::SELL_ZO > & A ) [inline]
```

15.1.3.212 sparse_print() [3/3]

```
void sparse_print (
    const Sparse< Field, SparseMatrix_t::SELL > & A ) [inline]
```

15.1.3.213 sparse_init() [15/16]

```
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::SELL > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz,
    uint64_t sigma = 0 ) [inline]
```

15.1.3.214 sparse_init() [16/16]

```
void sparse_init (
    const Field & F,
    Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
    const IndexT * row,
    const IndexT * col,
    typename Field::ConstElement_ptr dat,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz ) [inline]
```

15.1.3.215 computeDeviation()

```
double computeDeviation (
    It begin,
    It end )
```

15.1.3.216 getStat()

```
StatsMatrix getStat (
    const Field & F,
    const index_t * row,
    const index_t * col,
    typename Field::ConstElement_ptr val,
    uint64_t rowdim,
    uint64_t coldim,
    uint64_t nnz )
```

15.1.3.217 fflas_delete() [1/4]

```
void fflas_delete (
    FFPACK::rns_double_elt_ptr A ) [inline]
```

15.1.3.218 fflas_delete() [2/4]

```
void fflas_delete (
    FFPACK::rns_double_elt_cstptr A ) [inline]
```

15.1.3.219 fflas_new() [1/7]

```
FFPACK::rns_double_elt_ptr fflas_new (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t m,
    const Alignment align ) [inline]
```

15.1.3.220 fflas_new() [2/7]

```
FFPACK::rns_double_elt_ptr fflas_new (
    const FFPACK::RNSIntegerMod< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const Alignment align ) [inline]
```

15.1.3.221 finit_rns() [1/2]

```
void finit_rns (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const size_t m,
    const size_t n,
    size_t k,
    const Givaro::Integer * B,
    const size_t ldb,
    typename RNS::Element_ptr A )
```

15.1.3.222 finit_trans_rns()

```
void finit_trans_rns (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const size_t m,
    const size_t n,
    size_t k,
    const Givaro::Integer * B,
    const size_t ldb,
    typename RNS::Element_ptr A )
```

15.1.3.223 fconvert_rns() [1/2]

```
void fconvert_rns (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const size_t m,
    const size_t n,
    Givaro::Integer alpha,
    Givaro::Integer * B,
    const size_t ldb,
    typename RNS::ConstElement_ptr A )
```

15.1.3.224 fconvert_trans_rns()

```
void fconvert_trans_rns (
    const FFPACK::RNSIntegerMod< RNS > & F,
    const size_t m,
    const size_t n,
    Givaro::Integer alpha,
    Givaro::Integer * B,
    const size_t ldb,
    typename RNS::ConstElement_ptr A )
```

15.1.3.225 fflas_new() [3/7]

```
FFPACK::rns_double_elt_ptr fflas_new (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t m,
    const Alignment align ) [inline]
```

15.1.3.226 fflas_new() [4/7]

```
FFPACK::rns_double_elt_ptr fflas_new (
    const FFPACK::RNSInteger< FFPACK::rns_double > & F,
    const size_t m,
    const size_t n,
    const Alignment align ) [inline]
```

15.1.3.227 finit_rns() [2/2]

```
void finit_rns (
    const FFPACK::RNSInteger< RNS > & F,
    const size_t m,
    const size_t n,
    size_t k,
    const Givaro::Integer * B,
    const size_t ldb,
    typename FFPACK::RNSInteger< RNS >::Element_ptr A )
```

15.1.3.228 fconvert_rns() [2/2]

```
void fconvert_rns (
    const FFPACK::RNSInteger< RNS > & F,
    const size_t m,
    const size_t n,
    Givaro::Integer alpha,
    Givaro::Integer * B,
    const size_t ldb,
    typename FFPACK::RNSInteger< RNS >::ConstElement_ptr A )
```

15.1.3.229 freduce() [7/10]

```
template INST_OR_DECL void freduce (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    FFLAS_ELT * X,
    const size_t incX )
```

freduce $x \leftarrow x \bmod F$.

Parameters

F	field
n	size of the vectors
X	vector in F
$incX$	stride of X

Bug use `cblas_(d)scal` when possible

15.1.3.230 `freduce()` [8/10]

```
template INST_OR_DECL void freduce (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT * Y,
    const size_t incY,
    FFLAS_ELT * X,
    const size_t incX )
```

`freduce` $x \leftarrow y \bmod F$.

Parameters

F	field
n	size of the vectors
Y	vector of Element
$incY$	stride of Y
X	vector in F
$incX$	stride of X

Bug use `cblas_(d)scal` when possible

15.1.3.231 `finit()` [7/8]

```
template INST_OR_DECL void finit (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT * Y,
    const size_t incY,
    FFLAS_ELT * X,
    const size_t incX )
```

`finit` $x \leftarrow y \bmod F$.

Parameters

F	field
n	size of the vectors
Y	vector of OtherElement
$incY$	stride of Y
X	vector in F
$incX$	stride of X

Bug use `cblas_(d)scal` when possible

15.1.3.232 `fconvert()` [3/3]

```
template INST_OR_DECL void fconvert (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    FFLAS_ELT * X,
    const size_t incX,
    const FFLAS_ELT * Y,
    const size_t incY )
```

`fconvert` $x \leftarrow y \bmod F$.

Parameters

F	field
n	size of the vectors
Y	vector of F
$incY$	stride of Y
X	vector in OtherElement
$incX$	stride of X

Bug use `cblas_(d)scal` when possible

15.1.3.233 `fnegin()` [3/4]

```
template INST_OR_DECL void fnegin (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    FFLAS_ELT * X,
    const size_t incX )
```

`fnegin` $x \leftarrow -x$.

Parameters

F	field
n	size of the vectors
X	vector in F
$incX$	stride of X

Bug use `cblas_(d)scal` when possible

15.1.3.234 `fneg()` [3/4]

```
template INST_OR_DECL void fneg (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT * Y,
    const size_t incY,
    FFLAS_ELT * X,
    const size_t incX )
```

`fneg` $x \leftarrow -y$.

Parameters

F	field
n	size of the vectors
X	vector in F
$incX$	stride of X
Y	vector in F
$incY$	stride of Y

Bug use `cblas_(d)scal` when possible

15.1.3.235 `fzero()` [3/4]

```
template INST_OR_DECL void fzero (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    FFLAS_ELT * X,
    const size_t incX )
```

`fzero` : $A \leftarrow 0$.

Parameters

F	field
n	number of elements to zero
X	vector in F
$incX$	stride of X

15.1.3.236 fiszero() [3/4]

```
template INST_OR_DECL bool fiszero (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT * X,
    const size_t incX )
```

fiszero : test $X = 0$.

Parameters

F	field
n	vector dimension
X	vector in F
$incX$	increment of X

15.1.3.237 fequal() [3/4]

```
template INST_OR_DECL bool fequal (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT * X,
    const size_t incX,
    const FFLAS_ELT * Y,
    const size_t incY )
```

fequal : test $X = Y$.

Parameters

F	field
n	vector dimension
X	vector in F
$incX$	increment of X
Y	vector in F
$incY$	increment of Y

15.1.3.238 fassign() [9/10]

```
template INST_OR_DECL void fassign (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * Y,
    const size_t incY,
    FFLAS_ELT * X,
    const size_t incX )
```

fassign : $x \leftarrow y$.

X is preallocated

Todo variant for triagular matrix

Parameters

	F	field
	N	size of the vectors
out	X	vector in F
	$incX$	stride of X
in	Y	vector in F
	$incY$	stride of Y

15.1.3.239 fscaln() [9/10]

```
template INST_OR_DECL void fscaln (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT alpha,
    FFLAS_ELT * X,
    const size_t incX )
```

fscaln $x \leftarrow \alpha \cdot x$.

Parameters

F	field
n	size of the vectors
$alpha$	scalar
X	vector in F
$incX$	stride of X

Bug use cblas_(d)scal when possible

Todo check if comparison with +/-1,0 is necessary.

15.1.3.240 fscal() [9/10]

```
template INST_OR_DECL void fscal (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t n,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * X,
    const size_t incX,
    FFLAS_ELT * Y,
    const size_t incY )
```

fscal $y \leftarrow \alpha \cdot x$.

Parameters

	F	field
	n	size of the vectors
	α	scalar
in	X	vector in F
	$incX$	stride of X
out	Y	vector in F
	$incY$	stride of Y

Bug use cblas_(d)scal when possible

Todo check if comparison with +/-1,0 is necessary.

15.1.3.241 faxpy() [5/6]

```
template INST_OR_DECL void faxpy (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * X,
    const size_t incX,
    FFLAS_ELT * Y,
    const size_t incY )
```

faxpy : $y \leftarrow \alpha \cdot x + y$.

Parameters

	F	field
	N	size of the vectors
	α	scalar
in	X	vector in F
	$incX$	stride of X
in, out	Y	vector in F
	$incY$	stride of Y

15.1.3.242 fdot() [10/11]

```
template INST_OR_DECL FFLAS_ELT fdot (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * X,
    const size_t incX,
    const FFLAS_ELT * Y,
    const size_t incY )
```

faxpby : $y \leftarrow \alpha \cdot x + \beta \cdot y$.

Parameters

	F	field
	N	size of the vectors
	α	scalar
in	X	vector in F
	$incX$	stride of X
	β	scalar
in, out	Y	vector in F
	$incY$	stride of Y

Note

this is a catlas function

fdot: dot product $x^T y$.

Parameters

F	field
N	size of the vectors
X	vector in F
$incX$	stride of X
Y	vector in F
$incY$	stride of Y

15.1.3.243 fswap() [2/2]

```
template INST_OR_DECL void fswap (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    FFLAS_ELT * X,
    const size_t incX,
```

```

FFLAS_ELT * Y,
const size_t incY )

```

fswap: $X \leftrightarrow Y$.

Bug use cblas_dswap when double

Parameters

F	field
N	size of the vectors
X	vector in F
$incX$	stride of X
Y	vector in F
$incY$	stride of Y

15.1.3.244 fadd() [5/8]

```

template INST_OR_DECL void fadd (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t inca,
    const FFLAS_ELT * B,
    const size_t incb,
    FFLAS_ELT * C,
    const size_t incc )

```

15.1.3.245 fsub() [3/4]

```

template INST_OR_DECL void fsub (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t inca,
    const FFLAS_ELT * B,
    const size_t incb,
    FFLAS_ELT * C,
    const size_t incc )

```


15.1.3.246 faddin() [3/4]

```
template INST_OR_DECL void faddin (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * B,
    const size_t incb,
    FFLAS_ELT * C,
    const size_t incc )
```

15.1.3.247 fadd() [6/8]

```
template INST_OR_DECL void fadd (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t inca,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * B,
    const size_t incb,
    FFLAS_ELT * C,
    const size_t incc )
```

15.1.3.248 fassign() [10/10]

```
template INST_OR_DECL void fassign (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * A,
    const size_t lda )
```

fassign : $A \leftarrow B$.

Parameters

F	field
m	number of rows to copy
n	number of cols to copy
A	matrix in F
lda	stride of A
B	vector in F
ldb	stride of B

15.1.3.249 fzero() [4/4]

```
template INST_OR_DECL void fzero (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda )
```

fzero : $A \leftarrow 0$.

Parameters

F	field
m	number of rows to zero
n	number of cols to zero
A	matrix in F
lda	stride of A

Warning

may be buggy if Element is larger than int

15.1.3.250 fequal() [4/4]

```
template INST_OR_DECL bool fequal (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb )
```

fequal : test $A = B$.

Parameters

F	field
m	row dimension
n	column dimension
A	m x n matrix in F
lda	leading dimension of A
B	m x n matrix in F
ldb	leading dimension of B

15.1.3.251 fiszero() [4/4]

```
template INST_OR_DECL bool fiszero (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * A,
    const size_t lda )
```

fiszero : test $A = 0$.

Parameters

F	field
m	row dimension
n	column dimension
A	m x n matrix in F
lda	leading dimension of A

15.1.3.252 fidentity() [3/4]

```
template INST_OR_DECL void fidentity (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT & d )
```

creates a diagonal matrix

15.1.3.253 fidentity() [4/4]

```
template INST_OR_DECL void fidentity (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda )
```

creates a diagonal matrix

15.1.3.254 freduce() [9/10]

```
template INST_OR_DECL void freduce (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda )
```

freduce $A \leftarrow A \bmod F$.

Parameters

F	field
m	number of rows
n	number of cols
A	matrix in F
lda	stride of A

15.1.3.255 freduce() [10/10]

```
template INST_OR_DECL void freduce (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * A,
    const size_t lda )
```

$\text{freduce } A \leftarrow B \bmod F.$

Parameters

F	field
m	number of rows
n	number of cols
A	matrix in F
lda	stride of A
B	matrix in Element
ldb	stride of B

15.1.3.256 finit() [8/8]

```
template INST_OR_DECL void finit (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * A,
    const size_t lda )
```

$\text{finit } A \leftarrow B \bmod F.$

Parameters

F	field
-----	-------

Parameters

m	number of rows
n	number of cols
A	matrix in F
lda	stride of A
B	matrix in F
ldb	stride of B

15.1.3.257 fnegin() [4/4]

```
template INST_OR_DECL void fnegin (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda )
```

$\text{fnegin } A \leftarrow -A.$

Parameters

F	field
m	number of rows
n	number of cols
A	matrix in F
lda	stride of A

15.1.3.258 fneg() [4/4]

```
template INST_OR_DECL void fneg (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * A,
    const size_t lda )
```

$\text{fneg } A \leftarrow -B.$

Parameters

F	field
m	number of rows
n	number of cols
A	matrix in F
lda	stride of A

15.1.3.259 fscaln() [10/10]

```
template INST_OR_DECL void fscaln (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT alpha,
    FFLAS_ELT * A,
    const size_t lda )
```

$\text{fscaln } A \leftarrow a \cdot A.$

Parameters

F	field
m	number of rows
n	number of cols
α	homotecie scalar
A	matrix in F
lda	stride of A

15.1.3.260 fscal() [10/10]

```
template INST_OR_DECL void fscal (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * B,
    const size_t ldb )
```

$\text{fscal } B \leftarrow a \cdot A.$

Parameters

	F	field
	m	number of rows
	n	number of cols
	α	homotecie scalar
in	A	matrix in F
	lda	stride of A
out	B	matrix in F
	ldb	stride of B

15.1.3.261 faxpy() [6/6]

```
template INST_OR_DECL void faxpy (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * X,
    const size_t ldx,
    FFLAS_ELT * Y,
    const size_t ldy )
```

$\text{faxpy} : y \leftarrow \alpha \cdot x + y.$

Parameters

	F	field
	m	row dimension
	n	column dimension
	α	scalar
in	X	vector in F
	ldx	leading dimension of X
in, out	Y	vector in F
	ldy	leading dimension of Y

15.1.3.262 fmove() [2/2]

```
template INST_OR_DECL void fmove (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t m,
    const size_t n,
    FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * B,
    const size_t ldb )
```

$\text{faxpby} : y \leftarrow \alpha \cdot x + \beta \cdot y.$

Parameters

	F	field
	m	row dimension
	n	column dimension
	α	scalar
in	X	vector in F
	ldx	leading dimension of X
	β	scalar
in, out	Y	vector in F
	ldy	leading dimension of Y

Note

this is a catlas function

$\text{fmove} : A \leftarrow B \text{ and } B \leftarrow 0.$

Parameters

F	field
m	number of rows to copy
n	number of cols to copy
A	matrix in F
lda	stride of A
B	vector in F
ldb	stride of B

15.1.3.263 fadd() [7/8]

```
template INST_OR_DECL void fadd (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * C,
    const size_t ldc )
```

fadd : matrix addition.

Computes $C = A + B$.

Parameters

F	field
M	rows
N	cols
A	dense matrix of size $M \times N$
lda	leading dimension of A
B	dense matrix of size $M \times N$
ldb	leading dimension of B
C	dense matrix of size $M \times N$
ldc	leading dimension of C

15.1.3.264 fsub() [4/4]

```
template INST_OR_DECL void fsub (
```



```

    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * C,
    const size_t ldc )

```

fsub : matrix subtraction.

Computes $C = A - B$.

Parameters

<i>F</i>	field
<i>M</i>	rows
<i>N</i>	cols
<i>A</i>	dense matrix of size MxN
<i>lda</i>	leading dimension of A
<i>B</i>	dense matrix of size MxN
<i>ldb</i>	leading dimension of B
<i>C</i>	dense matrix of size MxN
<i>ldc</i>	leading dimension of C

15.1.3.265 fsubin() [3/3]

```

template INST_OR_DECL void fsubin (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * C,
    const size_t ldc )

```

fsubin $C = C - B$

15.1.3.266 fadd() [8/8]

```

template INST_OR_DECL void fadd (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT alpha,

```

```

    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * C,
    const size_t ldc )

```

fadd : matrix addition with scaling.

Computes $C = A + \alpha B$.

Parameters

<i>F</i>	field
<i>M</i>	rows
<i>N</i>	cols
<i>A</i>	dense matrix of size MxN
<i>lda</i>	leading dimension of A
<i>alpha</i>	some scalar
<i>B</i>	dense matrix of size MxN
<i>ldb</i>	leading dimension of B
<i>C</i>	dense matrix of size MxN
<i>ldc</i>	leading dimension of C

15.1.3.267 faddin() [4/4]

```

template INST_OR_DECL void faddin (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT * B,
    const size_t ldb,
    FFLAS_ELT * C,
    const size_t ldc )

```

faddin

15.1.3.268 fgemv() [17/19]

```

template INST_OR_DECL FFLAS_ELT * fgemv (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_TRANSPOSE TransA,
    const size_t M,
    const size_t N,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * X,
    const size_t incX,
    const FFLAS_ELT beta,

```

```
FFLAS_ELT * Y,  
const size_t incY )
```

finite prime FFLAS_FIELD<FFLAS_ELT> GEneral Matrix Vector multiplication.

Computes $Y \leftarrow \alpha \text{op}(A)X + \beta Y$.

Parameters

	<i>F</i>	field
	<i>TransA</i>	if <code>TransA==FflasTrans</code> then $\text{op}(A) = A^t$.
	<i>M</i>	rows
	<i>N</i>	cols
	<i>alpha</i>	scalar
	<i>A</i>	dense matrix of size MxN
	<i>lda</i>	leading dimension of A
	<i>X</i>	dense vector of size N
	<i>incX</i>	stride of X
	<i>beta</i>	scalar
out	<i>Y</i>	dense vector of size M
	<i>incY</i>	stride of Y

15.1.3.269 fger() [12/12]

```
template INST_OR_DECL void fger (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const size_t M,
    const size_t N,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * x,
    const size_t incx,
    const FFLAS_ELT * y,
    const size_t incy,
    FFLAS_ELT * A,
    const size_t lda )
```

fger: rank one update of a general matrix

Computes $A \leftarrow \alpha x y^T + A$

Parameters

	<i>F</i>	field
	<i>M</i>	rows
	<i>N</i>	cols
	<i>alpha</i>	scalar
in, out	<i>A</i>	dense matrix of size MxN and leading dimension lda
	<i>lda</i>	leading dimension of A
	<i>x</i>	dense vector of size M
	<i>incx</i>	stride of X
	<i>y</i>	dense vector of size N
	<i>incy</i>	stride of Y

15.1.3.270 ftrsv() [2/2]

```
template INST_OR_DECL void ftrsv (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t N,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * X,
    int incX )
```

ftrsv: **TR**angular System solve with Vector Computes $X \leftarrow \text{op}(A^{-1})X$

Parameters

<i>F</i>	field
<i>X</i>	vector of size N on a field F
<i>incX</i>	stride of X
<i>A</i>	a matrix of leading dimension lda and size N
<i>lda</i>	leading dimension of A
<i>N</i>	number of rows or columns of A according to TransA
<i>TransA</i>	if TransA==FflasTrans then $\text{op}(A) = A^t$.
<i>Diag</i>	if Diag==FflasUnit then A is unit.
<i>Uplo</i>	if Uplo==FflasUpper then A is upper triangular

15.1.3.271 ftrsm() [9/9]

```
template INST_OR_DECL void ftrsm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * B,
    const size_t ldb )
```

ftrsm: **TR**angular System solve with **M**atrix.

Computes $B \leftarrow \alpha \text{op}(A^{-1})B$ or $B \leftarrow \alpha B \text{op}(A^{-1})$.

Parameters

<i>F</i>	field
<i>Side</i>	if Side==FflasLeft then $B \leftarrow \alpha \text{op}(A^{-1})B$ is computed.

Parameters

<i>Uplo</i>	if <code>Uplo==FflasUpper</code> then A is upper triangular
<i>TransA</i>	if <code>TransA==FflasTrans</code> then $\text{op}(A) = A^t$.
<i>Diag</i>	if <code>Diag==FflasUnit</code> then A is unit.
<i>M</i>	rows of B
<i>N</i>	cols of B
<i>alpha</i>	scalar
<i>A</i>	triangular invertible matrix. If <code>Side==FflasLeft</code> then A is $N \times N$, otherwise A is $M \times M$
<i>lda</i>	leading dim of A
<i>B</i>	matrix of size MxN
<i>ldb</i>	leading dim of B

Bug α must be non zero.

15.1.3.272 `ftmrm()` [3/3]

```
template INST_OR_DECL void ftmrm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_SIDE Side,
    const FFLAS_UPLO Uplo,
    const FFLAS_TRANSPOSE TransA,
    const FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    FFLAS_ELT * B,
    const size_t ldb )
```

`ftmrm`: **TR**iangular **M**atrix **M**ultiply.

Computes $B \leftarrow \alpha \text{op}(A)B$ or $B \leftarrow \alpha B \text{op}(A)$.

Parameters

<i>F</i>	field
<i>Side</i>	if <code>Side==FflasLeft</code> then $B \leftarrow \alpha \text{op}(A)B$ is computed.
<i>Uplo</i>	if <code>Uplo==FflasUpper</code> then A is upper triangular
<i>TransA</i>	if <code>TransA==FflasTrans</code> then $\text{op}(A) = A^t$.
<i>Diag</i>	if <code>Diag==FflasUnit</code> then A is implicitly unit.
<i>M</i>	rows of B
<i>N</i>	cols of B
<i>alpha</i>	scalar
<i>A</i>	triangular matrix. If <code>Side==FflasLeft</code> then A is $N \times N$, otherwise A is $M \times M$
<i>lda</i>	leading dim of A
<i>B</i>	matrix of size MxN
<i>ldb</i>	leading dim of B

15.1.3.273 fgemm() [20/23]

```
template INST_OR_DECL FFLAS_ELT * fgemm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb,
    const FFLAS_ELT beta,
    FFLAS_ELT * C,
    const size_t ldc )
```

fgemm: **F**ield **G**eneral **M**atrix **M**ultiply.

Computes $C = \alpha \text{op}(A) \times \text{op}(B) + \beta C$ Automatically set Winograd recursion level

Parameters

<i>F</i>	field.
<i>ta</i>	if <code>ta==FflasTrans</code> then $\text{op}(A) = A^t$, else $\text{op}(A) = A$,
<i>tb</i>	same for matrix B
<i>m</i>	see A
<i>n</i>	see B
<i>k</i>	see A
<i>alpha</i>	scalar
<i>beta</i>	scalar
<i>A</i>	$\text{op}(A)$ is $m \times k$
<i>B</i>	$\text{op}(B)$ is $k \times n$
<i>C</i>	C is $m \times n$
<i>lda</i>	leading dimension of A
<i>ldb</i>	leading dimension of B
<i>ldc</i>	leading dimension of C
<i>w</i>	recursive levels of Winograd's algorithm are used. No argument (or -1) does auto computation of w .

Warning

α must be invertible

15.1.3.274 fgemm() [21/23]

```
template INST_OR_DECL FFLAS_ELT * fgemm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
```

```

const FFLAS_TRANSPOSE ta,
const FFLAS_TRANSPOSE tb,
const size_t m,
const size_t n,
const size_t k,
const FFLAS_ELT alpha,
const FFLAS_ELT * A,
const size_t lda,
const FFLAS_ELT * B,
const size_t ldb,
const FFLAS_ELT beta,
FFLAS_ELT * C,
const size_t ldc,
const ParSeqHelper::Sequential seq )

```

15.1.3.275 fgemm() [22/23]

```

template INST_OR_DECL FFLAS_ELT * fgemm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb,
    const FFLAS_ELT beta,
    FFLAS_ELT * C,
    const size_t ldc,
    const ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoDAdaptive
> par )

```

15.1.3.276 fgemm() [23/23]

```

template INST_OR_DECL FFLAS_ELT * fgemm (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT * B,
    const size_t ldb,
    const FFLAS_ELT beta,
    FFLAS_ELT * C,

```



```

        const size_t ldc,
        const ParSeqHelper::Parallel< CuttingStrategy::Block, StrategyParameter::Threads
> par )

```

15.1.3.277 fsquare() [6/6]

```

template INST_OR_DECL FFLAS_ELT * fsquare (
    const FFLAS_FIELD< FFLAS_ELT > & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const FFLAS_ELT alpha,
    const FFLAS_ELT * A,
    const size_t lda,
    const FFLAS_ELT beta,
    FFLAS_ELT * C,
    const size_t ldc )

```

fsquare: Squares a matrix.

compute $C \leftarrow \alpha \text{op}(A) \text{op}(A) + \beta C$ over a FFLAS_FIELD <FFLAS_ELT> F Avoid the conversion of B

Parameters

<i>ta</i>	if ta==FflasTrans, $\text{op}(A) = A^T$.
<i>F</i>	field
<i>n</i>	size of A
<i>alpha</i>	scalar
<i>beta</i>	scalar
<i>A</i>	dense matrix of size $n \times n$
<i>lda</i>	leading dimension of A
<i>C</i>	dense matrix of size $n \times n$
<i>ldc</i>	leading dimension of C

15.1.3.278 BlockCuts() [1/2]

```

void BlockCuts (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads ) [inline]

```

15.1.3.279 BlockCuts< CuttingStrategy::Single, StrategyParameter::Threads >()

```
void BlockCuts< CuttingStrategy::Single, StrategyParameter::Threads > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads ) [inline]
```

15.1.3.280 BlockCuts< CuttingStrategy::Row, StrategyParameter::Fixed >()

```
void BlockCuts< CuttingStrategy::Row, StrategyParameter::Fixed > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads ) [inline]
```

15.1.3.281 BlockCuts< CuttingStrategy::Row, StrategyParameter::Grain >()

```
void BlockCuts< CuttingStrategy::Row, StrategyParameter::Grain > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t grainsize ) [inline]
```

15.1.3.282 BlockCuts< CuttingStrategy::Block, StrategyParameter::Grain >()

```
void BlockCuts< CuttingStrategy::Block, StrategyParameter::Grain > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t grainsize ) [inline]
```

15.1.3.283 BlockCuts< CuttingStrategy::Column, StrategyParameter::Fixed >()

```
void BlockCuts< CuttingStrategy::Column, StrategyParameter::Fixed > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads ) [inline]
```

15.1.3.284 BlockCuts< CuttingStrategy::Column, StrategyParameter::Grain >()

```
void BlockCuts< CuttingStrategy::Column, StrategyParameter::Grain > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t grainsize ) [inline]
```

15.1.3.285 BlockCuts< CuttingStrategy::Block, StrategyParameter::Fixed >()

```
void BlockCuts< CuttingStrategy::Block, StrategyParameter::Fixed > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads ) [inline]
```

15.1.3.286 BlockCuts< CuttingStrategy::Row, StrategyParameter::Threads >()

```
void BlockCuts< CuttingStrategy::Row, StrategyParameter::Threads > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads ) [inline]
```

15.1.3.287 BlockCuts< CuttingStrategy::Column, StrategyParameter::Threads >()

```
void BlockCuts< CuttingStrategy::Column, StrategyParameter::Threads > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads ) [inline]
```

15.1.3.288 BlockCuts< CuttingStrategy::Block, StrategyParameter::Threads >()

```
void BlockCuts< CuttingStrategy::Block, StrategyParameter::Threads > (
    size_t & RBLOCKSIZE,
    size_t & CBLOCKSIZE,
    const size_t m,
    const size_t n,
    const size_t numthreads ) [inline]
```

15.1.3.289 BlockCuts() [2/2]

```

void BlockCuts (
    size_t & rowBlockSize,
    size_t & colBlockSize,
    size_t & lastRBS,
    size_t & lastCBS,
    size_t & changeRBS,
    size_t & changeCBS,
    size_t & numRowsBlock,
    size_t & numColBlock,
    size_t m,
    size_t n,
    const size_t numthreads ) [inline]

```

15.1.3.290 pfzero()

```

void pfzero (
    const Field & F,
    size_t m,
    size_t n,
    typename Field::Element_ptr C,
    size_t BS = 0 )

```

15.1.3.291 pfrand()

```

void pfrand (
    const Field & F,
    RandIter & G,
    size_t m,
    size_t n,
    typename Field::Element_ptr C,
    size_t BS = 0 )

```

15.1.3.292 fdot() [11/11]

```

Field::Element & fdot (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element & d,
    const ParSeqHelper::Parallel< Cut, Param > par ) [inline]

```

15.1.3.293 pfgemm() [2/7]

```
Field::Element * pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element * C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Block,
StrategyParameter::Threads > > & H )
```

15.1.3.294 pfgemm() [3/7]

```
Field::Element * pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr AA,
    const size_t lda,
    const typename Field::ConstElement_ptr BB,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element * C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::ThreeDAdaptive > > & H )
```

15.1.3.295 pfgemm() [4/7]

```
Field::Element * pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
```

```

    const typename Field::ConstElement_ptr AA,
    const size_t lda,
    const typename Field::ConstElement_ptr BB,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element * C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::TwoDAdaptive > > & H )

```

15.1.3.296 pfgemm() [5/7]

```

Field::Element * pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr AA,
    const size_t lda,
    const typename Field::ConstElement_ptr BB,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element * C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::TwoD > > & H )

```

15.1.3.297 pfgemm() [6/7]

```

Field::Element_ptr pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::ThreeD > > & H )

```

15.1.3.298 pfgemm() [7/7]

```
Field::Element * pfgemm (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::ThreeDInPlace > > & H )
```

15.1.3.299 fgemv() [18/19]

```
Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive,
StrategyParameter::Threads > > & H )
```

15.1.3.300 fgemv() [19/19]

```
Field::Element_ptr fgemv (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::ConstElement_ptr X,
    const size_t incX,
```

```

    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY,
    MMHelper< Field, AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Row,
Cut > > & H )

```

15.1.3.301 parseArguments()

```

void parseArguments (
    int argc,
    char ** argv,
    Argument * args,
    bool printDefaults = true )

```

15.1.3.302 writeCommandString()

```

std::ostream & writeCommandString (
    std::ostream & os,
    Argument * args,
    const char * programName = nullptr )

```

writes the values of all arguments, preceded by the programName

15.1.3.303 WriteMatrix() [1/2]

```

std::ostream & WriteMatrix (
    std::ostream & c,
    const Field & F,
    size_t m,
    size_t n,
    typename Field::ConstElement_ptr A,
    size_t lda,
    FFLAS_FORMAT format,
    bool column_major ) [inline]

```

WriteMatrix: write a matrix to an output stream.

Parameters

<i>c</i>	output stream
<i>F</i>	base field
<i>m</i>	row dimension
<i>n</i>	column dimension
<i>A</i>	matrix
<i>format</i>	input format (FflasAuto, FflasDense, FflasSMS, FflasBinary)
<i>column_major</i>	whether the matrix is stored in column or row major (row by default)

15.1.3.304 preamble()

```
void preamble (
    std::ifstream & ifs,
    FFLAS_FORMAT & format ) [inline]
```

15.1.3.305 ReadMatrix() [1/2]

```
Field::Element_ptr ReadMatrix (
    std::ifstream & ifs,
    Field & F,
    size_t & m,
    size_t & n,
    typename Field::Element_ptr & A,
    FFLAS_FORMAT format = FflasAuto )
```

ReadMatrix: read a matrix from an input stream.

Parameters

	<i>ifs</i>	input stream
	<i>F</i>	base field
out	<i>m</i>	row dimension
out	<i>n</i>	column dimension
out	<i>A</i>	output matrix
	<i>format</i>	input format (FflasAuto, FflasDense, FflasSMS, FflasBinary)

15.1.3.306 ReadMatrix() [2/2]

```
Field::Element_ptr ReadMatrix (
    const std::string & matrix_file,
    Field & F,
    size_t & m,
    size_t & n,
    typename Field::Element_ptr & A,
    FFLAS_FORMAT format = FflasAuto ) [inline]
```

ReadMatrix: read a matrix from a file.

Parameters

	<i>matrix_file</i>	filename
	<i>F</i>	base field
out	<i>m</i>	row dimension
out	<i>n</i>	column dimension
out	<i>A</i>	output matrix
Generated by Doxygen	<i>format</i>	input format (FflasAuto, FflasDense, FflasSMS, FflasBinary)

15.1.3.307 WriteMatrix() [2/2]

```

void WriteMatrix (
    std::string & matrix_file,
    const Field & F,
    int m,
    int n,
    typename Field::ConstElement_ptr A,
    size_t lda,
    FFLAS_FORMAT format = FflasDense,
    bool column_major = false )

```

WriteMatrix: write a matrix to a file.

Parameters

<i>matrix_file</i>	file name
<i>F</i>	base field
<i>m</i>	row dimension
<i>n</i>	column dimension
<i>A</i>	matrix
<i>format</i>	input format (FflasAuto, FflasDense, FflasSMS, FflasBinary)
<i>column_major</i>	whether the matrix is stored in column or row major (row by default)

15.1.3.308 WritePermutation()

```

std::ostream & WritePermutation (
    std::ostream & c,
    const size_t * P,
    size_t N ) [inline]

```

WritePermutation: write a permutation matrix to an output stream.

Parameters

<i>c</i>	output stream
<i>P</i>	permutation
<i>N</i>	size of the permutation

15.1.3.309 alignable()

```

bool alignable ( ) [inline]

```

15.1.3.310 alignable< Givaro::Integer * >()

```
bool alignable< Givaro::Integer * > ( ) [inline]
```

15.1.3.311 fflas_new() [5/7]

```
Field::Element_ptr fflas_new (
    const Field & F,
    const size_t m,
    const Alignment align = Alignment::DEFAULT ) [inline]
```

15.1.3.312 fflas_new() [6/7]

```
Field::Element_ptr fflas_new (
    const Field & F,
    const size_t m,
    const size_t n,
    const Alignment align = Alignment::DEFAULT ) [inline]
```

15.1.3.313 fflas_new() [7/7]

```
Element * fflas_new (
    const size_t m,
    const Alignment align = Alignment::DEFAULT ) [inline]
```

15.1.3.314 fflas_delete() [3/4]

```
void fflas_delete (
    Element_ptr A ) [inline]
```

15.1.3.315 fflas_delete() [4/4]

```
void fflas_delete (
    Ptr p,
    Args ... args ) [inline]
```

15.1.3.316 prefetch()

```
void prefetch (
    const int64_t * ) [inline]
```

15.1.3.317 getTLBSize()

```
void getTLBSize (
    int & tlb ) [inline]
```

15.1.3.318 queryCacheSizes()

```
void queryCacheSizes (
    int & l1,
    int & l2,
    int & l3 ) [inline]
```

Queries and returns the cache sizes in Bytes of the L1, L2, and L3 data caches respectively

15.1.3.319 queryL1CacheSize()

```
int queryL1CacheSize ( ) [inline]
```

Returns

the size in Bytes of the L1 data cache

15.1.3.320 queryTopLevelCacheSize()

```
int queryTopLevelCacheSize ( ) [inline]
```

Returns

the size in Bytes of the L2 or L3 cache if this later is present

15.1.3.321 getSeed()

```
uint64_t getSeed ( )
```

15.2 FFLAS::BLAS3 Namespace Reference

Functions

- `template<class Field >`
`void Bini (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr,`
`const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::Element_ptr A,`
`const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta,`
`typename Field::Element_ptr C, const size_t ldc, const size_t kmax, const size_t w, const FFLAS_BASE`
`base, const size_t rec_level)`
- `template<class Field , class FieldTrait , class Strat , class Param >`
`Field::Element_ptr WinoPar (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`
`tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename`
`Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb,`
`const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field,`
`MMHelperAlgo::WinogradPar, FieldTrait, ParSeqHelper::Parallel< Strat, Param > > &WH)`
- `template<class Field , class FieldTrait >`
`void Winograd (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t`
`mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::ConstElement_ptr`
`A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element`
`beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, Field↵`
`Trait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_3_23 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`
`tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename`
`Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb,`
`const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field,`
`MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_3_21 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`
`tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename`
`Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb,`
`const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field,`
`MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_2_24 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`
`tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const type-`
`name Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb,`
`const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field,`
`MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_2_27 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE`
`tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const type-`
`name Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb,`
`const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field,`
`MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_LR (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const`
`size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::Element_ptr`
`A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta,`
`typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, Field↵`
`Trait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_R_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb,`
`const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const type-`
`name Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const type-`
`name Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field,`
`MMHelperAlgo::Winograd, FieldTrait > &WH)`

- `template<class Field, class FieldTrait >`
`void WinogradAcc_L_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field, class FieldTrait >`
`void Winograd_LR_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field, class FieldTrait >`
`void Winograd_L_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field, class FieldTrait >`
`void Winograd_R_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`

15.2.1 Function Documentation

15.2.1.1 Bini()

```
void Bini (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const size_t kmax,
    const size_t w,
    const FFLAS_BASE base,
    const size_t rec_level ) [inline]
```

15.2.1.2 WinoPar()

```
Field::Element_ptr WinoPar (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::WinogradPar, FieldTrait, ParSeqHelper::Parallel<
Strat, Param > > & WH ) [inline]
```

15.2.1.3 Winograd()

```
void Winograd (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]
```

15.2.1.4 WinogradAcc_3_23()

```
void WinogradAcc_3_23 (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
```

```

const size_t lda,
typename Field::ConstElement_ptr B,
const size_t ldb,
const typename Field::Element beta,
typename Field::Element_ptr C,
const size_t ldc,
MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]

```

15.2.1.5 WinogradAcc_3_21()

```

void WinogradAcc_3_21 (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]

```

15.2.1.6 WinogradAcc_2_24()

```

void WinogradAcc_2_24 (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]

```


15.2.1.7 WinogradAcc_2_27()

```

void WinogradAcc_2_27 (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]

```

15.2.1.8 WinogradAcc_LR()

```

void WinogradAcc_LR (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]

```

15.2.1.9 WinogradAcc_R_S()

```

void WinogradAcc_R_S (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,

```

```

typename Field::Element_ptr B,
const size_t ldb,
const typename Field::Element beta,
typename Field::Element_ptr C,
const size_t ldc,
const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]

```

15.2.1.10 WinogradAcc_L_S()

```

void WinogradAcc_L_S (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]

```

15.2.1.11 Winograd_LR_S()

```

void Winograd_LR_S (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]

```

15.2.1.12 Winograd_L_S()

```
void Winograd_L_S (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    const typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]
```

15.2.1.13 Winograd_R_S()

```
void Winograd_R_S (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    const typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > & WH ) [inline]
```

15.3 FFLAS::csr_hyb_details Namespace Reference

Data Structures

- struct [Coo](#)
- struct [Info](#)

15.4 FFLAS::CuttingStrategy Namespace Reference

Data Structures

- struct [Block](#)
- struct [Column](#)
- struct [Recursive](#)
- struct [Row](#)
- struct [Single](#)

Typedefs

- typedef [Row](#) [RNSModulus](#)

15.4.1 Typedef Documentation

15.4.1.1 RNSModulus

```
typedef Row RNSModulus
```

15.5 FFLAS::details Namespace Reference

Functions

- template<class [Field](#), bool ADD>
std::enable_if< [FFLAS::support_simd_add](#)< typename [Field::Element](#) >::value, void >::type [fadd](#)
(const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t inca, typename [Field::ConstElement_ptr](#) B, const size_t incb, typename [Field::Element_ptr](#) C, const size_t incc, [FieldCategories::ModularTag](#))
- template<class [Field](#), bool ADD>
std::enable_if<![FFLAS::support_simd_add](#)< typename [Field::Element](#) >::value, void >::type [fadd](#)
(const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t inca, typename [Field::ConstElement_ptr](#) B, const size_t incb, typename [Field::Element_ptr](#) C, const size_t incc, [FieldCategories::ModularTag](#))
- template<class [Field](#), bool ADD>
void [fadd](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t inca, type-
name [Field::ConstElement_ptr](#) B, const size_t incb, typename [Field::Element_ptr](#) C, const size_t incc, [FieldCategories::GenericTag](#))
- template<class [Field](#), bool ADD>
std::enable_if<![FFLAS::support_simd_add](#)< typename [Field::Element](#) >::value, void >::type [fadd](#)
(const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t inca, typename [Field::ConstElement_ptr](#) B, const size_t incb, typename [Field::Element_ptr](#) C, const size_t incc, [FieldCategories::UnparametricTag](#))
- template<class [Field](#), bool ADD>
std::enable_if< [FFLAS::support_simd_add](#)< typename [Field::Element](#) >::value, void >::type [fadd](#)
(const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t inca, typename [Field::ConstElement_ptr](#) B, const size_t incb, typename [Field::Element_ptr](#) C, const size_t incc, [FieldCategories::UnparametricTag](#))
- template<class [Field](#) >
std::enable_if< [FFLAS::support_fast_mod](#)< typename [Field::Element](#) >::value, void >::type [freduce](#) (const [Field](#) &F, const size_t m, typename [Field::Element_ptr](#) A, const size_t incX, [FieldCategories::ModularTag](#))
- template<class [Field](#) >
std::enable_if< [FFLAS::support_fast_mod](#)< typename [Field::Element](#) >::value, void >::type [freduce](#)
(const [Field](#) &F, const size_t m, typename [Field::ConstElement_ptr](#) B, const size_t incY, typename [Field::Element_ptr](#) A, const size_t incX, [FieldCategories::ModularTag](#))
- template<class [Field](#), class FC >
void [freduce](#) (const [Field](#) &F, const size_t m, typename [Field::Element_ptr](#) A, const size_t incX, FC)
- template<class [Field](#), class FC >
void [freduce](#) (const [Field](#) &F, const size_t m, typename [Field::ConstElement_ptr](#) B, const size_t incY, type-
name [Field::Element_ptr](#) A, const size_t incX, FC)

- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type fscalin (const`
`Field &F, const size_t N, const typename Field::Element a, typename Field::Element_ptr X, const size_t incX,`
`FieldCategories::ModularTag)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type fscal (const`
`Field &F, const size_t N, const typename Field::Element a, typename Field::ConstElement_ptr X, const size_t`
`incX, typename Field::Element_ptr Y, const size_t incY, FieldCategories::ModularTag)`
- `template<class Field , class FC >`
`void fscalin (const Field &F, const size_t n, const typename Field::Element a, typename Field::Element_ptr X,`
`const size_t incX, FC)`
- `template<class Field , class FC >`
`void fscal (const Field &F, const size_t N, const typename Field::Element a, typename Field::ConstElement_ptr`
`X, const size_t incX, typename Field::Element_ptr Y, const size_t incY, FC)`
- `template<enum number_kind K>`
`void igebb44 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *blA, const int64_t`
`*blB, int64_t *C, size_t ldc)`
- `template<enum number_kind K>`
`void igebb24 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *blA, const int64_t`
`*blB, int64_t *C, size_t ldc)`
- `template<enum number_kind K>`
`void igebb14 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *blA, const int64_t`
`*blB, int64_t *C, size_t ldc)`
- `template<enum number_kind K>`
`void igebb41 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *blA, const int64_t`
`*blB, int64_t *C, size_t ldc)`
- `template<enum number_kind K>`
`void igebb21 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *blA, const int64_t`
`*blB, int64_t *C, size_t ldc)`
- `template<enum number_kind K>`
`void igebb11 (size_t i, size_t j, size_t depth, size_t pdeth, const int64_t alpha, const int64_t *blA, const int64_t`
`*blB, int64_t *C, size_t ldc)`
- `template<enum number_kind K>`
`void igebp (size_t rows, size_t cols, size_t depth, const int64_t alpha, const int64_t *blockA, size_t lda, const`
`int64_t *blockB, size_t ldb, int64_t *C, size_t ldc)`
- `template<size_t k, bool transpose>`
`void pack_lhs (int64_t *XX, const int64_t *X, size_t ldx, size_t rows, size_t cols)`
- `template<size_t k, bool transpose>`
`void pack_rhs (int64_t *XX, const int64_t *X, size_t ldx, size_t rows, size_t cols)`
- `void gebp (size_t rows, size_t cols, size_t depth, int64_t *C, size_t ldc, const int64_t *blockA, size_t lda, const`
`int64_t *BlockB, size_t ldb, int64_t *BlockW)`
- `void BlockingFactor (size_t &m, size_t &n, size_t &k)`

15.5.1 Function Documentation

15.5.1.1 fadd() [1/5]

```
std::enable_if< FFLAS::support_simd_add< typenameField::Element >::value, void >::type fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
```

```

typename Field::ConstElement_ptr B,
const size_t incb,
typename Field::Element_ptr C,
const size_t incc,
FieldCategories::ModularTag )

```

15.5.1.2 fadd() [2/5]

```

std::enable_if<!FFLAS::support_simd_add< typenameField::Element >::value, void >::type fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc,
    FieldCategories::ModularTag )

```

15.5.1.3 fadd() [3/5]

```

void fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc,
    FieldCategories::GenericTag )

```

15.5.1.4 fadd() [4/5]

```

std::enable_if<!FFLAS::support_simd_add< typenameField::Element >::value, void >::type fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc,
    FieldCategories::UnparametricTag ) [inline]

```

15.5.1.5 fadd() [5/5]

```
std::enable_if< FFLAS::support_simd_add< typenameField::Element >::value, void >::type fadd (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t inca,
    typename Field::ConstElement_ptr B,
    const size_t incb,
    typename Field::Element_ptr C,
    const size_t incc,
    FieldCategories::UnparametricTag ) [inline]
```

15.5.1.6 freduce() [1/4]

```
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type freduce
(
    const Field & F,
    const size_t m,
    typename Field::Element_ptr A,
    const size_t incX,
    FieldCategories::ModularTag ) [inline]
```

15.5.1.7 freduce() [2/4]

```
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type freduce
(
    const Field & F,
    const size_t m,
    typename Field::ConstElement_ptr B,
    const size_t incY,
    typename Field::Element_ptr A,
    const size_t incX,
    FieldCategories::ModularTag ) [inline]
```

15.5.1.8 freduce() [3/4]

```
void freduce (
    const Field & F,
    const size_t m,
    typename Field::Element_ptr A,
    const size_t incX,
    FC ) [inline]
```

15.5.1.9 freduce() [4/4]

```

void freduce (
    const Field & F,
    const size_t m,
    typename Field::ConstElement_ptr B,
    const size_t incY,
    typename Field::Element_ptr A,
    const size_t incX,
    FC ) [inline]

```

15.5.1.10 fscaln() [1/2]

```

std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type fscaln
(
    const Field & F,
    const size_t N,
    const typename Field::Element a,
    typename Field::Element_ptr X,
    const size_t incX,
    FieldCategories::ModularTag ) [inline]

```

15.5.1.11 fscl() [1/2]

```

std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type fscl
(
    const Field & F,
    const size_t N,
    const typename Field::Element a,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY,
    FieldCategories::ModularTag ) [inline]

```

15.5.1.12 fscaln() [2/2]

```

void fscaln (
    const Field & F,
    const size_t n,
    const typename Field::Element a,
    typename Field::Element_ptr X,
    const size_t incX,
    FC ) [inline]

```


15.5.1.13 fscal() [2/2]

```
void fscal (
    const Field & F,
    const size_t N,
    const typename Field::Element a,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    typename Field::Element_ptr Y,
    const size_t incY,
    FC ) [inline]
```

15.5.1.14 igebb44()

```
void igebb44 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc ) [inline]
```

15.5.1.15 igebb24()

```
void igebb24 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc ) [inline]
```

15.5.1.16 igebb14()

```
void igebb14 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc ) [inline]
```

15.5.1.17 igebb41()

```
void igebb41 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc ) [inline]
```

bug ,B_0 dans VEC_MADD_32 ?

bug ,B_0 dans VEC_MADD_32 ?

15.5.1.18 igebb21()

```
void igebb21 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc ) [inline]
```

15.5.1.19 igebb11()

```
void igebb11 (
    size_t i,
    size_t j,
    size_t depth,
    size_t pdeth,
    const int64_t alpha,
    const int64_t * blA,
    const int64_t * blB,
    int64_t * C,
    size_t ldc ) [inline]
```

15.5.1.20 igebp()

```
void igebp (
    size_t rows,
    size_t cols,
    size_t depth,
    const int64_t alpha,
    const int64_t * blockA,
    size_t lda,
    const int64_t * blockB,
    size_t ldb,
    int64_t * C,
    size_t ldc )
```

15.5.1.21 pack_lhs()

```
void pack_lhs (
    int64_t * XX,
    const int64_t * X,
    size_t ldx,
    size_t rows,
    size_t cols )
```

Bug this is fassign

Bug this is fassign

Bug this is fassign

Bug this is fassign

15.5.1.22 pack_rhs()

```
void pack_rhs (
    int64_t * XX,
    const int64_t * X,
    size_t ldx,
    size_t rows,
    size_t cols )
```

Bug this is fassign

Bug this is fassign

Bug this is fassign

Bug this is fassign

15.5.1.23 `gebp()`

```
void gebp (
    size_t rows,
    size_t cols,
    size_t depth,
    int64_t * C,
    size_t ldc,
    const int64_t * blockA,
    size_t lda,
    const int64_t * BlockB,
    size_t ldb,
    int64_t * BlockW )
```

15.5.1.24 `BlockingFactor()`

```
void BlockingFactor (
    size_t & m,
    size_t & n,
    size_t & k ) [inline]
```

15.6 `FFLAS::details_spmv` Namespace Reference

Data Structures

- struct [Coo](#)

15.7 `FFLAS::ElementCategories` Namespace Reference

Data Structures

- struct [ArbitraryPrecIntTag](#)
Arbitrary precision integers: GMP.
- struct [FixedPrecIntTag](#)
Fixed precision integers above machine precision: Givaro::reclnt.
- struct [GenericTag](#)
default is generic
- struct [MachineFloatTag](#)
float or double
- struct [MachineIntTag](#)
short, int, long, long long, and unsigned variants
- struct [RNSElementTag](#)
Representation in a Residue Number System.

15.8 FFLAS::FieldCategories Namespace Reference

Traits and categories will need to be placed in a proper file later.

Data Structures

- struct [GenericTag](#)
generic ring.
- struct [ModularTag](#)
This is a modular field like e.g. `Modular<T>` or `ModularBalanced<T>`
- struct [UnparametricTag](#)
If the field uses a representation with infix operators.

15.8.1 Detailed Description

Traits and categories will need to be placed in a proper file later.

15.9 FFLAS::MMHelperAlgo Namespace Reference

Data Structures

- struct [Auto](#)
- struct [Bini](#)
- struct [Classic](#)
- struct [Winograd](#)
- struct [WinogradPar](#)

15.10 FFLAS::ModeCategories Namespace Reference

Specifies the mode of action for an algorithm w.r.t.

Data Structures

- struct [ConvertTo](#)
Force conversion to appropriate element type of `ElementCategory T`.
- struct [DefaultBoundedTag](#)
Use standard field operations, but keeps track of bounds on input and output.
- struct [DefaultTag](#)
No specific mode of action: use standard field operations.
- struct [DelayedTag](#)
Performs field operations with delayed mod reductions. Ensures result is reduced.
- struct [LazyTag](#)
Performs field operations with delayed mod only when necessary. Result may not be reduced.

15.10.1 Detailed Description

Specifies the mode of action for an algorithm w.r.t.

its field

15.11 FFLAS::ParSeqHelper Namespace Reference

[ParSeqHelper](#) for both fgemmm and ftrsm.

Data Structures

- struct [Compose](#)
- struct [Parallel](#)
- struct [Sequential](#)

15.11.1 Detailed Description

[ParSeqHelper](#) for both fgemmm and ftrsm.

[ParSeqHelper](#) for both fgemmm and ftrsm

15.12 FFLAS::Protected Namespace Reference

Data Structures

- class [AreEqual](#)
- class [AreEqual< X, X >](#)
- class [ftrmmLeftLowerNoTransNonUnit](#)
- class [ftrmmLeftLowerNoTransUnit](#)
- class [ftrmmLeftLowerTransNonUnit](#)
- class [ftrmmLeftLowerTransUnit](#)
- class [ftrmmLeftUpperNoTransNonUnit](#)
- class [ftrmmLeftUpperNoTransUnit](#)
- class [ftrmmLeftUpperTransNonUnit](#)
- class [ftrmmLeftUpperTransUnit](#)
- class [ftrmmRightLowerNoTransNonUnit](#)
- class [ftrmmRightLowerNoTransUnit](#)
- class [ftrmmRightLowerTransNonUnit](#)
- class [ftrmmRightLowerTransUnit](#)
- class [ftrmmRightUpperNoTransNonUnit](#)
- class [ftrmmRightUpperNoTransUnit](#)
- class [ftrmmRightUpperTransNonUnit](#)
- class [ftrmmRightUpperTransUnit](#)
- class [ftrsmLeftLowerNoTransNonUnit](#)
- class [ftrsmLeftLowerNoTransUnit](#)
- class [ftrsmLeftLowerTransNonUnit](#)

- class [ftrsmLeftLowerTransUnit](#)
- class [ftrsmLeftUpperNoTransNonUnit](#)

Computes the maximal size for delaying the modular reduction in a triangular system resolution.

- class [ftrsmLeftUpperNoTransUnit](#)
- class [ftrsmLeftUpperTransNonUnit](#)
- class [ftrsmLeftUpperTransUnit](#)
- class [ftrsmRightLowerNoTransNonUnit](#)
- class [ftrsmRightLowerNoTransUnit](#)
- class [ftrsmRightLowerTransNonUnit](#)
- class [ftrsmRightLowerTransUnit](#)
- class [ftrsmRightUpperNoTransNonUnit](#)
- class [ftrsmRightUpperNoTransUnit](#)
- class [ftrsmRightUpperTransNonUnit](#)
- class [ftrsmRightUpperTransUnit](#)

Functions

- template<class [Field](#) >
double [computeFactorClassic](#) (const [Field](#) &F)
- template<> double [computeFactorClassic](#) (const [Givaro::ModularBalanced](#)< double > &F)
- template<> double [computeFactorClassic](#) (const [Givaro::ModularBalanced](#)< float > &F)
- template<class [Field](#) >
size_t [DotProdBoundClassic](#) (const [Field](#) &F, const typename [Field::Element](#) &beta)
- template<class [Field](#) >
size_t [TRSMBound](#) (const [Field](#) &)
TRSMBound.
- template<class [Element](#) >
size_t [TRSMBound](#) (const [Givaro::Modular](#)< [Element](#) > &F)
Specialization for positive modular representation over float.
- template<class [Element](#) >
size_t [TRSMBound](#) (const [Givaro::ModularBalanced](#)< [Element](#) > &F)
Specialization for balanced modular representation over double.
- template<class [NewField](#) , class [Field](#) , class [FieldMode](#) >
[Field::Element_ptr](#) [fgemm_convert](#) (const [Field](#) &F, const [FFLAS_TRANSPOSE](#) ta, const [FFLAS_TRANSPOSE](#) tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, [MMHelper](#)< [Field](#), [MMHelperAlgo::Winograd](#), [FieldMode](#) > &H)
- template<class [Field](#) , class [Element](#) , class [AlgoT](#) , class [ParSeqTrait](#) >
bool [NeedPreAddReduction](#) ([Element](#) &Outmin, [Element](#) &Outmax, [Element](#) &Op1min, [Element](#) &Op1max, [Element](#) &Op2min, [Element](#) &Op2max, [MMHelper](#)< [Field](#), [AlgoT](#), [ModeCategories::LazyTag](#), [ParSeqTrait](#) > &WH)
- template<class [Field](#) , class [Element](#) , class [AlgoT](#) , class [ModeT](#) , class [ParSeqTrait](#) >
bool [NeedPreAddReduction](#) ([Element](#) &Outmin, [Element](#) &Outmax, [Element](#) &Op1min, [Element](#) &Op1max, [Element](#) &Op2min, [Element](#) &Op2max, [MMHelper](#)< [Field](#), [AlgoT](#), [ModeT](#), [ParSeqTrait](#) > &WH)
- template<class [Field](#) , class [Element](#) , class [AlgoT](#) , class [ParSeqTrait](#) >
bool [NeedPreSubReduction](#) ([Element](#) &Outmin, [Element](#) &Outmax, [Element](#) &Op1min, [Element](#) &Op1max, [Element](#) &Op2min, [Element](#) &Op2max, [MMHelper](#)< [Field](#), [AlgoT](#), [ModeCategories::LazyTag](#), [ParSeqTrait](#) > &WH)
- template<class [Field](#) , class [Element](#) , class [AlgoT](#) , class [ModeT](#) , class [ParSeqTrait](#) >
bool [NeedPreSubReduction](#) ([Element](#) &Outmin, [Element](#) &Outmax, [Element](#) &Op1min, [Element](#) &Op1max, [Element](#) &Op2min, [Element](#) &Op2max, [MMHelper](#)< [Field](#), [AlgoT](#), [ModeT](#), [ParSeqTrait](#) > &WH)

- `template<class Field, class Element, class AlgoT, class ParSeqTrait >`
`bool NeedDoublePreAddReduction (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, Element beta, MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > &WH)`
- `template<class Field, class Element, class AlgoT, class ModeT, class ParSeqTrait >`
`bool NeedDoublePreAddReduction (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, Element beta, MMHelper< Field, AlgoT, ModeT, ParSeqTrait > &WH)`
- `template<class Field, class AlgoT, class ParSeqTrait >`
`void ScalAndReduce (const Field &F, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr X, const size_t incX, const MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > &H)`
- `template<class Field, class AlgoT, class ParSeqTrait >`
`void ScalAndReduce (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, const MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > &H)`
- `template<class Field >`
`Field::Element_ptr fsquareCommon (const Field &F, const FFLAS_TRANSPOSE ta, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`
- `template<class Field >`
`int WinogradThreshold (const Field &F)`
Computes the number of recursive levels to perform.
- `template<> int WinogradThreshold (const Givaro::Modular< float > &F)`
- `template<> int WinogradThreshold (const Givaro::ModularBalanced< double > &F)`
- `template<> int WinogradThreshold (const Givaro::ModularBalanced< float > &F)`
- `template<class Field >`
`int WinogradSteps (const Field &F, const size_t &m)`
Computes the number of recursive levels to perform.
- `template<class Field, class FieldMode >`
`void DynamicPeeling (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > &H, const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::DelayedField::Element Cmin, const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::DelayedField::Element Cmax)`
- `template<class Field, class FieldMode >`
`void DynamicPeeling2 (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > &H, const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::DelayedField::Element Cmin, const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::DelayedField::Element Cmax)`
- `template<class Field, class FieldMode >`
`void WinogradCalc (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > &H)`
- `template<typename FloatElement, class Field >`
`Field::Element_ptr fgemv_convert (const Field &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr X, const size_t incX, const typename Field::Element beta, typename Field::Element_ptr Y, const size_t incY)`

- `template<class FloatElement , class Field >`
`void fger_convert (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha,`
`typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t`
`incy, typename Field::Element_ptr A, const size_t lda)`
- `template<class DFE >`
`size_t min_types (const DFE &k)`
- `template<> size_t min_types (const Reclnt::rint< 6 > &k)`
- `template<> size_t min_types (const Reclnt::rint< 7 > &k)`
- `template<> size_t min_types (const Reclnt::rint< 8 > &k)`
- `template<> size_t min_types (const Reclnt::rint< 9 > &k)`
- `template<> size_t min_types (const Reclnt::rint< 10 > &k)`
- `template<> size_t min_types (const Givaro::Integer &k)`
- `template<class T >`
`bool unfit (T x)`
- `template<> bool unfit (int64_t x)`
- `template<size_t K>`
`bool unfit (Reclnt::rint< K > x)`
- `template<> bool unfit (Reclnt::rint< 6 > x)`
- `template<enum FFLAS_TRANSPOSE tA, enum FFLAS_TRANSPOSE tB>`
`void igemm_colmajor (size_t rows, size_t cols, size_t depth, const int64_t alpha, const int64_t *A, size_t lda,`
`const int64_t *B, size_t ldb, int64_t *C, size_t ldc)`
- `template<enum FFLAS_TRANSPOSE tA, enum FFLAS_TRANSPOSE tB, enum number_kind alpha_kind>`
`void igemm_colmajor (size_t rows, size_t cols, size_t depth, const int64_t alpha, const int64_t *A, size_t lda,`
`const int64_t *B, size_t ldb, int64_t *C, size_t ldc)`
- `void igemm (const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_TRANSPOSE TransB, size_t`
`rows, size_t cols, size_t depth, const int64_t alpha, const int64_t *A, size_t lda, const int64_t *B, size_t ldb,`
`const int64_t beta, int64_t *C, size_t ldc)`
- `template<class Field >`
`void MatF2MatD_Triangular (const Field &F, Givaro::DoubleDomain::Element_ptr S, const size_t lds, type-`
`name Field::ConstElement_ptr const E, const size_t lde, const size_t m, const size_t n)`
- `template<class Field >`
`void MatF2MatFI_Triangular (const Field &F, Givaro::FloatDomain::Element_ptr S, const size_t lds, typename`
`Field::ConstElement_ptr const E, const size_t lde, const size_t m, const size_t n)`

15.12.1 Function Documentation

15.12.1.1 computeFactorClassic() [1/3]

```
double computeFactorClassic (
    const Field & F ) [inline]
```

15.12.1.2 computeFactorClassic() [2/3]

```
double computeFactorClassic (
    const Givaro::ModularBalanced< double > & F ) [inline]
```

15.12.1.3 computeFactorClassic() [3/3]

```
double computeFactorClassic (
    const Givaro::ModularBalanced< float > & F ) [inline]
```

15.12.1.4 DotProdBoundClassic()

```
size_t DotProdBoundClassic (
    const Field & F,
    const typename Field::Element & beta ) [inline]
```

15.12.1.5 TRSMBound() [1/3]

```
size_t TRSMBound (
    const Field & ) [inline]
```

TRSMBound.

computes the maximal size for delaying the modular reduction in a triangular system resolution

This is the default version over an arbitrary field. It is currently never used (the recursive algorithm is run until $n=1$ in this case)

Parameters

F	Finite Field/Ring of the computation
-----	--------------------------------------

15.12.1.6 TRSMBound() [2/3]

```
size_t TRSMBound (
    const Givaro::Modular< Element > & F ) [inline]
```

Specialization for positive modular representation over float.

Computes n_{\max} s.t. $(p-1)/2 * (p^{\{n_{\max}-1\}} + (p-2)^{\{n_{\max}-1\}}) < 2^{24}$ @pbi See [Dumas Giorgi Pernet 06, arXiv:cs/0601133]

15.12.1.7 TRSMBound() [3/3]

```
size_t TRSMBound (
    const Givaro::ModularBalanced< Element > & F ) [inline]
```

Specialization for balanced modular representation over double.

Computes n_{\max} s.t. $(p-1)/2 * (((p+1)/2)^{\{n_{\max}-1\}}) < 2^{53}$

Bibliography • Dumas Giorgi Pernet 06, arXiv:cs/0601133

15.12.1.8 fgemm_convert()

```
Field::Element_ptr fgemm_convert (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > & H ) [inline]
```

15.12.1.9 NeedPreAddReduction() [1/2]

```
bool NeedPreAddReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & WH ) [inline]
```

15.12.1.10 NeedPreAddReduction() [2/2]

```
bool NeedPreAddReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    MMHelper< Field, AlgoT, ModeT, ParSeqTrait > & WH ) [inline]
```

15.12.1.11 NeedPreSubReduction() [1/2]

```
bool NeedPreSubReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & WH ) [inline]
```

15.12.1.12 NeedPreSubReduction() [2/2]

```

bool NeedPreSubReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    MMHelper< Field, AlgoT, ModeT, ParSeqTrait > & WH ) [inline]

```

15.12.1.13 NeedDoublePreAddReduction() [1/2]

```

bool NeedDoublePreAddReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    Element beta,
    MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & WH ) [inline]

```

15.12.1.14 NeedDoublePreAddReduction() [2/2]

```

bool NeedDoublePreAddReduction (
    Element & Outmin,
    Element & Outmax,
    Element & Op1min,
    Element & Op1max,
    Element & Op2min,
    Element & Op2max,
    Element beta,
    MMHelper< Field, AlgoT, ModeT, ParSeqTrait > & WH ) [inline]

```

15.12.1.15 ScalAndReduce() [1/2]

```

void ScalAndReduce (
    const Field & F,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr X,
    const size_t incX,
    const MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & H ) [inline]

```

15.12.1.16 ScalAndReduce() [2/2]

```

void ScalAndReduce (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::Element_ptr A,
    const size_t lda,
    const MMHelper< Field, AlgoT, ModeCategories::LazyTag, ParSeqTrait > & H ) [inline]

```

15.12.1.17 fsquareCommon()

```

Field::Element_ptr fsquareCommon (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t n,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc ) [inline]

```

15.12.1.18 WinogradThreshold() [1/4]

```

int WinogradThreshold (
    const Field & F ) [inline]

```

Computes the number of recursive levels to perform.

Parameters

<i>m</i>	the common dimension in the product AxB
----------	---

15.12.1.19 WinogradThreshold() [2/4]

```

int WinogradThreshold (
    const Givaro::Modular< float > & F ) [inline]

```

15.12.1.20 WinogradThreshold() [3/4]

```
int WinogradThreshold (
    const Givaro::ModularBalanced< double > & F ) [inline]
```

15.12.1.21 WinogradThreshold() [4/4]

```
int WinogradThreshold (
    const Givaro::ModularBalanced< float > & F ) [inline]
```

15.12.1.22 WinogradSteps()

```
int WinogradSteps (
    const Field & F,
    const size_t & m ) [inline]
```

Computes the number of recursive levels to perform.

Parameters

<i>m</i>	the common dimension in the product AxB
----------	---

15.12.1.23 DynamicPeeling()

```
void DynamicPeeling (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > & H,
    const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::Delayed↔
    Field::Element Cmin,
```

```

        const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::Delayed↵
Field::Element Cmax ) [inline]

```

15.12.1.24 DynamicPeeling2()

```

void DynamicPeeling2 (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > & H,
    const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::Delayed↵
Field::Element Cmin,
    const typename MMHelper< Field, MMHelperAlgo::Winograd, FieldMode >::Delayed↵
Field::Element Cmax ) [inline]

```

15.12.1.25 WinogradCalc()

```

void WinogradCalc (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const FFLAS_TRANSPOSE tb,
    const size_t mr,
    const size_t nr,
    const size_t kr,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    const typename Field::Element beta,
    typename Field::Element_ptr C,
    const size_t ldc,
    MMHelper< Field, MMHelperAlgo::Winograd, FieldMode > & H ) [inline]

```

15.12.1.26 fgemv_convert()

```
Field::Element_ptr fgemv_convert (
    const Field & F,
    const FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr X,
    const size_t incX,
    const typename Field::Element beta,
    typename Field::Element_ptr Y,
    const size_t incY ) [inline]
```

15.12.1.27 fger_convert()

```
void fger_convert (
    const Field & F,
    const size_t M,
    const size_t N,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr x,
    const size_t incx,
    typename Field::ConstElement_ptr y,
    const size_t incy,
    typename Field::Element_ptr A,
    const size_t lda ) [inline]
```

15.12.1.28 min_types() [1/7]

```
size_t min_types (
    const DFE & k ) [inline]
```

15.12.1.29 min_types() [2/7]

```
size_t min_types (
    const RecInt::rint< 6 > & k ) [inline]
```

15.12.1.30 min_types() [3/7]

```
size_t min_types (
    const RecInt::rint< 7 > & k ) [inline]
```


15.12.1.31 min_types() [4/7]

```
size_t min_types (
    const RecInt::rint< 8 > & k )    [inline]
```

15.12.1.32 min_types() [5/7]

```
size_t min_types (
    const RecInt::rint< 9 > & k )    [inline]
```

15.12.1.33 min_types() [6/7]

```
size_t min_types (
    const RecInt::rint< 10 > & k )    [inline]
```

15.12.1.34 min_types() [7/7]

```
size_t min_types (
    const Givaro::Integer & k )    [inline]
```

15.12.1.35 unfit() [1/4]

```
bool unfit (
    T x )    [inline]
```

15.12.1.36 unfit() [2/4]

```
bool unfit (
    int64_t x )    [inline]
```

15.12.1.37 unfit() [3/4]

```
bool unfit (
    RecInt::rint< K > x )    [inline]
```

15.12.1.38 unfit() [4/4]

```
bool unfit (
    RecInt::rint< 6 > x ) [inline]
```

15.12.1.39 igemm_colmajor() [1/2]

```
void igemm_colmajor (
    size_t rows,
    size_t cols,
    size_t depth,
    const int64_t alpha,
    const int64_t * A,
    size_t lda,
    const int64_t * B,
    size_t ldb,
    int64_t * C,
    size_t ldc )
```

15.12.1.40 igemm_colmajor() [2/2]

```
void igemm_colmajor (
    size_t rows,
    size_t cols,
    size_t depth,
    const int64_t alpha,
    const int64_t * A,
    size_t lda,
    const int64_t * B,
    size_t ldb,
    int64_t * C,
    size_t ldc )
```

15.12.1.41 igemm()

```
void igemm (
    const enum FFLAS_TRANSPOSE TransA,
    const enum FFLAS_TRANSPOSE TransB,
    size_t rows,
    size_t cols,
    size_t depth,
    const int64_t alpha,
    const int64_t * A,
    size_t lda,
    const int64_t * B,
    size_t ldb,
    const int64_t beta,
    int64_t * C,
    size_t ldc ) [inline]
```

Todo use primitive (no [Field\(\)](#)) and specialise for int64.

Todo use primitive (no [Field\(\)](#)) and specialise for int64.

15.12.1.42 MatF2MatD_Triangular()

```
void MatF2MatD_Triangular (
    const Field & F,
    Givaro::DoubleDomain::Element\_ptr S,
    const size_t lds,
    typename Field::ConstElement\_ptr const E,
    const size_t lde,
    const size_t m,
    const size_t n )
```

15.12.1.43 MatF2MatFI_Triangular()

```
void MatF2MatFI_Triangular (
    const Field & F,
    Givaro::FloatDomain::Element\_ptr S,
    const size_t lds,
    typename Field::ConstElement\_ptr const E,
    const size_t lde,
    const size_t m,
    const size_t n )
```

Todo do finit(...,FFLAS_TRANS,FFLAS_DIAG)
do fconvert(...,FFLAS_TRANS,FFLAS_DIAG)

15.13 FFLAS::sell_details Namespace Reference

Data Structures

- struct [Coo](#)
- struct [Info](#)

15.14 FFLAS::sparse_details Namespace Reference

Functions

- `template<class Field >`
`void init_y (const Field &F, const size_t m, const typename Field::Element b, typename Field::Element_ptr y)`
- `template<class Field >`
`void init_y (const Field &F, const size_t m, const size_t n, const typename Field::Element b, typename Field::Element_ptr y, const int ldy)`
- `template<class Field , class SM , class FC , class MZO >`
`std::enable_if<!(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value)||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value)>::type fspmv_dispatch (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FC fc, MZO mzo)`
- `template<class Field , class SM , class FC , class MZO >`
`std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value)||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value >::type fspmv_dispatch (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FC fc, MZO mzo)`
- `template<class Field , class SM >`
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, std::true_type)`
- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if<!(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value)||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value)>::type fspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`

- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value || std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value >::type fspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, ZOSparseMatrix)`
- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if< !(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value || std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value) >::type pfspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloat >::value || std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value >::type pfspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field , class SM >`
`void pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< !support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM`

- &A, size_t blockSize, typename [Field::ConstElement_ptr](#) x, int ldx, typename [Field::Element_ptr](#) y, int ldy, [FieldCategories::UnparametricTag](#), [NotZOSparseMatrix](#))
- `template<class Field , class SM >`
`std::enable_if< support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
 - `template<class Field , class SM >`
`std::enable_if< !support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
 - `template<class Field , class SM >`
`void pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, ZOSparseMatrix)`
 - `template<class Field , class SM >`
`std::enable_if< support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
 - `template<class Field , class SM >`
`std::enable_if< !support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
 - `template<class Field , class SM >`
`void pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, ZOSparseMatrix)`
 - `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, std::false_type)`
 - `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, std::false_type)`
 - `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, std::false_type)`
 - `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, std::true_type)`
 - `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, std::true_type)`
 - `template<class Field , class SM >`
`void pfspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, std::true_type)`
 - `template<class Field , class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value &&support_simd< typenameField::Element >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
 - `template<class Field , class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value &&support_simd< typenameField::Element >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, NotZOSparseMatrix)`
 - `template<class Field , class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value &&support_simd< typenameField::Element >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, ZOSparseMatrix)`

15.14.1 Function Documentation

15.14.1.1 init_y() [1/2]

```
void init_y (
    const Field & F,
    const size_t m,
    const typename Field::Element b,
    typename Field::Element_ptr y ) [inline]
```

15.14.1.2 init_y() [2/2]

```
void init_y (
    const Field & F,
    const size_t m,
    const size_t n,
    const typename Field::Element b,
    typename Field::Element_ptr y,
    const int ldy ) [inline]
```

15.14.1.3 fspmv_dispatch() [1/2]

```
std::enable_if<!(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt>::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt>::value)>::type fspmv_dispatch (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FC fC,
    MZO mzo ) [inline]
```

15.14.1.4 fspmv_dispatch() [2/2]

```
std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt>::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt>::value >::type fspmv_dispatch (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FC fC,
    MZO mzo ) [inline]
```

15.14.1.5 fspmv() [1/12]

```

void fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ,
    NotZOSparseMatrix ) [inline]

```

15.14.1.6 fspmv() [2/12]

```

std::enable_if<!isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]

```

15.14.1.7 fspmv() [3/12]

```

std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]

```

15.14.1.8 fspmv() [4/12]

```

std::enable_if<!isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]

```


15.14.1.9 fspmv() [5/12]

```
std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.10 fspmv() [6/12]

```
void fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ,
    ZOSparseMatrix ) [inline]
```

15.14.1.11 fspmv() [7/12]

```
std::enable_if<!isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

15.14.1.12 fspmv() [8/12]

```
std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

15.14.1.13 fspmv() [9/12]

```

void fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    std::true_type ) [inline]

```

15.14.1.14 fspmm_dispatch() [1/2]

```

std::enable_if<!(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::Mac
>::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt
>::value)>::type fspmm_dispatch (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FCat ,
    MZO ) [inline]

```

15.14.1.15 fspmm_dispatch() [2/2]

```

std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::Mac
>::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt
>::value >::type fspmm_dispatch (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FCat ,
    MZO ) [inline]

```

15.14.1.16 fspmm() [1/9]

```

void fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ,
    NotZOSparseMatrix ) [inline]

```

15.14.1.17 fspmm() [2/9]

```

std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]

```

15.14.1.18 fspmm() [3/9]

```

std::enable_if< !support_simd< typenameField::Element >::value >::type fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]

```

15.14.1.19 fspmm() [4/9]

```

std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]

```

15.14.1.20 fspmm() [5/9]

```
std::enable_if<!support\_simd< typenameField::Element >::value >::type fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.21 fspmm() [6/9]

```
void fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ,
    ZOSparseMatrix ) [inline]
```

15.14.1.22 fspmm() [7/9]

```
std::enable_if< support\_simd< typenameField::Element >::value >::type fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

15.14.1.23 fspmm() [8/9]

```
std::enable_if<!support\_simd< typenameField::Element >::value >::type fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

15.14.1.24 fspmm() [9/9]

```

void fspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    ZOSparseMatrix ) [inline]

```

15.14.1.25 pfspmm_dispatch() [1/2]

```

std::enable_if<!(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::Mac
>::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt
>::value)>::type pfspmm_dispatch (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FCat ,
    MZO ) [inline]

```

15.14.1.26 pfspmm_dispatch() [2/2]

```

std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::Mac
>::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineInt
>::value >::type pfspmm_dispatch (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FCat ,
    MZO ) [inline]

```

15.14.1.27 pfspmm() [1/9]

```

void pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ,
    NotZOSparseMatrix ) [inline]

```

15.14.1.28 pfspmm() [2/9]

```

std::enable_if< support_simd< typenameField::Element >::value >::type pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]

```

15.14.1.29 pfspmm() [3/9]

```

std::enable_if< !support_simd< typenameField::Element >::value >::type pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]

```

15.14.1.30 pfspmm() [4/9]

```

std::enable_if< support_simd< typenameField::Element >::value >::type pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]

```

15.14.1.31 pfspmm() [5/9]

```
std::enable_if<!support\_simd< typenameField::Element >::value >::type pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.32 pfspmm() [6/9]

```
void pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::GenericTag ,
    ZOSparseMatrix ) [inline]
```

15.14.1.33 pfspmm() [7/9]

```
std::enable_if< support\_simd< typenameField::Element >::value >::type pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

15.14.1.34 pfspmm() [8/9]

```
std::enable_if<!support\_simd< typenameField::Element >::value >::type pfspmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

15.14.1.35 pfsppmm() [9/9]

```

void pfsppmm (
    const Field & F,
    const SM & A,
    size_t blockSize,
    typename Field::ConstElement_ptr x,
    int ldx,
    typename Field::Element_ptr y,
    int ldy,
    FieldCategories::ModularTag ,
    ZOSparseMatrix ) [inline]

```

15.14.1.36 pfsppmv() [1/6]

```

void pfsppmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ,
    std::false_type ) [inline]

```

15.14.1.37 pfsppmv() [2/6]

```

void pfsppmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    std::false_type ) [inline]

```

15.14.1.38 pfsppmv() [3/6]

```

void pfsppmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    std::false_type ) [inline]

```


15.14.1.39 pfspmv() [4/6]

```

void pfspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::GenericTag ,
    std::true_type ) [inline]

```

15.14.1.40 pfspmv() [5/6]

```

void pfspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    std::true_type ) [inline]

```

15.14.1.41 pfspmv() [6/6]

```

void pfspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    std::true_type ) [inline]

```

15.14.1.42 fspmv() [10/12]

```

std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value &&support_simd< typenameField↵
::Element >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    NotZOSparseMatrix ) [inline]

```

15.14.1.43 fspmv() [11/12]

```
std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value &&support_simd< typenameField↵
::Element >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::ModularTag ,
    NotZOSparseMatrix ) [inline]
```

15.14.1.44 fspmv() [12/12]

```
std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value &&support_simd< typenameField↵
::Element >::value >::type fspmv (
    const Field & F,
    const SM & A,
    typename Field::ConstElement_ptr x,
    typename Field::Element_ptr y,
    FieldCategories::UnparametricTag ,
    ZOSparseMatrix ) [inline]
```

15.15 FFLAS::sparse_details_impl Namespace Reference

Functions

- template<class Field >
void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)
- template<class Field >
void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)
- template<class Field >
void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)
- template<class Field >
void fspmm_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t block↵
Size, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)
- template<class Field >
void fspmm_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_↵
t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)
- template<class Field >
void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_↵
t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)
- template<class Field >
void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_↵
t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)

- `template<class Field >`
`void fspmm_one_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A,`
`size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_one_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A,`
`size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A,`
`size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A,`
`size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, typename Field::ConstElement_ptr`
`x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, typename Field::ConstElement_ptr`
`x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, typename Field::ConstElement_ptr`
`x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename`
`Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename`
`Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename`
`Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`
`void pfspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t ↵`
`blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t ↵`
`blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t ↵`
`blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::UnparametricTag)`

- `template<class Field >`
`void pfspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_↵`
`t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr`
`x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_task (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const index_t iStart, const index_t iStop,`
`FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr`
`x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr`
`x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename`
`Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, index_t block_↵`
`Size, typename Field::ConstElement_ptr x_, index_t ldx, typename Field::Element_ptr y_, index_t ldy,`
`FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_↵`
`_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_↵`
`_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename`
`Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_↵`
`t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_↵`
`t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm_one_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A,`

- ```
size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,
FieldCategories::UnparametricTag)
```
- `template<class Field >`  
`void fspmm_one_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A,`  
`size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`  
`FieldCategories::UnparametricTag)`
  - `template<class Field >`  
`void fspmm_mone_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A,`  
`size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`  
`FieldCategories::UnparametricTag)`
  - `template<class Field >`  
`void fspmm_mone_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A,`  
`size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`  
`FieldCategories::UnparametricTag)`
  - `template<class Field >`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr`  
`x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
  - `template<class Field >`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr`  
`x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
  - `template<class Field >`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr`  
`x_, typename Field::Element_ptr y_, const int64_t kmax)`
  - `template<class Field >`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename`  
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
  - `template<class Field >`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename`  
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
  - `template<class Field >`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename`  
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
  - `template<class Field >`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename`  
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
  - `template<class Field >`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, type-`  
`name Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag)`
  - `template<class Field >`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, type-`  
`name Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag)`
  - `template<class Field >`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, type-`  
`name Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag)`
  - `template<class Field >`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_↵`  
`t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy,`  
`FieldCategories::UnparametricTag)`
  - `template<class Field >`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, type-`  
`name Field::ConstElement_ptr x, typename Field::Element_ptr y, const int64_t kmax)`
  - `template<class Field >`  
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, type-`  
`name Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, const int64_t kmax)`
  - `template<class Field >`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename`  
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`

- `template<class Field >`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`
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`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`  
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- `template<class Field >`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field >`  
`void pfspm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag)`
- `template<class Field >`  
`void pfspm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`  
`void pfspm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void pfspm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void pfspm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, const int64_t kmax)`
- `template<class Field >`  
`void pfspm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, const int64_t kmax)`
- `template<class Field, class Func >`  
`void pfspm_zo (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, Func &&func)`
- `template<class Field, class Func >`  
`void pfspm_zo (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, Func &&func)`
- `template<class Field >`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`



- `template<class Field >`  
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`  
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`  
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`  
`void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`  
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`  
`void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void fspmm_one_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void fspmm_one_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void fspmm_mone_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void fspmm_mone_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`





[illegible]

- `template<class Field >`  
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field >`  
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`  
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`  
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`  
`void fspmv_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void fspmv_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field >`  
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field >`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`  
`void fspmv_one_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void fspmv_mone_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`  
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

### 15.15.1 Function Documentation

**15.15.1.1 fspmm()** [1/15]

```
void fspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::GenericTag) [inline]
```

**15.15.1.2 fspmm()** [2/15]

```
void fspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]
```

**15.15.1.3 fspmm()** [3/15]

```
void fspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 const int64_t kmax) [inline]
```

**15.15.1.4 fspmm\_simd\_aligned()** [1/2]

```
void fspmm_simd_aligned (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 const int64_t kmax) [inline]
```

**15.15.1.5 fspmm\_simd\_unaligned()** [1/2]

```

void fspmm_simd_unaligned (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 const int64_t kmax) [inline]

```

**15.15.1.6 fspmm\_one()** [1/4]

```

void fspmm_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.7 fspmm\_mone()** [1/4]

```

void fspmm_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.8 fspmm\_one\_simd\_aligned()** [1/3]

```

void fspmm_one_simd_aligned (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.9 fspmm\_one\_simd\_unaligned()** [1/3]

```

void fspmm_one_simd_unaligned (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.10 fspmm\_mone\_simd\_aligned()** [1/3]

```

void fspmm_mone_simd_aligned (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.11 fspmm\_mone\_simd\_unaligned()** [1/3]

```

void fspmm_mone_simd_unaligned (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.12 fspmv()** [1/21]

```

void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.13 fspmv()** [2/21]

```
void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]
```

**15.15.1.14 fspmv()** [3/21]

```
void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 const uint64_t kmax) [inline]
```

**15.15.1.15 fspmv\_one()** [1/10]

```
void fspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]
```

**15.15.1.16 fspmv\_mone()** [1/10]

```
void fspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]
```

**15.15.1.17 fspmv\_one()** [2/10]

```
void fspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]
```

**15.15.1.18 fspmv\_mone()** [2/10]

```

void fspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::COO_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.19 pfspmm()** [1/18]

```

void pfspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.20 pfspmm()** [2/18]

```

void pfspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.21 pfspmm()** [3/18]

```

void pfspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 const int64_t kmax) [inline]

```

**15.15.1.22 pfspmm\_one()** [1/2]

```

void pfspmm_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.23 pfspmm\_mone()** [1/2]

```

void pfspmm_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.24 pfspmm\_one()** [2/2]

```

void pfspmm_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.25 pfspmm\_mone()** [2/2]

```

void pfspmm_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```



**15.15.1.26 pfspmv()** [1/18]

```
void pfspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]
```

**15.15.1.27 pfspmv\_task()**

```
void pfspmv_task (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 const index_t iStart,
 const index_t iStop,
 FieldCategories::UnparametricTag) [inline]
```

**15.15.1.28 pfspmv()** [2/18]

```
void pfspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]
```

**15.15.1.29 pfspmv()** [3/18]

```
void pfspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 const int64_t kmax) [inline]
```

**15.15.1.30 pfspmv\_one()** [1/8]

```
void pfspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]
```

**15.15.1.31 pfspmv\_mone()** [1/8]

```

void pfspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.32 pfspmv\_one()** [2/8]

```

void pfspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.33 pfspmv\_mone()** [2/8]

```

void pfspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.34 fspmm()** [4/15]

```

void fspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.35 fspmm()** [5/15]

```

void fspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR > & A,
 index_t blockSize,
 typename Field::ConstElement_ptr x_,
 index_t ldx,
 typename Field::Element_ptr y_,
 index_t ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.36 fspmm\_simd\_aligned()** [2/2]

```

void fspmm_simd_aligned (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.37 fspmm\_simd\_unaligned()** [2/2]

```

void fspmm_simd_unaligned (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.38 fspmm()** [6/15]

```

void fspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 const int64_t kmax) [inline]

```

**15.15.1.39 fspmm\_one() [2/4]**

```

void fspmm_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.40 fspmm\_mone() [2/4]**

```

void fspmm_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.41 fspmm\_one\_simd\_aligned() [2/3]**

```

void fspmm_one_simd_aligned (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.42 fspmm\_one\_simd\_unaligned() [2/3]**

```

void fspmm_one_simd_unaligned (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.143 fspmm\_mone\_simd\_aligned()** [2/3]

```

void fspmm_mone_simd_aligned (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.144 fspmm\_mone\_simd\_unaligned()** [2/3]

```

void fspmm_mone_simd_unaligned (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.145 fspmv()** [4/21]

```

void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]

```

**15.15.146 fspmv()** [5/21]

```

void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.47 fspmv()** [6/21]

```
void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 const int64_t kmax) [inline]
```

**15.15.1.48 fspmv\_one()** [3/10]

```
void fspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]
```

**15.15.1.49 fspmv\_mone()** [3/10]

```
void fspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]
```

**15.15.1.50 fspmv\_one()** [4/10]

```
void fspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]
```

**15.15.1.51 fspmv\_mone()** [4/10]

```
void fspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]
```

**15.15.152 pfsppmm()** [4/18]

```

void pfsppmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 typename Field::Element_ptr y,
 FieldCategories::GenericTag) [inline]

```

**15.15.153 pfsppmm()** [5/18]

```

void pfsppmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 int ldx,
 typename Field::Element_ptr y,
 int ldy,
 FieldCategories::GenericTag) [inline]

```

**15.15.154 pfsppmm()** [6/18]

```

void pfsppmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 typename Field::Element_ptr y,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.155 pfsppmm()** [7/18]

```

void pfsppmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 int ldx,
 typename Field::Element_ptr y,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.56 pfsppmm()** [8/18]

```

void pfsppmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 typename Field::Element_ptr y,
 const int64_t kmax) [inline]

```

**15.15.1.57 pfsppmm()** [9/18]

```

void pfsppmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 int ldx,
 typename Field::Element_ptr y,
 int ldy,
 const int64_t kmax) [inline]

```

**15.15.1.58 pfsppmv()** [4/18]

```

void pfsppmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.59 pfsppmv()** [5/18]

```

void pfsppmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```



**15.15.1.60 pfspmv()** [6/18]

```

void pfspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 const int64_t kmax) [inline]

```

**15.15.1.61 fspmm()** [7/15]

```

void fspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.62 fspmm()** [8/15]

```

void fspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.63 fspmm()** [9/15]

```

void fspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 const int64_t kmax) [inline]

```

**15.15.1.64 fspmv()** [7/21]

```

void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.65 fspmv()** [8/21]

```

void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.66 fspmv()** [9/21]

```

void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::CSR_HYB > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 const uint64_t kmax) [inline]

```

**15.15.1.67 pfspmm()** [10/18]

```

void pfspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 typename Field::Element_ptr y,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.68 pfspmm()** [11/18]

```

void pfspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 int ldx,
 typename Field::Element_ptr y,
 int ldy,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.69 pfsppmm()** [12/18]

```

void pfsppmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 typename Field::Element_ptr y,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.70 pfsppmm()** [13/18]

```

void pfsppmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 int ldx,
 typename Field::Element_ptr y,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.71 pfsppmm()** [14/18]

```

void pfsppmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 typename Field::Element_ptr y,
 const int64_t kmax) [inline]

```

**15.15.1.72 pfsppmm()** [15/18]

```

void pfsppmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 int ldx,
 typename Field::Element_ptr y,
 int ldy,
 const int64_t kmax) [inline]

```

**15.15.1.73 pfspmm\_zo()** [1/2]

```

void pfspmm_zo (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 typename Field::Element_ptr y,
 Func && func) [inline]

```

**15.15.1.74 pfspmm\_zo()** [2/2]

```

void pfspmm_zo (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 int ldx,
 typename Field::Element_ptr y,
 int ldy,
 Func && func) [inline]

```

**15.15.1.75 pfspmv()** [7/18]

```

void pfspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.76 pfspmv()** [8/18]

```

void pfspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.77 pfspmv()** [9/18]

```
void pfspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 const int64_t kmax) [inline]
```

**15.15.1.78 pfspmv\_one()** [3/8]

```
void pfspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]
```

**15.15.1.79 pfspmv\_mone()** [3/8]

```
void pfspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]
```

**15.15.1.80 pfspmv\_one()** [4/8]

```
void pfspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]
```

**15.15.1.81 pfspmv\_mone()** [4/8]

```
void pfspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]
```

**15.15.1.82 fspmm()** [10/15]

```

void fspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.83 fspmm()** [11/15]

```

void fspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.84 fspmm()** [12/15]

```

void fspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 const int64_t kmax) [inline]

```

**15.15.1.85 fspmm\_mone()** [3/4]

```

void fspmm_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.86 fspmm\_one()** [3/4]

```

void fspmm_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.87 fspmm\_mone()** [4/4]

```

void fspmm_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.88 fspmm\_one()** [4/4]

```

void fspmm_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.89 fspmm\_one\_simd\_aligned()** [3/3]

```

void fspmm_one_simd_aligned (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.90 fspmm\_one\_simd\_unaligned()** [3/3]

```

void fspmm_one_simd_unaligned (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.91 fspmm\_mone\_simd\_aligned()** [3/3]

```

void fspmm_mone_simd_aligned (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.92 fspmm\_mone\_simd\_unaligned()** [3/3]

```

void fspmm_mone_simd_unaligned (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x_,
 int ldx,
 typename Field::Element_ptr y_,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.93 fspmv()** [10/21]

```

void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]

```



**15.15.1.94 fspmv()** [11/21]

```

void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.95 fspmv()** [12/21]

```

void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 const uint64_t kmax) [inline]

```

**15.15.1.96 fspmv\_one()** [5/10]

```

void fspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.97 fspmv\_mone()** [5/10]

```

void fspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.98 fspmv\_one()** [6/10]

```

void fspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.99 fspmv\_mone()** [6/10]

```

void fspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.100 pfspmv()** [10/18]

```

void pfspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.101 pfspmv()** [11/18]

```

void pfspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.102 pfspmv()** [12/18]

```

void pfspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 const uint64_t kmax) [inline]

```

**15.15.1.103 pfspmv\_one()** [5/8]

```

void pfspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.104 pfspmv\_mone()** [5/8]

```

void pfspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.105 pfspmv\_one()** [6/8]

```

void pfspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.106 pfspmv\_mone()** [6/8]

```

void pfspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.107 fspmv()** [13/21]

```

void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.108 fspmv\_simd()** [1/4]

```

void fspmv_simd (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.109 fspmv()** [14/21]

```

void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.110 fspmv\_simd()** [2/4]

```

void fspmv_simd (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 const uint64_t kmax) [inline]

```

**15.15.1.111 fspmv()** [15/21]

```

void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 const uint64_t kmax) [inline]

```

**15.15.1.112 fspmv\_one()** [7/10]

```

void fspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.113 fspmv\_mone()** [7/10]

```

void fspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.114 fspmv\_one()** [8/10]

```

void fspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.115 fspmv\_mone()** [8/10]

```

void fspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.116 fspmv\_one\_simd()** [1/2]

```

void fspmv_one_simd (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.117 fspmv\_mone\_simd()** [1/2]

```

void fspmv_mone_simd (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::ELL_simd_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.118 pfspmm()** [16/18]

```

void pfspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 int ldx,
 typename Field::Element_ptr y,
 int ldy,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.119 pfsppmm()** [17/18]

```

void pfsppmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 int ldx,
 typename Field::Element_ptr y,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.120 pfsppmm()** [18/18]

```

void pfsppmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 int ldx,
 typename Field::Element_ptr y,
 int ldy,
 uint64_t kmax) [inline]

```

**15.15.1.121 pfsppmv()** [13/18]

```

void pfsppmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
 typename Field::ConstElement_ptr x,
 typename Field::Element_ptr y,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.122 pfsppmv()** [14/18]

```

void pfsppmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
 typename Field::ConstElement_ptr x,
 typename Field::Element_ptr y,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.123 pfspmv()** [15/18]

```

void pfspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
 typename Field::ConstElement_ptr x,
 typename Field::Element_ptr y,
 uint64_t kmax) [inline]

```

**15.15.1.124 fspmm()** [13/15]

```

void fspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 int ldx,
 typename Field::Element_ptr y,
 int ldy,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.125 fspmm()** [14/15]

```

void fspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 int ldx,
 typename Field::Element_ptr y,
 int ldy,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.126 fspmm()** [15/15]

```

void fspmm (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
 size_t blockSize,
 typename Field::ConstElement_ptr x,
 int ldx,
 typename Field::Element_ptr y,
 int ldy,
 uint64_t kmax) [inline]

```

**15.15.1.127 fspmv()** [16/21]

```

void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
 typename Field::ConstElement_ptr x,
 typename Field::Element_ptr y,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.128 fspmv()** [17/21]

```

void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
 typename Field::ConstElement_ptr x,
 typename Field::Element_ptr y,
 FieldCategories::UnparametricTag) [inline]

```

**15.15.1.129 fspmv()** [18/21]

```

void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::HYB_ZO > & A,
 typename Field::ConstElement_ptr x,
 typename Field::Element_ptr y,
 uint64_t kmax) [inline]

```

**15.15.1.130 pfspmv()** [16/18]

```

void pfspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]

```

**15.15.1.131 pfspmv()** [17/18]

```

void pfspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```



**15.15.1.132 pfspmv()** [18/18]

```
void pfspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 const int64_t kmax) [inline]
```

**15.15.1.133 pfspmv\_one()** [7/8]

```
void pfspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]
```

**15.15.1.134 pfspmv\_mone()** [7/8]

```
void pfspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]
```

**15.15.1.135 pfspmv\_one()** [8/8]

```
void pfspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]
```

**15.15.1.136 pfspmv\_mone()** [8/8]

```
void pfspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]
```

**15.15.1.137 fspmv()** [19/21]

```
void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]
```

**15.15.1.138 fspmv\_simd()** [3/4]

```
void fspmv_simd (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]
```

**15.15.1.139 fspmv()** [20/21]

```
void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]
```

**15.15.1.140 fspmv\_simd()** [4/4]

```
void fspmv_simd (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 const uint64_t kmax) [inline]
```

**15.15.1.141 fspmv()** [21/21]

```
void fspmv (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 const uint64_t kmax) [inline]
```

**15.15.1.142 fspmv\_one()** [9/10]

```
void fspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]
```

**15.15.1.143 fspmv\_mone()** [9/10]

```
void fspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::GenericTag) [inline]
```

**15.15.1.144 fspmv\_one\_simd()** [2/2]

```
void fspmv_one_simd (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]
```

**15.15.1.145 fspmv\_mone\_simd()** [2/2]

```
void fspmv_mone_simd (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]
```

**15.15.1.146 fspmv\_one()** [10/10]

```
void fspmv_one (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]
```

**15.15.1.147 fspmv\_mone()** [10/10]

```

void fspmv_mone (
 const Field & F,
 const Sparse< Field, SparseMatrix_t::SELL_ZO > & A,
 typename Field::ConstElement_ptr x_,
 typename Field::Element_ptr y_,
 FieldCategories::UnparametricTag) [inline]

```

**15.16 FFLAS::StrategyParameter Namespace Reference****Data Structures**

- struct [Fixed](#)
- struct [Grain](#)
- struct [Threads](#)
- struct [ThreeD](#)
- struct [ThreeDAdaptive](#)
- struct [ThreeDInPlace](#)
- struct [TwoD](#)
- struct [TwoDAdaptive](#)

**15.17 FFLAS::StructureHelper Namespace Reference**

[StructureHelper](#) for ftrsm.

**Data Structures**

- struct [Hybrid](#)
- struct [Iterative](#)
- struct [Recursive](#)

**15.17.1 Detailed Description**

[StructureHelper](#) for ftrsm.

**15.18 FFLAS::vectorised Namespace Reference****Namespaces**

- namespace [unswitch](#)

## Data Structures

- struct [HelperMod](#)
- struct [HelperMod](#)< Field, ElementCategories::MachineIntTag >
- struct [HelperMod](#)< Field, FFLAS::ElementCategories::ArbitraryPrecIntTag >
- struct [HelperMod](#)< Field, FFLAS::ElementCategories::FixedPrecIntTag >
- struct [HelperMod](#)< Field, FFLAS::ElementCategories::MachineFloatTag >

## Functions

- template<class SimdT, class Element, bool positive>  
std::enable\_if< [is\\_simd](#)< SimdT >::value, void >::type [VEC\\_ADD](#) (SimdT &C, SimdT &A, SimdT &B, SimdT &Q, SimdT &T, SimdT &P, SimdT &NEGP, SimdT &MIN, SimdT &MAX)
- template<bool positive, class Element, class T1, class T2 >  
std::enable\_if< [FFLAS::support\\_simd\\_add](#)< Element >::value, void >::type [addp](#) (Element \*T, const Element \*TA, const Element \*TB, size\_t n, Element p, T1 min\_, T2 max\_)
- template<class SimdT, class Element, bool positive>  
std::enable\_if< [is\\_simd](#)< SimdT >::value, void >::type [VEC\\_SUB](#) (SimdT &C, SimdT &A, SimdT &B, SimdT &Q, SimdT &T, SimdT &P, SimdT &NEGP, SimdT &MIN, SimdT &MAX)
- template<bool positive, class Element, class T1, class T2 >  
std::enable\_if< [FFLAS::support\\_simd\\_add](#)< Element >::value, void >::type [subp](#) (Element \*T, const Element \*TA, const Element \*TB, const size\_t n, const Element p, const T1 min\_, const T2 max\_)
- template<class Element >  
std::enable\_if< [FFLAS::support\\_simd\\_add](#)< Element >::value, void >::type [add](#) (Element \*T, const Element \*TA, const Element \*TB, size\_t n)
- template<class Element >  
std::enable\_if< [FFLAS::support\\_simd\\_add](#)< Element >::value, void >::type [sub](#) (Element \*T, const Element \*TA, const Element \*TB, size\_t n)
- template<class T >  
std::enable\_if< !std::is\_integral< T >::value, T >::type [reduce](#) (T A, T B)
- template<class T >  
std::enable\_if< std::is\_integral< T >::value, T >::type [reduce](#) (T A, T B)
- template<> Givaro::Integer [reduce](#) (Givaro::Integer A, Givaro::Integer B)
- float [reduce](#) (float A, float B, float invB, float min, float max)
- double [reduce](#) (double A, double B, double invB, double min, double max)
- [int64\\_t reduce](#) ([int64\\_t](#) A, [int64\\_t](#) p, double invp, double min, double max, [int64\\_t](#) pow50rem)
- template<class Field >  
[Field::Element reduce](#) (typename [Field::Element](#) A, [HelperMod](#)< Field, ElementCategories::MachineIntTag > &H)
- template<class Field >  
[Field::Element reduce](#) (typename [Field::Element](#) A, [HelperMod](#)< Field, ElementCategories::MachineFloatTag > &H)
- template<class Field >  
[Field::Element reduce](#) (typename [Field::Element](#) A, [HelperMod](#)< Field, ElementCategories::ArbitraryPrecIntTag > &H)
- template<class Field >  
std::enable\_if< [FFLAS::support\\_fast\\_mod](#)< typename [Field::Element](#) >::value, void >::type [modp](#) (const [Field](#) &F, typename [Field::ConstElement\\_ptr](#) U, const size\_t &n, typename [Field::Element\\_ptr](#) T)
- template<class Field >  
std::enable\_if< [FFLAS::support\\_fast\\_mod](#)< typename [Field::Element](#) >::value, void >::type [modp](#) (const [Field](#) &F, typename [Field::ConstElement\\_ptr](#) U, const size\_t &n, const size\_t &incX, typename [Field::Element\\_ptr](#) T)
- template<class Field >  
std::enable\_if< [FFLAS::support\\_fast\\_mod](#)< typename [Field::Element](#) >::value, void >::type [scalp](#) (const [Field](#) &F, typename [Field::Element\\_ptr](#) T, const typename [Field::Element](#) alpha, typename [Field::ConstElement\\_ptr](#) U, const size\_t n)

- `template<class Field >`  
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type scalp`  
`(const Field &F, typename Field::Element_ptr T, const typename Field::Element alpha, typename`  
`Field::ConstElement_ptr U, const size_t n, const size_t &incX)`

## 15.18.1 Function Documentation

### 15.18.1.1 VEC\_ADD()

```
std::enable_if< is_simd< SimdT >::value, void >::type VEC_ADD (
 SimdT & C,
 SimdT & A,
 SimdT & B,
 SimdT & Q,
 SimdT & T,
 SimdT & P,
 SimdT & NEGP,
 SimdT & MIN,
 SimdT & MAX) [inline]
```

### 15.18.1.2 addp()

```
std::enable_if< FFLAS::support_simd_add< Element >::value, void >::type addp (
 Element * T,
 const Element * TA,
 const Element * TB,
 size_t n,
 Element p,
 T1 min_,
 T2 max_) [inline]
```

### 15.18.1.3 VEC\_SUB()

```
std::enable_if< is_simd< SimdT >::value, void >::type VEC_SUB (
 SimdT & C,
 SimdT & A,
 SimdT & B,
 SimdT & Q,
 SimdT & T,
 SimdT & P,
 SimdT & NEGP,
 SimdT & MIN,
 SimdT & MAX) [inline]
```

**15.18.1.4 subp()**

```
std::enable_if< FFLAS::support_simd_add< Element >::value, void >::type subp (
 Element * T,
 const Element * TA,
 const Element * TB,
 const size_t n,
 const Element p,
 const T1 min_,
 const T2 max_) [inline]
```

**15.18.1.5 add()**

```
std::enable_if< FFLAS::support_simd_add< Element >::value, void >::type add (
 Element * T,
 const Element * TA,
 const Element * TB,
 size_t n) [inline]
```

**15.18.1.6 sub()**

```
std::enable_if< FFLAS::support_simd_add< Element >::value, void >::type sub (
 Element * T,
 const Element * TA,
 const Element * TB,
 size_t n) [inline]
```

**15.18.1.7 reduce() [1/9]**

```
std::enable_if<!std::is_integral< T >::value, T >::type reduce (
 T A,
 T B) [inline]
```

**15.18.1.8 reduce() [2/9]**

```
std::enable_if< std::is_integral< T >::value, T >::type reduce (
 T A,
 T B) [inline]
```

**15.18.1.9 reduce()** [3/9]

```
Givaro::Integer reduce (
 Givaro::Integer A,
 Givaro::Integer B) [inline]
```

**15.18.1.10 reduce()** [4/9]

```
float reduce (
 float A,
 float B,
 float invB,
 float min,
 float max) [inline]
```

**15.18.1.11 reduce()** [5/9]

```
double reduce (
 double A,
 double B,
 double invB,
 double min,
 double max) [inline]
```

**15.18.1.12 reduce()** [6/9]

```
int64_t reduce (
 int64_t A,
 int64_t P,
 double invp,
 double min,
 double max,
 int64_t pow50rem) [inline]
```

**15.18.1.13 reduce()** [7/9]

```
Field::Element reduce (
 typename Field::Element A,
 HelperMod< Field, ElementCategories::MachineIntTag > & H) [inline]
```



**15.18.1.14 reduce()** [8/9]

```
Field::Element reduce (
 typename Field::Element A,
 HelperMod< Field, ElementCategories::MachineFloatTag > & H) [inline]
```

**15.18.1.15 reduce()** [9/9]

```
Field::Element reduce (
 typename Field::Element A,
 HelperMod< Field, ElementCategories::ArbitraryPrecIntTag > & H) [inline]
```

**15.18.1.16 modp()** [1/2]

```
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type modp (
 const Field & F,
 typename Field::ConstElement_ptr U,
 const size_t & n,
 typename Field::Element_ptr T) [inline]
```

**15.18.1.17 modp()** [2/2]

```
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type modp (
 const Field & F,
 typename Field::ConstElement_ptr U,
 const size_t & n,
 const size_t & incX,
 typename Field::Element_ptr T) [inline]
```

**15.18.1.18 scalp()** [1/2]

```
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type scalp
(
 const Field & F,
 typename Field::Element_ptr T,
 const typename Field::Element alpha,
 typename Field::ConstElement_ptr U,
 const size_t n) [inline]
```

### 15.18.1.19 scalp() [2/2]

```
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type scalp
(
 const Field & F,
 typename Field::Element_ptr T,
 const typename Field::Element alpha,
 typename Field::ConstElement_ptr U,
 const size_t n,
 const size_t & incX) [inline]
```

## 15.19 FFLAS::vectorised::unswitch Namespace Reference

### Functions

- template<class Field >  
std::enable\_if<!FFLAS::support\_simd\_mod< typenameField::Element >::value &&FFLAS::support\_fast\_mod< typenameField::Element >::value, void >::type modp (const Field &F, typename Field::ConstElement\_ptr U, const size\_t &n, typename Field::Element\_ptr T, HelperMod< Field > &H)
- template<class Field >  
std::enable\_if< FFLAS::support\_fast\_mod< typenameField::Element >::value, void >::type modp (const Field &F, typename Field::ConstElement\_ptr U, const size\_t &n, const size\_t &incX, typename Field::Element\_ptr T, HelperMod< Field > &H)
- template<class Field >  
std::enable\_if<!FFLAS::support\_simd\_mod< typenameField::Element >::value &&FFLAS::support\_fast\_mod< typenameField::Element >::value, void >::type scalp (const Field &F, typename Field::Element\_ptr T, const typename Field::Element alpha, typename Field::ConstElement\_ptr U, const size\_t n, HelperMod< Field > &H)
- template<class Field >  
std::enable\_if< FFLAS::support\_fast\_mod< typenameField::Element >::value, void >::type scalp (const Field &F, typename Field::Element\_ptr T, const typename Field::Element alpha, typename Field::ConstElement\_ptr U, const size\_t n, const size\_t &incX, HelperMod< Field > &H)

### 15.19.1 Function Documentation

#### 15.19.1.1 modp() [1/2]

```
std::enable_if<!FFLAS::support_simd_mod< typenameField::Element >::value &&FFLAS::support_fast_mod< typenameField::Element >::value, void >::type modp (
 const Field & F,
 typename Field::ConstElement_ptr U,
 const size_t & n,
 typename Field::Element_ptr T,
 HelperMod< Field > & H) [inline]
```

**15.19.1.2 modp()** [2/2]

```
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type modp (
 const Field & F,
 typename Field::ConstElement_ptr U,
 const size_t & n,
 const size_t & incX,
 typename Field::Element_ptr T,
 HelperMod< Field > & H) [inline]
```

**15.19.1.3 scalp()** [1/2]

```
std::enable_if<!FFLAS::support_simd_mod< typenameField::Element >::value &&FFLAS::support_fast_mod<
typenameField::Element >::value, void >::type scalp (
 const Field & F,
 typename Field::Element_ptr T,
 const typename Field::Element alpha,
 typename Field::ConstElement_ptr U,
 const size_t n,
 HelperMod< Field > & H) [inline]
```

**15.19.1.4 scalp()** [2/2]

```
std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type scalp
(
 const Field & F,
 typename Field::Element_ptr T,
 const typename Field::Element alpha,
 typename Field::ConstElement_ptr U,
 const size_t n,
 const size_t & incX,
 HelperMod< Field > & H) [inline]
```

**15.20 FFPACK Namespace Reference**

Finite Field **PACK** Set of elimination based routines for dense linear algebra.

**Namespaces**

- namespace [Protected](#)

## Data Structures

- class [callLUdivine\\_small](#)
- class [callLUdivine\\_small< double >](#)
- class [callLUdivine\\_small< float >](#)
- class [CharpolyFailed](#)
- class [CheckerImplem\\_charpoly](#)
- class [CheckerImplem\\_Det](#)
- class [CheckerImplem\\_invert](#)
- class [CheckerImplem\\_PLUQ](#)
- class [Failure](#)  
*A precondition failed.*
- struct [rns\\_double](#)
- struct [rns\\_double\\_elt](#)
- struct [rns\\_double\\_elt\\_cstptr](#)
- struct [rns\\_double\\_elt\\_ptr](#)
- struct [rns\\_double\\_extended](#)
- class [RNSInteger](#)
- class [RNSIntegerMod](#)
- class [rnsRandIter](#)

## Typedefs

- `template<class Field >`  
  using [Checker\\_PLUQ](#) = [FFLAS::Checker\\_Empty< \[Field\]\(#\) >](#)
- `template<class Field >`  
  using [Checker\\_Det](#) = [FFLAS::Checker\\_Empty< \[Field\]\(#\) >](#)
- `template<class Field >`  
  using [Checker\\_invert](#) = [FFLAS::Checker\\_Empty< \[Field\]\(#\) >](#)
- `template<class Field , class Polynomial >`  
  using [Checker\\_charpoly](#) = [FFLAS::Checker\\_Empty< \[Field\]\(#\) >](#)
- `template<class Field >`  
  using [ForceCheck\\_PLUQ](#) = [CheckerImplem\\_PLUQ< \[Field\]\(#\) >](#)
- `template<class Field >`  
  using [ForceCheck\\_Det](#) = [CheckerImplem\\_Det< \[Field\]\(#\) >](#)
- `template<class Field >`  
  using [ForceCheck\\_invert](#) = [CheckerImplem\\_invert< \[Field\]\(#\) >](#)
- `template<class Field , class Polynomial >`  
  using [ForceCheck\\_charpoly](#) = [CheckerImplem\\_charpoly< \[Field\]\(#\), Polynomial >](#)

## Functions

- void [LAPACKPerm2MathPerm](#) (size\_t \*MathP, const size\_t \*LapackP, const size\_t N)  
*Conversion of a permutation from LAPACK format to Math format.*
- void [MathPerm2LAPACKPerm](#) (size\_t \*LapackP, const size\_t \*MathP, const size\_t N)  
*Conversion of a permutation from Maths format to LAPACK format.*
- `template<class Field >`  
  void [applyP](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [FFLAS::FFLAS\\_TRANSPOSE](#) Trans, const size\_t M, const size\_t ibeg, const size\_t iend, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t \*P)  
*Computes  $P1 \times \text{Diag}(I_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $P1$  as a LAPACK permutation.*

- `template<class Field >`  
`void applyP (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t m, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const size_t *P, const FFLAS::ParSeqHelper::Sequential seq)`
- `template<class Field , class Cut , class Param >`  
`void applyP (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t m, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const size_t *P, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par)`
- `template<class Field >`  
`void MonotonicApplyP (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t M, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const size_t *P, const size_t R)`  
*Apply a R-monotonically increasing permutation P, to the matrix A.*
- `template<class Field >`  
`void fgetrs (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr A, const size_t lda, const size_t *P, const size_t *Q, typename Field::Element_ptr B, const size_t ldb, int *info)`  
*Solve the system  $AX = B$  or  $XA = B$ .*
- `template<class Field >`  
`Field::Element_ptr fgetrs (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t NRHS, const size_t R, typename Field::Element_ptr A, const size_t lda, const size_t *P, const size_t *Q, typename Field::Element_ptr X, const size_t ldX, typename Field::ConstElement_ptr B, const size_t ldb, int *info)`  
*Solve the system  $AX = B$  or  $XA = B$ .*
- `template<class Field >`  
`size_t fgesv (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, int *info)`  
*Square system solver.*
- `template<class Field >`  
`size_t fgesv (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t NRHS, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldX, typename Field::ConstElement_ptr B, const size_t ldb, int *info)`  
*Rectangular system solver.*
- `template<class Field >`  
`void ftrtri (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG Diag, const size_t N, typename Field::Element_ptr A, const size_t lda, const size_t threshold=__FFLASFFPACK_FTRTRI_THRESHOLD)`  
*Compute the inverse of a triangular matrix.*
- `template<class Field >`  
`void trinv_left (const Field &F, const size_t N, typename Field::ConstElement_ptr L, const size_t ldL, typename Field::Element_ptr X, const size_t ldX)`
- `template<class Field >`  
`void ftrrm (const Field &F, const FFLAS::FFLAS_SIDE side, const FFLAS::FFLAS_DIAG diag, const size_t N, typename Field::Element_ptr A, const size_t lda)`  
*Compute the product of two triangular matrices of opposite shape.*
- `template<class Field >`  
`void ftrstr (const Field &F, const FFLAS::FFLAS_SIDE side, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diagA, const FFLAS::FFLAS_DIAG diagB, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const size_t threshold=__FFLASFFPACK_FTRSTR_THRESHOLD)`  
*Solve a triangular system with a triangular right hand side of the same shape.*
- `template<class Field >`  
`void ftrssyr2k (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diagA, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const size_t threshold=__FFLASFFPACK_FTRSSYR2K_THRESHOLD)`  
*Solve a triangular system in a symmetric sum: find B upper/lower triangular such that  $A^T B + B^T A = C$  where C is symmetric.*

- `template<class Field >`  
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`  
*Triangular factorization of symmetric matrices.*
- `template<class Field >`  
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const FFLAS::ParSeqHelper::Sequential seq, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
- `template<class Field , class Cut , class Param >`  
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
- `template<class Field >`  
`bool fsytrf_nonunit (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr D, const size_t incD, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`  
*Triangular factorization of symmetric matrices.*
- `template<class Field >`  
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q)`  
*Compute a PLUQ factorization of the given matrix.*
- `template<class Field >`  
`size_t pPLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q)`
- `template<class Field >`  
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFLAS::ParSeqHelper::Sequential &PHelper, size_t BCThreshold=__FFLASFFPACK_PLUQ_THRESHOLD)`
- `template<class Field , class Cut , class Param >`  
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFLAS::ParSeqHelper::Parallel< Cut, Param > &PHelper)`
- `template<class Field >`  
`size_t LUdivine (const Field &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const FFPACK_LU_TAG LuTag=FpackSlabRecursive, const size_t cutoff=__FFLASFFPACK_LUDIVINE_THRESHOLD)`  
*Compute the CUP or PLE factorization of the given matrix.*
- `template<class Field >`  
`size_t ColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, bool transform=false, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`  
*Compute the Column Echelon form of the input matrix in-place.*
- `template<class Field >`  
`size_t pColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, bool transform=false, size_t numthreads=0, const FFPACK_LU_TAG LuTag=FpackTileRecursive)`
- `template<class Field , class PSHelper >`  
`size_t ColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag, const PSHelper &psH)`
- `template<class Field >`  
`size_t RowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`  
*Compute the Row Echelon form of the input matrix in-place.*

- `template<class Field >`  
`size_t pRowEchelonForm` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` \*P, `size_t` \*Qt, const bool transform=false, `size_t` numthreads=0, const FFPACK\_LU\_TAG LuTag=FfpackTileRecursive)
- `template<class Field , class PSHelper >`  
`size_t RowEchelonForm` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` \*P, `size_t` \*Qt, const bool transform, const FFPACK\_LU\_TAG LuTag, const PSHelper &psH)
- `template<class Field >`  
`size_t ReducedColumnEchelonForm` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` \*P, `size_t` \*Qt, const bool transform=false, const FFPACK\_LU\_TAG LuTag=FfpackSlabRecursive)  
*Compute the Reduced Column Echelon form of the input matrix in-place.*
- `template<class Field >`  
`size_t pReducedColumnEchelonForm` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` \*P, `size_t` \*Qt, const bool transform=false, `size_t` numthreads=0, const FFPACK\_LU\_TAG LuTag=FfpackTileRecursive)
- `template<class Field , class PSHelper >`  
`size_t ReducedColumnEchelonForm` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` \*P, `size_t` \*Qt, const bool transform, const FFPACK\_LU\_TAG LuTag, const PSHelper &psH)
- `template<class Field >`  
`size_t ReducedRowEchelonForm` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` \*P, `size_t` \*Qt, const bool transform=false, const FFPACK\_LU\_TAG LuTag=FfpackSlabRecursive)  
*Compute the Reduced Row Echelon form of the input matrix in-place.*
- `template<class Field >`  
`size_t pReducedRowEchelonForm` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` \*P, `size_t` \*Qt, const bool transform=false, `size_t` numthreads=0, const FFPACK\_LU\_TAG LuTag=FfpackTileRecursive)
- `template<class Field , class PSHelper >`  
`size_t ReducedRowEchelonForm` (const `Field` &F, const `size_t` M, const `size_t` N, typename `Field::Element_ptr` A, const `size_t` lda, `size_t` \*P, `size_t` \*Qt, const bool transform, const FFPACK\_LU\_TAG LuTag, const PSHelper &psH)
- `template<class Field >`  
`Field::Element_ptr Invert` (const `Field` &F, const `size_t` M, typename `Field::Element_ptr` A, const `size_t` lda, int &nullity)  
*Invert the given matrix in place or computes its nullity if it is singular.*
- `template<class Field >`  
`Field::Element_ptr Invert` (const `Field` &F, const `size_t` M, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::Element_ptr` X, const `size_t` ldx, int &nullity)  
*Invert the given matrix or computes its nullity if it is singular.*
- `template<class Field >`  
`Field::Element_ptr Invert2` (const `Field` &F, const `size_t` M, typename `Field::Element_ptr` A, const `size_t` lda, typename `Field::Element_ptr` X, const `size_t` ldx, int &nullity)  
*Invert the given matrix or computes its nullity if it is singular.*
- `template<class PolRing >`  
`std::list< typename PolRing::Element > & CharPoly` (const `PolRing` &R, std::list< typename `PolRing::Element` > &charp, const `size_t` N, typename `PolRing::Domain_t::Element_ptr` A, const `size_t` lda, typename `PolRing::Domain_t::RandIter` &G, const FFPACK\_CHARPOLY\_TAG CharpTag=FfpackAuto, const `size_t` degree=\_\_FFLASFFPACK\_ARITHPROG\_THRESHOLD)  
*Compute the characteristic polynomial of the matrix A.*
- `template<class PolRing >`  
`PolRing::Element & CharPoly` (const `PolRing` &R, typename `PolRing::Element` &charp, const `size_t` N, typename `PolRing::Domain_t::Element_ptr` A, const `size_t` lda, typename `PolRing::Domain_t::RandIter` &G, const FFPACK\_CHARPOLY\_TAG CharpTag=FfpackAuto, const `size_t` degree=\_\_FFLASFFPACK\_ARITHPROG\_THRESHOLD)

*Compute the characteristic polynomial of the matrix A.*

- template<class PolRing >  
PolRing::Element & CharPoly (const PolRing &R, typename PolRing::Element &charp, const size\_t N, typename PolRing::Domain\_t::Element\_ptr A, const size\_t lda, const FFPACK\_CHARPOLY\_TAG Charp↔ Tag=FFpackAuto, const size\_t degree=\_\_FFLASFFPACK\_ARITHPROG\_THRESHOLD)

*Compute the characteristic polynomial of the matrix A.*

- template<class Field , class Polynomial >  
Polynomial & MinPoly (const Field &F, Polynomial &minP, const size\_t N, typename Field::ConstElement\_ptr A, const size\_t lda)

*Compute the minimal polynomial of the matrix A.*

- template<class Field , class Polynomial , class RandIter >  
Polynomial & MinPoly (const Field &F, Polynomial &minP, const size\_t N, typename Field::ConstElement\_ptr A, const size\_t lda, RandIter &G)

*Compute the minimal polynomial of the matrix A.*

- template<class Field , class Polynomial >  
Polynomial & MatVecMinPoly (const Field &F, Polynomial &minP, const size\_t N, typename Field::ConstElement\_ptr A, const size\_t lda, typename Field::ConstElement\_ptr v, const size\_t incv)

*Compute the minimal polynomial of the matrix A and a vector v, namely the first linear dependency relation in the Krylov basis  $(v, Av, \dots, A^N v)$ .*

- template<class Field >  
size\_t Rank (const Field &F, const size\_t M, const size\_t N, typename Field::Element\_ptr A, const size\_t lda)

*Computes the rank of the given matrix using a PLUQ factorization.*

- template<class Field >  
size\_t pRank (const Field &F, const size\_t M, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, size\_t numthreads=0)
- template<class Field , class PSHelper >  
size\_t Rank (const Field &F, const size\_t M, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, const PSHelper &psH)

- template<class Field >  
bool IsSingular (const Field &F, const size\_t M, const size\_t N, typename Field::Element\_ptr A, const size\_t lda)

*Returns true if the given matrix is singular.*

- template<class Field >  
Field::Element & Det (const Field &F, typename Field::Element &det, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, size\_t \*P=NULL, size\_t \*Q=NULL)

*Returns the determinant of the given square matrix.*

- template<class Field >  
Field::Element & pDet (const Field &F, typename Field::Element &det, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, size\_t numthreads=0, size\_t \*P=NULL, size\_t \*Q=NULL)

- template<class Field , class PSHelper >  
Field::Element & Det (const Field &F, typename Field::Element &det, const size\_t N, typename Field::Element\_ptr A, const size\_t lda, const PSHelper &psH, size\_t \*P=NULL, size\_t \*Q=NULL)

- template<class Field >  
Field::Element\_ptr Solve (const Field &F, const size\_t M, typename Field::Element\_ptr A, const size\_t lda, typename Field::Element\_ptr x, const int incx, typename Field::ConstElement\_ptr b, const int incb)

*Solves a linear system  $AX = b$  using PLUQ factorization.*

- template<class Field , class PSHelper >  
Field::Element\_ptr Solve (const Field &F, const size\_t M, typename Field::Element\_ptr A, const size\_t lda, typename Field::Element\_ptr x, const int incx, typename Field::ConstElement\_ptr b, const int incb, PSHelper &psH)

- template<class Field >  
Field::Element\_ptr pSolve (const Field &F, const size\_t M, typename Field::Element\_ptr A, const size\_t lda, typename Field::Element\_ptr x, const int incx, typename Field::ConstElement\_ptr b, const int incb, size\_t numthreads=0)



- template<class [Field](#) >  
 \*void [RandomNullSpaceVector](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) X, const size\_t incX)  
*Solve  $LX = B$  or  $XL = B$  in place.*
- template<class [Field](#) >  
 size\_t [NullSpaceBasis](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) &NS, size\_t &ldn, size\_t &NSdim)  
*Computes a basis of the Left/Right nullspace of the matrix A.*
- template<class [Field](#) >  
 size\_t [RowRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*&rkprofile, const FFPACK\_LU\_TAG LuTag=[FfpackSlabRecursive](#))  
*Computes the row rank profile of A.*
- template<class [Field](#) >  
 size\_t [pRowRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*&rkprofile, size\_t numthreads=0, const FFPACK\_LU\_TAG LuTag=[FfpackTileRecursive](#))
- template<class [Field](#) , class PSHelper >  
 size\_t [RowRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*&rkprofile, const FFPACK\_LU\_TAG LuTag, PSHelper &psH)
- template<class [Field](#) >  
 size\_t [ColumnRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*&rkprofile, const FFPACK\_LU\_TAG LuTag=[FfpackSlabRecursive](#))  
*Computes the column rank profile of A.*
- template<class [Field](#) >  
 size\_t [pColumnRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*&rkprofile, size\_t numthreads=0, const FFPACK\_LU\_TAG LuTag=[FfpackTileRecursive](#))
- template<class [Field](#) , class PSHelper >  
 size\_t [ColumnRankProfile](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*&rkprofile, const FFPACK\_LU\_TAG LuTag, PSHelper &psH)
- void [RankProfileFromLU](#) (const size\_t \*P, const size\_t N, const size\_t R, size\_t \*rkprofile, const FFPACK\_LU\_TAG LuTag)  
*Recovers the column/row rank profile from the permutation of an LU decomposition.*
- size\_t [LeadingSubmatrixRankProfiles](#) (const size\_t M, const size\_t N, const size\_t R, const size\_t LSm, const size\_t LSn, const size\_t \*P, const size\_t \*Q, size\_t \*RRP, size\_t \*CRP)  
*Recovers the row and column rank profiles of any leading submatrix from the PLUQ decomposition.*
- template<class [Field](#) >  
 size\_t [RowRankProfileSubmatrixIndices](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*&rowindices, size\_t \*&colindices, size\_t &R)  
*RowRankProfileSubmatrixIndices.*
- template<class [Field](#) >  
 size\_t [ColRankProfileSubmatrixIndices](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*&rowindices, size\_t \*&colindices, size\_t &R)  
*Computes the indices of the submatrix  $r \times r$  X of A whose columns correspond to the column rank profile of A.*
- template<class [Field](#) >  
 size\_t [RowRankProfileSubmatrix](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) &X, size\_t &R)  
*Computes the  $r \times r$  submatrix X of A, by picking the row rank profile rows of A.*
- template<class [Field](#) >  
 size\_t [ColRankProfileSubmatrix](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) &X, size\_t &R)  
*Compute the  $r \times r$  submatrix X of A, by picking the row rank profile rows of A.*
- template<class [Field](#) >  
 void [getTriangular](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_UPLO](#) Uplo, const [FFLAS::FFLAS\\_DIAG](#) diag, const size\_t M, const size\_t N, const size\_t R, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) T, const size\_t ldt, const bool OnlyNonZeroVectors=false)

*Extracts a triangular matrix from a compact storage  $A=L\backslash U$  of rank  $R$ .*

- `template<class Field >`  
`void getTriangular (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr A, const size_t Ida)`

*Cleans up a compact storage  $A=L\backslash U$  to reveal a triangular matrix of rank  $R$ .*

- `template<class Field >`  
`void getEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::ConstElement_ptr A, const size_t Ida, typename Field::Element_ptr T, const size_t Idt, const bool OnlyNonZeroVectors=false, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`

*Extracts a matrix in echelon form from a compact storage  $A=L\backslash U$  of rank  $R$  obtained by RowEchelonForm or ColumnEchelonForm.*

- `template<class Field >`  
`void getEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::Element_ptr A, const size_t Ida, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`

*Cleans up a compact storage  $A=L\backslash U$  obtained by RowEchelonForm or ColumnEchelonForm to reveal an echelon form of rank  $R$ .*

- `template<class Field >`  
`void getEchelonTransform (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diag, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, typename Field::ConstElement_ptr A, const size_t Ida, typename Field::Element_ptr T, const size_t Idt, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`

*Extracts a transformation matrix to echelon form from a compact storage  $A=L\backslash U$  of rank  $R$  obtained by RowEchelonForm or ColumnEchelonForm.*

- `template<class Field >`  
`void getReducedEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::ConstElement_ptr A, const size_t Ida, typename Field::Element_ptr T, const size_t Idt, const bool OnlyNonZeroVectors=false, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`

*Extracts a matrix in echelon form from a compact storage  $A=L\backslash U$  of rank  $R$  obtained by ReducedRowEchelonForm or ReducedColumnEchelonForm with transform = true.*

- `template<class Field >`  
`void getReducedEchelonForm (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, typename Field::Element_ptr A, const size_t Ida, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`

*Cleans up a compact storage  $A=L\backslash U$  of rank  $R$  obtained by ReducedRowEchelonForm or ReducedColumnEchelonForm with transform = true.*

- `template<class Field >`  
`void getReducedEchelonTransform (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, typename Field::ConstElement_ptr A, const size_t Ida, typename Field::Element_ptr T, const size_t Idt, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`

*Extracts a transformation matrix to echelon form from a compact storage  $A=L\backslash U$  of rank  $R$  obtained by RowEchelonForm or ColumnEchelonForm.*

- `void PLUQtoEchelonPermutation (const size_t N, const size_t R, const size_t *P, size_t *outPerm)`

*Auxiliary routine: determines the permutation that changes a PLUQ decomposition into a echelon form revealing PLUQ decomposition.*

- `template<class Field >`  
`Field::Element_ptr LQUPtoInverseOfFullRankMinor (const Field &F, const size_t rank, typename Field::Element_ptr A_factors, const size_t Ida, const size_t *QtPointer, typename Field::Element_ptr X, const size_t Idx)`

*LQUPtoInverseOfFullRankMinor.*

- `template<class Field >`  
`void RandomNullSpaceVector (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t Ida, typename Field::Element_ptr X, const size_t incX)`

*Solve  $LX = B$  or  $XL = B$  in place.*

- `template<class Field >`  
`void solveLB (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr L, const size_t ldl, const size_t *Q, typename Field::Element_ptr B, const size_t ldb)`
- `template<class Field >`  
`void solveLB2 (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr L, const size_t ldl, const size_t *Q, typename Field::Element_ptr B, const size_t ldb)`
- `template<class Field , class Polynomial >`  
`std::list< Polynomial > & Danilevski (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t lda)`
- `template<class Field >`  
`Field::Element_ptr buildMatrix (const Field &F, typename Field::ConstElement_ptr E, typename Field::ConstElement_ptr C, const size_t lda, const size_t *B, const size_t *T, const size_t me, const size_t mc, const size_t lambda, const size_t mu)`
- `FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr CharPoly (const FFPACK::RNSInteger< FFPACK::rns_double > &F, typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr charp, const size_t N, typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr A, const size_t lda, Givaro::ZRing< Givaro::Integer >::RandIter &G, const FFPACK_CHARPOLY_TAG CharpTag, size_t degree)`
- `template<> Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > >::Element & CharPoly (const Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > > &R, Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > >::Element &charp, const size_t N, Givaro::Integer *A, const size_t lda, Givaro::ZRing< Givaro::Integer >::RandIter &G, const FFPACK_CHARPOLY_TAG CharpTag, size_t degree)`
- `template<class PSHelper >`  
`FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr & Det (const FFPACK::RNSInteger< FFPACK::rns_double > &F, typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr &det, const size_t N, typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr A, const size_t lda, const PSHelper &psH)`
- `template<class PSHelper >`  
`Givaro::Integer & Det (const Givaro::ZRing< Givaro::Integer > &F, Givaro::Integer &det, const size_t N, Givaro::Integer *A, const size_t lda, const PSHelper &psH, size_t *P, size_t *Q)`
- `template<class Field >`  
`bool fsytrf_BC_Crout (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv)`
- `template<class Field >`  
`size_t fsytrf_BC_RL (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv)`
- `template<class Field >`  
`size_t fsytrf_UP_RPM_BC_RL (const Field &F, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, size_t *P)`
- `template<class Field >`  
`size_t fsytrf_LOW_RPM_BC_Crout (const Field &F, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, size_t *P)`
- `template<class Field >`  
`size_t fsytrf_UP_RPM_BC_Crout (const Field &F, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, size_t *P)`
- `template<class Field >`  
`size_t fsytrf_UP_RPM (const Field &F, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, size_t *P, size_t BCThreshold)`
- `template<class Field >`  
`bool fsytrf_nonunit (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, FFLAS::ParSeqHelper::Sequential seq, size_t threshold)`
- `template<class Field , class Cut , class Param >`  
`bool fsytrf_nonunit (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, FFLAS::ParSeqHelper::Parallel< Cut, Param > par, size_t threshold)`

- `template<class Field >`  
`size_t fsytrf_RPM (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t threshold)`
- `template<class Field >`  
`void getTridiagonal (const Field &F, const size_t N, const size_t R, typename Field::ConstElement_ptr A, const size_t lda, size_t *P, typename Field::Element_ptr T, const size_t ldt)`
- `template<class Field >`  
`size_t LUdivine_gauss (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFPACK::FFPACK_LU_TAG LuTag)`
- `template<class Field >`  
`size_t LUdivine_small (const Field &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFPACK::FFPACK_LU_TAG LuTag)`
- `template<class Field >`  
`size_t LUdivine (const Field &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFPACK::FFPACK_LU_TAG LuTag, const size_t cutoff)`
- `template<> size_t LUdivine (const Givaro::Modular< Givaro::Integer > &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans, const size_t M, const size_t N, typename Givaro::Integer *A, const size_t lda, size_t *P, size_t *Q, const FFPACK::FFPACK_LU_TAG LuTag, const size_t cutoff)`
- `template<class Field >`  
`void MonotonicCompress (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, typename Field::Element_ptr A, const size_t lda, const size_t incA, const size_t *MathP, const size_t R, const size_t maxpiv, const size_t rowstomove, const std::vector< bool > &ispiv)`
- `template<class Field >`  
`void MonotonicCompressMorePivots (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, typename Field::Element_ptr A, const size_t lda, const size_t incA, const size_t *MathP, const size_t R, const size_t rowstomove, const size_t lenP)`
- `template<class Field >`  
`void MonotonicCompressCycles (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, typename Field::Element_ptr A, const size_t lda, const size_t incA, const size_t *MathP, const size_t lenP)`
- `template<class Field >`  
`void MonotonicExpand (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, typename Field::Element_ptr A, const size_t lda, const size_t incA, const size_t *MathP, const size_t R, const size_t maxpiv, const size_t rowstomove, const std::vector< bool > &ispiv)`
- `template<class Field >`  
`void applyP_block (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t M, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const size_t *P)`
- `template<class Field >`  
`void doApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field >`  
`void MatrixApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field >`  
`void MatrixApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const FFLAS::ParSeqHelper::Sequential seq)`
- `template<class Field, class Cut, class Param >`  
`void MatrixApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par)`
- `template<class T >`  
`void PermApplyS (T *A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`

- template<class [Field](#) >  
void [doApplyT](#) (const [Field](#) &F, typename [Field::Element\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) tmp, const size\_t width, const size\_t N2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4)
- template<class [Field](#) >  
void [MatrixApplyT](#) (const [Field](#) &F, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t width, const size\_t N2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4)
- template<class [Field](#) >  
void [MatrixApplyT](#) (const [Field](#) &F, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t width, const size\_t N2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4, const [FFLAS::ParSeqHelper::Sequential](#) seq)
- template<class [Field](#) , class [Cut](#) , class [Param](#) >  
void [MatrixApplyT](#) (const [Field](#) &F, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t width, const size\_t N2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4, const [FFLAS::ParSeqHelper::Parallel](#)< [Cut](#), [Param](#) > par)
- template<class [T](#) >  
void [PermApplyT](#) ([T](#) \*A, const size\_t lda, const size\_t width, const size\_t N2, const size\_t R1, const size\_t R2, const size\_t R3, const size\_t R4)
- void [composePermutationsLLL](#) (size\_t \*P1, const size\_t \*P2, const size\_t R, const size\_t N)  
*Computes  $P1 \times \text{Diag}(I_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $P1$  as a LAPACK permutation.*
- void [composePermutationsLLM](#) (size\_t \*MathP, const size\_t \*P1, const size\_t \*P2, const size\_t R, const size\_t N)  
*Computes  $P1 \times \text{Diag}(I_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $MathP$  as a MathPermutation format.*
- void [composePermutationsMLM](#) (size\_t \*MathP1, const size\_t \*P2, const size\_t R, const size\_t N)  
*Computes  $MathP1 \times \text{Diag}(I_R, P2)$  where  $MathP1$  is a MathPermutation and  $P2$  a LAPACK permutation and store the result in  $MathP1$  as a MathPermutation format.*
- void [cyclic\\_shift\\_mathPerm](#) (size\_t \*P, const size\_t s)
- template<class [Field](#) >  
void [cyclic\\_shift\\_row\\_col](#) (const [Field](#) &F, typename [Field::Element\\_ptr](#) A, size\_t m, size\_t n, size\_t lda)
- template<class [Field](#) >  
void [cyclic\\_shift\\_row](#) (const [Field](#) &F, typename [Field::Element\\_ptr](#) A, size\_t m, size\_t n, size\_t lda)
- template<typename [T](#) >  
void [cyclic\\_shift\\_row](#) (const [RNSIntegerMod](#)< [T](#) > &F, typename [T::Element\\_ptr](#) A, size\_t m, size\_t n, size\_t lda)
- template<class [Field](#) >  
void [cyclic\\_shift\\_col](#) (const [Field](#) &F, typename [Field::Element\\_ptr](#) A, size\_t m, size\_t n, size\_t lda)
- template<typename [T](#) >  
void [cyclic\\_shift\\_col](#) (const [RNSIntegerMod](#)< [T](#) > &F, typename [T::Element\\_ptr](#) A, size\_t m, size\_t n, size\_t lda)
- template<class [Field](#) >  
size\_t [PLUQ\\_basecaseV3](#) (const [Field](#) &Fi, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, typename [Field::Element](#) \*A, const size\_t lda, size\_t \*P, size\_t \*Q)
- template<class [Field](#) >  
size\_t [PLUQ\\_basecaseV2](#) (const [Field](#) &Fi, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, typename [Field::Element](#) \*A, const size\_t lda, size\_t \*P, size\_t \*Q)
- template<class [Field](#) >  
size\_t [PLUQ\\_basecaseCrout](#) (const [Field](#) &Fi, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*P, size\_t \*Q)
- template<class [Field](#) >  
size\_t [\\_PLUQ](#) (const [Field](#) &Fi, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, size\_t \*P, size\_t \*Q, size\_t BCThreshold)
- template<class [Cut](#) , class [Param](#) >  
size\_t [PLUQ](#) (const [Givaro::Modular](#)< [Givaro::Integer](#) > &F, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, typename [Givaro::Integer](#) \*A, const size\_t lda, size\_t \*P, size\_t \*Q, size\_t BCThreshold, [FFLAS::ParSeqHelper::Parallel](#)< [Cut](#), [Param](#) > &PSHelper)



- `template<class Field >`  
`void threads_fgemm (const size_t m, const size_t n, const size_t r, int nbthreads, size_t *W1, size_t *W2, size_t *W3, size_t gamma)`
- `template<class Field >`  
`void threads_ftrsm (const size_t m, const size_t n, int nbthreads, size_t *t1, size_t *t2)`
- `template<class Field >`  
`size_t PLUQ (const Field &Fi, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, type-name Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFLAS::ParSeqHelper::Parallel< FFLAS::CuttingStrategy::Recursive, FFLAS::StrategyParameter::Threads > &PSHelper)`
- `template<> rns_double_elt_ptr fflas_const_cast (rns_double_elt_cstptr x)`
- `template<> rns_double_elt_cstptr fflas_const_cast (rns_double_elt_ptr x)`
- `template<typename Base_t >`  
`void cyclic_shift_row_col (Base_t *A, size_t m, size_t n, size_t lda)`
- `template INST_OR_DECL void cyclic_shift_row (const FFLAS_FIELD< FFLAS_ELT > &F, FFLAS_ELT *A, size_t m, size_t n, size_t lda)`
- `template INST_OR_DECL void cyclic_shift_col (const FFLAS_FIELD< FFLAS_ELT > &F, FFLAS_ELT *A, size_t m, size_t n, size_t lda)`
- `template INST_OR_DECL void applyP (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t M, const size_t ibeg, const size_t iend, FFLAS_ELT *A, const size_t lda, const size_t *P)`
- `template INST_OR_DECL void fgetrs (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, FFLAS_ELT *A, const size_t lda, const size_t *P, const size_t *Q, FFLAS_ELT *B, const size_t ldb, int *info)`
- `template INST_OR_DECL FFLAS_ELT * fgetrs (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t NRHS, const size_t R, FFLAS_ELT *A, const size_t lda, const size_t *P, const size_t *Q, FFLAS_ELT *X, const size_t ldx, const FFLAS_ELT *B, const size_t ldb, int *info)`
- `template INST_OR_DECL size_t fgesv (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, FFLAS_ELT *A, const size_t lda, FFLAS_ELT *B, const size_t ldb, int *info)`
- `template INST_OR_DECL size_t fgesv (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t NRHS, FFLAS_ELT *A, const size_t lda, FFLAS_ELT *X, const size_t ldx, const FFLAS_ELT *B, const size_t ldb, int *info)`
- `template INST_OR_DECL void ftrtri (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG Diag, const size_t N, FFLAS_ELT *A, const size_t lda, const size_t threshold)`
- `template INST_OR_DECL void trinv_left (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t N, const FFLAS_ELT *L, const size_t ldl, FFLAS_ELT *X, const size_t ldx)`
- `template INST_OR_DECL void ftrtrm (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_SIDE side, const FFLAS::FFLAS_DIAG diag, const size_t N, FFLAS_ELT *A, const size_t lda)`
- `template INST_OR_DECL size_t PLUQ (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, FFLAS_ELT *A, const size_t lda, size_t *P, size_t *Q)`
- `template INST_OR_DECL size_t LUdivine (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans, const size_t M, const size_t N, FFLAS_ELT *A, const size_t lda, size_t *P, size_t *Qt, const FFPACK_LU_TAG LuTag, const size_t cutoff)`
- `template INST_OR_DECL size_t LUdivine_small (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans, const size_t M, const size_t N, FFLAS_ELT *A, const size_t lda, size_t *P, size_t *Q, const FFPACK_LU_TAG LuTag)`
- `template INST_OR_DECL size_t LUdivine_gauss (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, FFLAS_ELT *A, const size_t lda, size_t *P, size_t *Q, const FFPACK_LU_TAG LuTag)`
- `template INST_OR_DECL size_t RowEchelonForm (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t M, const size_t N, FFLAS_ELT *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag)`
- `template INST_OR_DECL size_t ReducedRowEchelonForm (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t M, const size_t N, FFLAS_ELT *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag)`

- template [INST\\_OR\\_DECL](#) [size\\_t](#) [ColumnEchelonForm](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [size\\_t](#) M, const [size\\_t](#) N, [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda, [size\\_t](#) \*P, [size\\_t](#) \*Qt, const bool transform, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) [size\\_t](#) [ReducedColumnEchelonForm](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [size\\_t](#) M, const [size\\_t](#) N, [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda, [size\\_t](#) \*P, [size\\_t](#) \*Qt, const bool transform, const [FFPACK\\_LU\\_TAG](#) LuTag)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) \* [Invert](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [size\\_t](#) M, [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda, int &nullity)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) \* [Invert](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [size\\_t](#) M, const [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda, [FFLAS\\_ELT](#) \*X, const [size\\_t](#) ldx, int &nullity)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) \* [Invert2](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [size\\_t](#) M, [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda, [FFLAS\\_ELT](#) \*X, const [size\\_t](#) ldx, int &nullity)
- template [INST\\_OR\\_DECL](#) std::list< [Givaro::Poly1Dom](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > >::Element > &[CharPoly](#) (const [Givaro::Poly1Dom](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > &R, std::list< [Givaro::Poly1Dom](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > >::Element > &charp, const [size\\_t](#) N, [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda, [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) >::RandIter &G, const [FFPACK\\_CHARPOLY\\_TAG](#) CharpTag, const [size\\_t](#) degree)
- template [INST\\_OR\\_DECL](#) [Givaro::Poly1Dom](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > >::Element & [CharPoly](#) (const [Givaro::Poly1Dom](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > &R, [Givaro::Poly1Dom](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > >::Element &charp, const [size\\_t](#) N, [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda, [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) >::RandIter &G, const [FFPACK\\_CHARPOLY\\_TAG](#) CharpTag, const [size\\_t](#) degree)
- template [INST\\_OR\\_DECL](#) [Givaro::Poly1Dom](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > >::Element & [CharPoly](#) (const [Givaro::Poly1Dom](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > > &R, [Givaro::Poly1Dom](#)< [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > >::Element &charp, const [size\\_t](#) N, [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda, const [FFPACK\\_CHARPOLY\\_TAG](#) CharpTag, const [size\\_t](#) degree)
- template [INST\\_OR\\_DECL](#) std::vector< [FFLAS\\_ELT](#) > & [MinPoly](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, std::vector< [FFLAS\\_ELT](#) > &minP, const [size\\_t](#) N, const [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda, [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) >::RandIter &G)
- template [INST\\_OR\\_DECL](#) std::vector< [FFLAS\\_ELT](#) > & [MinPoly](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, std::vector< [FFLAS\\_ELT](#) > &minP, const [size\\_t](#) N, const [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda)
- template [INST\\_OR\\_DECL](#) std::vector< [FFLAS\\_ELT](#) > & [MatVecMinPoly](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, std::vector< [FFLAS\\_ELT](#) > &minP, const [size\\_t](#) N, const [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda, const [FFLAS\\_ELT](#) \*V, const [size\\_t](#) incv)
- template [INST\\_OR\\_DECL](#) [size\\_t](#) [KrylovElim](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [size\\_t](#) M, const [size\\_t](#) N, [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda, [size\\_t](#) \*P, [size\\_t](#) \*Q, const [size\\_t](#) deg, [size\\_t](#) \*iterates, [size\\_t](#) \*inviterates, const [size\\_t](#) maxit, [size\\_t](#) virt)
- template [INST\\_OR\\_DECL](#) [size\\_t](#) [SpecRankProfile](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [size\\_t](#) M, const [size\\_t](#) N, [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda, const [size\\_t](#) deg, [size\\_t](#) \*rankProfile)
- template [INST\\_OR\\_DECL](#) [size\\_t](#) [Rank](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [size\\_t](#) M, const [size\\_t](#) N, [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda)
- template [INST\\_OR\\_DECL](#) bool [IsSingular](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [size\\_t](#) M, const [size\\_t](#) N, [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) & [Det](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, [FFLAS\\_ELT](#) &det, const [size\\_t](#) N, [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda, [size\\_t](#) \*P, [size\\_t](#) \*Q)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) & [Det](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, [FFLAS\\_ELT](#) &det, const [size\\_t](#) N, [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda, const [FFLAS::ParSeqHelper::Parallel](#)< [FFLAS::CuttingStrategy::Recursive](#), [FFLAS::StrategyParameter::Threads](#) > &parH, [size\\_t](#) \*P, [size\\_t](#) \*Q)
- template [INST\\_OR\\_DECL](#) [FFLAS\\_ELT](#) \* [Solve](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [size\\_t](#) M, [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda, [FFLAS\\_ELT](#) \*x, const int incx, const [FFLAS\\_ELT](#) \*b, const int incb)
- template [INST\\_OR\\_DECL](#) void [solveLB](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [size\\_t](#) M, const [size\\_t](#) N, const [size\\_t](#) R, [FFLAS\\_ELT](#) \*L, const [size\\_t](#) ldl, const [size\\_t](#) \*Q, [FFLAS\\_ELT](#) \*B, const [size\\_t](#) ldb)
- template [INST\\_OR\\_DECL](#) void [solveLB2](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [size\\_t](#) M, const [size\\_t](#) N, const [size\\_t](#) R, [FFLAS\\_ELT](#) \*L, const [size\\_t](#) ldl, const [size\\_t](#) \*Q, [FFLAS\\_ELT](#) \*B, const [size\\_t](#) ldb)
- template [INST\\_OR\\_DECL](#) void [RandomNullSpaceVector](#) (const [FFLAS\\_FIELD](#)< [FFLAS\\_ELT](#) > &F, const [FFLAS::FFLAS\\_SIDE](#) Side, const [size\\_t](#) M, const [size\\_t](#) N, [FFLAS\\_ELT](#) \*A, const [size\\_t](#) lda, [FFLAS\\_ELT](#) \*X, const [size\\_t](#) incX)

- template `INST_OR_DECL` `size_t` `NullSpaceBasis` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, `FFLAS_ELT` \*&NS, `size_t` &ldn, `size_t` &NSdim)
- template `INST_OR_DECL` `size_t` `RowRankProfile` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, `size_t` \*&rkprofile, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` `size_t` `ColumnRankProfile` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, `size_t` \*&rkprofile, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` `size_t` `RowRankProfileSubmatrixIndices` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, `size_t` \*&rowindices, `size_t` \*&colindices, `size_t` &R)
- template `INST_OR_DECL` `size_t` `ColRankProfileSubmatrixIndices` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, `size_t` \*&rowindices, `size_t` \*&colindices, `size_t` &R)
- template `INST_OR_DECL` `size_t` `RowRankProfileSubmatrix` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, `FFLAS_ELT` \*&X, `size_t` &R)
- template `INST_OR_DECL` `size_t` `ColRankProfileSubmatrix` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` \*A, const `size_t` lda, `FFLAS_ELT` \*&X, `size_t` &R)
- template `INST_OR_DECL` void `getTriangular< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const `size_t` M, const `size_t` N, const `size_t` R, const `FFLAS_ELT` \*A, const `size_t` lda, `FFLAS_ELT` \*T, const `size_t` ldt, const bool OnlyNonZeroVectors)
- template `INST_OR_DECL` void `getTriangular< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const `size_t` M, const `size_t` N, const `size_t` R, `FFLAS_ELT` \*A, const `size_t` lda)
- template `INST_OR_DECL` void `getEchelonForm< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` \*P, const `FFLAS_ELT` \*A, const `size_t` lda, `FFLAS_ELT` \*T, const `size_t` ldt, const bool OnlyNonZeroVectors, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` void `getEchelonForm< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` \*P, `FFLAS_ELT` \*A, const `size_t` lda, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` void `getEchelonTransform< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` \*P, const `size_t` \*Q, const `FFLAS_ELT` \*A, const `size_t` lda, `FFLAS_ELT` \*T, const `size_t` ldt, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` void `getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` \*P, const `FFLAS_ELT` \*A, const `size_t` lda, `FFLAS_ELT` \*T, const `size_t` ldt, const bool OnlyNonZeroVectors, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` void `getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` \*P, `FFLAS_ELT` \*A, const `size_t` lda, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` void `getReducedEchelonTransform< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` \*P, const `size_t` \*Q, const `FFLAS_ELT` \*A, const `size_t` lda, `FFLAS_ELT` \*T, const `size_t` ldt, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` `FFLAS_ELT` \* `LQUPtoInverseOfFullRankMinor` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` rank, `FFLAS_ELT` \*A\_factors, const `size_t` lda, const `size_t` \*QtPointer, `FFLAS_ELT` \*X, const `size_t` ldx)
- template<class T, class CT = const T>  
T `fflas_const_cast` (CT x)
- `Failure` & `failure` ()
- template<class T >  
bool `isOdd` (const T &a)
- bool `isOdd` (const float &a)
- bool `isOdd` (const double &a)



- template<class [Field](#) , class RandIter >  
[Field::Element\\_ptr NonZeroRandomMatrix](#) (const [Field](#) &F, size\_t m, size\_t n, typename [Field::Element\\_ptr](#) A, size\_t lda, RandIter &G)  
*Random non-zero Matrix.*
- template<class [Field](#) , class RandIter >  
[Field::Element\\_ptr NonZeroRandomMatrix](#) (const [Field](#) &F, size\_t m, size\_t n, typename [Field::Element\\_ptr](#) A, size\_t lda)  
*Random non-zero Matrix.*
- template<class [Field](#) , class RandIter >  
[Field::Element\\_ptr RandomMatrix](#) (const [Field](#) &F, size\_t m, size\_t n, typename [Field::Element\\_ptr](#) A, size\_t lda, RandIter &G)  
*Random Matrix.*
- template<class [Field](#) >  
[Field::Element\\_ptr RandomMatrix](#) (const [Field](#) &F, size\_t m, size\_t n, typename [Field::Element\\_ptr](#) A, size\_t lda)  
*Random Matrix.*
- template<class [Field](#) , class RandIter >  
[Field::Element\\_ptr RandomTriangularMatrix](#) (const [Field](#) &F, size\_t m, size\_t n, const [FFLAS::FFLAS\\_UPLO](#) UpLo, const [FFLAS::FFLAS\\_DIAG](#) Diag, bool nonsingular, typename [Field::Element\\_ptr](#) A, size\_t lda, RandIter &G)  
*Random Triangular Matrix.*
- template<class [Field](#) >  
[Field::Element\\_ptr RandomTriangularMatrix](#) (const [Field](#) &F, size\_t m, size\_t n, const [FFLAS::FFLAS\\_UPLO](#) UpLo, const [FFLAS::FFLAS\\_DIAG](#) Diag, bool nonsingular, typename [Field::Element\\_ptr](#) A, size\_t lda)  
*Random Triangular Matrix.*
- size\_t [RandInt](#) (size\_t a, size\_t b)
- template<class [Field](#) , class RandIter >  
[Field::Element\\_ptr RandomSymmetricMatrix](#) (const [Field](#) &F, size\_t n, bool nonsingular, typename [Field::Element\\_ptr](#) A, size\_t lda, RandIter &G)  
*Random Symmetric Matrix.*
- template<class [Field](#) , class RandIter >  
[Field::Element\\_ptr RandomMatrixWithRank](#) (const [Field](#) &F, size\_t m, size\_t n, size\_t r, typename [Field::Element\\_ptr](#) A, size\_t lda, RandIter &G)  
*Random Matrix with prescribed rank.*
- template<class [Field](#) >  
[Field::Element\\_ptr RandomMatrixWithRank](#) (const [Field](#) &F, size\_t m, size\_t n, size\_t r, typename [Field::Element\\_ptr](#) A, size\_t lda)  
*Random Matrix with prescribed rank.*
- size\_t \* [RandomIndexSubset](#) (size\_t N, size\_t R, size\_t \*P)  
*Pick uniformly at random a sequence of  $R$  distinct elements from the set  $\{0, \dots, N - 1\}$  using Knuth's shuffle.*
- size\_t \* [RandomPermutation](#) (size\_t N, size\_t \*P)  
*Pick uniformly at random a permutation of size  $N$  stored in LAPACK format using Knuth's shuffle.*
- void [RandomRankProfileMatrix](#) (size\_t M, size\_t N, size\_t R, size\_t \*rows, size\_t \*cols)  
*Pick uniformly at random an  $R$ -subpermutation of dimension  $M \times N$  : a matrix with only  $R$  non-zeros equal to one, in a random rook placement.*
- void [swapval](#) (size\_t k, size\_t N, size\_t \*P, size\_t val)
- void [RandomSymmetricRankProfileMatrix](#) (size\_t N, size\_t R, size\_t \*rows, size\_t \*cols)  
*Pick uniformly at random a symmetric  $R$ -subpermutation of dimension  $N \times N$  : a symmetric matrix with only  $R$  non-zeros, all equal to one, in a random rook placement.*
- template<class [Field](#) , class RandIter >  
[Field::Element\\_ptr RandomMatrixWithRankandRPM](#) (const [Field](#) &F, size\_t M, size\_t N, size\_t R, typename [Field::Element\\_ptr](#) A, size\_t lda, const size\_t \*RRP, const size\_t \*CRP, RandIter &G)  
*Random Matrix with prescribed rank and rank profile matrix Creates an  $m \times n$  matrix with random entries and rank  $r$ .*

- `template<class Field >`  
`Field::Element_ptr RandomMatrixWithRankandRPM` (const `Field` &F, size\_t M, size\_t N, size\_t R, typename `Field::Element_ptr` A, size\_t lda, const size\_t \*RRP, const size\_t \*CRP)  
*Random Matrix with prescribed rank and rank profile matrix Creates an  $m \times n$  matrix with random entries and rank  $r$ .*
- `template<class Field , class Randlter >`  
`Field::Element_ptr RandomSymmetricMatrixWithRankandRPM` (const `Field` &F, size\_t N, size\_t R, typename `Field::Element_ptr` A, size\_t lda, const size\_t \*RRP, const size\_t \*CRP, Randlter &G)  
*Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an  $n \times n$  symmetric matrix with random entries and rank  $r$ .*
- `template<class Field >`  
`Field::Element_ptr RandomSymmetricMatrixWithRankandRPM` (const `Field` &F, size\_t M, size\_t N, size\_t R, typename `Field::Element_ptr` A, size\_t lda, const size\_t \*RRP, const size\_t \*CRP)  
*Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an  $n \times n$  symmetric matrix with random entries and rank  $r$ .*
- `template<class Field , class Randlter >`  
`Field::Element_ptr RandomMatrixWithRankandRandomRPM` (const `Field` &F, size\_t M, size\_t N, size\_t R, typename `Field::Element_ptr` A, size\_t lda, Randlter &G)  
*Random Matrix with prescribed rank, with random rank profile matrix Creates an  $m \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.*
- `template<class Field >`  
`Field::Element_ptr RandomMatrixWithRankandRandomRPM` (const `Field` &F, size\_t M, size\_t N, size\_t R, typename `Field::Element_ptr` A, size\_t lda)  
*Random Matrix with prescribed rank, with random rank profile matrix Creates an  $m \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.*
- `template<class Field , class Randlter >`  
`Field::Element_ptr RandomSymmetricMatrixWithRankandRandomRPM` (const `Field` &F, size\_t N, size\_t R, typename `Field::Element_ptr` A, size\_t lda, Randlter &G)  
*Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an  $n \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.*
- `template<class Field >`  
`Field::Element_ptr RandomSymmetricMatrixWithRankandRandomRPM` (const `Field` &F, size\_t N, size\_t R, typename `Field::Element_ptr` A, size\_t lda)  
*Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an  $n \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.*
- `template<class Field >`  
`Field::Element_ptr RandomMatrixWithDet` (const `Field` &F, size\_t n, const typename `Field::Element` d, typename `Field::Element_ptr` A, size\_t lda)  
*Random Matrix with prescribed det.*
- `template<class Field , class Randlter >`  
`Field::Element_ptr RandomMatrixWithDet` (const `Field` &F, size\_t n, const typename `Field::Element` d, typename `Field::Element_ptr` A, size\_t lda, Randlter &G)  
*Random Matrix with prescribed det.*
- `template<typename Field >`  
`Givaro::Integer maxFieldElt` ()
- `template<> Givaro::Integer maxFieldElt< Givaro::ZRing< Givaro::Integer > > ()`
- `template<typename Field >`  
`Field * chooseField` (Givaro::Integer q, uint64\_t b, uint64\_t seed)
- `template<> Givaro::ZRing< int32_t > * chooseField< Givaro::ZRing< int32_t > > (Givaro::Integer q, uint64_t b, uint64_t seed)`
- `template<> Givaro::ZRing< int64_t > * chooseField< Givaro::ZRing< int64_t > > (Givaro::Integer q, uint64_t b, uint64_t seed)`
- `template<> Givaro::ZRing< float > * chooseField< Givaro::ZRing< float > > (Givaro::Integer q, uint64_t b, uint64_t seed)`
- `template<> Givaro::ZRing< double > * chooseField< Givaro::ZRing< double > > (Givaro::Integer q, uint64_t b, uint64_t seed)`

### 15.20.1 Detailed Description

Finite Field **PACK** Set of elimination based routines for dense linear algebra.

This namespace enlarges the set of BLAS routines of the class [FFLAS](#), with higher level routines based on elimination.

### 15.20.2 Typedef Documentation

#### 15.20.2.1 Checker\_PLUQ

```
using Checker_PLUQ = FFLAS::Checker_Empty<Field>
```

#### 15.20.2.2 Checker\_Det

```
using Checker_Det = FFLAS::Checker_Empty<Field>
```

#### 15.20.2.3 Checker\_invert

```
using Checker_invert = FFLAS::Checker_Empty<Field>
```

#### 15.20.2.4 Checker\_charpoly

```
using Checker_charpoly = FFLAS::Checker_Empty<Field>
```

#### 15.20.2.5 ForceCheck\_PLUQ

```
using ForceCheck_PLUQ = CheckerImplem_PLUQ<Field>
```

#### 15.20.2.6 ForceCheck\_Det

```
using ForceCheck_Det = CheckerImplem_Det<Field>
```

### 15.20.2.7 ForceCheck\_invert

```
using ForceCheck_invert = CheckerImplem_invert<Field>
```

### 15.20.2.8 ForceCheck\_charpoly

```
using ForceCheck_charpoly = CheckerImplem_charpoly<Field, Polynomial>
```

## 15.20.3 Function Documentation

### 15.20.3.1 LAPACKPerm2MathPerm()

```
void LAPACKPerm2MathPerm (
 size_t * MathP,
 const size_t * LapackP,
 const size_t N) [inline]
```

Conversion of a permutation from LAPACK format to Math format.

### 15.20.3.2 MathPerm2LAPACKPerm()

```
void MathPerm2LAPACKPerm (
 size_t * LapackP,
 const size_t * MathP,
 const size_t N) [inline]
```

Conversion of a permutation from Maths format to LAPACK format.

### 15.20.3.3 applyP() [1/4]

```
void applyP (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const FFLAS::FFLAS_TRANSPOSE Trans,
 const size_t M,
 const size_t ibeg,
 const size_t iend,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t * P) [inline]
```

Computes  $P1 \times \text{Diag}(I\_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $P1$  as a LAPACK permutation.

## Parameters

|                |           |                                  |
|----------------|-----------|----------------------------------|
| <i>in, out</i> | <i>P1</i> | a LAPACK permutation of size N   |
|                | <i>P2</i> | a LAPACK permutation of size N-R |

Applies a permutation P to the matrix A. Apply a permutation P, stored in the LAPACK format (a sequence of transpositions) between indices *ibeg* and *iend* of P to (*iend-ibeg*) vectors of size M stored in A (as column for NoTrans and rows for Trans). Side==FFLAS::FflasLeft for row permutation Side==FFLAS::FflasRight for a column permutation Trans==FFLAS::FflasTrans for the inverse permutation of P

## Parameters

|              |                                                                                                 |
|--------------|-------------------------------------------------------------------------------------------------|
| <i>F</i>     | base field                                                                                      |
| <i>Side</i>  | decides if rows (FflasLeft) or columns (FflasRight) are permuted                                |
| <i>Trans</i> | decides if the matrix is seen as columns (FflasTrans) or rows (FflasNoTrans)                    |
| <i>M</i>     | size of the elements to permute                                                                 |
| <i>ibeg</i>  | first index to consider in P                                                                    |
| <i>iend</i>  | last index to consider in P                                                                     |
| <i>A</i>     | input matrix                                                                                    |
| <i>lda</i>   | leading dimension of A                                                                          |
| <i>P</i>     | permutation in LAPACK format                                                                    |
| <i>psh</i>   | (optional): a sequential or parallel helper, to choose between sequential or parallel execution |

## Warning

not sure the submatrix is still a permutation and the one we expect in all cases... examples for *iend*=2, *ibeg*=1 and *P*=[2,2,2]

## 15.20.3.4 applyP() [2/4]

```
void applyP (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const FFLAS::FFLAS_TRANSPOSE Trans,
 const size_t m,
 const size_t ibeg,
 const size_t iend,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t * P,
 const FFLAS::ParSeqHelper::Sequential seq) [inline]
```

### 15.20.3.5 applyP() [3/4]

```
void applyP (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const FFLAS::FFLAS_TRANSPOSE Trans,
 const size_t m,
 const size_t ibeg,
 const size_t iend,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t * P,
 const FFLAS::ParSeqHelper::Parallel< Cut, Param > par) [inline]
```

### 15.20.3.6 MonotonicApplyP()

```
void MonotonicApplyP (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const FFLAS::FFLAS_TRANSPOSE Trans,
 const size_t M,
 const size_t ibeg,
 const size_t iend,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t * P,
 const size_t R) [inline]
```

Apply a R-monotonically increasing permutation P, to the matrix A.

MonotonicApplyP Apply a permutation defined by the first R entries of the vector P (the pivots).

The permutation represented by P is defined as follows:

- the first R values of P is a LAPACK representation (a sequence of transpositions)
- the remaining iend-ibeg-R values of the permutation are in a monotonically increasing progression Side==FFLAS::FflasLeft for row permutation Side==FFLAS::FflasRight for a column permutation Trans==FFLAS::FflasTrans for the inverse permutation of P

#### Parameters

|              |                                                                       |
|--------------|-----------------------------------------------------------------------|
| <i>F</i>     | base field                                                            |
| <i>Side</i>  | selects if it is a row (FflasLeft) or column (FflasRight) permutation |
| <i>Trans</i> | inverse permutation (FflasTrans/NoTrans)                              |
| <i>M</i>     |                                                                       |
| <i>ibeg</i>  |                                                                       |
| <i>iend</i>  |                                                                       |
| <i>A</i>     | input matrix                                                          |
| <i>lda</i>   | leading dimension of A                                                |
| <i>P</i>     | LAPACK permuation                                                     |
| <i>R</i>     | first values of P                                                     |

The non pivot elements, are located in montonically increasing order.

### 15.20.3.7 fgetrs() [1/4]

```
void fgetrs (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 const size_t N,
 const size_t R,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t * P,
 const size_t * Q,
 typename Field::Element_ptr B,
 const size_t ldb,
 int * info)
```

Solve the system  $AX = B$  or  $XA = B$ .

Solving using the PLUQ decomposition of A already computed inplace with PLUQ (FFLAS::FflasNonUnit). Version for A square. If A is rank deficient, a solution is returned if the system is consistent, Otherwise an info is 1

#### Parameters

|             |                                                                                    |
|-------------|------------------------------------------------------------------------------------|
| <i>F</i>    | base field                                                                         |
| <i>Side</i> | Determine wheter the resolution is left (FflasLeft) or right (FflasRight) looking. |
| <i>M</i>    | row dimension of B                                                                 |
| <i>N</i>    | col dimension of B                                                                 |
| <i>R</i>    | rank of A                                                                          |
| <i>A</i>    | input matrix                                                                       |
| <i>lda</i>  | leading dimension of A                                                             |
| <i>P</i>    | row permutation of the PLUQ decomposition of A                                     |
| <i>Q</i>    | column permutation of the PLUQ decomposition of A                                  |
| <i>B</i>    | Right/Left hand side matrix. Initially stores B, finally stores the solution X.    |
| <i>ldb</i>  | leading dimension of B                                                             |
| <i>info</i> | Success of the computation: 0 if successfull, >0 if system is inconsistent         |

### 15.20.3.8 fgetrs() [2/4]

```
Field::Element_ptr fgetrs (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 const size_t N,
 const size_t NRHS,
```

```

 const size_t R,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t * P,
 const size_t * Q,
 typename Field::Element_ptr X,
 const size_t ldx,
 typename Field::ConstElement_ptr B,
 const size_t ldb,
 int * info)

```

Solve the system  $A X = B$  or  $X A = B$ .

Solving using the PLUQ decomposition of A already computed inplace with PLUQ(FFLAS::FflasNonUnit). Version for A rectangular. If A is rank deficient, a solution is returned if the system is consistent, Otherwise an info is 1

#### Parameters

|             |                                                                                                             |
|-------------|-------------------------------------------------------------------------------------------------------------|
| <i>F</i>    | base field                                                                                                  |
| <i>Side</i> | Determine wheter the resolution is left (FflasLeft) or right (FflasRight) looking.                          |
| <i>M</i>    | row dimension of A                                                                                          |
| <i>N</i>    | col dimension of A                                                                                          |
| <i>NRHS</i> | number of columns (if Side = FFLAS::FflasLeft) or row (if Side = FFLAS::FflasRight) of the matrices X and B |
| <i>R</i>    | rank of A                                                                                                   |
| <i>A</i>    | input matrix                                                                                                |
| <i>lda</i>  | leading dimension of A                                                                                      |
| <i>P</i>    | row permutation of the PLUQ decomposition of A                                                              |
| <i>Q</i>    | column permutation of the PLUQ decomposition of A                                                           |
| <i>X</i>    | solution matrix                                                                                             |
| <i>ldx</i>  | leading dimension of X                                                                                      |
| <i>B</i>    | Right/Left hand side matrix.                                                                                |
| <i>ldb</i>  | leading dimension of B                                                                                      |
| <i>info</i> | Succes of the computation: 0 if successfull, >0 if system is inconsistent                                   |

#### 15.20.3.9 fgesv() [1/4]

```

size_t fgesv (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr B,
 const size_t ldb,
 int * info)

```

Square system solver.



## Parameters

|             |                                                                                     |
|-------------|-------------------------------------------------------------------------------------|
| <i>F</i>    | The computation domain                                                              |
| <i>Side</i> | Determine wheter the resolution is left (FflasLeft) or right (FflasRight) looking   |
| <i>M</i>    | row dimension of B                                                                  |
| <i>N</i>    | col dimension of B                                                                  |
| <i>A</i>    | input matrix                                                                        |
| <i>lda</i>  | leading dimension of A                                                              |
| <i>B</i>    | Right/Left hand side matrix. Initially contains B, finally contains the solution X. |
| <i>ldb</i>  | leading dimension of B                                                              |
| <i>info</i> | Success of the computation: 0 if successfull, >0 if system is inconsistent          |

## Returns

the rank of the system

Solve the system  $A X = B$  or  $X A = B$ . Version for A square. If A is rank deficient, a solution is returned if the system is consistent, Otherwise an info is 1

## 15.20.3.10 fgesv() [2/4]

```
size_t fgesv (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 const size_t N,
 const size_t NRHS,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr X,
 const size_t ldx,
 typename Field::ConstElement_ptr B,
 const size_t ldb,
 int * info)
```

Rectangular system solver.

## Parameters

|             |                                                                                                             |
|-------------|-------------------------------------------------------------------------------------------------------------|
| <i>F</i>    | The computation domain                                                                                      |
| <i>Side</i> | Determine wheter the resolution is left (FflasLeft) or right (FflasRight) looking                           |
| <i>M</i>    | row dimension of A                                                                                          |
| <i>N</i>    | col dimension of A                                                                                          |
| <i>NRHS</i> | number of columns (if Side = FFLAS::FflasLeft) or row (if Side = FFLAS::FflasRight) of the matrices X and B |
| <i>A</i>    | input matrix                                                                                                |
| <i>lda</i>  | leading dimension of A                                                                                      |
| <i>B</i>    | Right/Left hand side matrix. Initially contains B, finally contains the solution X.                         |
| <i>ldb</i>  | leading dimension of B                                                                                      |
| <i>X</i>    |                                                                                                             |
| <i>ldx</i>  |                                                                                                             |
| <i>info</i> | Success of the computation: 0 if successfull, >0 if system is inconsistent                                  |

**Returns**

the rank of the system

Solve the system  $A X = B$  or  $X A = B$ . Version for  $A$  square. If  $A$  is rank deficient, a solution is returned if the system is consistent, Otherwise an info is 1

**15.20.3.11 ftrtri() [1/2]**

```
void ftrtri (
 const Field & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const FFLAS::FFLAS_DIAG Diag,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t threshold = __FFLASFFPACK_FTRTRI_THRESHOLD)
```

Compute the inverse of a triangular matrix.

**Parameters**

|             |                                                        |
|-------------|--------------------------------------------------------|
| <i>F</i>    | base field                                             |
| <i>Uplo</i> | whether the matrix is upper or lower triangular        |
| <i>Diag</i> | whether the matrix is unit diagonal (FflasUnit/NoUnit) |
| <i>N</i>    | input matrix order                                     |
| <i>A</i>    | the input matrix                                       |
| <i>lda</i>  | leading dimension of A                                 |

**15.20.3.12 trinv\_left() [1/2]**

```
void trinv_left (
 const Field & F,
 const size_t N,
 typename Field::ConstElement_ptr L,
 const size_t ldl,
 typename Field::Element_ptr X,
 const size_t ldx)
```

**15.20.3.13 ftrtrm() [1/2]**

```
void ftrtrm (
 const Field & F,
 const FFLAS::FFLAS_SIDE side,
 const FFLAS::FFLAS_DIAG diag,
 const size_t N,
```

```

typename Field::Element_ptr A,
const size_t lda)

```

Compute the product of two triangular matrices of opposite shape.

Product UL or LU of the upper, resp lower triangular matrices U and L stored one above the other in the square matrix A.

#### Parameters

|             |                                                                      |
|-------------|----------------------------------------------------------------------|
| <i>F</i>    | base field                                                           |
| <i>Side</i> | set to FflasLeft to compute the product UL, FflasRight to compute LU |
| <i>diag</i> | whether the matrix U is unit diagonal (FflasUnit/NoUnit)             |
| <i>N</i>    | input matrix order                                                   |
| <i>A</i>    | the input matrix                                                     |
| <i>lda</i>  | leading dimension of A                                               |

#### 15.20.3.14 ftrstr()

```

void ftrstr (
 const Field & F,
 const FFLAS::FFLAS_SIDE side,
 const FFLAS::FFLAS_UPLO Uplo,
 const FFLAS::FFLAS_DIAG diagA,
 const FFLAS::FFLAS_DIAG diagB,
 const size_t N,
 typename Field::ConstElement_ptr A,
 const size_t lda,
 typename Field::Element_ptr B,
 const size_t ldb,
 const size_t threshold = __FFLASFFPACK_FTRSTR_THRESHOLD) [inline]

```

Solve a triangular system with a triangular right hand side of the same shape.

#### Parameters

|              |                                                                                                                       |
|--------------|-----------------------------------------------------------------------------------------------------------------------|
| <i>F</i>     | base field                                                                                                            |
| <i>Side</i>  | set to FflasLeft to compute $U1^{-1} * U2$ or $L1^{-1} * L2$ , FflasRight to compute $U1 * U2^{-1}$ or $L1 * L2^{-1}$ |
| <i>Uplo</i>  | whether the matrix A is upper or lower triangular                                                                     |
| <i>diag1</i> | whether the matrix U1 or L2 is unit diagonal (FflasUnit/NoUnit)                                                       |
| <i>diag2</i> | whether the matrix U2 or L2 is unit diagonal (FflasUnit/NoUnit)                                                       |
| <i>N</i>     | order of the input matrices                                                                                           |
| <i>A</i>     | the input matrix to be inverted (U1 or L1)                                                                            |
| <i>lda</i>   | leading dimension of A                                                                                                |
| <i>B</i>     | the input right hand side (U2 or L2)                                                                                  |
| <i>ldb</i>   | leading dimension of B                                                                                                |

### 15.20.3.15 ftrssyr2k()

```
void ftrssyr2k (
 const Field & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const FFLAS::FFLAS_DIAG diagA,
 const size_t N,
 typename Field::ConstElement_ptr A,
 const size_t lda,
 typename Field::Element_ptr B,
 const size_t ldb,
 const size_t threshold = __FFLASFFPACK_FTRSSYR2K_THRESHOLD) [inline]
```

Solve a triangular system in a symmetric sum: find B upper/lower triangular such that  $A^T B + B^T A = C$  where C is symmetric.

C is overwritten by B.

#### Parameters

|         |              |                                                                                                                       |
|---------|--------------|-----------------------------------------------------------------------------------------------------------------------|
|         | <i>F</i>     | base field                                                                                                            |
|         | <i>Side</i>  | set to FflasLeft to compute $U1^{-1} * U2$ or $L1^{-1} * L2$ , FflasRight to compute $U1 * U2^{-1}$ or $L1 * L2^{-1}$ |
|         | <i>Uplo</i>  | whether the matrix A is upper or lower triangular                                                                     |
|         | <i>diagA</i> | whether the matrix A is unit diagonal (FflasUnit/NoUnit)                                                              |
|         | <i>N</i>     | order of the input matrices                                                                                           |
|         | <i>A</i>     | the input matrix                                                                                                      |
|         | <i>lda</i>   | leading dimension of A                                                                                                |
| in, out | <i>B</i>     | the input right hand side where the output is written                                                                 |
|         | <i>ldb</i>   | leading dimension of B                                                                                                |

### 15.20.3.16 fsytrf() [1/3]

```
bool fsytrf (
 const Field & F,
 const FFLAS::FFLAS_UPLO UpLo,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t threshold = __FFLASFFPACK_FSYTRF_THRESHOLD)
```

Triangular factorization of symmetric matrices.

#### Parameters

|         |             |                                                                                          |
|---------|-------------|------------------------------------------------------------------------------------------|
|         | <i>F</i>    | The computation domain                                                                   |
|         | <i>UpLo</i> | Determine wheter to store the upper (FflasUpper) or lower (FflasLower) triangular factor |
|         | <i>N</i>    | order of the matrix A                                                                    |
| in, out | <i>A</i>    | input matrix                                                                             |
|         | <i>lda</i>  | leading dimension of A                                                                   |

## Returns

false if the  $A$  does not have generic rank profile, making the computation fail.

Compute the a triangular factorization of the matrix  $A$ :  $A = L \times D \times L^T$  if UpLo = FflasLower or  $A = U^T \times D \times U$  otherwise.  $D$  is a diagonal matrix. The matrices  $L$  and  $U$  are unit diagonal lower (resp. upper) triangular and overwrite the input matrix  $A$ . The matrix  $D$  is stored on the diagonal of  $A$ , as the diagonal of  $L$  or  $U$  is known to be all ones. If  $A$  does not have generic rank profile, the LDLT or UTDU factorizations is not defined, and the algorithm returns false.

## 15.20.3.17 fsytrf() [2/3]

```
bool fsytrf (
 const Field & F,
 const FFLAS::FFLAS_UPLO UpLo,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 const FFLAS::ParSeqHelper::Sequential seq,
 const size_t threshold = __FFLASFFPACK_FSYTRF_THRESHOLD) [inline]
```

## 15.20.3.18 fsytrf() [3/3]

```
bool fsytrf (
 const Field & F,
 const FFLAS::FFLAS_UPLO UpLo,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 const FFLAS::ParSeqHelper::Parallel< Cut, Param > par,
 const size_t threshold = __FFLASFFPACK_FSYTRF_THRESHOLD) [inline]
```

## 15.20.3.19 fsytrf\_nonunit() [1/3]

```
bool fsytrf_nonunit (
 const Field & F,
 const FFLAS::FFLAS_UPLO UpLo,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr D,
 const size_t incD,
 const size_t threshold = __FFLASFFPACK_FSYTRF_THRESHOLD)
```

Triangular factorization of symmetric matrices.

## Parameters

|                      |        |                                                                                          |
|----------------------|--------|------------------------------------------------------------------------------------------|
|                      | $F$    | The computation domain                                                                   |
|                      | $UpLo$ | Determine wheter to store the upper (FflasUpper) or lower (FflasLower) triangular factor |
| Generated by Doxygen | $N$    | order of the matrix $A$                                                                  |
| in, out              | $A$    | input matrix                                                                             |
| in, out              | $D$    |                                                                                          |
|                      | $lda$  | leading dimension of $A$                                                                 |

## Returns

false if the  $A$  does not have generic rank profile, making the computation fail.

Compute the a triangular factorization of the matrix  $A$ :  $A = L \times D_{inv} \times L^T$  if UpLo = FflasLower or  $A = U^T \times D \times U$  otherwise.  $D$  is a diagonal matrix. The matrices  $L$  and  $U$  are lower (resp. upper) triangular and overwrite the input matrix  $A$ . The matrix  $D$  need to be stored separately, as the diagonal of  $L$  or  $U$  are not unit. If  $A$  does not have generic rank profile, the LDLT or UTDU factorizations is not defined, and the algorithm returns false.

## 15.20.3.20 PLUQ() [1/6]

```
size_t PLUQ (
 const Field & F,
 const FFLAS::FFLAS_DIAG Diag,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Q) [inline]
```

Compute a PLUQ factorization of the given matrix.

Return its rank. The permutations P and Q are represented using LAPACK's convention.

## Parameters

|        |                                                                        |
|--------|------------------------------------------------------------------------|
| $F$    | base field                                                             |
| $Diag$ | whether U should have a unit diagonal (FflasUnit) or not (FflasNoUnit) |
| $M$    | matrix row dimension                                                   |
| $N$    | matrix column dimension                                                |
| $A$    | input matrix                                                           |
| $lda$  | leading dimension of $A$                                               |
| $P$    | the row permutation                                                    |
| $Q$    | the column permutation                                                 |

## Returns

the rank of  $A$

## Bibliography

- Dumas J-G., Pernet C., and Sultan Z. *Simultaneous computation of the row and column rank profiles*, ISSAC'13, 2013

## 15.20.3.21 pPLUQ()

```
size_t pPLUQ (
 const Field & F,
 const FFLAS::FFLAS_DIAG Diag,
```

```

const size_t M,
const size_t N,
typename Field::Element_ptr A,
const size_t lda,
size_t * P,
size_t * Q) [inline]

```

### 15.20.3.22 PLUQ() [2/6]

```

size_t PLUQ (
 const Field & F,
 const FFLAS::FFLAS_DIAG Diag,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Q,
 const FFLAS::ParSeqHelper::Sequential & PSHelper,
 size_t BCThreshold = __FFLASFFPACK_PLUQ_THRESHOLD) [inline]

```

### 15.20.3.23 PLUQ() [3/6]

```

size_t PLUQ (
 const Field & F,
 const FFLAS::FFLAS_DIAG Diag,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Q,
 const FFLAS::ParSeqHelper::Parallel< Cut, Param > & PSHelper)

```

### 15.20.3.24 LUdivine() [1/4]

```

size_t LUdivine (
 const Field & F,
 const FFLAS::FFLAS_DIAG Diag,
 const FFLAS::FFLAS_TRANSPOSE trans,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Qt,
 const FFPACK_LU_TAG LuTag = FfpackSlabRecursive,
 const size_t cutoff = __FFLASFFPACK_LUDIVINE_THRESHOLD)

```

Compute the CUP or PLE factorization of the given matrix.

Using a block algorithm and return its rank. The permutations P and Q are represented using LAPACK's convention.

## Parameters

|               |                                                                                                                             |
|---------------|-----------------------------------------------------------------------------------------------------------------------------|
| <i>F</i>      | base field                                                                                                                  |
| <i>Diag</i>   | whether the transformation matrix (U of the CUP, L of the PLE) should have a unit diagonal (FflasUnit) or not (FflasNoUnit) |
| <i>trans</i>  | whether to compute the CUP decomposition (FflasNoTrans) or the PLE decomposition (FflasTrans)                               |
| <i>M</i>      | matrix row dimension                                                                                                        |
| <i>N</i>      | matrix column dimension                                                                                                     |
| <i>A</i>      | input matrix                                                                                                                |
| <i>lda</i>    | leading dimension of A                                                                                                      |
| <i>P</i>      | the factor of CUP or PLE                                                                                                    |
| <i>Q</i>      | a permutation indicating the pivot position in the echelon form C or E in its first r positions                             |
| <i>LuTag</i>  | flag for setting the earling termination if the matrix is singular                                                          |
| <i>cutoff</i> | threshold to basecase                                                                                                       |

## Returns

the rank of A

## Bibliography

- Jeannerod C-P, Pernet, C. and Storjohann, A. *Rank-profile revealing Gaussian elimination and the CUP matrix decomposition*, J. of Symbolic Comp., 2013
- Pernet C, Brassel M *LUdivine, une divine factorisation LU*, 2002

## 15.20.3.25 ColumnEchelonForm() [1/3]

```
size_t ColumnEchelonForm (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Qt,
 bool transform = false,
 const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]
```

Compute the Column Echelon form of the input matrix in-place.

If LuTag == FfpackTileRecursive, then after the computation  $A = [M \setminus V]$  such that  $AU = C$  is a column echelon decomposition of A, with  $U = P^T [V]$  and  $C = M + Q [I_r] [0 \text{ } I_{n-r}] [0]$  If LuTag == FfpackTileRecursive then  $A = [N \setminus V]$  such that the same holds with  $M = QN$

$Q_t = Q^T$  If transform=false, the matrix V is not computed. See also test-colechelon for an example of use

## Parameters

|    |                  |                                                    |
|----|------------------|----------------------------------------------------|
|    | <i>F</i>         | base field                                         |
|    | <i>M</i>         | number of rows                                     |
|    | <i>N</i>         | number of columns                                  |
| in | <i>A</i>         | input matrix                                       |
|    | <i>lda</i>       | leading dimension of A                             |
|    | <i>P</i>         | the column permutation                             |
|    | <i>Qt</i>        | the row position of the pivots in the echelon form |
|    | <i>transform</i> | decides whether V is computed                      |



**15.20.3.26 pColumnEchelonForm()**

```

size_t pColumnEchelonForm (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Qt,
 bool transform = false,
 size_t numthreads = 0,
 const FFPACK_LU_TAG LuTag = FfpackTileRecursive) [inline]

```

**15.20.3.27 ColumnEchelonForm() [2/3]**

```

size_t ColumnEchelonForm (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Qt,
 const bool transform,
 const FFPACK_LU_TAG LuTag,
 const PSHelper & psH) [inline]

```

**15.20.3.28 RowEchelonForm() [1/3]**

```

size_t RowEchelonForm (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Qt,
 const bool transform = false,
 const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]

```

Compute the Row Echelon form of the input matrix in-place.

If  $\text{LuTag} == \text{FfpackTileRecursive}$ , then after the computation  $A = [L \setminus M]$  such that  $XA = R$  is a row echelon decomposition of  $A$ , with  $X = [L \ 0]P$  and  $R = M + [I \ 0]Q^T$ . If  $\text{LuTag} == \text{FfpackTileRecursive}$  then  $A = [L \setminus N]$  such that the same holds with  $M = NQ^TQt = Q^T$ . If  $\text{transform} = \text{false}$ , the matrix  $L$  is not computed. See also `test-rowechelon` for an example of use

## Parameters

|    |                  |                                                                                       |
|----|------------------|---------------------------------------------------------------------------------------|
|    | $F$              | base field                                                                            |
|    | $M$              | number of rows                                                                        |
|    | $N$              | number of columns                                                                     |
| in | $A$              | the input matrix                                                                      |
|    | $lda$            | leading dimension of A                                                                |
|    | $P$              | the row permutation                                                                   |
|    | $Qt$             | the column position of the pivots in the echelon form                                 |
|    | <i>transform</i> | decides whether L is computed                                                         |
|    | <i>LuTag</i>     | chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ |

## 15.20.3.29 pRowEchelonForm()

```

size_t pRowEchelonForm (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Qt,
 const bool transform = false,
 size_t numthreads = 0,
 const FFPACK_LU_TAG LuTag = FfpackTileRecursive) [inline]

```

## 15.20.3.30 RowEchelonForm() [2/3]

```

size_t RowEchelonForm (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Qt,
 const bool transform,
 const FFPACK_LU_TAG LuTag,
 const PSHelper & psh) [inline]

```

**15.20.3.31 ReducedColumnEchelonForm()** [1/3]

```

size_t ReducedColumnEchelonForm (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Qt,
 const bool transform = false,
 const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]

```

Compute the Reduced Column Echelon form of the input matrix in-place.

After the computation  $A = [V]$  such that  $AX = R$  is a reduced col echelon  $[M \ 0]$  decomposition of  $A$ , where  $X = P^T [V]$  and  $R = Q [I_r] [0 \ I_{n-r}] [M \ 0] Q^T = Q^T I$  If transform=false, the matrix  $X$  is not computed and the matrix  $A = R$

**Parameters**

|    |             |                                                                                       |
|----|-------------|---------------------------------------------------------------------------------------|
|    | $F$         | base field                                                                            |
|    | $M$         | number of rows                                                                        |
|    | $N$         | number of columns                                                                     |
| in | $A$         | input matrix                                                                          |
|    | $lda$       | leading dimension of $A$                                                              |
|    | $P$         | the column permutation                                                                |
|    | $Qt$        | the row position of the pivots in the echelon form                                    |
|    | $transform$ | decides whether $X$ is computed                                                       |
|    | $LuTag$     | chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ |

**15.20.3.32 pReducedColumnEchelonForm()**

```

size_t pReducedColumnEchelonForm (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Qt,
 const bool transform = false,
 size_t numthreads = 0,
 const FFPACK_LU_TAG LuTag = FfpackTileRecursive) [inline]

```

**15.20.3.33 ReducedColumnEchelonForm()** [2/3]

```

size_t ReducedColumnEchelonForm (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Qt,
 const bool transform,
 const FFPACK_LU_TAG LuTag,
 const PSHelper & pSH) [inline]

```

**15.20.3.34 ReducedRowEchelonForm()** [1/3]

```

size_t ReducedRowEchelonForm (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Qt,
 const bool transform = false,
 const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]

```

Compute the Reduced Row Echelon form of the input matrix in-place.

After the computation  $A = [V1 \ M]$  such that  $X A = R$  is a reduced row echelon  $[V2 \ 0]$  decomposition of  $A$ , where  $X = [V1 \ 0] P$  and  $R = [I_r \ M] Q^T [V2 \ In-r] [0] Qt = Q^T$  If transform=false, the matrix  $X$  is not computed and the matrix  $A = R$

**Parameters**

|    |                  |                                                                                       |
|----|------------------|---------------------------------------------------------------------------------------|
|    | $F$              | base field                                                                            |
|    | $M$              | number of rows                                                                        |
|    | $N$              | number of columns                                                                     |
| in | $A$              | input matrix                                                                          |
|    | $lda$            | leading dimension of $A$                                                              |
|    | $P$              | the row permutation                                                                   |
|    | $Qt$             | the column position of the pivots in the echelon form                                 |
|    | <i>transform</i> | decides whether $X$ is computed                                                       |
|    | $LuTag$          | chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ |

**15.20.3.35 pReducedRowEchelonForm()**

```

size_t pReducedRowEchelonForm (
 const Field & F,

```

```

const size_t M,
const size_t N,
typename Field::Element_ptr A,
const size_t lda,
size_t * P,
size_t * Qt,
const bool transform = false,
size_t numthreads = 0,
const FFPACK_LU_TAG LuTag = FfpackTileRecursive) [inline]

```

### 15.20.3.36 ReducedRowEchelonForm() [2/3]

```

size_t ReducedRowEchelonForm (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Qt,
 const bool transform,
 const FFPACK_LU_TAG LuTag,
 const PSHelper & psH) [inline]

```

### 15.20.3.37 Invert() [1/4]

```

Field::Element_ptr Invert (
 const Field & F,
 const size_t M,
 typename Field::Element_ptr A,
 const size_t lda,
 int & nullity)

```

Invert the given matrix in place or computes its nullity if it is singular.

An inplace  $2n^3$  algorithm is used.

#### Parameters

|         |           |                               |
|---------|-----------|-------------------------------|
|         | $F$       | The computation domain        |
|         | $M$       | order of the matrix           |
| in, out | $A$       | input matrix ( $M \times M$ ) |
|         | $lda$     | leading dimension of A        |
|         | $nullity$ | dimension of the kernel of A  |

#### Returns

pointer to  $A$  and  $A \leftarrow A^{-1}$

**15.20.3.38 Invert()** [2/4]

```
Field::Element_ptr Invert (
 const Field & F,
 const size_t M,
 typename Field::ConstElement_ptr A,
 const size_t lda,
 typename Field::Element_ptr X,
 const size_t ldX,
 int & nullity)
```

Invert the given matrix or computes its nullity if it is singular.

**Precondition**

X is preallocated and should be large enough to store the  $m \times m$  matrix A.

**Parameters**

|     |           |                                                                                                    |
|-----|-----------|----------------------------------------------------------------------------------------------------|
|     | $F$       | The computation domain                                                                             |
|     | $M$       | order of the matrix                                                                                |
| in  | $A$       | input matrix ( $M \times M$ )                                                                      |
|     | $lda$     | leading dimension of A                                                                             |
| out | $X$       | this is the inverse of A if A is invertible (non NULL and nullity = 0). It is untouched otherwise. |
|     | $ldx$     | leading dimension of X                                                                             |
|     | $nullity$ | dimension of the kernel of A                                                                       |

**Returns**

pointer to  $X = A^{-1}$

**15.20.3.39 Invert2()** [1/2]

```
Field::Element_ptr Invert2 (
 const Field & F,
 const size_t M,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr X,
 const size_t ldX,
 int & nullity)
```

Invert the given matrix or computes its nullity if it is singular.

An  $2n^3f$  algorithm is used. This routine can be % faster than [FFPACK::Invert](#) but is not totally inplace.

**Precondition**

$X$  is preallocated and should be large enough to store the  $m \times m$  matrix  $A$ .

**Warning**

$A$  is overwritten here !

**Bug** not tested.

**Parameters**

|         |           |                                                                                                             |
|---------|-----------|-------------------------------------------------------------------------------------------------------------|
|         | $F$       | the computation domain                                                                                      |
|         | $M$       | order of the matrix                                                                                         |
| in, out | $A$       | input matrix ( $M \times M$ ). On output, $A$ is modified and represents a "psycological" factorisation LU. |
|         | $lda$     | leading dimension of $A$                                                                                    |
| out     | $X$       | this is the inverse of $A$ if $A$ is invertible (non NULL and nullity = 0). It is untouched otherwise.      |
|         | $ldx$     | leading dimension of $X$                                                                                    |
|         | $nullity$ | dimension of the kernel of $A$                                                                              |

**Returns**

pointer to  $X = A^{-1}$

**Todo** this init is not all necessary (done after ftrtri)

**Todo** this init is not all necessary (done after ftrtri)

**15.20.3.40 CharPoly() [1/8]**

```
std::list< typename PolRing::Element > & CharPoly (
 const PolRing & R,
 std::list< typename PolRing::Element > & charp,
 const size_t N,
 typename PolRing::Domain_t::Element_ptr A,
 const size_t lda,
 typename PolRing::Domain_t::RandIter & G,
 const FFPACK_CHARPOLY_TAG CharpTag = FfpackAuto,
 const size_t degree = __FFLASFFPACK_ARITHPROG_THRESHOLD) [inline]
```

Compute the characteristic polynomial of the matrix  $A$ .

**Parameters**

|                            |            |                                                                                       |
|----------------------------|------------|---------------------------------------------------------------------------------------|
|                            | $R$        | the polynomial ring of charp (contains the base field)                                |
| out                        | $charp$    | the characteristic polynomial of $A$ as a list of factors                             |
|                            | $N$        | order of the matrix $A$                                                               |
| Generated by Doxygen<br>in | $A$        | the input matrix ( $N \times N$ ) (could be overwritten in some algorithmic variants) |
|                            | $lda$      | leading dimension of $A$                                                              |
|                            | $CharpTag$ | the algorithmic variant                                                               |
|                            | $G$        | a random iterator (required for the randomized variants LUKernel and ArithProg)       |

### 15.20.3.41 CharPoly() [2/8]

```
PolRing::Element & CharPoly (
 const PolRing & R,
 typename PolRing::Element & charp,
 const size_t N,
 typename PolRing::Domain_t::Element_ptr A,
 const size_t lda,
 typename PolRing::Domain_t::RandIter & G,
 const FFPACK_CHARPOLY_TAG CharpTag = FfpackAuto,
 const size_t degree = __FFLASFFPACK_ARITHPROG_THRESHOLD) [inline]
```

Compute the characteristic polynomial of the matrix A.

#### Parameters

|     |                 |                                                                                       |
|-----|-----------------|---------------------------------------------------------------------------------------|
|     | <i>R</i>        | the polynomial ring of charp (contains the base field)                                |
| out | <i>charp</i>    | the characteristic polynomial of as a single polynomial                               |
|     | <i>N</i>        | order of the matrix A                                                                 |
| in  | <i>A</i>        | the input matrix ( $N \times N$ ) (could be overwritten in some algorithmic variants) |
|     | <i>lda</i>      | leading dimension of A                                                                |
|     | <i>CharpTag</i> | the algorithmic variant                                                               |
|     | <i>G</i>        | a random iterator (required for the randomized variants LUKrylov and ArithProg)       |

### 15.20.3.42 CharPoly() [3/8]

```
PolRing::Element & CharPoly (
 const PolRing & R,
 typename PolRing::Element & charp,
 const size_t N,
 typename PolRing::Domain_t::Element_ptr A,
 const size_t lda,
 const FFPACK_CHARPOLY_TAG CharpTag = FfpackAuto,
 const size_t degree = __FFLASFFPACK_ARITHPROG_THRESHOLD) [inline]
```

Compute the characteristic polynomial of the matrix A.

#### Parameters

|     |                 |                                                                                       |
|-----|-----------------|---------------------------------------------------------------------------------------|
|     | <i>R</i>        | the polynomial ring of charp (contains the base field)                                |
| out | <i>charp</i>    | the characteristic polynomial of as a single polynomial                               |
|     | <i>N</i>        | order of the matrix A                                                                 |
| in  | <i>A</i>        | the input matrix ( $N \times N$ ) (could be overwritten in some algorithmic variants) |
|     | <i>lda</i>      | leading dimension of A                                                                |
|     | <i>CharpTag</i> | the algorithmic variant                                                               |



**15.20.3.43 MinPoly()** [1/4]

```
Polynomial & MinPoly (
 const Field & F,
 Polynomial & minP,
 const size_t N,
 typename Field::ConstElement_ptr A,
 const size_t lda) [inline]
```

Compute the minimal polynomial of the matrix A.

The algorithm is randomized probabilistic, and computes the minimal polynomial of the Krylov iterates of a random vector:  $(v, Av, \dots, A^k v)$

**Parameters**

|     |             |                                   |
|-----|-------------|-----------------------------------|
|     | <i>F</i>    | the base field                    |
| out | <i>minP</i> | the minimal polynomial of A       |
|     | <i>N</i>    | order of the matrix A             |
| in  | <i>A</i>    | the input matrix ( $N \times N$ ) |
|     | <i>lda</i>  | leading dimension of A            |

**15.20.3.44 MinPoly()** [2/4]

```
Polynomial & MinPoly (
 const Field & F,
 Polynomial & minP,
 const size_t N,
 typename Field::ConstElement_ptr A,
 const size_t lda,
 RandIter & G) [inline]
```

Compute the minimal polynomial of the matrix A.

The algorithm is randomized probabilistic, and computes the minimal polynomial of the Krylov iterates of a random vector:  $(v, Av, \dots, A^k v)$

**Parameters**

|     |             |                                   |
|-----|-------------|-----------------------------------|
|     | <i>F</i>    | the base field                    |
| out | <i>minP</i> | the minimal polynomial of A       |
|     | <i>N</i>    | order of the matrix A             |
| in  | <i>A</i>    | the input matrix ( $N \times N$ ) |
|     | <i>lda</i>  | leading dimension of A            |
|     | <i>G</i>    | a random iterator                 |

**15.20.3.45 MatVecMinPoly()** [1/2]

```
Polynomial & MatVecMinPoly (
 const Field & F,
 Polynomial & minP,
 const size_t N,
 typename Field::ConstElement_ptr A,
 const size_t lda,
 typename Field::ConstElement_ptr v,
 const size_t incv) [inline]
```

Compute the minimal polynomial of the matrix A and a vector v, namely the first linear dependency relation in the Krylov basis  $(v, Av, \dots, A^N v)$ .

**Parameters**

|     |        |                                                                                 |
|-----|--------|---------------------------------------------------------------------------------|
|     | $F$    | the base field                                                                  |
| out | $minP$ | the minimal polynomial of A and v                                               |
|     | $N$    | order of the matrix A                                                           |
| in  | $A$    | the input matrix ( $N \times N$ )                                               |
|     | $lda$  | leading dimension of A                                                          |
|     | $K$    | an $N \times (N + 1)$ matrix containing the vector v on its first row           |
|     | $ldk$  | leading dimension of K                                                          |
|     | $P$    | [out] (optional) the permutation used in the elimination of the Krylov matrix K |

**15.20.3.46 Rank()** [1/3]

```
size_t Rank (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda)
```

Computes the rank of the given matrix using a PLUQ factorization.

The input matrix is modified.

**Parameters**

|    |       |                                                                               |
|----|-------|-------------------------------------------------------------------------------|
|    | $F$   | base field                                                                    |
|    | $M$   | row dimension of the matrix                                                   |
|    | $N$   | column dimension of the matrix                                                |
| in | $A$   | input matrix                                                                  |
|    | $lda$ | leading dimension of A                                                        |
|    | $psH$ | (optional) a ParSeqHelper to choose between sequential and parallel execution |

**15.20.3.47 pRank()**

```
size_t pRank (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t numthreads = 0)
```

**15.20.3.48 Rank()** [2/3]

```
size_t Rank (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 const PSHelper & pSH)
```

**15.20.3.49 IsSingular()** [1/2]

```
bool IsSingular (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda)
```

Returns true if the given matrix is singular.

The method is a block elimination with early termination

using LQUP factorization with early termination. If  $M \neq N$ , then the matrix is virtually padded with zeros to make it square and it's determinant is zero.

**Warning**

The input matrix is modified.

**Parameters**

|         |       |                                 |
|---------|-------|---------------------------------|
|         | $F$   | base field                      |
|         | $M$   | row dimension of the matrix     |
|         | $N$   | column dimension of the matrix. |
| in, out | $A$   | input matrix                    |
|         | $lda$ | leading dimension of $A$        |

**15.20.3.50 Det()** [1/6]

```
Field::Element & Det (
 const Field & F,
 typename Field::Element & det,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P = NULL,
 size_t * Q = NULL) [inline]
```

Returns the determinant of the given square matrix.

The method is a block elimination using PLUQ factorization. The input matrix A is overwritten.

**Warning**

The input matrix is modified.

**Parameters**

|         |            |                                                                                                                                                             |
|---------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | <i>F</i>   | base field                                                                                                                                                  |
| out     | <i>det</i> | the determinant of A                                                                                                                                        |
|         | <i>N</i>   | the order of the square matrix A.                                                                                                                           |
| in, out | <i>A</i>   | input matrix                                                                                                                                                |
|         | <i>lda</i> | leading dimension of A                                                                                                                                      |
|         | <i>psH</i> | (optional) a ParSeqHelper to choose between sequential and parallel execution                                                                               |
|         | <i>P,Q</i> | (optional) row and column permutations to be used by the PLUQ factorization. randomized checkers (see cherckes/checker_det.inl) need them for certification |

**15.20.3.51 pDet()**

```
Field::Element & pDet (
 const Field & F,
 typename Field::Element & det,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t numthreads = 0,
 size_t * P = NULL,
 size_t * Q = NULL) [inline]
```

**15.20.3.52 Det()** [2/6]

```
Field::Element & Det (
 const Field & F,
 typename Field::Element & det,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 const PSHelper & pSH,
 size_t * P = NULL,
 size_t * Q = NULL)
```

**15.20.3.53 Solve()** [1/3]

```
Field::Element_ptr Solve (
 const Field & F,
 const size_t M,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr x,
 const int incx,
 typename Field::ConstElement_ptr b,
 const int incb) [inline]
```

Solves a linear system  $AX = b$  using PLUQ factorization.

@oaram F base field @oaram M matrix order

**Parameters**

|     |             |                                     |
|-----|-------------|-------------------------------------|
| in  | <i>A</i>    | input matrix                        |
|     | <i>lda</i>  | leading dimension of A              |
| out | <i>x</i>    | output solution vector              |
|     | <i>incx</i> | increment of x                      |
|     | <i>b</i>    | input right hand side of the system |
|     | <i>incb</i> | increment of b                      |

**15.20.3.54 Solve()** [2/3]

```
Field::Element_ptr Solve (
 const Field & F,
 const size_t M,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr x,
 const int incx,
 typename Field::ConstElement_ptr b,
```

```
const int incb,
PSHelper & psH)
```

### 15.20.3.55 pSolve()

```
Field::Element_ptr pSolve (
 const Field & F,
 const size_t M,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr x,
 const int incx,
 typename Field::ConstElement_ptr b,
 const int incb,
 size_t numthreads = 0) [inline]
```

### 15.20.3.56 RandomNullSpaceVector() [1/3]

```
*void RandomNullSpaceVector (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr X,
 const size_t incX)
```

Solve  $LX = B$  or  $XL = B$  in place.

$L$  is  $M \times M$  if `Side == FFLAS::FflasLeft` and  $N \times N$  if `Side == FFLAS::FflasRight`,  $B$  is  $M \times N$ . Only the  $R$  non trivial column of  $L$  are stored in the  $M \times R$  matrix  $L$  Requirement : so that  $L$  could be expanded in-place Computes a vector of the Left/Right nullspace of the matrix  $A$ .

#### Parameters

|         |             |                                                                                  |
|---------|-------------|----------------------------------------------------------------------------------|
|         | <i>F</i>    | The computation domain                                                           |
|         | <i>Side</i> | decides whether it computes the left (FflasLeft) or right (FflasRight) nullspace |
|         | <i>M</i>    | number of rows                                                                   |
|         | <i>N</i>    | number of columns                                                                |
| in, out | <i>A</i>    | input matrix of dimension $M \times N$ , $A$ is modified to its LU version       |
|         | <i>lda</i>  | leading dimension of $A$                                                         |
| out     | <i>X</i>    | output vector                                                                    |
|         | <i>incX</i> | increment of $X$                                                                 |

**15.20.3.57 NullSpaceBasis()** [1/2]

```

size_t NullSpaceBasis (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr & NS,
 size_t & ldn,
 size_t & NSdim)

```

Computes a basis of the Left/Right nullspace of the matrix A.

return the dimension of the nullspace.

**Parameters**

|         |              |                                                                                  |
|---------|--------------|----------------------------------------------------------------------------------|
|         | <i>F</i>     | The computation domain                                                           |
|         | <i>Side</i>  | decides whether it computes the left (FflasLeft) or right (FflasRight) nullspace |
|         | <i>M</i>     | number of rows                                                                   |
|         | <i>N</i>     | number of columns                                                                |
| in, out | <i>A</i>     | input matrix of dimension M x N, A is modified                                   |
|         | <i>lda</i>   | leading dimension of A                                                           |
| out     | <i>NS</i>    | output matrix of dimension N x NSdim (allocated here)                            |
| out     | <i>ldn</i>   | leading dimension of NS                                                          |
| out     | <i>NSdim</i> | the dimension of the Nullspace (N-rank(A))                                       |

**15.20.3.58 RowRankProfile()** [1/3]

```

size_t RowRankProfile (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t *& rkprofile,
 const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]

```

Computes the row rank profile of A.

**Parameters**

|     |                  |                                                                                       |
|-----|------------------|---------------------------------------------------------------------------------------|
|     | <i>F</i>         | base field                                                                            |
|     | <i>M</i>         | number of rows                                                                        |
|     | <i>N</i>         | number of columns                                                                     |
| in  | <i>A</i>         | input matrix of dimension M x N                                                       |
|     | <i>lda</i>       | leading dimension of A                                                                |
| out | <i>rkprofile</i> | return the rank profile as an array of row indexes, of dimension r=rank(A)            |
|     | <i>LuTag</i>     | chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ |

A modified rkprofile is allocated during the computation.

#### Returns

R

#### 15.20.3.59 pRowRankProfile()

```
size_t pRowRankProfile (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t *rkprofile,
 size_t numthreads = 0,
 const FFPACK_LU_TAG LuTag = FfpackTileRecursive) [inline]
```

#### 15.20.3.60 RowRankProfile() [2/3]

```
size_t RowRankProfile (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t *rkprofile,
 const FFPACK_LU_TAG LuTag,
 PSHelper & psH) [inline]
```

#### 15.20.3.61 ColumnRankProfile() [1/3]

```
size_t ColumnRankProfile (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t *rkprofile,
 const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]
```

Computes the column rank profile of A.

#### Parameters

|     |             |                                                                                     |                      |
|-----|-------------|-------------------------------------------------------------------------------------|----------------------|
|     | $F$         | base field                                                                          | Generated by Doxygen |
|     | $M$         | number of rows                                                                      |                      |
|     | $N$         | number of columns                                                                   |                      |
| in  | $A$         | input matrix of dimension                                                           |                      |
|     | $lda$       | leading dimension of A                                                              |                      |
| out | $rkprofile$ | return the rank profile as an array of row indexes. of dimension $r=\text{rank}(A)$ |                      |



A is modified rkprofile is allocated during the computation.

#### Returns

R

#### 15.20.3.62 pColumnRankProfile()

```
size_t pColumnRankProfile (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t *& rkprofile,
 size_t numthreads = 0,
 const FFPACK_LU_TAG LuTag = FfpackTileRecursive) [inline]
```

#### 15.20.3.63 ColumnRankProfile() [2/3]

```
size_t ColumnRankProfile (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t *& rkprofile,
 const FFPACK_LU_TAG LuTag,
 PSHelper & psH) [inline]
```

#### 15.20.3.64 RankProfileFromLU()

```
void RankProfileFromLU (
 const size_t * P,
 const size_t N,
 const size_t R,
 size_t * rkprofile,
 const FFPACK_LU_TAG LuTag) [inline]
```

Recovers the column/row rank profile from the permutation of an LU decomposition.

Works with both the CUP/PLE decompositions (obtained by LUdivine) or the PLUQ decomposition. Assumes that the output vector containing the rank profile is already allocated.

## Parameters

|     |             |                                                                                       |
|-----|-------------|---------------------------------------------------------------------------------------|
|     | $P$         | the permutation carrying the rank profile information                                 |
|     | $N$         | the row/col dimension for a row/column rank profile                                   |
|     | $R$         | the rank of the matrix                                                                |
| out | $rkprofile$ | return the rank profile as an array of indices                                        |
|     | $LuTag$     | chooses the elimination algorithm. SlabRecursive for LUdivine, TileRecursive for PLUQ |

## 15.20.3.65 LeadingSubmatrixRankProfiles()

```
size_t LeadingSubmatrixRankProfiles (
 const size_t M,
 const size_t N,
 const size_t R,
 const size_t LSm,
 const size_t LSn,
 const size_t * P,
 const size_t * Q,
 size_t * RRP,
 size_t * CRP) [inline]
```

Recovers the row and column rank profiles of any leading submatrix from the PLUQ decomposition.

Only works with the PLUQ decomposition Assumes that the output vectors containing the rank profiles are already allocated.

## Parameters

|       |                                                          |
|-------|----------------------------------------------------------|
| $P$   | the permutation carrying the rank profile information    |
| $M$   | the row dimension of the initial matrix                  |
| $N$   | the column dimension of the initial matrix               |
| $R$   | the rank of the initial matrix                           |
| $LSm$ | the row dimension of the leading submatrix considered    |
| $LSn$ | the column dimension of the leading submatrix considered |
| $P$   | the row permutation of the PLUQ decomposition            |
| $Q$   | the column permutation of the PLUQ decomposition         |
| $RRP$ | return the row rank profile of the leading submatrix     |

## Returns

the rank of the  $LSm \times LSn$  leading submatrix

A is modified

## Bibliography

- Dumas J-G., Pernet C., and Sultan Z. *Simultaneous computation of the row and column rank profiles*, ISSAC'13.

**15.20.3.66 RowRankProfileSubmatrixIndices()** [1/2]

```

size_t RowRankProfileSubmatrixIndices (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t *& rowindices,
 size_t *& colindices,
 size_t & R)

```

RowRankProfileSubmatrixIndices.

Computes the indices of the submatrix  $r \times r$  X of A whose rows correspond to the row rank profile of A.

**Parameters**

|     |                   |                                    |
|-----|-------------------|------------------------------------|
|     | $F$               | base field                         |
|     | $M$               | number of rows                     |
|     | $N$               | number of columns                  |
| in  | $A$               | input matrix of dimension          |
|     | <i>rowindices</i> | array of the row indices of X in A |
|     | <i>colindices</i> | array of the col indices of X in A |
|     | <i>lda</i>        | leading dimension of A             |
| out | $R$               | list of indices                    |

rowindices and colindices are allocated during the computation. A is modified

**Returns**

R

**15.20.3.67 ColRankProfileSubmatrixIndices()** [1/2]

```

size_t ColRankProfileSubmatrixIndices (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t *& rowindices,
 size_t *& colindices,
 size_t & R)

```

Computes the indices of the submatrix  $r \times r$  X of A whose columns correspond to the column rank profile of A.

**Parameters**

|  |     |                |
|--|-----|----------------|
|  | $F$ | base field     |
|  | $M$ | number of rows |

## Parameters

|     |                   |                                    |
|-----|-------------------|------------------------------------|
|     | $N$               | number of columns                  |
| in  | $A$               | input matrix of dimension          |
|     | <i>rowindices</i> | array of the row indices of X in A |
|     | <i>colindices</i> | array of the col indices of X in A |
|     | <i>lda</i>        | leading dimension of A             |
| out | $R$               | list of indices                    |

rowindices and colindices are allocated during the computation.

## Warning

A is modified

## Returns

R

## 15.20.3.68 RowRankProfileSubmatrix() [1/2]

```
size_t RowRankProfileSubmatrix (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr & X,
 size_t & R)
```

Computes the  $r \times r$  submatrix X of A, by picking the row rank profile rows of A.

## Parameters

|     |            |                                 |
|-----|------------|---------------------------------|
|     | $F$        | base field                      |
|     | $M$        | number of rows                  |
|     | $N$        | number of columns               |
| in  | $A$        | input matrix of dimension M x N |
|     | <i>lda</i> | leading dimension of A          |
| out | $X$        | the output matrix               |
| out | $R$        | list of indices                 |

A is not modified X is allocated during the computation.

## Returns

R

**15.20.3.69 ColRankProfileSubmatrix()** [1/2]

```
size_t ColRankProfileSubmatrix (
 const Field & F,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr & X,
 size_t & R)
```

Compute the  $r \times r$  submatrix X of A, by picking the row rank profile rows of A.

**Parameters**

|     |       |                                 |
|-----|-------|---------------------------------|
|     | $F$   | base field                      |
|     | $M$   | number of rows                  |
|     | $N$   | number of columns               |
| in  | $A$   | input matrix of dimension M x N |
|     | $lda$ | leading dimension of A          |
| out | $X$   | the output matrix               |
| out | $R$   | list of indices                 |

A is not modified X is allocated during the computation.

**Returns**

R

**15.20.3.70 getTriangular()** [1/2]

```
void getTriangular (
 const Field & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const FFLAS::FFLAS_DIAG diag,
 const size_t M,
 const size_t N,
 const size_t R,
 typename Field::ConstElement_ptr A,
 const size_t lda,
 typename Field::Element_ptr T,
 const size_t ldt,
 const bool OnlyNonZeroVectors = false) [inline]
```

Extracts a triangular matrix from a compact storage A=L\U of rank R.

if OnlyNonZeroVectors is false, then T and A have the same dimensions Otherwise, T is R x N if UpLo = FflasUpper, else T is M x R

## Parameters

|     |                           |                                                                                       |
|-----|---------------------------|---------------------------------------------------------------------------------------|
|     | <i>F</i>                  | base field                                                                            |
|     | <i>UpLo</i>               | selects if the upper (FflasUpper) or lower (FflasLower) triangular matrix is returned |
|     | <i>diag</i>               | selects if the triangular matrix unit-diagonal (FflasUnit/NoUnit)                     |
|     | <i>M</i>                  | row dimension of T                                                                    |
|     | <i>N</i>                  | column dimension of T                                                                 |
|     | <i>R</i>                  | rank of the triangular matrix (how many rows/columns need to be copied)               |
| in  | <i>A</i>                  | input matrix                                                                          |
|     | <i>lda</i>                | leading dimension of A                                                                |
| out | <i>T</i>                  | output matrix                                                                         |
|     | <i>ldt</i>                | leading dimension of T                                                                |
|     | <i>OnlyNonZeroVectors</i> | decides whether the last zero rows/columns should be ignored                          |

**Todo** just one triangular fzero+fassign ?

**Todo** just one triangular fzero+fassign ?

### 15.20.3.71 getTriangular() [2/2]

```
void getTriangular (
 const Field & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const FFLAS::FFLAS_DIAG diag,
 const size_t M,
 const size_t N,
 const size_t R,
 typename Field::Element_ptr A,
 const size_t lda) [inline]
```

Cleans up a compact storage  $A=LU$  to reveal a triangular matrix of rank  $R$ .

## Parameters

|         |             |                                                                                       |
|---------|-------------|---------------------------------------------------------------------------------------|
|         | <i>F</i>    | base field                                                                            |
|         | <i>UpLo</i> | selects if the upper (FflasUpper) or lower (FflasLower) triangular matrix is revealed |
|         | <i>diag</i> | selects if the triangular matrix unit-diagonal (FflasUnit/NoUnit)                     |
|         | <i>M</i>    | row dimension of A                                                                    |
|         | <i>N</i>    | column dimension of A                                                                 |
|         | <i>R</i>    | rank of the triangular matrix                                                         |
| in, out | <i>A</i>    | input/output matrix                                                                   |
|         | <i>lda</i>  | leading dimension of A                                                                |

**Todo** just one triangular fzero+fassign ?

**Todo** just one triangular fzero+fassign ?

### 15.20.3.72 getEchelonForm() [1/2]

```
void getEchelonForm (
 const Field & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const FFLAS::FFLAS_DIAG diag,
 const size_t M,
 const size_t N,
 const size_t R,
 const size_t * P,
 typename Field::ConstElement_ptr A,
 const size_t lda,
 typename Field::Element_ptr T,
 const size_t ldt,
 const bool OnlyNonZeroVectors = false,
 const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]
```

Extracts a matrix in echelon form from a compact storage A=LU of rank R obtained by RowEchelonForm or ColumnEchelonForm.

Either L or U is in Echelon form (depending on Uplo) The echelon structure is defined by the first R values of the array P. row and column dimension of T are greater or equal to that of A

#### Parameters

|     |                           |                                                                                       |
|-----|---------------------------|---------------------------------------------------------------------------------------|
|     | <i>F</i>                  | base field                                                                            |
|     | <i>UpLo</i>               | selects if the upper (FflasUpper) or lower (FflasLower) triangular matrix is returned |
|     | <i>diag</i>               | selects if the echelon matrix has unit pivots (FflasUnit/NoUnit)                      |
|     | <i>M</i>                  | row dimension of T                                                                    |
|     | <i>N</i>                  | column dimension of T                                                                 |
|     | <i>R</i>                  | rank of the triangular matrix (how many rows/columns need to be copied)               |
|     | <i>P</i>                  | positions of the R pivots                                                             |
| in  | <i>A</i>                  | input matrix                                                                          |
|     | <i>lda</i>                | leading dimension of A                                                                |
| out | <i>T</i>                  | output matrix                                                                         |
|     | <i>ldt</i>                | leading dimension of T                                                                |
|     | <i>OnlyNonZeroVectors</i> | decides whether the last zero rows/columns should be ignored                          |
|     | <i>LuTag</i>              | which factorized form (CUP/PLE if FfpackSlabRecursive, PLUQ if FfpackTileRecursive)   |

### 15.20.3.73 getEchelonForm() [2/2]

```
void getEchelonForm (
 const Field & F,
```

```

const FFLAS::FFLAS_UPLO Uplo,
const FFLAS::FFLAS_DIAG diag,
const size_t M,
const size_t N,
const size_t R,
const size_t * P,
typename Field::Element_ptr A,
const size_t lda,
const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]

```

Cleans up a compact storage  $A=L\backslash U$  obtained by RowEchelonForm or ColumnEchelonForm to reveal an echelon form of rank  $R$ .

Either  $L$  or  $U$  is in Echelon form (depending on  $Uplo$ ) The echelon structure is defined by the first  $R$  values of the array  $P$ .

#### Parameters

|         |         |                                                                                       |
|---------|---------|---------------------------------------------------------------------------------------|
|         | $F$     | base field                                                                            |
|         | $UpLo$  | selects if the upper (FflasUpper) or lower (FflasLower) triangular matrix is returned |
|         | $diag$  | selects if the echelon matrix has unit pivots (FflasUnit/NoUnit)                      |
|         | $M$     | row dimension of $A$                                                                  |
|         | $N$     | column dimension of $A$                                                               |
|         | $R$     | rank of the triangular matrix (how many rows/columns need to be copied)               |
|         | $P$     | positions of the $R$ pivots                                                           |
| in, out | $A$     | input/output matrix                                                                   |
|         | $lda$   | leading dimension of $A$                                                              |
|         | $LuTag$ | which factorized form (CUP/PLE if FfpackSlabRecursive, PLUQ if FfpackTileRecursive)   |

#### 15.20.3.74 getEchelonTransform()

```

void getEchelonTransform (
 const Field & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const FFLAS::FFLAS_DIAG diag,
 const size_t M,
 const size_t N,
 const size_t R,
 const size_t * P,
 const size_t * Q,
 typename Field::ConstElement_ptr A,
 const size_t lda,
 typename Field::Element_ptr T,
 const size_t ldt,
 const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]

```

Extracts a transformation matrix to echelon form from a compact storage  $A=L\backslash U$  of rank  $R$  obtained by Row↔ EchelonForm or ColumnEchelonForm.

If  $Uplo == FflasLower$ :  $T$  is  $N \times N$  (already allocated) such that  $A T = C$  is a transformation of  $A$  in Column echelon form Else  $T$  is  $M \times M$  (already allocated) such that  $T A = E$  is a transformation of  $A$  in Row Echelon form



## Parameters

|     |              |                                                                                                         |
|-----|--------------|---------------------------------------------------------------------------------------------------------|
|     | <i>F</i>     | base field                                                                                              |
|     | <i>UpLo</i>  | Lower (FflasLower) means Transformation to Column Echelon Form, Upper (FflasUpper), to Row Echelon Form |
|     | <i>diag</i>  | selects if the echelon matrix has unit pivots (FflasUnit/NoUnit)                                        |
|     | <i>M</i>     | row dimension of A                                                                                      |
|     | <i>N</i>     | column dimension of A                                                                                   |
|     | <i>R</i>     | rank of the triangular matrix                                                                           |
|     | <i>P</i>     | permutation matrix                                                                                      |
| in  | <i>A</i>     | input matrix                                                                                            |
|     | <i>lda</i>   | leading dimension of A                                                                                  |
| out | <i>T</i>     | output matrix                                                                                           |
|     | <i>ldt</i>   | leading dimension of T                                                                                  |
|     | <i>LuTag</i> | which factorized form (CUP/PLE if FfpackSlabRecursive, PLUQ if FfpackTileRecursive)                     |

15.20.3.75 `getReducedEchelonForm()` [1/2]

```

void getReducedEchelonForm (
 const Field & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const size_t M,
 const size_t N,
 const size_t R,
 const size_t * P,
 typename Field::ConstElement_ptr A,
 const size_t lda,
 typename Field::Element_ptr T,
 const size_t ldt,
 const bool OnlyNonZeroVectors = false,
 const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]

```

Extracts a matrix in echelon form from a compact storage  $A=L\backslash U$  of rank  $R$  obtained by `ReducedRowEchelonForm` or `ReducedColumnEchelonForm` with `transform = true`.

Either  $L$  or  $U$  is in Echelon form (depending on `Uplo`) The echelon structure is defined by the first  $R$  values of the array  $P$ . row and column dimension of  $T$  are greater or equal to that of  $A$

## Parameters

|    |             |                                                                                       |
|----|-------------|---------------------------------------------------------------------------------------|
|    | <i>F</i>    | base field                                                                            |
|    | <i>UpLo</i> | selects if the upper (FflasUpper) or lower (FflasLower) triangular matrix is returned |
|    | <i>diag</i> | selects if the echelon matrix has unit pivots (FflasUnit/NoUnit)                      |
|    | <i>M</i>    | row dimension of T                                                                    |
|    | <i>N</i>    | column dimension of T                                                                 |
|    | <i>R</i>    | rank of the triangular matrix (how many rows/columns need to be copied)               |
|    | <i>P</i>    | positions of the R pivots                                                             |
| in | <i>A</i>    | input matrix                                                                          |
|    | <i>lda</i>  | leading dimension of A                                                                |

## Parameters

|  |                           |                                                                                     |
|--|---------------------------|-------------------------------------------------------------------------------------|
|  | <i>ldt</i>                | leading dimension of T                                                              |
|  | <i>LuTag</i>              | which factorized form (CUP/PLE if FfpackSlabRecursive, PLUQ if FfpackTileRecursive) |
|  | <i>OnlyNonZeroVectors</i> | decides whether the last zero rows/columns should be ignored                        |

15.20.3.76 `getReducedEchelonForm()` [2/2]

```

void getReducedEchelonForm (
 const Field & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const size_t M,
 const size_t N,
 const size_t R,
 const size_t * P,
 typename Field::Element_ptr A,
 const size_t lda,
 const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]

```

Cleans up a compact storage  $A=L\backslash U$  of rank R obtained by ReducedRowEchelonForm or ReducedColumnEchelonForm with transform = true.

Either L or U is in Echelon form (depending on Uplo) The echelon structure is defined by the first R values of the array P.

## Parameters

|                |              |                                                                                       |
|----------------|--------------|---------------------------------------------------------------------------------------|
|                | <i>F</i>     | base field                                                                            |
|                | <i>UpLo</i>  | selects if the upper (FflasUpper) or lower (FflasLower) triangular matrix is returned |
|                | <i>diag</i>  | selects if the echelon matrix has unit pivots (FflasUnit/NoUnit)                      |
|                | <i>M</i>     | row dimension of A                                                                    |
|                | <i>N</i>     | column dimension of A                                                                 |
|                | <i>R</i>     | rank of the triangular matrix (how many rows/columns need to be copied)               |
|                | <i>P</i>     | positions of the R pivots                                                             |
| <i>in, out</i> | <i>A</i>     | input/output matrix                                                                   |
|                | <i>lda</i>   | leading dimension of A                                                                |
|                | <i>LuTag</i> | which factorized form (CUP/PLE if FfpackSlabRecursive, PLUQ if FfpackTileRecursive)   |

15.20.3.77 `getReducedEchelonTransform()`

```

void getReducedEchelonTransform (
 const Field & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const size_t M,

```

```

const size_t N,
const size_t R,
const size_t * P,
const size_t * Q,
typename Field::ConstElement_ptr A,
const size_t lda,
typename Field::Element_ptr T,
const size_t ldt,
const FFPACK_LU_TAG LuTag = FfpackSlabRecursive) [inline]

```

Extracts a transformation matrix to echelon form from a compact storage  $A=LU$  of rank  $R$  obtained by Row↔EchelonForm or ColumnEchelonForm.

If Uplo == FflasLower:  $T$  is  $N \times N$  (already allocated) such that  $A T = C$  is a transformation of  $A$  in Column echelon form Else  $T$  is  $M \times M$  (already allocated) such that  $T A = E$  is a transformation of  $A$  in Row Echelon form

#### Parameters

|     |              |                                                                                     |
|-----|--------------|-------------------------------------------------------------------------------------|
|     | <i>F</i>     | base field                                                                          |
|     | <i>UpLo</i>  | selects Col (FflasLower) or Row (FflasUpper) Echelon Form                           |
|     | <i>diag</i>  | selects if the echelon matrix has unit pivots (FflasUnit/NoUnit)                    |
|     | <i>M</i>     | row dimension of A                                                                  |
|     | <i>N</i>     | column dimension of A                                                               |
|     | <i>R</i>     | rank of the triangular matrix                                                       |
|     | <i>P</i>     | permutation matrix                                                                  |
| in  | <i>A</i>     | input matrix                                                                        |
|     | <i>lda</i>   | leading dimension of A                                                              |
| out | <i>T</i>     | output matrix                                                                       |
|     | <i>ldt</i>   | leading dimension of T                                                              |
|     | <i>LuTag</i> | which factorized form (CUP/PLE if FfpackSlabRecursive, PLUQ if FfpackTileRecursive) |

#### 15.20.3.78 PLUQtoEchelonPermutation()

```

void PLUQtoEchelonPermutation (
 const size_t N,
 const size_t R,
 const size_t * P,
 size_t * outPerm) [inline]

```

Auxiliary routine: determines the permutation that changes a PLUQ decomposition into a echelon form revealing PLUQ decomposition.

#### 15.20.3.79 LQUPtoInverseOfFullRankMinor() [1/2]

```

Field::Element_ptr LQUPtoInverseOfFullRankMinor (
 const Field & F,
 const size_t rank,

```

```

typename Field::Element_ptr A_factors,
const size_t lda,
const size_t * QtPointer,
typename Field::Element_ptr X,
const size_t ldx)

```

LQUPtoInverseOfFullRankMinor.

Suppose A has been factorized as L.Q.U.P, with rank r. Then Qt.A.Pt has an invertible leading principal  $r \times r$  submatrix This procedure efficiently computes the inverse of this minor and puts it into X.

#### Note

It changes the lower entries of A\_factors in the process (NB: unless A was nonsingular and square)

#### Parameters

|                  |                                                            |
|------------------|------------------------------------------------------------|
| <i>F</i>         | base field                                                 |
| <i>rank</i>      | rank of the matrix.                                        |
| <i>A_factors</i> | matrix containing the L and U entries of the factorization |
| <i>lda</i>       | leading dimension of A                                     |
| <i>QtPointer</i> | theLQUP->getQ()->getPointer() (note: getQ returns Qt!)     |
| <i>X</i>         | desired location for output                                |
| <i>ldx</i>       | leading dimension of X                                     |

### 15.20.3.80 RandomNullSpaceVector() [2/3]

```

void RandomNullSpaceVector (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr X,
 const size_t incX)

```

Solve  $LX = B$  or  $XL = B$  in place.

L is  $M \times M$  if Side == FFLAS::FflasLeft and  $N \times N$  if Side == FFLAS::FflasRight, B is  $M \times N$ . Only the R non trivial column of L are stored in the  $M \times R$  matrix L Requirement : so that L could be expanded in-place Computes a vector of the Left/Right nullspace of the matrix A.

#### Parameters

|         |             |                                                                                  |
|---------|-------------|----------------------------------------------------------------------------------|
|         | <i>F</i>    | The computation domain                                                           |
|         | <i>Side</i> | decides whether it computes the left (FflasLeft) or right (FflasRight) nullspace |
|         | <i>M</i>    | number of rows                                                                   |
|         | <i>N</i>    | number of columns                                                                |
| in, out | <i>A</i>    | input matrix of dimension $M \times N$ , A is modified to its LU version         |
|         | <i>lda</i>  | leading dimension of A                                                           |
| out     | <i>X</i>    | output vector                                                                    |
|         | <i>incX</i> | increment of X                                                                   |

**15.20.3.81 solveLB()** [1/2]

```
void solveLB (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 const size_t N,
 const size_t R,
 typename Field::Element_ptr L,
 const size_t ldl,
 const size_t * Q,
 typename Field::Element_ptr B,
 const size_t ldb)
```

**15.20.3.82 solveLB2()** [1/2]

```
void solveLB2 (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 const size_t N,
 const size_t R,
 typename Field::Element_ptr L,
 const size_t ldl,
 const size_t * Q,
 typename Field::Element_ptr B,
 const size_t ldb)
```

**15.20.3.83 Danilevski()**

```
std::list< Polynomial > & Danilevski (
 const Field & F,
 std::list< Polynomial > & charp,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda)
```

**15.20.3.84 buildMatrix()**

```
Field::Element_ptr buildMatrix (
 const Field & F,
 typename Field::ConstElement_ptr E,
 typename Field::ConstElement_ptr C,
 const size_t lda,
 const size_t * B,
 const size_t * T,
 const size_t me,
 const size_t mc,
 const size_t lambda,
 const size_t mu)
```

**Bug** is this :

**15.20.3.85 CharPoly()** [4/8]

```
FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr CharPoly (
 const FFPACK::RNSInteger< FFPACK::rns_double > & F,
 typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr charp,
 const size_t N,
 typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr A,
 const size_t lda,
 Givaro::ZRing< Givaro::Integer >::RandIter & G,
 const FFPACK_CHARPOLY_TAG CharpTag,
 size_t degree) [inline]
```

**15.20.3.86 CharPoly()** [5/8]

```
Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > >::Element & CharPoly (
 const Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > > & R,
 Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > >::Element & charp,
 const size_t N,
 Givaro::Integer * A,
 const size_t lda,
 Givaro::ZRing< Givaro::Integer >::RandIter & G,
 const FFPACK_CHARPOLY_TAG CharpTag,
 size_t degree) [inline]
```

**15.20.3.87 Det()** [3/6]

```
FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr & Det (
 const FFPACK::RNSInteger< FFPACK::rns_double > & F,
 typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr & det,
 const size_t N,
 typename FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr A,
 const size_t lda,
 const PSHelper & psH) [inline]
```

**15.20.3.88 Det() [4/6]**

```
Givaro::Integer & Det (
 const Givaro::ZRing< Givaro::Integer > & F,
 Givaro::Integer & det,
 const size_t N,
 Givaro::Integer * A,
 const size_t lda,
 const PSHelper & psH,
 size_t * P,
 size_t * Q) [inline]
```

**15.20.3.89 fsytrf\_BC\_Crout()**

```
bool fsytrf_BC_Crout (
 const Field & F,
 const FFLAS::FFLAS_UPLO UpLo,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr Dinv,
 const size_t incDinv) [inline]
```

**15.20.3.90 fsytrf\_BC\_RL()**

```
size_t fsytrf_BC_RL (
 const Field & F,
 const FFLAS::FFLAS_UPLO UpLo,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr Dinv,
 const size_t incDinv) [inline]
```

**15.20.3.91 fsytrf\_UP\_RPM\_BC\_RL()**

```
size_t fsytrf_UP_RPM_BC_RL (
 const Field & F,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr Dinv,
 const size_t incDinv,
 size_t * P) [inline]
```

**15.20.3.92 fsytrf\_LOW\_RPM\_BC\_Crout()**

```
size_t fsytrf_LOW_RPM_BC_Crout (
 const Field & F,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr Dinv,
 const size_t incDinv,
 size_t * P) [inline]
```

**15.20.3.93 fsytrf\_UP\_RPM\_BC\_Crout()**

```
size_t fsytrf_UP_RPM_BC_Crout (
 const Field & F,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr Dinv,
 const size_t incDinv,
 size_t * P) [inline]
```

**15.20.3.94 fsytrf\_UP\_RPM()**

```
size_t fsytrf_UP_RPM (
 const Field & Fi,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr Dinv,
 const size_t incDinv,
 size_t * P,
 size_t BCThreshold) [inline]
```

MathP  $\leftarrow \begin{bmatrix} I \\ P_1 \end{bmatrix} \begin{bmatrix} I & (N+R_2) \end{bmatrix} \begin{bmatrix} P_2^T \\ P_3^T \end{bmatrix} \begin{bmatrix} \text{-----} & | & \text{---} \end{bmatrix} \begin{bmatrix} Q_2^T \end{bmatrix}$

Changing  $\begin{bmatrix} U_1 & V_1 & | & E_1 & E_{21} & E_{22} \end{bmatrix}$  into  $\begin{bmatrix} U_1 & E_{11} & E_{12} & V_1 & E^* & E^* \end{bmatrix} \begin{bmatrix} 0 & | & L_2 & U_2 & V_{21} & V_{22} \end{bmatrix} \begin{bmatrix} U_4 & V_{41} & 0 & V_{42} & V_{43} \end{bmatrix} \begin{bmatrix} 0 & | & M_2 & 0 & 0 \end{bmatrix} \begin{bmatrix} U_3 & 0 & 0 & V_3 \end{bmatrix} \begin{bmatrix} \text{---} & | & \text{-----} \end{bmatrix} \begin{bmatrix} 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & | & H_1 & H_{21} & H_{22} \end{bmatrix} \begin{bmatrix} 0 & | & U_3 & V_3 \end{bmatrix} \begin{bmatrix} 0 & | & 0 \end{bmatrix}$  where  $U_4$  is the  $2R_2 \times 2R_2$  matrix formed by interleaving  $U_2$ ,  $L_2^T$  and  $H_1$

**15.20.3.95 fsytrf\_nonunit() [2/3]**

```
bool fsytrf_nonunit (
 const Field & F,
 const FFLAS::FFLAS_UPLO UpLo,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr Dinv,
 const size_t incDinv,
 FFLAS::ParSeqHelper::Sequential seq,
 size_t threshold) [inline]
```



**15.20.3.96 fsytrf\_nonunit()** [3/3]

```

bool fsytrf_nonunit (
 const Field & F,
 const FFLAS::FFLAS_UPLO UpLo,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr Dinv,
 const size_t incDinv,
 FFLAS::ParSeqHelper::Parallel< Cut, Param > par,
 size_t threshold) [inline]

```

**15.20.3.97 fsytrf\_RPM()**

```

size_t fsytrf_RPM (
 const Field & F,
 const FFLAS::FFLAS_UPLO UpLo,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t threshold) [inline]

```

**15.20.3.98 getTridiagonal()**

```

void getTridiagonal (
 const Field & F,
 const size_t N,
 const size_t R,
 typename Field::ConstElement_ptr A,
 const size_t lda,
 size_t * P,
 typename Field::Element_ptr T,
 const size_t ldt) [inline]

```

**15.20.3.99 LUdivine\_gauss()** [1/2]

```

size_t LUdivine_gauss (
 const Field & F,
 const FFLAS::FFLAS_DIAG Diag,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Q,
 const FFPACK::FFPACK_LU_TAG LuTag) [inline]

```

**15.20.3.100 LUdivine\_small()** [1/2]

```

size_t LUdivine_small (
 const Field & F,
 const FFLAS::FFLAS_DIAG Diag,
 const FFLAS::FFLAS_TRANSPOSE trans,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Q,
 const FFPACK::FFPACK_LU_TAG LuTag) [inline]

```

**15.20.3.101 LUdivine()** [2/4]

```

size_t LUdivine (
 const Field & F,
 const FFLAS::FFLAS_DIAG Diag,
 const FFLAS::FFLAS_TRANSPOSE trans,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Q,
 const FFPACK::FFPACK_LU_TAG LuTag,
 const size_t cutoff) [inline]

```

**Todo** std::swap ?

**15.20.3.102 LUdivine()** [3/4]

```

size_t LUdivine (
 const Givaro::Modular< Givaro::Integer > & F,
 const FFLAS::FFLAS_DIAG Diag,
 const FFLAS::FFLAS_TRANSPOSE trans,
 const size_t M,
 const size_t N,
 typename Givaro::Integer * A,
 const size_t lda,
 size_t * P,
 size_t * Q,
 const FFPACK::FFPACK_LU_TAG LuTag,
 const size_t cutoff) [inline]

```

### 15.20.3.103 MonotonicCompress()

```
void MonotonicCompress (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t incA,
 const size_t * MathP,
 const size_t R,
 const size_t maxpiv,
 const size_t rowstomove,
 const std::vector< bool > & ispiv) [inline]
```

### 15.20.3.104 MonotonicCompressMorePivots()

```
void MonotonicCompressMorePivots (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t incA,
 const size_t * MathP,
 const size_t R,
 const size_t rowstomove,
 const size_t lenP) [inline]
```

### 15.20.3.105 MonotonicCompressCycles()

```
void MonotonicCompressCycles (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t incA,
 const size_t * MathP,
 const size_t lenP) [inline]
```

### 15.20.3.106 MonotonicExpand()

```
void MonotonicExpand (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t incA,
 const size_t * MathP,
 const size_t R,
 const size_t maxpiv,
 const size_t rowstomove,
 const std::vector< bool > & ispiv)
```

### 15.20.3.107 applyP\_block()

```
void applyP_block (
 const Field & F,
 const FFLAS::FFLAS_SIDE Side,
 const FFLAS::FFLAS_TRANSPOSE Trans,
 const size_t M,
 const size_t ibeg,
 const size_t iend,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t * P) [inline]
```

### 15.20.3.108 doApplyS()

```
void doApplyS (
 const Field & F,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr tmp,
 const size_t width,
 const size_t M2,
 const size_t R1,
 const size_t R2,
 const size_t R3,
 const size_t R4) [inline]
```

**15.20.3.109 MatrixApplyS() [1/3]**

```
void MatrixApplyS (
 const Field & F,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t width,
 const size_t M2,
 const size_t R1,
 const size_t R2,
 const size_t R3,
 const size_t R4) [inline]
```

**15.20.3.110 MatrixApplyS() [2/3]**

```
void MatrixApplyS (
 const Field & F,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t width,
 const size_t M2,
 const size_t R1,
 const size_t R2,
 const size_t R3,
 const size_t R4,
 const FFLAS::ParSeqHelper::Sequential seq) [inline]
```

**15.20.3.111 MatrixApplyS() [3/3]**

```
void MatrixApplyS (
 const Field & F,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t width,
 const size_t M2,
 const size_t R1,
 const size_t R2,
 const size_t R3,
 const size_t R4,
 const FFLAS::ParSeqHelper::Parallel< Cut, Param > par) [inline]
```

**15.20.3.112 PermApplyS()**

```

void PermApplyS (
 T * A,
 const size_t lda,
 const size_t width,
 const size_t M2,
 const size_t R1,
 const size_t R2,
 const size_t R3,
 const size_t R4) [inline]

```

**15.20.3.113 doApplyT()**

```

void doApplyT (
 const Field & F,
 typename Field::Element_ptr A,
 const size_t lda,
 typename Field::Element_ptr tmp,
 const size_t width,
 const size_t N2,
 const size_t R1,
 const size_t R2,
 const size_t R3,
 const size_t R4) [inline]

```

**15.20.3.114 MatrixApplyT() [1/3]**

```

void MatrixApplyT (
 const Field & F,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t width,
 const size_t N2,
 const size_t R1,
 const size_t R2,
 const size_t R3,
 const size_t R4) [inline]

```

**15.20.3.115 MatrixApplyT() [2/3]**

```

void MatrixApplyT (
 const Field & F,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t width,
 const size_t N2,

```

```

const size_t R1,
const size_t R2,
const size_t R3,
const size_t R4,
const FFLAS::ParSeqHelper::Sequential seq) [inline]

```

### 15.20.3.116 MatrixApplyT() [3/3]

```

void MatrixApplyT (
 const Field & F,
 typename Field::Element_ptr A,
 const size_t lda,
 const size_t width,
 const size_t N2,
 const size_t R1,
 const size_t R2,
 const size_t R3,
 const size_t R4,
 const FFLAS::ParSeqHelper::Parallel< Cut, Param > par) [inline]

```

### 15.20.3.117 PermApplyT()

```

void PermApplyT (
 T * A,
 const size_t lda,
 const size_t width,
 const size_t N2,
 const size_t R1,
 const size_t R2,
 const size_t R3,
 const size_t R4) [inline]

```

### 15.20.3.118 composePermutationsLLL()

```

void composePermutationsLLL (
 size_t * P1,
 const size_t * P2,
 const size_t R,
 const size_t N) [inline]

```

Computes  $P1 \times \text{Diag}(I_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $P1$  as a LAPACK permutation.

#### Parameters

|         |      |                                  |
|---------|------|----------------------------------|
| in, out | $P1$ | a LAPACK permutation of size N   |
|         | $P2$ | a LAPACK permutation of size N-R |

**15.20.3.119 composePermutationsLLM()**

```
void composePermutationsLLM (
 size_t * MathP,
 const size_t * P1,
 const size_t * P2,
 const size_t R,
 const size_t N) [inline]
```

Computes  $P1 \times \text{Diag}(I_R, P2)$  where  $P1$  is a LAPACK and  $P2$  a LAPACK permutation and store the result in  $\text{MathP}$  as a  $\text{MathPermutation}$  format.

**Parameters**

|     |  |  |
|-----|--|--|
| out |  |  |
|-----|--|--|

a  $\text{MathPermutation}$  of size  $N$

**Parameters**

|      |                                    |
|------|------------------------------------|
| $P1$ | a LAPACK permutation of size $N$   |
| $P2$ | a LAPACK permutation of size $N-R$ |

**15.20.3.120 composePermutationsMLM()**

```
void composePermutationsMLM (
 size_t * MathP1,
 const size_t * P2,
 const size_t R,
 const size_t N) [inline]
```

Computes  $\text{MathP1} \times \text{Diag}(I_R, P2)$  where  $\text{MathP1}$  is a  $\text{MathPermutation}$  and  $P2$  a LAPACK permutation and store the result in  $\text{MathP1}$  as a  $\text{MathPermutation}$  format.

**Parameters**

|         |                 |                                        |
|---------|-----------------|----------------------------------------|
| in, out | $\text{MathP1}$ | a $\text{MathPermutation}$ of size $N$ |
|         | $P2$            | a LAPACK permutation of size $N-R$     |

**15.20.3.121 cyclic\_shift\_mathPerm()**

```
void cyclic_shift_mathPerm (
 size_t * P,
 const size_t s) [inline]
```



**15.20.3.122 cyclic\_shift\_row\_col() [1/2]**

```
void cyclic_shift_row_col (
 const Field & F,
 typename Field::Element_ptr A,
 size_t m,
 size_t n,
 size_t lda) [inline]
```

**15.20.3.123 cyclic\_shift\_row() [1/3]**

```
void cyclic_shift_row (
 const Field & F,
 typename Field::Element_ptr A,
 size_t m,
 size_t n,
 size_t lda) [inline]
```

**15.20.3.124 cyclic\_shift\_row() [2/3]**

```
void cyclic_shift_row (
 const RNSIntegerMod< T > & F,
 typename T::Element_ptr A,
 size_t m,
 size_t n,
 size_t lda) [inline]
```

**15.20.3.125 cyclic\_shift\_col() [1/3]**

```
void cyclic_shift_col (
 const Field & F,
 typename Field::Element_ptr A,
 size_t m,
 size_t n,
 size_t lda) [inline]
```

**15.20.3.126 cyclic\_shift\_col()** [2/3]

```
void cyclic_shift_col (
 const RNSIntegerMod< T > & F,
 typename T::Element_ptr A,
 size_t m,
 size_t n,
 size_t lda) [inline]
```

**15.20.3.127 PLUQ\_basecaseV3()**

```
size_t PLUQ_basecaseV3 (
 const Field & Fi,
 const FFLAS::FFLAS_DIAG Diag,
 const size_t M,
 const size_t N,
 typename Field::Element * A,
 const size_t lda,
 size_t * P,
 size_t * Q) [inline]
```

**15.20.3.128 PLUQ\_basecaseV2()**

```
size_t PLUQ_basecaseV2 (
 const Field & Fi,
 const FFLAS::FFLAS_DIAG Diag,
 const size_t M,
 const size_t N,
 typename Field::Element * A,
 const size_t lda,
 size_t * P,
 size_t * Q) [inline]
```

**15.20.3.129 PLUQ\_basecaseCrout()**

```
size_t PLUQ_basecaseCrout (
 const Field & Fi,
 const FFLAS::FFLAS_DIAG Diag,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Q) [inline]
```

**15.20.3.130 \_PLUQ()**

```
size_t _PLUQ (
 const Field & Fi,
 const FFLAS::FFLAS_DIAG Diag,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Q,
 size_t BCThreshold) [inline]
```

**15.20.3.131 PLUQ() [4/6]**

```
size_t PLUQ (
 const Givaro::Modular< Givaro::Integer > & F,
 const FFLAS::FFLAS_DIAG Diag,
 const size_t M,
 const size_t N,
 typename Givaro::Integer * A,
 const size_t lda,
 size_t * P,
 size_t * Q,
 size_t BCThreshold,
 FFLAS::ParSeqHelper::Parallel< Cut, Param > & PSHelper) [inline]
```

**15.20.3.132 threads\_fgemm()**

```
void threads_fgemm (
 const size_t m,
 const size_t n,
 const size_t r,
 int nbthreads,
 size_t * W1,
 size_t * W2,
 size_t * W3,
 size_t gamma)
```

**15.20.3.133 threads\_ftrsm()**

```
void threads_ftrsm (
 const size_t m,
 const size_t n,
 int nbthreads,
 size_t * t1,
 size_t * t2)
```

**15.20.3.134 PLUQ()** [5/6]

```

size_t PLUQ (
 const Field & Fi,
 const FFLAS::FFLAS_DIAG Diag,
 const size_t M,
 const size_t N,
 typename Field::Element_ptr A,
 const size_t lda,
 size_t * P,
 size_t * Q,
 const FFLAS::ParSeqHelper::Parallel< FFLAS::CuttingStrategy::Recursive, FFLAS::StrategyParameter
> & PSHelper) [inline]

```

**15.20.3.135 fflas\_const\_cast()** [1/3]

```

rns_double_elt_ptr fflas_const_cast (
 rns_double_elt_cstptr x) [inline]

```

**15.20.3.136 fflas\_const\_cast()** [2/3]

```

rns_double_elt_cstptr fflas_const_cast (
 rns_double_elt_ptr x) [inline]

```

**15.20.3.137 cyclic\_shift\_row\_col()** [2/2]

```

void cyclic_shift_row_col (
 Base_t * A,
 size_t m,
 size_t n,
 size_t lda)

```

**15.20.3.138 cyclic\_shift\_row()** [3/3]

```

template INST_OR_DECL void cyclic_shift_row (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 FFLAS_ELT * A,
 size_t m,
 size_t n,
 size_t lda)

```

**15.20.3.139 cyclic\_shift\_col()** [3/3]

```
template INST_OR_DECL void cyclic_shift_col (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 FFLAS_ELT * A,
 size_t m,
 size_t n,
 size_t lda)
```

**15.20.3.140 applyP()** [4/4]

```
template INST_OR_DECL void applyP (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_SIDE Side,
 const FFLAS::FFLAS_TRANSPOSE Trans,
 const size_t M,
 const size_t ibeg,
 const size_t iend,
 FFLAS_ELT * A,
 const size_t lda,
 const size_t * P)
```

**15.20.3.141 fgetrs()** [3/4]

```
template INST_OR_DECL void fgetrs (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 const size_t N,
 const size_t R,
 FFLAS_ELT * A,
 const size_t lda,
 const size_t * P,
 const size_t * Q,
 FFLAS_ELT * B,
 const size_t ldb,
 int * info)
```

**15.20.3.142 fgetrs()** [4/4]

```
template INST_OR_DECL FFLAS_ELT * fgetrs (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 const size_t N,
 const size_t NRHS,
 const size_t R,
```

```

FFLAS_ELT * A,
const size_t lda,
const size_t * P,
const size_t * Q,
FFLAS_ELT * X,
const size_t ldx,
const FFLAS_ELT * B,
const size_t ldb,
int * info)

```

#### 15.20.3.143 fgesv() [3/4]

```

template INST_OR_DECL size_t fgesv (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 FFLAS_ELT * B,
 const size_t ldb,
 int * info)

```

#### 15.20.3.144 fgesv() [4/4]

```

template INST_OR_DECL size_t fgesv (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 const size_t N,
 const size_t NRHS,
 FFLAS_ELT * A,
 const size_t lda,
 FFLAS_ELT * X,
 const size_t ldx,
 const FFLAS_ELT * B,
 const size_t ldb,
 int * info)

```

#### 15.20.3.145 ftrtri() [2/2]

```

template INST_OR_DECL void ftrtri (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const FFLAS::FFLAS_DIAG Diag,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 const size_t threshold)

```

**15.20.3.146 trinv\_left()** [2/2]

```
template INST_OR_DECL void trinv_left (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t N,
 const FFLAS_ELT * L,
 const size_t ldl,
 FFLAS_ELT * X,
 const size_t ldX)
```

**15.20.3.147 ftrtrm()** [2/2]

```
template INST_OR_DECL void ftrtrm (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_SIDE side,
 const FFLAS::FFLAS_DIAG diag,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda)
```

**15.20.3.148 PLUQ()** [6/6]

```
template INST_OR_DECL size_t PLUQ (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_DIAG Diag,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 size_t * P,
 size_t * Q)
```

**15.20.3.149 LUdivine()** [4/4]

```
template INST_OR_DECL size_t LUdivine (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_DIAG Diag,
 const FFLAS::FFLAS_TRANSPOSE trans,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 size_t * P,
 size_t * Qt,
 const FFPACK_LU_TAG LuTag,
 const size_t cutoff)
```

**15.20.3.150 LUdivine\_small() [2/2]**

```
template INST_OR_DECL size_t LUdivine_small (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_DIAG Diag,
 const FFLAS::FFLAS_TRANSPOSE trans,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 size_t * P,
 size_t * Q,
 const FFPACK_LU_TAG LuTag)
```

**15.20.3.151 LUdivine\_gauss() [2/2]**

```
template INST_OR_DECL size_t LUdivine_gauss (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_DIAG Diag,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 size_t * P,
 size_t * Q,
 const FFPACK_LU_TAG LuTag)
```

**15.20.3.152 RowEchelonForm() [3/3]**

```
template INST_OR_DECL size_t RowEchelonForm (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 size_t * P,
 size_t * Qt,
 const bool transform,
 const FFPACK_LU_TAG LuTag)
```



**15.20.3.153 ReducedRowEchelonForm()** [3/3]

```
template INST_OR_DECL size_t ReducedRowEchelonForm (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 size_t * P,
 size_t * Qt,
 const bool transform,
 const FFPACK_LU_TAG LuTag)
```

**15.20.3.154 ColumnEchelonForm()** [3/3]

```
template INST_OR_DECL size_t ColumnEchelonForm (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 size_t * P,
 size_t * Qt,
 const bool transform,
 const FFPACK_LU_TAG LuTag)
```

**15.20.3.155 ReducedColumnEchelonForm()** [3/3]

```
template INST_OR_DECL size_t ReducedColumnEchelonForm (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 size_t * P,
 size_t * Qt,
 const bool transform,
 const FFPACK_LU_TAG LuTag)
```

**15.20.3.156 Invert()** [3/4]

```
template INST_OR_DECL FFLAS_ELT * Invert (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 FFLAS_ELT * A,
 const size_t lda,
 int & nullity)
```

**15.20.3.157 Invert()** [4/4]

```
template INST_OR_DECL FFLAS_ELT * Invert (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 const FFLAS_ELT * A,
 const size_t lda,
 FFLAS_ELT * X,
 const size_t ldx,
 int & nullity)
```

**15.20.3.158 Invert2()** [2/2]

```
template INST_OR_DECL FFLAS_ELT * Invert2 (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 FFLAS_ELT * A,
 const size_t lda,
 FFLAS_ELT * X,
 const size_t ldx,
 int & nullity)
```

**15.20.3.159 CharPoly()** [6/8]

```
template INST_OR_DECL std::list< Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element > &
CharPoly (
 const Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > > & R,
 std::list< Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element > & charp,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 FFLAS_FIELD< FFLAS_ELT >::RandIter & G,
 const FFPACK_CHARPOLY_TAG CharpTag,
 const size_t degree)
```

**15.20.3.160 CharPoly()** [7/8]

```
template INST_OR_DECL Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element & CharPoly (
 const Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > > & R,
 Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element & charp,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 FFLAS_FIELD< FFLAS_ELT >::RandIter & G,
 const FFPACK_CHARPOLY_TAG CharpTag,
 const size_t degree)
```

**15.20.3.161 CharPoly()** [8/8]

```
template INST_OR_DECL Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element & CharPoly (
 const Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > > & R,
 Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element & charp,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 const FFPACK_CHARPOLY_TAG CharpTag,
 const size_t degree)
```

**15.20.3.162 MinPoly()** [3/4]

```
template INST_OR_DECL std::vector< FFLAS_ELT > & MinPoly (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 std::vector< FFLAS_ELT > & minP,
 const size_t N,
 const FFLAS_ELT * A,
 const size_t lda,
 FFLAS_FIELD< FFLAS_ELT >::RandIter & G)
```

**15.20.3.163 MinPoly()** [4/4]

```
template INST_OR_DECL std::vector< FFLAS_ELT > & MinPoly (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 std::vector< FFLAS_ELT > & minP,
 const size_t N,
 const FFLAS_ELT * A,
 const size_t lda)
```

**15.20.3.164 MatVecMinPoly()** [2/2]

```
template INST_OR_DECL std::vector< FFLAS_ELT > & MatVecMinPoly (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 std::vector< FFLAS_ELT > & minP,
 const size_t N,
 const FFLAS_ELT * A,
 const size_t lda,
 const FFLAS_ELT * V,
 const size_t incv)
```

**15.20.3.165 KrylovElim()**

```
template INST_OR_DECL size_t KrylovElim (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 size_t * P,
 size_t * Q,
 const size_t deg,
 size_t * iterates,
 size_t * inviterates,
 const size_t maxit,
 size_t virt)
```

**15.20.3.166 SpecRankProfile()**

```
template INST_OR_DECL size_t SpecRankProfile (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 const size_t deg,
 size_t * rankProfile)
```

**15.20.3.167 Rank() [3/3]**

```
template INST_OR_DECL size_t Rank (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda)
```

**15.20.3.168 IsSingular() [2/2]**

```
template INST_OR_DECL bool IsSingular (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda)
```

**15.20.3.169 Det()** [5/6]

```
template INST_OR_DECL FFLAS_ELT & Det (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 FFLAS_ELT & det,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 size_t * P,
 size_t * Q)
```

**15.20.3.170 Det()** [6/6]

```
template INST_OR_DECL FFLAS_ELT & Det (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 FFLAS_ELT & det,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 const FFLAS::ParSeqHelper::Parallel< FFLAS::CuttingStrategy::Recursive, FFLAS::StrategyParameter
> & parH,
 size_t * P,
 size_t * Q)
```

**15.20.3.171 Solve()** [3/3]

```
template INST_OR_DECL FFLAS_ELT * Solve (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 FFLAS_ELT * A,
 const size_t lda,
 FFLAS_ELT * x,
 const int incx,
 const FFLAS_ELT * b,
 const int incb)
```

**15.20.3.172 solveLB()** [2/2]

```
template INST_OR_DECL void solveLB (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 const size_t N,
 const size_t R,
 FFLAS_ELT * L,
 const size_t ldl,
 const size_t * Q,
 FFLAS_ELT * B,
 const size_t ldb)
```

**15.20.3.173 solveLB2()** [2/2]

```
template INST_OR_DECL void solveLB2 (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 const size_t N,
 const size_t R,
 FFLAS_ELT * L,
 const size_t ldl,
 const size_t * Q,
 FFLAS_ELT * B,
 const size_t ldb)
```

**15.20.3.174 RandomNullSpaceVector()** [3/3]

```
template INST_OR_DECL void RandomNullSpaceVector (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 FFLAS_ELT * X,
 const size_t incX)
```

**15.20.3.175 NullSpaceBasis()** [2/2]

```
template INST_OR_DECL size_t NullSpaceBasis (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_SIDE Side,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 FFLAS_ELT *& NS,
 size_t & ldn,
 size_t & NSdim)
```

**15.20.3.176 RowRankProfile()** [3/3]

```
template INST_OR_DECL size_t RowRankProfile (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 size_t *& rkprofile,
 const FFPACK_LU_TAG LuTag)
```

**15.20.3.177 ColumnRankProfile()** [3/3]

```
template INST_OR_DECL size_t ColumnRankProfile (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 size_t *& rkprofile,
 const FFPACK_LU_TAG LuTag)
```

**15.20.3.178 RowRankProfileSubmatrixIndices()** [2/2]

```
template INST_OR_DECL size_t RowRankProfileSubmatrixIndices (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 size_t *& rowindices,
 size_t *& colindices,
 size_t & R)
```

**15.20.3.179 ColRankProfileSubmatrixIndices()** [2/2]

```
template INST_OR_DECL size_t ColRankProfileSubmatrixIndices (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 size_t *& rowindices,
 size_t *& colindices,
 size_t & R)
```

**15.20.3.180 RowRankProfileSubmatrix()** [2/2]

```
template INST_OR_DECL size_t RowRankProfileSubmatrix (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 FFLAS_ELT *& X,
 size_t & R)
```

**15.20.3.181 ColRankProfileSubmatrix() [2/2]**

```
template INST_OR_DECL size_t ColRankProfileSubmatrix (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t M,
 const size_t N,
 FFLAS_ELT * A,
 const size_t lda,
 FFLAS_ELT *& X,
 size_t & R)
```

**15.20.3.182 getTriangular< FFLAS\_FIELD< FFLAS\_ELT > >() [1/2]**

```
template INST_OR_DECL void getTriangular< FFLAS_FIELD< FFLAS_ELT > > (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const FFLAS::FFLAS_DIAG diag,
 const size_t M,
 const size_t N,
 const size_t R,
 const FFLAS_ELT * A,
 const size_t lda,
 FFLAS_ELT * T,
 const size_t ldt,
 const bool OnlyNonZeroVectors)
```

**15.20.3.183 getTriangular< FFLAS\_FIELD< FFLAS\_ELT > >() [2/2]**

```
template INST_OR_DECL void getTriangular< FFLAS_FIELD< FFLAS_ELT > > (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const FFLAS::FFLAS_DIAG diag,
 const size_t M,
 const size_t N,
 const size_t R,
 FFLAS_ELT * A,
 const size_t lda)
```

**15.20.3.184 getEchelonForm< FFLAS\_FIELD< FFLAS\_ELT > >() [1/2]**

```
template INST_OR_DECL void getEchelonForm< FFLAS_FIELD< FFLAS_ELT > > (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const FFLAS::FFLAS_DIAG diag,
 const size_t M,
 const size_t N,
 const size_t R,
```



```

const size_t * P,
const FFLAS_ELT * A,
const size_t lda,
FFLAS_ELT * T,
const size_t ldt,
const bool OnlyNonZeroVectors,
const FFPACK_LU_TAG LuTag)

```

### 15.20.3.185 getEchelonForm< FFLAS\_FIELD< FFLAS\_ELT > >() [2/2]

```

template INST_OR_DECL void getEchelonForm< FFLAS_FIELD< FFLAS_ELT > > (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const FFLAS::FFLAS_DIAG diag,
 const size_t M,
 const size_t N,
 const size_t R,
 const size_t * P,
 FFLAS_ELT * A,
 const size_t lda,
 const FFPACK_LU_TAG LuTag)

```

### 15.20.3.186 getEchelonTransform< FFLAS\_FIELD< FFLAS\_ELT > >()

```

template INST_OR_DECL void getEchelonTransform< FFLAS_FIELD< FFLAS_ELT > > (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const FFLAS::FFLAS_DIAG diag,
 const size_t M,
 const size_t N,
 const size_t R,
 const size_t * P,
 const size_t * Q,
 const FFLAS_ELT * A,
 const size_t lda,
 FFLAS_ELT * T,
 const size_t ldt,
 const FFPACK_LU_TAG LuTag)

```

### 15.20.3.187 getReducedEchelonForm< FFLAS\_FIELD< FFLAS\_ELT > >() [1/2]

```

template INST_OR_DECL void getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > > (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const size_t M,
 const size_t N,
 const size_t R,

```

```

const size_t * P,
const FFLAS_ELT * A,
const size_t lda,
FFLAS_ELT * T,
const size_t ldt,
const bool OnlyNonZeroVectors,
const FFPACK_LU_TAG LuTag)

```

### 15.20.3.188 getReducedEchelonForm< FFLAS\_FIELD< FFLAS\_ELT > >() [2/2]

```

template INST_OR_DECL void getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > > (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const size_t M,
 const size_t N,
 const size_t R,
 const size_t * P,
 FFLAS_ELT * A,
 const size_t lda,
 const FFPACK_LU_TAG LuTag)

```

### 15.20.3.189 getReducedEchelonTransform< FFLAS\_FIELD< FFLAS\_ELT > >()

```

template INST_OR_DECL void getReducedEchelonTransform< FFLAS_FIELD< FFLAS_ELT > > (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const FFLAS::FFLAS_UPLO Uplo,
 const size_t M,
 const size_t N,
 const size_t R,
 const size_t * P,
 const size_t * Q,
 const FFLAS_ELT * A,
 const size_t lda,
 FFLAS_ELT * T,
 const size_t ldt,
 const FFPACK_LU_TAG LuTag)

```

### 15.20.3.190 LQUPtoInverseOfFullRankMinor() [2/2]

```

template INST_OR_DECL FFLAS_ELT * LQUPtoInverseOfFullRankMinor (
 const FFLAS_FIELD< FFLAS_ELT > & F,
 const size_t rank,
 FFLAS_ELT * A_factors,
 const size_t lda,
 const size_t * QtPointer,
 FFLAS_ELT * X,
 const size_t ldx)

```

**15.20.3.191 fflas\_const\_cast()** [3/3]

```
T fflas_const_cast (
 CT x)
```

**15.20.3.192 failure()**

```
Failure & failure () [inline]
```

**15.20.3.193 isOdd()** [1/3]

```
bool isOdd (
 const T & a) [inline]
```

**15.20.3.194 isOdd()** [2/3]

```
bool isOdd (
 const float & a) [inline]
```

**15.20.3.195 isOdd()** [3/3]

```
bool isOdd (
 const double & a) [inline]
```

**15.20.3.196 NonZeroRandomMatrix()** [1/2]

```
Field::Element_ptr NonZeroRandomMatrix (
 const Field & F,
 size_t m,
 size_t n,
 typename Field::Element_ptr A,
 size_t lda,
 RandIter & G) [inline]
```

Random non-zero Matrix.

Creates a  $m \times n$  matrix with random entries, and at least one of them is non zero.

## Parameters

|     |       |                                                                     |
|-----|-------|---------------------------------------------------------------------|
|     | $F$   | field                                                               |
|     | $m$   | number of rows in $A$                                               |
|     | $n$   | number of cols in $A$                                               |
| out | $A$   | the matrix (preallocated to at least $m \times lda$ field elements) |
|     | $lda$ | leading dimension of $A$                                            |
|     | $G$   | a random iterator                                                   |

## Returns

$A$ .

## 15.20.3.197 NonZeroRandomMatrix() [2/2]

```
Field::Element_ptr NonZeroRandomMatrix (
 const Field & F,
 size_t m,
 size_t n,
 typename Field::Element_ptr A,
 size_t lda) [inline]
```

Random non-zero Matrix.

Creates a  $m \times n$  matrix with random entries, and at least one of them is non zero.

## Parameters

|     |       |                                                                     |
|-----|-------|---------------------------------------------------------------------|
|     | $F$   | field                                                               |
|     | $m$   | number of rows in $A$                                               |
|     | $n$   | number of cols in $A$                                               |
| out | $A$   | the matrix (preallocated to at least $m \times lda$ field elements) |
|     | $lda$ | leading dimension of $A$                                            |

## Returns

$A$ .

## 15.20.3.198 RandomMatrix() [1/2]

```
Field::Element_ptr RandomMatrix (
 const Field & F,
 size_t m,
 size_t n,
 typename Field::Element_ptr A,
```

```
size_t lda,
RandIter & G) [inline]
```

Random Matrix.

Creates a  $m \times n$  matrix with random entries.

#### Parameters

|     |       |                                                                     |
|-----|-------|---------------------------------------------------------------------|
|     | $F$   | field                                                               |
|     | $m$   | number of rows in $A$                                               |
|     | $n$   | number of cols in $A$                                               |
| out | $A$   | the matrix (preallocated to at least $m \times lda$ field elements) |
|     | $lda$ | leading dimension of $A$                                            |
|     | $G$   | a random iterator                                                   |

#### Returns

$A$ .

#### 15.20.3.199 RandomMatrix() [2/2]

```
Field::Element_ptr RandomMatrix (
 const Field & F,
 size_t m,
 size_t n,
 typename Field::Element_ptr A,
 size_t lda) [inline]
```

Random Matrix.

Creates a  $m \times n$  matrix with random entries.

#### Parameters

|     |       |                                                                     |
|-----|-------|---------------------------------------------------------------------|
|     | $F$   | field                                                               |
|     | $m$   | number of rows in $A$                                               |
|     | $n$   | number of cols in $A$                                               |
| out | $A$   | the matrix (preallocated to at least $m \times lda$ field elements) |
|     | $lda$ | leading dimension of $A$                                            |

#### Returns

$A$ .

**15.20.3.200 RandomTriangularMatrix()** [1/2]

```
Field::Element_ptr RandomTriangularMatrix (
 const Field & F,
 size_t m,
 size_t n,
 const FFLAS::FFLAS_UPLO UpLo,
 const FFLAS::FFLAS_DIAG Diag,
 bool nonsingular,
 typename Field::Element_ptr A,
 size_t lda,
 RandIter & G) [inline]
```

Random Triangular Matrix.

Creates a  $m \times n$  triangular matrix with random entries. The `UpLo` parameter defines whether it is upper or lower triangular.

**Parameters**

|     |             |                                                                     |
|-----|-------------|---------------------------------------------------------------------|
|     | <i>F</i>    | field                                                               |
|     | <i>m</i>    | number of rows in A                                                 |
|     | <i>n</i>    | number of cols in A                                                 |
|     | <i>UpLo</i> | whether A is upper or lower triangular                              |
| out | <i>A</i>    | the matrix (preallocated to at least $m \times lda$ field elements) |
|     | <i>lda</i>  | leading dimension of A                                              |
|     | <i>G</i>    | a random iterator                                                   |

**Returns**

A.

**15.20.3.201 RandomTriangularMatrix()** [2/2]

```
Field::Element_ptr RandomTriangularMatrix (
 const Field & F,
 size_t m,
 size_t n,
 const FFLAS::FFLAS_UPLO UpLo,
 const FFLAS::FFLAS_DIAG Diag,
 bool nonsingular,
 typename Field::Element_ptr A,
 size_t lda) [inline]
```

Random Triangular Matrix.

Creates a  $m \times n$  triangular matrix with random entries. The `UpLo` parameter defines whether it is upper or lower triangular.

## Parameters

|     |        |                                                                     |
|-----|--------|---------------------------------------------------------------------|
|     | $F$    | field                                                               |
|     | $m$    | number of rows in $A$                                               |
|     | $n$    | number of cols in $A$                                               |
|     | $UpLo$ | whether $A$ is upper or lower triangular                            |
| out | $A$    | the matrix (preallocated to at least $m \times lda$ field elements) |
|     | $lda$  | leading dimension of $A$                                            |

## Returns

$A$ .

## 15.20.3.202 RandInt()

```
size_t RandInt (
 size_t a,
 size_t b) [inline]
```

## 15.20.3.203 RandomSymmetricMatrix()

```
Field::Element_ptr RandomSymmetricMatrix (
 const Field & F,
 size_t n,
 bool nonsingular,
 typename Field::Element_ptr A,
 size_t lda,
 RandIter & G) [inline]
```

Random Symmetric Matrix.

Creates a  $m \times n$  triangular matrix with random entries. The  $UpLo$  parameter defines whether it is upper or lower triangular.

## Parameters

|     |       |                                                                     |
|-----|-------|---------------------------------------------------------------------|
|     | $F$   | field                                                               |
|     | $n$   | order of $A$                                                        |
| out | $A$   | the matrix (preallocated to at least $n \times lda$ field elements) |
|     | $lda$ | leading dimension of $A$                                            |
|     | $G$   | a random iterator                                                   |

## Returns

$A$ .

**15.20.3.204 RandomMatrixWithRank()** [1/2]

```
Field::Element_ptr RandomMatrixWithRank (
 const Field & F,
 size_t m,
 size_t n,
 size_t r,
 typename Field::Element_ptr A,
 size_t lda,
 RandIter & G) [inline]
```

Random Matrix with prescribed rank.

Creates an  $m \times n$  matrix with random entries and rank  $r$ .

**Parameters**

|       |                                                                     |
|-------|---------------------------------------------------------------------|
| $F$   | field                                                               |
| $m$   | number of rows in $A$                                               |
| $n$   | number of cols in $A$                                               |
| $r$   | rank of the matrix to build                                         |
| $A$   | the matrix (preallocated to at least $m \times lda$ field elements) |
| $lda$ | leading dimension of $A$                                            |
| $G$   | a random iterator                                                   |

**Returns**

$A$ .

**15.20.3.205 RandomMatrixWithRank()** [2/2]

```
Field::Element_ptr RandomMatrixWithRank (
 const Field & F,
 size_t m,
 size_t n,
 size_t r,
 typename Field::Element_ptr A,
 size_t lda) [inline]
```

Random Matrix with prescribed rank.

Creates an  $m \times n$  matrix with random entries and rank  $r$ .

**Parameters**

|     |       |                                                                     |
|-----|-------|---------------------------------------------------------------------|
|     | $F$   | field                                                               |
|     | $m$   | number of rows in $A$                                               |
|     | $n$   | number of cols in $A$                                               |
|     | $r$   | rank of the matrix to build                                         |
| out | $A$   | the matrix (preallocated to at least $m \times lda$ field elements) |
|     | $lda$ | leading dimension of $A$                                            |



## Returns

A.

**15.20.3.206 RandomIndexSubset()**

```
size_t * RandomIndexSubset (
 size_t N,
 size_t R,
 size_t * P) [inline]
```

Pick uniformly at random a sequence of  $R$  distinct elements from the set  $\{0, \dots, N - 1\}$  using Knuth's shuffle.

## Parameters

|     |     |                                                             |
|-----|-----|-------------------------------------------------------------|
|     | $N$ | the cardinality of the sampling set                         |
|     | $R$ | the number of elements to sample                            |
| out | $P$ | the output sequence (pre-allocated to at least $R$ indices) |

**15.20.3.207 RandomPermutation()**

```
size_t * RandomPermutation (
 size_t N,
 size_t * P) [inline]
```

Pick uniformly at random a permutation of size  $N$  stored in LAPACK format using Knuth's shuffle.

## Parameters

|     |     |                                                                |
|-----|-----|----------------------------------------------------------------|
|     | $N$ | the length of the permutation                                  |
| out | $P$ | the output permutation (pre-allocated to at least $N$ indices) |

**15.20.3.208 RandomRankProfileMatrix()**

```
void RandomRankProfileMatrix (
 size_t M,
 size_t N,
 size_t R,
 size_t * rows,
 size_t * cols) [inline]
```

Pick uniformly at random an  $R$ -subpermutation of dimension  $M \times N$  : a matrix with only  $R$  non-zeros equal to one, in a random rook placement.

## Parameters

|     |             |                                                              |
|-----|-------------|--------------------------------------------------------------|
|     | $M$         | row dimension                                                |
|     | $N$         | column dimension                                             |
| out | <i>rows</i> | the row position of each non zero element (pre-allocated)    |
| out | <i>cols</i> | the column position of each non zero element (pre-allocated) |

**15.20.3.209 swapval()**

```
void swapval (
 size_t k,
 size_t N,
 size_t * P,
 size_t val) [inline]
```

**15.20.3.210 RandomSymmetricRankProfileMatrix()**

```
void RandomSymmetricRankProfileMatrix (
 size_t N,
 size_t R,
 size_t * rows,
 size_t * cols) [inline]
```

Pick uniformly at random a symmetric R-subpermutation of dimension  $N \times N$  : a symmetric matrix with only R non-zeros, all equal to one, in a random rook placement.

## Parameters

|     |             |                                                              |
|-----|-------------|--------------------------------------------------------------|
|     | $N$         | matrix order                                                 |
| out | <i>rows</i> | the row position of each non zero element (pre-allocated)    |
| out | <i>cols</i> | the column position of each non zero element (pre-allocated) |

**15.20.3.211 RandomMatrixWithRankandRPM()** [1/2]

```
Field::Element_ptr RandomMatrixWithRankandRPM (
 const Field & F,
 size_t M,
 size_t N,
 size_t R,
 typename Field::Element_ptr A,
 size_t lda,
 const size_t * RRP,
```

```
const size_t * CRP,
RandIter & G) [inline]
```

Random Matrix with prescribed rank and rank profile matrix Creates an  $m \times n$  matrix with random entries and rank  $r$ .

#### Parameters

|            |                                                                                  |
|------------|----------------------------------------------------------------------------------|
| <i>F</i>   | field                                                                            |
| <i>m</i>   | number of rows in A                                                              |
| <i>n</i>   | number of cols in A                                                              |
| <i>r</i>   | rank of the matrix to build                                                      |
| <i>A</i>   | the matrix (preallocated to at least $m \times lda$ field elements)              |
| <i>lda</i> | leading dimension of A                                                           |
| <i>RRP</i> | the R dimensional array with row positions of the rank profile matrix' pivots    |
| <i>CRP</i> | the R dimensional array with column positions of the rank profile matrix' pivots |
| <i>G</i>   | a random iterator                                                                |

#### Returns

A.

#### 15.20.3.212 RandomMatrixWithRankandRPM() [2/2]

```
Field::Element_ptr RandomMatrixWithRankandRPM (
 const Field & F,
 size_t M,
 size_t N,
 size_t R,
 typename Field::Element_ptr A,
 size_t lda,
 const size_t * RRP,
 const size_t * CRP) [inline]
```

Random Matrix with prescribed rank and rank profile matrix Creates an  $m \times n$  matrix with random entries and rank  $r$ .

#### Parameters

|            |                                                                                  |
|------------|----------------------------------------------------------------------------------|
| <i>F</i>   | field                                                                            |
| <i>m</i>   | number of rows in A                                                              |
| <i>n</i>   | number of cols in A                                                              |
| <i>r</i>   | rank of the matrix to build                                                      |
| <i>A</i>   | the matrix (preallocated to at least $m \times lda$ field elements)              |
| <i>lda</i> | leading dimension of A                                                           |
| <i>RRP</i> | the R dimensional array with row positions of the rank profile matrix' pivots    |
| <i>CRP</i> | the R dimensional array with column positions of the rank profile matrix' pivots |

## Returns

A.

### 15.20.3.213 RandomSymmetricMatrixWithRankandRPM() [1/2]

```
Field::Element_ptr RandomSymmetricMatrixWithRankandRPM (
 const Field & F,
 size_t N,
 size_t R,
 typename Field::Element_ptr A,
 size_t lda,
 const size_t * RRP,
 const size_t * CRP,
 RandIter & G) [inline]
```

Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an  $n \times n$  symmetric matrix with random entries and rank  $r$ .

## Parameters

|       |                                                                                  |
|-------|----------------------------------------------------------------------------------|
| $F$   | field                                                                            |
| $n$   | order of A                                                                       |
| $r$   | rank of A                                                                        |
| $A$   | the matrix (preallocated to at least $n \times lda$ field elements)              |
| $lda$ | leading dimension of A                                                           |
| $RRP$ | the R dimensional array with row positions of the rank profile matrix' pivots    |
| $CRP$ | the R dimensional array with column positions of the rank profile matrix' pivots |
| $G$   | a random iterator                                                                |

## Returns

A.

### 15.20.3.214 RandomSymmetricMatrixWithRankandRPM() [2/2]

```
Field::Element_ptr RandomSymmetricMatrixWithRankandRPM (
 const Field & F,
 size_t M,
 size_t N,
 size_t R,
 typename Field::Element_ptr A,
 size_t lda,
 const size_t * RRP,
 const size_t * CRP) [inline]
```

Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an  $n \times n$  symmetric matrix with random entries and rank  $r$ .

## Parameters

|            |                                                                                  |
|------------|----------------------------------------------------------------------------------|
| <i>F</i>   | field                                                                            |
| <i>n</i>   | order of A                                                                       |
| <i>r</i>   | rank of A                                                                        |
| <i>A</i>   | the matrix (preallocated to at least $n \times lda$ field elements)              |
| <i>lda</i> | leading dimension of A                                                           |
| <i>RRP</i> | the R dimensional array with row positions of the rank profile matrix' pivots    |
| <i>CRP</i> | the R dimensional array with column positions of the rank profile matrix' pivots |

## Returns

A.

**15.20.3.215 RandomMatrixWithRankandRandomRPM()** [1/2]

```
Field::Element_ptr RandomMatrixWithRankandRandomRPM (
 const Field & F,
 size_t M,
 size_t N,
 size_t R,
 typename Field::Element_ptr A,
 size_t lda,
 RandIter & G) [inline]
```

Random Matrix with prescribed rank, with random rank profile matrix Creates an  $m \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.

## Parameters

|            |                                                                     |
|------------|---------------------------------------------------------------------|
| <i>F</i>   | field                                                               |
| <i>m</i>   | number of rows in A                                                 |
| <i>n</i>   | number of cols in A                                                 |
| <i>r</i>   | rank of the matrix to build                                         |
| <i>A</i>   | the matrix (preallocated to at least $m \times lda$ field elements) |
| <i>lda</i> | leading dimension of A                                              |
| <i>G</i>   | a random iterator                                                   |

## Returns

A.

**15.20.3.216 RandomMatrixWithRankandRandomRPM()** [2/2]

```
Field::Element_ptr RandomMatrixWithRankandRandomRPM (
 const Field & F,
```

```

 size_t M,
 size_t N,
 size_t R,
 typename Field::Element_ptr A,
 size_t lda) [inline]

```

Random Matrix with prescribed rank, with random rank profile matrix Creates an  $m \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.

#### Parameters

|       |                                                                     |
|-------|---------------------------------------------------------------------|
| $F$   | field                                                               |
| $m$   | number of rows in $A$                                               |
| $n$   | number of cols in $A$                                               |
| $r$   | rank of the matrix to build                                         |
| $A$   | the matrix (preallocated to at least $m \times lda$ field elements) |
| $lda$ | leading dimension of $A$                                            |

#### Returns

$A$ .

### 15.20.3.217 RandomSymmetricMatrixWithRankandRandomRPM() [1/2]

```

Field::Element_ptr RandomSymmetricMatrixWithRankandRandomRPM (
 const Field & F,
 size_t N,
 size_t R,
 typename Field::Element_ptr A,
 size_t lda,
 RandIter & G) [inline]

```

Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an  $n \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.

#### Parameters

|       |                                                                     |
|-------|---------------------------------------------------------------------|
| $F$   | field                                                               |
| $n$   | order of $A$                                                        |
| $r$   | rank of $A$                                                         |
| $A$   | the matrix (preallocated to at least $n \times lda$ field elements) |
| $lda$ | leading dimension of $A$                                            |
| $G$   | a random iterator                                                   |

#### Returns

$A$ .

**15.20.3.218 RandomSymmetricMatrixWithRankandRandomRPM()** [2/2]

```
Field::Element_ptr RandomSymmetricMatrixWithRankandRandomRPM (
 const Field & F,
 size_t N,
 size_t R,
 typename Field::Element_ptr A,
 size_t lda) [inline]
```

Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an  $n \times n$  matrix with random entries, rank  $r$  and with a rank profile matrix chosen uniformly at random.

**Parameters**

|       |                                                                     |
|-------|---------------------------------------------------------------------|
| $F$   | field                                                               |
| $n$   | order of $A$                                                        |
| $r$   | rank of $A$                                                         |
| $A$   | the matrix (preallocated to at least $n \times lda$ field elements) |
| $lda$ | leading dimension of $A$                                            |

**Returns**

$A$ .

**15.20.3.219 RandomMatrixWithDet()** [1/2]

```
Field::Element_ptr RandomMatrixWithDet (
 const Field & F,
 size_t n,
 const typename Field::Element d,
 typename Field::Element_ptr A,
 size_t lda) [inline]
```

Random Matrix with prescribed det.

Creates a  $m \times n$  matrix with random entries and rank  $r$ .

**Parameters**

|       |                                                                                     |
|-------|-------------------------------------------------------------------------------------|
| $F$   | field                                                                               |
| $d$   | the prescribed value for the determinant of $A$                                     |
| $n$   | number of cols in $A$                                                               |
| $A$   | the matrix to be generated (preallocated to at least $n \times lda$ field elements) |
| $lda$ | leading dimension of $A$                                                            |

**Returns**

$A$ .

**15.20.3.220 RandomMatrixWithDet()** [2/2]

```
Field::Element_ptr RandomMatrixWithDet (
 const Field & F,
 size_t n,
 const typename Field::Element d,
 typename Field::Element_ptr A,
 size_t lda,
 RandIter & G) [inline]
```

Random Matrix with prescribed det.

Creates a  $m \times n$  matrix with random entries and rank  $r$ .

**Parameters**

|       |                                                                                     |
|-------|-------------------------------------------------------------------------------------|
| $F$   | field                                                                               |
| $d$   | the prescribed value for the determinant of A                                       |
| $n$   | number of cols in A                                                                 |
| $A$   | the matrix to be generated (preallocated to at least $n \times lda$ field elements) |
| $lda$ | leading dimension of A                                                              |

**Returns**

A.

**15.20.3.221 maxFieldElt()**

```
Givaro::Integer maxFieldElt ()
```

**15.20.3.222 maxFieldElt< Givaro::ZRing< Givaro::Integer > >()**

```
Givaro::Integer maxFieldElt< Givaro::ZRing< Givaro::Integer > > ()
```

**15.20.3.223 chooseField()**

```
Field * chooseField (
 Givaro::Integer q,
 uint64_t b,
 uint64_t seed)
```



**15.20.3.224 chooseField< Givaro::ZRing< int32\_t > >()**

```
Givaro::ZRing< int32_t > * chooseField< Givaro::ZRing< int32_t > > (
 Givaro::Integer q,
 uint64_t b,
 uint64_t seed)
```

**15.20.3.225 chooseField< Givaro::ZRing< int64\_t > >()**

```
Givaro::ZRing< int64_t > * chooseField< Givaro::ZRing< int64_t > > (
 Givaro::Integer q,
 uint64_t b,
 uint64_t seed)
```

**15.20.3.226 chooseField< Givaro::ZRing< float > >()**

```
Givaro::ZRing< float > * chooseField< Givaro::ZRing< float > > (
 Givaro::Integer q,
 uint64_t b,
 uint64_t seed)
```

**15.20.3.227 chooseField< Givaro::ZRing< double > >()**

```
Givaro::ZRing< double > * chooseField< Givaro::ZRing< double > > (
 Givaro::Integer q,
 uint64_t b,
 uint64_t seed)
```

**15.21 FFPACK::Protected Namespace Reference****Functions**

- template<class [Field](#) >  
size\_t [LUdivine\\_construct](#) (const [Field](#) &F, const [FFLAS::FFLAS\\_DIAG](#) Diag, const size\_t M, const size\_t N, typename [Field::ConstElement\\_ptr](#) A, const size\_t lda, typename [Field::Element\\_ptr](#) X, const size\_t ldx, typename [Field::Element\\_ptr](#) u, const size\_t incu, size\_t \*P, bool computeX, const FFPACK\_MINPOLY\_TAG MinTag=[FfpackDense](#), const size\_t kg\_mc=0, const size\_t kg\_mb=0, const size\_t kg\_j=0)
- template<class [Field](#) >  
size\_t [GaussJordan](#) (const [Field](#) &F, const size\_t M, const size\_t N, typename [Field::Element\\_ptr](#) A, const size\_t lda, const size\_t colbeg, const size\_t rowbeg, const size\_t colsize, size\_t \*P, size\_t \*Q, const FFPACK::FFPACK\_LU\_TAG LuTag)

*Gauss-Jordan algorithm computing the Reduced Row echelon form and its transform matrix.*

- `template<class Field , class Polynomial >`  
`std::list< Polynomial > & KellerGehrig (const Field &F, std::list< Polynomial > &charp, const size_t N, type-`  
`name Field::ConstElement_ptr A, const size_t lda)`
- `template<class Field , class Polynomial >`  
`int KGFast (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A,`  
`const size_t lda, size_t *kg_mc, size_t *kg_mb, size_t *kg_j)`
- `template<class Field , class Polynomial >`  
`std::list< Polynomial > & KGFast_generalized (const Field &F, std::list< Polynomial > &charp, const size_t`  
`N, typename Field::Element_ptr A, const size_t lda)`
- `template<class Field >`  
`void fgemv_kgf (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, type-`  
`name Field::ConstElement_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY, const`  
`size_t kg_mc, const size_t kg_mb, const size_t kg_j)`
- `template<class Field , class Polynomial , class RandIter >`  
`std::list< Polynomial > & LUKrylov (const Field &F, std::list< Polynomial > &charp, const size_t N, typename`  
`Field::Element_ptr A, const size_t lda, typename Field::Element_ptr U, const size_t ldu, RandIter &G)`
- `template<class Field , class Polynomial >`  
`std::list< Polynomial > & Danilevski (const Field &F, std::list< Polynomial > &charp, const size_t N, type-`  
`name Field::Element_ptr A, const size_t lda)`
- `template<class PolRing >`  
`void RandomKrylovPrecond (const PolRing &PR, std::list< typename PolRing::Element > &completed,`  
`Factors, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda, size_t &Nb, typename`  
`PolRing::Domain_t::Element_ptr &B, size_t &ldb, typename PolRing::Domain_t::RandIter &g, const size_t`  
`degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`
- `template<class PolRing >`  
`std::list< typename PolRing::Element > & ArithProg (const PolRing &PR, std::list< typename PolRing::`  
`Element > &frobeniusForm, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t lda,`  
`const size_t degree)`
- `template<class Field , class Polynomial >`  
`std::list< Polynomial > & LUKrylov_KGFast (const Field &F, std::list< Polynomial > &charp, const size_t N,`  
`typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx)`
- `template<class Field , class Polynomial >`  
`Polynomial & MatVecMinPoly (const Field &F, Polynomial &minP, const size_t N, typename Field::ConstElement_ptr`  
`A, const size_t lda, typename Field::Element_ptr v, const size_t incv, typename Field::Element_ptr K, const`  
`size_t ldk, size_t *P)`
- `template<class Field , class Polynomial >`  
`Polynomial & Hybrid_KGF_LUK_MinPoly (const Field &F, Polynomial &minP, const size_t N, typename`  
`Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx, size_t *P,`  
`const FFPACK_MINPOLY_TAG MinTag=FFPACK::FfpackDense, const size_t kg_mc=0, const size_t kg_`  
`mb=0, const size_t kg_j=0)`
- `template<class Field >`  
`size_t updatedD (const Field &F, size_t *d, size_t k, std::vector< std::vector< typename Field::Element > >`  
`&minpt)`
- `template<class Field >`  
`size_t newD (const Field &F, size_t *d, bool &KeepOn, const size_t l, const size_t N, typename`  
`Field::Element_ptr X, const size_t *Q, std::vector< std::vector< typename Field::Element > > &minpt)`
- `template<class Field >`  
`void CompressRows (Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename`  
`Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)`
- `template<class Field >`  
`void CompressRowsQK (Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename`  
`Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t deg, const size_t nb_blocs)`
- `template<class Field >`  
`void DeCompressRows (Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t`  
`lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)`
- `template<class Field >`  
`void DeCompressRowsQK (Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const`

- ```
size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t deg, const
size_t nb_blocs)
```
- `template<class Field >`
`void CompressRowsQA (Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename`
`Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)`
 - `template<class Field >`
`void DeCompressRowsQA (Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const`
`size_t lda, typename Field::Element_ptr tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)`
 - `template<class Field >`
`size_t LUdivine_construct (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t`
`N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t`
`ldx, typename Field::Element_ptr u, const size_t incu, size_t *P, bool computeX, const FFPACK::FFPACK_`
`_MINPOLY_TAG MinTag, const size_t kg_mc, const size_t kg_mb, const size_t kg_j)`

15.21.1 Function Documentation

15.21.1.1 LUdivine_construct() [1/2]

```
size_t LUdivine_construct (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t ldx,
    typename Field::Element_ptr u,
    const size_t incu,
    size_t * P,
    bool computeX,
    const FFPACK_MINPOLY_TAG MinTag = FfpackDense,
    const size_t kg_mc = 0,
    const size_t kg_mb = 0,
    const size_t kg_j = 0 )
```

15.21.1.2 GaussJordan()

```
size_t GaussJordan (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    const size_t colbeg,
    const size_t rowbeg,
    const size_t colsize,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag ) [inline]
```

Gauss-Jordan algorithm computing the Reduced Row echelon form and its transform matrix.

Bibliography

- Algorithm 2.8 of A. Storjohann Thesis 2000,
- Algorithm 11 of Jeannerod C-P., Pernet, C. and Storjohann, A. *Rank-profile revealing Gaussian elimination and the CUP matrix decomposition*, J. of Symbolic Comp., 2013

Parameters

	M	row dimension of A
	N	column dimension of A
in, out	A	an m x n matrix
	lda	leading dimension of A
	P	row permutation
	Q	column permutation
	$LuTag$	set the base case to a Tile (FfpackGaussJordanTile) or Slab (FfpackGaussJordanSlab) recursive RedEchelon

where the transformation matrix is stored at the pivot column position

15.21.1.3 KellerGehrig()

```
std::list< Polynomial > & KellerGehrig (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda )
```

15.21.1.4 KGFast()

```
int KGFast (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * kg_mc,
    size_t * kg_mb,
    size_t * kg_j )
```

15.21.1.5 KGFast_generalized()

```
std::list< Polynomial > & KGFast_generalized (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda )
```

15.21.1.6 fgemv_kgf()

```
void fgemv_kgf (
    const Field & F,
    const size_t N,
    typename Field::ConstElement_ptr A,
```

```

const size_t lda,
typename Field::ConstElement_ptr X,
const size_t incX,
typename Field::Element_ptr Y,
const size_t incY,
const size_t kg_mc,
const size_t kg_mb,
const size_t kg_j )

```

15.21.1.7 LUKrylov()

```

std::list< Polynomial > & LUKrylov (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr U,
    const size_t ldu,
    RandIter & G )

```

15.21.1.8 Danilevski()

```

std::list< Polynomial > & Danilevski (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda )

```

15.21.1.9 RandomKrylovPrecond()

```

void RandomKrylovPrecond (
    const PolRing & PR,
    std::list< typename PolRing::Element > & completedFactors,
    const size_t N,
    typename PolRing::Domain_t::Element_ptr A,
    const size_t lda,
    size_t & Nb,
    typename PolRing::Domain_t::Element_ptr & B,
    size_t & ldb,
    typename PolRing::Domain_t::RandIter & g,
    const size_t degree = __FFPACK_ARITHPROG_THRESHOLD ) [inline]

```

Todo swap to save space ??

Todo

Todo don't assing K2 c*noc x N but only mas (c,noc) x N and store each one after the other

Todo swap to save space ??

Todo

Todo don't assing K2 c*noc x N but only mas (c,noc) x N and store each one after the other

15.21.1.10 ArithProg()

```
std::list< typename PolRing::Element > & ArithProg (
    const PolRing & PR,
    std::list< typename PolRing::Element > & frobeniusForm,
    const size_t N,
    typename PolRing::Domain_t::Element_ptr A,
    const size_t lda,
    const size_t degree ) [inline]
```

15.21.1.11 LUKrylov_KGFast()

```
std::list< Polynomial > & LUKrylov_KGFast (
    const Field & F,
    std::list< Polynomial > & charp,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t ldx )
```

15.21.1.12 MatVecMinPoly()

```
Polynomial & MatVecMinPoly (
    const Field & F,
    Polynomial & minP,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr v,
    const size_t incv,
    typename Field::Element_ptr K,
    const size_t ldk,
    size_t * P ) [inline]
```

15.21.1.13 Hybrid_KGF_LUK_MinPoly()

```
Polynomial & Hybrid_KGF_LUK_MinPoly (
    const Field & F,
    Polynomial & minP,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t ldx,
    size_t * P,
    const FFPACK_MINPOLY_TAG MinTag = FFPACK::FfpackDense,
    const size_t kg_mc = 0,
    const size_t kg_mb = 0,
    const size_t kg_j = 0 )
```

15.21.1.14 updateD()

```
size_t updateD (
    const Field & F,
```

```

size_t * d,
size_t k,
std::vector< std::vector< typename Field::Element > > & minpt )

```

15.21.1.15 newD()

```

size_t newD (
    const Field & F,
    size_t * d,
    bool & KeepOn,
    const size_t l,
    const size_t N,
    typename Field::Element_ptr X,
    const size_t * Q,
    std::vector< std::vector< typename Field::Element > > & minpt )

```

15.21.1.16 CompressRows()

```

void CompressRows (
    Field & F,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t ldtmp,
    const size_t * d,
    const size_t nb_blocs ) [inline]

```

15.21.1.17 CompressRowsQK()

```

void CompressRowsQK (
    Field & F,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t ldtmp,
    const size_t * d,
    const size_t deg,
    const size_t nb_blocs ) [inline]

```

15.21.1.18 DeCompressRows()

```

void DeCompressRows (
    Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t ldtmp,
    const size_t * d,
    const size_t nb_blocs ) [inline]

```

15.21.1.19 DeCompressRowsQK()

```

void DeCompressRowsQK (
    Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t ldtmp,
    const size_t * d,
    const size_t deg,
    const size_t nb_blocs ) [inline]

```

15.21.1.20 CompressRowsQA()

```

void CompressRowsQA (
    Field & F,
    const size_t M,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t ldtmp,
    const size_t * d,
    const size_t nb_blocs ) [inline]

```

15.21.1.21 DeCompressRowsQA()

```

void DeCompressRowsQA (
    Field & F,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    typename Field::Element_ptr tmp,
    const size_t ldtmp,
    const size_t * d,
    const size_t nb_blocs ) [inline]

```

15.21.1.22 LUdivine_construct() [2/2]

```

size_t LUdivine_construct (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::Element_ptr X,
    const size_t ldx,
    typename Field::Element_ptr u,
    const size_t incu,
    size_t * P,
    bool computeX,
    const FFPACK::FFPACK_MINPOLY_TAG MinTag,
    const size_t kg_mc,

```



```
const size_t kg_mb,  
const size_t kg_j )
```

15.22 Givaro Namespace Reference

Data Structures

- class [ModularBalanced](#)
- class [Montgomery](#)

15.23 MKL_CONFIG Namespace Reference

15.24 Reclnt Namespace Reference

Data Structures

- class [rint](#)
- class [ruint](#)

Chapter 16

Data Structure Documentation

16.1 AlgoChooser< ModeT, ParSeq > Struct Template Reference

Public Types

- typedef [MMHelperAlgo::Winograd value](#)

16.1.1 Member Typedef Documentation

16.1.1.1 value

typedef [MMHelperAlgo::Winograd value](#)

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.2 AlgoChooser< ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > Struct Template Reference

Public Types

- typedef [MMHelperAlgo::Classic value](#)

16.2.1 Member Typedef Documentation

16.2.1.1 value

typedef [MMHelperAlgo::Classic value](#)

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.3 ArbitraryPrecIntTag Struct Reference

Arbitrary precision integers: GMP.

```
#include <field-traits.h>
```

16.3.1 Detailed Description

Arbitrary precision integers: GMP.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.4 AreEqual< X, Y > Class Template Reference

```
#include <fflas_enum.h>
```

Static Public Attributes

- static const bool [value](#) = false

16.4.1 Field Documentation

16.4.1.1 value

```
const bool value = false [static]
```

The documentation for this class was generated from the following file:

- [fflas_enum.h](#)

16.5 AreEqual< X, X > Class Template Reference

```
#include <fflas_enum.h>
```

Static Public Attributes

- static const bool [value](#) = true

16.5.1 Field Documentation

16.5.1.1 value

```
const bool value = true [static]
```

The documentation for this class was generated from the following file:

- [fflas_enum.h](#)

16.6 Argument Struct Reference

```
#include <args-parser.h>
```

Data Fields

- char [c](#)
- const char * [example](#)
- const char * [helpString](#)
- [ArgumentType](#) type
- void * [data](#)

16.6.1 Field Documentation

16.6.1.1 c

char c

16.6.1.2 example

const char* example

16.6.1.3 helpString

const char* helpString

16.6.1.4 type

[ArgumentType](#) type

16.6.1.5 data

void* data

The documentation for this struct was generated from the following file:

- [args-parser.h](#)

16.7 associatedDelayedField< Field > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [Field](#) field
- typedef [Field](#) & [type](#)

16.7.1 Member Typedef Documentation

16.7.1.1 field

typedef [Field](#) field

16.7.1.2 type

typedef [Field](#)& [type](#)

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.8 associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FFPACK::RNSInteger< RNS >](#) [field](#)
- typedef [FFPACK::RNSInteger< RNS >](#) [type](#)

16.8.1 Member Typedef Documentation

16.8.1.1 field

```
typedef FFPACK::RNSInteger<RNS> field
```

16.8.1.2 type

```
typedef FFPACK::RNSInteger<RNS> type
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.9 associatedDelayedField< const Givaro::Modular< T, X > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef Givaro::ZRing< T > [field](#)
- typedef Givaro::ZRing< T > [type](#)

16.9.1 Member Typedef Documentation

16.9.1.1 field

```
typedef Givaro::ZRing<T> field
```

16.9.1.2 type

```
typedef Givaro::ZRing<T> type
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.10 associatedDelayedField< const Givaro::ModularBalanced< T > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef Givaro::ZRing< T > [field](#)
- typedef Givaro::ZRing< T > [type](#)

16.10.1 Member Typedef Documentation

16.10.1.1 field

```
typedef Givaro::ZRing<T> field
```

16.10.1.2 type

```
typedef Givaro::ZRing<T> type
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.11 associatedDelayedField< const Givaro::ZRing< T > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef Givaro::ZRing< T > [field](#)
- typedef Givaro::ZRing< T > [type](#)

16.11.1 Member Typedef Documentation

16.11.1.1 field

```
typedef Givaro::ZRing<T> field
```

16.11.1.2 type

```
typedef Givaro::ZRing<T> type
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.12 Auto Struct Reference

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.13 Bini Struct Reference

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.14 Block Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.15 callLUdivine_small< Element > Class Template Reference

Public Member Functions

- `template<class Field >`
`size_t operator()` (const `Field` &`F`, const `FFLAS::FFLAS_DIAG` `Diag`, const `FFLAS::FFLAS_TRANSPOSE` `trans`, const `size_t` `M`, const `size_t` `N`, typename `Field::Element_ptr` `A`, const `size_t` `lda`, `size_t` *`P`, `size_t` *`Q`, const `FFPACK::FFPACK_LU_TAG` `LuTag`)

16.15.1 Member Function Documentation

16.15.1.1 operator>()()

```
size_t operator() (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag ) [inline]
```

The documentation for this class was generated from the following file:

- [ffpack_ludivine.inl](#)

16.16 callLUdivine_small< double > Class Reference

Public Member Functions

- `template<class Field >`
`size_t operator()` (const `Field` &`F`, const `FFLAS::FFLAS_DIAG` `Diag`, const `FFLAS::FFLAS_TRANSPOSE` `trans`, const `size_t` `M`, const `size_t` `N`, typename `Field::Element_ptr` `A`, const `size_t` `lda`, `size_t` *`P`, `size_t` *`Q`, const `FFPACK::FFPACK_LU_TAG` `LuTag`)

16.16.1 Member Function Documentation

16.16.1.1 operator>()()

```
size_t operator() (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag ) [inline]
```

The documentation for this class was generated from the following file:

- [ffpack_ludivine.inl](#)

16.17 callLUdivine_small< float > Class Reference

Public Member Functions

- `template<class Field >`
`size_t operator() (const Field &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFPACK::FFPACK_LU_TAG LuTag)`

16.17.1 Member Function Documentation

16.17.1.1 operator>()()

```
size_t operator() (
    const Field & F,
    const FFLAS::FFLAS_DIAG Diag,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    typename Field::Element_ptr A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const FFPACK::FFPACK_LU_TAG LuTag ) [inline]
```

The documentation for this class was generated from the following file:

- [ffpack_ludivine.inl](#)

16.18 CharpolyFailed Class Reference

```
#include <ffpack.h>
```

The documentation for this class was generated from the following file:

- [ffpack.h](#)

16.19 Checker_Empty< Field > Struct Template Reference

```
#include <checker_empty.h>
```

Public Member Functions

- `template<typename... Params>`
`Checker_Empty (Params... parameters)`
- `template<typename... Params>`
`bool check (Params... parameters)`

16.19.1 Constructor & Destructor Documentation

16.19.1.1 Checker_Empty()

```
Checker_Empty (
    Params... parameters ) [inline]
```

16.19.2 Member Function Documentation

16.19.2.1 check()

```
bool check (
    Params... parameters ) [inline]
```

The documentation for this struct was generated from the following file:

- [checker_empty.h](#)

16.20 CheckerImplem_charpoly< Field, Polynomial > Class Template Reference

Public Member Functions

- [CheckerImplem_charpoly](#) (const [Field](#) &F_, const [size_t](#) n_, typename [Field::ConstElement_ptr](#) A, [size_t](#) lda_)
- [CheckerImplem_charpoly](#) (typename [Field::RandIter](#) &G, const [size_t](#) n_, typename [Field::ConstElement_ptr](#) A, [size_t](#) lda_)
- [~CheckerImplem_charpoly](#) ()
- bool [check](#) (Polynomial &g)

16.20.1 Constructor & Destructor Documentation

16.20.1.1 CheckerImplem_charpoly() [1/2]

```
CheckerImplem_charpoly (
    const Field & F_,
    const size\_t n_,
    typename Field::ConstElement\_ptr A,
    size\_t lda_ ) [inline]
```

16.20.1.2 CheckerImplem_charpoly() [2/2]

```
CheckerImplem_charpoly (
    typename Field::RandIter & G,
    const size\_t n_,
    typename Field::ConstElement\_ptr A,
    size\_t lda_ ) [inline]
```

16.20.1.3 ~CheckerImplem_charpoly()

```
~CheckerImplem\_charpoly ( ) [inline]
```

16.20.2 Member Function Documentation

16.20.2.1 check()

```
bool check (
    Polynomial & g ) [inline]
```

The documentation for this class was generated from the following file:

- [checker_charpoly.inl](#)

16.21 CheckerImplem_Det< Field > Class Template Reference

Public Member Functions

- [CheckerImplem_Det](#) (const [Field](#) &F_, size_t n_, typename [Field::ConstElement_ptr](#) A, size_t lda)
- [CheckerImplem_Det](#) (typename [Field::RandIter](#) &G, size_t n_, typename [Field::ConstElement_ptr](#) A, size_t lda)
- [~CheckerImplem_Det](#) ()
- bool [check](#) (const typename [Field::Element](#) &det, typename [Field::ConstElement_ptr](#) LU, size_t lda, size_t *P, size_t *Q) const

check if the Det factorization is correct.

16.21.1 Constructor & Destructor Documentation

16.21.1.1 CheckerImplem_Det() [1/2]

```
CheckerImplem_Det (
    const Field & F_,
    size_t n_,
    typename Field::ConstElement\_ptr A,
    size_t lda ) [inline]
```

16.21.1.2 CheckerImplem_Det() [2/2]

```
CheckerImplem_Det (
    typename Field::RandIter & G,
    size_t n_,
    typename Field::ConstElement\_ptr A,
    size_t lda ) [inline]
```

16.21.1.3 ~CheckerImplem_Det()

```
~CheckerImplem_Det ( ) [inline]
```

16.21.2 Member Function Documentation

16.21.2.1 check()

```
bool check (
    const typename Field::Element & det,
    typename Field::ConstElement\_ptr LU,
    size_t lda,
    size_t * P,
    size_t * Q ) const [inline]
```

check if the Det factorization is correct.

Needs matrix in LU form

Parameters

<i>LU,storage</i>	for L and U
-------------------	-------------

Parameters

<i>det</i>	
<i>P</i>	
<i>Q</i>	

The documentation for this class was generated from the following file:

- [checker_det.inl](#)

16.22 CheckerImplem_fgemm< Field > Class Template Reference

Public Member Functions

- [CheckerImplem_fgemm](#) (const [Field](#) &F_, const size_t m_, const size_t n_, const size_t k_, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc_)
- [CheckerImplem_fgemm](#) (typename [Field::RandIter](#) &G, const size_t m_, const size_t n_, const size_t k_, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc_)
- [~CheckerImplem_fgemm](#) ()
- bool [check](#) (const [FFLAS::FFLAS_TRANSPOSE](#) ta, const [FFLAS::FFLAS_TRANSPOSE](#) tb, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, typename [Field::ConstElement_ptr](#) C)

16.22.1 Constructor & Destructor Documentation

16.22.1.1 CheckerImplem_fgemm() [1/2]

```
CheckerImplem_fgemm (
    const Field & F_,
    const size_t m_,
    const size_t n_,
    const size_t k_,
    const typename Field::Element beta,
    typename Field::Element\_ptr C,
    const size_t ldc_ ) [inline]
```

16.22.1.2 CheckerImplem_fgemm() [2/2]

```
CheckerImplem_fgemm (
    typename Field::RandIter & G,
    const size_t m_,
    const size_t n_,
    const size_t k_,
    const typename Field::Element beta,
    typename Field::Element\_ptr C,
    const size_t ldc_ ) [inline]
```

16.22.1.3 ~CheckerImplem_fgemm()

```
~CheckerImplem_fgemm ( ) [inline]
```

16.22.2 Member Function Documentation

16.22.2.1 check()

```
bool check (
    const FFLAS::FFLAS_TRANSPOSE ta,
    const FFLAS::FFLAS_TRANSPOSE tb,
    const typename Field::Element alpha,
    typename Field::ConstElement_ptr A,
    const size_t lda,
    typename Field::ConstElement_ptr B,
    const size_t ldb,
    typename Field::ConstElement_ptr C ) [inline]
```

The documentation for this class was generated from the following file:

- [checker_fgemm.inl](#)

16.23 CheckerImplem_ftrsm< Field > Class Template Reference

Public Member Functions

- [CheckerImplem_ftrsm](#) (const [Field](#) &F_, const size_t m, const size_t n, const typename [Field::Element](#) alpha, const typename [Field::ConstElement_ptr](#) B, const size_t ldb)
- [CheckerImplem_ftrsm](#) (typename [Field::RandIter](#) &G, const size_t m, const size_t n, const typename [Field::Element](#) alpha, const typename [Field::ConstElement_ptr](#) B, const size_t ldb)
- [~CheckerImplem_ftrsm](#) ()
- bool [check](#) (const [FFLAS::FFLAS_SIDE](#) side, const [FFLAS::FFLAS_UPLO](#) uplo, const [FFLAS::FFLAS_TRANSPOSE](#) trans, const [FFLAS::FFLAS_DIAG](#) diag, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, size_t lda, const typename [Field::ConstElement_ptr](#) X, size_t ldx)

16.23.1 Constructor & Destructor Documentation

16.23.1.1 CheckerImplem_ftrsm() [1/2]

```
CheckerImplem_ftrsm (
    const Field & F_,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr B,
    const size_t ldb ) [inline]
```

16.23.1.2 CheckerImplem_ftrsm() [2/2]

```
CheckerImplem_ftrsm (
    typename Field::RandIter & G,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const typename Field::ConstElement_ptr B,
    const size_t ldb ) [inline]
```

16.23.1.3 ~CheckerImplem_ftrsm()

```
~CheckerImplem_ftrsm ( ) [inline]
```

16.23.2 Member Function Documentation

16.23.2.1 check()

```
bool check (
    const FFLAS::FFLAS_SIDE side,
    const FFLAS::FFLAS_UPLO uplo,
    const FFLAS::FFLAS_TRANSPOSE trans,
    const FFLAS::FFLAS_DIAG diag,
    const size_t m,
    const size_t n,
    typename Field::Element_ptr A,
    size_t lda,
    const typename Field::ConstElement_ptr X,
    size_t ldx ) [inline]
```

The documentation for this class was generated from the following file:

- [checker_ftsm.inl](#)

16.24 CheckerImplem_invert< Field > Class Template Reference

Public Member Functions

- [CheckerImplem_invert](#) (const [Field](#) &F_, const size_t m_, typename [Field::ConstElement_ptr](#) A, const size_t lda_)
- [CheckerImplem_invert](#) (typename [Field::RandIter](#) &G, const size_t m_, typename [Field::ConstElement_ptr](#) A, const size_t lda_)
- [~CheckerImplem_invert](#) ()
- bool [check](#) (typename [Field::ConstElement_ptr](#) A, int nullity)

16.24.1 Constructor & Destructor Documentation

16.24.1.1 CheckerImplem_invert() [1/2]

```
CheckerImplem_invert (
    const Field & F_,
    const size_t m_,
    typename Field::ConstElement_ptr A,
    const size_t lda_ ) [inline]
```

16.24.1.2 CheckerImplem_invert() [2/2]

```
CheckerImplem_invert (
    typename Field::RandIter & G,
    const size_t m_,
    typename Field::ConstElement_ptr A,
    const size_t lda_ ) [inline]
```

16.24.1.3 ~CheckerImplem_invert()

```
~CheckerImplem_invert ( ) [inline]
```

16.24.2 Member Function Documentation

16.24.2.1 check()

```
bool check (
    typename Field::ConstElement_ptr A,
    int nullity ) [inline]
```

The documentation for this class was generated from the following file:

- [checker_invert.inl](#)

16.25 CheckerImplem_PLUQ< Field > Class Template Reference

Public Member Functions

- [CheckerImplem_PLUQ](#) (const [Field](#) &F_, size_t m_, size_t n_, typename [Field::ConstElement_ptr](#) A, size_t lda)
- [CheckerImplem_PLUQ](#) (typename [Field::RandIter](#) &G, size_t m_, size_t n_, typename [Field::ConstElement_ptr](#) A, size_t lda)
- [~CheckerImplem_PLUQ](#) ()
- bool [check](#) (typename [Field::ConstElement_ptr](#) A, size_t lda, const [FFLAS::FFLAS_DIAG](#) Diag, size_t r, size_t *P, size_t *Q) const
check if the PLUQ factorization is correct.

16.25.1 Constructor & Destructor Documentation

16.25.1.1 CheckerImplem_PLUQ() [1/2]

```
CheckerImplem_PLUQ (
    const Field & F_,
    size_t m_,
    size_t n_,
    typename Field::ConstElement_ptr A,
    size_t lda ) [inline]
```

16.25.1.2 CheckerImplem_PLUQ() [2/2]

```
CheckerImplem_PLUQ (
    typename Field::RandIter & G,
    size_t m_,
    size_t n_,
    typename Field::ConstElement_ptr A,
    size_t lda ) [inline]
```

16.25.1.3 ~CheckerImplem_PLUQ()

```
~CheckerImplem_PLUQ ( ) [inline]
```

16.25.2 Member Function Documentation

16.25.2.1 check()

```
bool check (
    typename Field::ConstElement_ptr A,
    size_t lda,
    const FFLAS::FFLAS_DIAG Diag,
    size_t r,
    size_t * P,
    size_t * Q ) const [inline]
```

check if the PLUQ factorization is correct.

Returns true if $w - P(L(U(Q.v))) == 0$

Parameters

<i>A</i>	
<i>r</i>	
<i>P</i>	
<i>Q</i>	

The documentation for this class was generated from the following file:

- [checker_pluq.inl](#)

16.26 Classic Struct Reference

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.27 Column Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.28 CompactElement< Element > Struct Template Reference

Public Types

- typedef Element [type](#)

16.28.1 Member Typedef Documentation

16.28.1.1 type

```
typedef Element type
```

The documentation for this struct was generated from the following file:

- [test-io.C](#)

16.29 CompactElement< double > Struct Reference

Public Types

- typedef [int32_t](#) [type](#)

16.29.1 Member Typedef Documentation

16.29.1.1 type

typedef [int32_t](#) type

The documentation for this struct was generated from the following file:

- [test-io.C](#)

16.30 CompactElement< float > Struct Reference

Public Types

- typedef [int16_t](#) type

16.30.1 Member Typedef Documentation

16.30.1.1 type

typedef [int16_t](#) type

The documentation for this struct was generated from the following file:

- [test-io.C](#)

16.31 CompactElement< int16_t > Struct Reference

Public Types

- typedef [int8_t](#) type

16.31.1 Member Typedef Documentation

16.31.1.1 type

typedef [int8_t](#) type

The documentation for this struct was generated from the following file:

- [test-io.C](#)

16.32 CompactElement< int32_t > Struct Reference

Public Types

- typedef [int16_t](#) type

16.32.1 Member Typedef Documentation

16.32.1.1 type

typedef [int16_t](#) type

The documentation for this struct was generated from the following file:

- [test-io.C](#)

16.33 CompactElement< int64_t > Struct Reference

Public Types

- typedef [int32_t](#) [type](#)

16.33.1 Member Typedef Documentation

16.33.1.1 type

typedef [int32_t](#) [type](#)

The documentation for this struct was generated from the following file:

- [test-io.C](#)

16.34 compatible_data_type< Field > Struct Template Reference

Static Public Attributes

- static constexpr bool [value](#) = true

16.34.1 Field Documentation

16.34.1.1 value

constexpr bool [value](#) = true [static], [constexpr]

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

16.35 compatible_data_type< Givaro::ZRing< double > > Struct Reference

Static Public Attributes

- static constexpr bool [value](#) = false

16.35.1 Field Documentation

16.35.1.1 value

constexpr bool [value](#) = false [static], [constexpr]

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

16.36 compatible_data_type< Givaro::ZRing< float > > Struct Reference

Static Public Attributes

- static constexpr bool [value](#) = false

16.36.1 Field Documentation

16.36.1.1 value

constexpr bool value = false [static], [constexpr]

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

16.37 Compose< H1, H2 > Struct Template Reference

Public Member Functions

- [Compose](#) ()
- [Compose](#) (const [Compose](#) &other)
- [Compose](#) (const [Sequential](#) &S)
- [Compose](#) (size_t th1, size_t th2)
- [Compose](#) (const H1 &o1, const H2 &o2)
- H1 [first_component](#) () const
- H2 [second_component](#) () const

Friends

- std::ostream & [operator<<](#) (std::ostream &o, const [Compose](#) &c)

16.37.1 Constructor & Destructor Documentation

16.37.1.1 Compose() [1/5]

```
Compose ( ) [inline]
```

16.37.1.2 Compose() [2/5]

```
Compose (
    const Compose< H1, H2 > & other ) [inline]
```

16.37.1.3 Compose() [3/5]

```
Compose (
    const Sequential & S ) [inline]
```

16.37.1.4 Compose() [4/5]

```
Compose (
    size_t th1,
    size_t th2 ) [inline]
```

16.37.1.5 Compose() [5/5]

```
Compose (
    const H1 & o1,
    const H2 & o2 ) [inline]
```

16.37.2 Member Function Documentation

16.37.2.1 first_component()

```
H1 first_component ( ) const [inline]
```

16.37.2.2 second_component()

```
H2 second_component ( ) const [inline]
```

16.37.3 Friends And Related Function Documentation

16.37.3.1 operator<<

```
std::ostream & operator<< (
    std::ostream & o,
    const Compose< H1, H2 > & c ) [friend]
```

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.38 Const_int_t< n > Class Template Reference

```
#include <instrset.h>
```

The documentation for this class was generated from the following file:

- [instrset.h](#)

16.39 Const_uint_t< n > Class Template Reference

```
#include <instrset.h>
```

The documentation for this class was generated from the following file:

- [instrset.h](#)

16.40 Simd128_impl< true, true, false, 2 >::Converter Union Reference

Data Fields

- [vect_t](#) v
- [scalar_t](#) t [vect_size]

16.40.1 Field Documentation

16.40.1.1 v

```
vect\_t v
```

16.40.1.2 t

`scalar_t t[vect_size]`

The documentation for this union was generated from the following file:

- [simd128_int16.inl](#)

16.41 Simd128_impl< true, true, false, 4 >::Converter Union Reference**Data Fields**

- [vect_t v](#)
- [scalar_t t\[vect_size\]](#)

16.41.1 Field Documentation**16.41.1.1 v**

`vect_t v`

16.41.1.2 t

`scalar_t t[vect_size]`

The documentation for this union was generated from the following file:

- [simd128_int32.inl](#)

16.42 Simd128_impl< true, true, false, 8 >::Converter Union Reference**Data Fields**

- [vect_t v](#)
- [scalar_t t\[vect_size\]](#)

16.42.1 Field Documentation**16.42.1.1 v**

`vect_t v`

16.42.1.2 t

`scalar_t t[vect_size]`

The documentation for this union was generated from the following file:

- [simd128_int64.inl](#)

16.43 Simd128_impl< true, true, true, 2 >::Converter Union Reference**Data Fields**

- [vect_t v](#)
- [scalar_t t\[vect_size\]](#)

16.43.1 Field Documentation

16.43.1.1 v

[vect_t](#) v

16.43.1.2 t

[scalar_t](#) t[[vect_size](#)]

The documentation for this union was generated from the following file:

- [simd128_int16.inl](#)

16.44 Simd128_impl< true, true, true, 4 >::Converter Union Reference

Data Fields

- [vect_t](#) v
- [scalar_t](#) t[[vect_size](#)]

16.44.1 Field Documentation

16.44.1.1 v

[vect_t](#) v

16.44.1.2 t

[scalar_t](#) t[[vect_size](#)]

The documentation for this union was generated from the following file:

- [simd128_int32.inl](#)

16.45 Simd128_impl< true, true, true, 8 >::Converter Union Reference

Data Fields

- [vect_t](#) v
- [scalar_t](#) t[[vect_size](#)]

16.45.1 Field Documentation

16.45.1.1 v

[vect_t](#) v

16.45.1.2 t

[scalar_t](#) t[[vect_size](#)]

The documentation for this union was generated from the following file:

- [simd128_int64.inl](#)

16.46 Simd256_impl< true, true, false, 2 >::Converter Union Reference

Data Fields

- [vect_t v](#)
- [scalar_t t \[vect_size\]](#)

16.46.1 Field Documentation

16.46.1.1 v

[vect_t v](#)

16.46.1.2 t

[scalar_t t \[vect_size\]](#)

The documentation for this union was generated from the following file:

- [simd256_int16.inl](#)

16.47 Simd256_impl< true, true, false, 4 >::Converter Union Reference

Data Fields

- [vect_t v](#)
- [scalar_t t \[vect_size\]](#)

16.47.1 Field Documentation

16.47.1.1 v

[vect_t v](#)

16.47.1.2 t

[scalar_t t](#)

The documentation for this union was generated from the following files:

- [simd256_int32.inl](#)
- [simd512_int32.inl](#)

16.48 Simd256_impl< true, true, false, 8 >::Converter Union Reference

Data Fields

- [vect_t v](#)
- [scalar_t t \[vect_size\]](#)

16.48.1 Field Documentation

16.48.1.1 v

`vect_t` v

16.48.1.2 t

`scalar_t` t[`vect_size`]

The documentation for this union was generated from the following file:

- [simd256_int64.inl](#)

16.49 Simd256_impl< true, true, true, 2 >::Converter Union Reference**Data Fields**

- [vect_t](#) v
- [scalar_t](#) t[`vect_size`]

16.49.1 Field Documentation**16.49.1.1 v**

`vect_t` v

16.49.1.2 t

`scalar_t` t[`vect_size`]

The documentation for this union was generated from the following file:

- [simd256_int16.inl](#)

16.50 Simd256_impl< true, true, true, 4 >::Converter Union Reference**Data Fields**

- [vect_t](#) v
- [scalar_t](#) t[`vect_size`]

16.50.1 Field Documentation**16.50.1.1 v**

`vect_t` v

16.50.1.2 t

`scalar_t` t

The documentation for this union was generated from the following files:

- [simd256_int32.inl](#)
- [simd512_int32.inl](#)

16.51 Simd256_impl< true, true, true, 8 >::Converter Union Reference

Data Fields

- [vect_t v](#)
- [scalar_t t \[vect_size\]](#)

16.51.1 Field Documentation

16.51.1.1 v

[vect_t v](#)

16.51.1.2 t

[scalar_t t \[vect_size\]](#)

The documentation for this union was generated from the following file:

- [simd256_int64.inl](#)

16.52 Simd512_impl< true, true, false, 8 >::Converter Union Reference

Data Fields

- [vect_t v](#)
- [scalar_t t \[vect_size\]](#)

16.52.1 Field Documentation

16.52.1.1 v

[vect_t v](#)

16.52.1.2 t

[scalar_t t \[vect_size\]](#)

The documentation for this union was generated from the following file:

- [simd512_int64.inl](#)

16.53 Simd512_impl< true, true, true, 8 >::Converter Union Reference

Data Fields

- [vect_t v](#)
- [scalar_t t \[vect_size\]](#)

16.53.1 Field Documentation

16.53.1.1 v

`vect_t` [v](#)

16.53.1.2 t

`scalar_t` [t](#)[`vect_size`]

The documentation for this union was generated from the following file:

- [simd512_int64.inl](#)

16.54 ConvertTo< T > Struct Template Reference

Force conversion to appropriate element type of ElementCategory T.

`#include <field-traits.h>`

16.54.1 Detailed Description

`template<class T>`

`struct FFLAS::ModeCategories::ConvertTo< T >`

Force conversion to appropriate element type of ElementCategory T.

e.g.

- `ConvertTo<ElementCategories::MachineFloatTag>` tries conversion of `Modular<int>` to `Modular<double>`
- `ConvertTo<ElementCategories::FixedPrecIntTag>` tries conversion of `Modular<Integer>` to `Modular<RecInt<K>>`
- `ConvertTo<ElementCategories::ArbitraryPrecIntTag>` tries conversion of `Modular<Integer>` to `RNSInteger`

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.55 Coo< ValT, IdxT > Struct Template Reference**Public Types**

- using `Self` = `Coo< ValT, IdxT >`

Public Member Functions

- `Coo` (`ValT` v, `IdxT` r, `IdxT` c)
- `Coo` ()=default
- `Coo` (const `Self` &)=default
- `Coo` (`Self` &&)=default
- `Self` & `operator=` (const `Self` &)=default
- `Self` & `operator=` (`Self` &&)=default

Data Fields

- `ValT` `val` = 0
- `IdxT` `row` = 0
- `IdxT` `col` = 0

16.55.1 Member Typedef Documentation

16.55.1.1 Self

```
using Self = Coo<ValT, IdxT>
```

16.55.2 Constructor & Destructor Documentation

16.55.2.1 `Coo()` [1/4]

```
Coo (
    ValT v,
    IdxT r,
    IdxT c ) [inline]
```

16.55.2.2 `Coo()` [2/4]

```
Coo ( ) [default]
```

16.55.2.3 `Coo()` [3/4]

```
Coo (
    const Self & ) [default]
```

16.55.2.4 `Coo()` [4/4]

```
Coo (
    Self && ) [default]
```

16.55.3 Member Function Documentation

16.55.3.1 `operator=()` [1/2]

```
Self & operator= (
    const Self & ) [default]
```

16.55.3.2 `operator=()` [2/2]

```
Self & operator= (
    Self && ) [default]
```

16.55.4 Field Documentation

16.55.4.1 `val`

```
ValT val = 0
```

16.55.4.2 `row`

```
IdxT row = 0
```

16.55.4.3 col

```
IdxT col = 0
```

The documentation for this struct was generated from the following file:

- [csr_hyb_utils.inl](#)

16.56 **Coo**< **Field** > Struct Template Reference

```
#include <read_sparse.h>
```

Public Member Functions

- **Coo** ()=default
- **Coo** (typename [Field::Element](#) v, [index_t](#) r, [index_t](#) c)
- **Coo** (const [Self](#) &)=default
- **Coo** ([Self](#) &&)=default
- [Self](#) & **operator=** (const [Self](#) &)=default
- [Self](#) & **operator=** ([Self](#) &&)=default

Data Fields

- [Field::Element](#) val = 0
- [index_t](#) col = 0
- [index_t](#) row = 0
- bool [deleted](#) = false

16.56.1 Constructor & Destructor Documentation

16.56.1.1 **Coo**() [1/4]

```
Coo ( ) [default]
```

16.56.1.2 **Coo**() [2/4]

```
Coo (
    typename Field::Element v,
    index\_t r,
    index\_t c ) [inline]
```

16.56.1.3 **Coo**() [3/4]

```
Coo (
    const Self & ) [default]
```

16.56.1.4 **Coo**() [4/4]

```
Coo (
    Self && ) [default]
```

16.56.2 Member Function Documentation

16.56.2.1 `operator=()` [1/2]

```
Self & operator= (
    const Self & ) [default]
```

16.56.2.2 `operator=()` [2/2]

```
Self & operator= (
    Self && ) [default]
```

16.56.3 Field Documentation**16.56.3.1 `val`**

```
Field::Element val = 0
```

16.56.3.2 `col`

```
index_t col = 0
```

16.56.3.3 `row`

```
index_t row = 0
```

16.56.3.4 `deleted`

```
bool deleted = false
```

The documentation for this struct was generated from the following file:

- [read_sparse.h](#)

16.57 `Coo< ValT, IdxT >` Struct Template Reference**Public Types**

- using `Self` = `Coo< ValT, IdxT >`

Public Member Functions

- `Coo` (`ValT` v, `IdxT` r, `IdxT` c)
- `Coo` ()=default
- `Coo` (const `Self` &)=default
- `Coo` (`Self` &&)=default
- `Self` & `operator=` (const `Self` &)=default
- `Self` & `operator=` (`Self` &&)=default

Data Fields

- `ValT` `val` = 0
- `IdxT` `row` = 0
- `IdxT` `col` = 0

16.57.1 Member Typedef Documentation

16.57.1.1 Self

```
using Self = Coo<ValT, IdxT>
```

16.57.2 Constructor & Destructor Documentation

16.57.2.1 Coo() [1/4]

```
Coo (
    ValT v,
    IdxT r,
    IdxT c ) [inline]
```

16.57.2.2 Coo() [2/4]

```
Coo ( ) [default]
```

16.57.2.3 Coo() [3/4]

```
Coo (
    const Self & ) [default]
```

16.57.2.4 Coo() [4/4]

```
Coo (
    Self && ) [default]
```

16.57.3 Member Function Documentation

16.57.3.1 operator=() [1/2]

```
Self & operator= (
    const Self & ) [default]
```

16.57.3.2 operator=() [2/2]

```
Self & operator= (
    Self && ) [default]
```

16.57.4 Field Documentation

16.57.4.1 val

```
ValT val = 0
```

16.57.4.2 row

```
IdxT row = 0
```

16.57.4.3 col

```
IdxT col = 0
```

The documentation for this struct was generated from the following file:

- [sell_utils.inl](#)

16.58 CooMat< Field > Struct Template Reference

```
#include <fflas_sparse.h>
```

Data Fields

- [FFLAS::Sparse< Field, SparseMatrix_t::COO, int16_t > * _coo16](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::COO, int32_t > * _coo32](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::COO, int64_t > * _coo64](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::COO_ZO, int16_t > * _coo16_zo](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::COO_ZO, int32_t > * _coo32_zo](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::COO_ZO, int64_t > * _coo64_zo](#) = nullptr

16.58.1 Field Documentation**16.58.1.1 _coo16**

```
FFLAS::Sparse<Field, SparseMatrix_t::COO, int16_t>* _coo16 = nullptr
```

16.58.1.2 _coo32

```
FFLAS::Sparse<Field, SparseMatrix_t::COO, int32_t>* _coo32 = nullptr
```

16.58.1.3 _coo64

```
FFLAS::Sparse<Field, SparseMatrix_t::COO, int64_t>* _coo64 = nullptr
```

16.58.1.4 _coo16_zo

```
FFLAS::Sparse<Field, SparseMatrix_t::COO_ZO, int16_t>* _coo16_zo = nullptr
```

16.58.1.5 _coo32_zo

```
FFLAS::Sparse<Field, SparseMatrix_t::COO_ZO, int32_t>* _coo32_zo = nullptr
```

16.58.1.6 _coo64_zo

```
FFLAS::Sparse<Field, SparseMatrix_t::COO_ZO, int64_t>* _coo64_zo = nullptr
```

The documentation for this struct was generated from the following file:

- [fflas_sparse.h](#)

16.59 CsrMat< Field > Struct Template Reference

```
#include <fflas_sparse.h>
```

Data Fields

- [FFLAS::Sparse< Field, SparseMatrix_t::CSR, int16_t > * _csr16](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::CSR, int32_t > * _csr32](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::CSR, int64_t > * _csr64](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::CSR_ZO, int16_t > * _csr16_zo](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::CSR_ZO, int32_t > * _csr32_zo](#) = nullptr
- [FFLAS::Sparse< Field, SparseMatrix_t::CSR_ZO, int64_t > * _csr64_zo](#) = nullptr

16.59.1 Field Documentation

16.59.1.1 _csr16

```
FFLAS::Sparse<Field, SparseMatrix_t::CSR, int16_t>* _csr16 = nullptr
```

16.59.1.2 _csr32

```
FFLAS::Sparse<Field, SparseMatrix_t::CSR, int32_t>* _csr32 = nullptr
```

16.59.1.3 _csr64

```
FFLAS::Sparse<Field, SparseMatrix_t::CSR, int64_t>* _csr64 = nullptr
```

16.59.1.4 _csr16_zo

```
FFLAS::Sparse<Field, SparseMatrix_t::CSR_ZO, int16_t>* _csr16_zo = nullptr
```

16.59.1.5 _csr32_zo

```
FFLAS::Sparse<Field, SparseMatrix_t::CSR_ZO, int32_t>* _csr32_zo = nullptr
```

16.59.1.6 _csr64_zo

```
FFLAS::Sparse<Field, SparseMatrix_t::CSR_ZO, int64_t>* _csr64_zo = nullptr
```

The documentation for this struct was generated from the following file:

- [fflas_sparse.h](#)

16.60 DefaultBoundedTag Struct Reference

Use standard field operations, but keeps track of bounds on input and output.

```
#include <field-traits.h>
```

16.60.1 Detailed Description

Use standard field operations, but keeps track of bounds on input and output.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.61 DefaultTag Struct Reference

No specific mode of action: use standard field operations.

```
#include <field-traits.h>
```

16.61.1 Detailed Description

No specific mode of action: use standard field operations.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.62 DelayedTag Struct Reference

Performs field operations with delayed mod reductions. Ensures result is reduced.

```
#include <field-traits.h>
```

16.62.1 Detailed Description

Performs field operations with delayed mod reductions. Ensures result is reduced.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.63 ElementTraits< Element > Struct Template Reference

[ElementTraits](#).

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::GenericTag](#) value

16.63.1 Detailed Description

```
template<class Element>
```

```
struct FFLAS::ElementTraits< Element >
```

[ElementTraits](#).

16.63.2 Member Typedef Documentation

16.63.2.1 value

```
typedef ElementCategories::GenericTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.64 ElementTraits< double > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineFloatTag](#) value

16.64.1 Member Typedef Documentation

16.64.1.1 value

typedef [ElementCategories::MachineFloatTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.65 ElementTraits< FFPACK::rns_double_elt > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::RNSElementTag](#) value

16.65.1 Member Typedef Documentation

16.65.1.1 value

typedef [ElementCategories::RNSElementTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.66 ElementTraits< float > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineFloatTag](#) value

16.66.1 Member Typedef Documentation

16.66.1.1 value

typedef [ElementCategories::MachineFloatTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.67 ElementTraits< Givaro::Integer > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::ArbitraryPrecIntTag](#) value

16.67.1 Member Typedef Documentation

16.67.1.1 value

typedef [ElementCategories::ArbitraryPrecIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.68 ElementTraits< int16_t > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineIntTag](#) value

16.68.1 Member Typedef Documentation

16.68.1.1 value

typedef [ElementCategories::MachineIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.69 ElementTraits< int32_t > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineIntTag](#) value

16.69.1 Member Typedef Documentation

16.69.1.1 value

typedef [ElementCategories::MachineIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.70 ElementTraits< int64_t > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineIntTag](#) value

16.70.1 Member Typedef Documentation

16.70.1.1 value

typedef [ElementCategories::MachineIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.71 ElementTraits< int8_t > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineIntTag](#) value

16.71.1 Member Typedef Documentation

16.71.1.1 value

typedef [ElementCategories::MachineIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.72 ElementTraits< RecInt::rint< K > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::FixedPrecIntTag](#) value

16.72.1 Member Typedef Documentation

16.72.1.1 value

typedef [ElementCategories::FixedPrecIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.73 ElementTraits< RecInt::rmint< K, MG > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::FixedPrecIntTag](#) value

16.73.1 Member Typedef Documentation

16.73.1.1 value

typedef [ElementCategories::FixedPrecIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.74 ElementTraits< RecInt::ruint< K > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::FixedPrecIntTag](#) value

16.74.1 Member Typedef Documentation

16.74.1.1 value

typedef [ElementCategories::FixedPrecIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.75 ElementTraits< uint16_t > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineIntTag](#) value

16.75.1 Member Typedef Documentation

16.75.1.1 value

typedef [ElementCategories::MachineIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.76 ElementTraits< uint32_t > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineIntTag](#) value

16.76.1 Member Typedef Documentation

16.76.1.1 value

typedef [ElementCategories::MachineIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.77 ElementTraits< uint64_t > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineIntTag](#) value

16.77.1 Member Typedef Documentation

16.77.1.1 value

typedef [ElementCategories::MachineIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.78 ElementTraits< uint8_t > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ElementCategories::MachineIntTag](#) value

16.78.1 Member Typedef Documentation

16.78.1.1 value

typedef [ElementCategories::MachineIntTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.79 EII Mat< Field > Struct Template Reference

```
#include <fflas_sparse.h>
```

Data Fields

- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix_t::ELL](#), [int16_t](#) > * [_ell16](#) = nullptr
- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix_t::ELL](#), [int32_t](#) > * [_ell32](#) = nullptr
- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix_t::ELL](#), [int64_t](#) > * [_ell64](#) = nullptr
- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix_t::ELL_ZO](#), [int16_t](#) > * [_ell16_zo](#) = nullptr
- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix_t::ELL_ZO](#), [int32_t](#) > * [_ell32_zo](#) = nullptr
- [FFLAS::Sparse](#)< [Field](#), [SparseMatrix_t::ELL_ZO](#), [int64_t](#) > * [_ell64_zo](#) = nullptr

16.79.1 Field Documentation

16.79.1.1 [_ell16](#)

```
FFLAS::Sparse<Field, SparseMatrix_t::ELL, int16_t>* _ell16 = nullptr
```

16.79.1.2 [_ell32](#)

```
FFLAS::Sparse<Field, SparseMatrix_t::ELL, int32_t>* _ell32 = nullptr
```

16.79.1.3 [_ell64](#)

```
FFLAS::Sparse<Field, SparseMatrix_t::ELL, int64_t>* _ell64 = nullptr
```

16.79.1.4 [_ell16_zo](#)

```
FFLAS::Sparse<Field, SparseMatrix_t::ELL_ZO, int16_t>* _ell16_zo = nullptr
```

16.79.1.5 [_ell32_zo](#)

```
FFLAS::Sparse<Field, SparseMatrix_t::ELL_ZO, int32_t>* _ell32_zo = nullptr
```

16.79.1.6 [_ell64_zo](#)

```
FFLAS::Sparse<Field, SparseMatrix_t::ELL_ZO, int64_t>* _ell64_zo = nullptr
```

The documentation for this struct was generated from the following file:

- [fflas_sparse.h](#)

16.80 Failure Class Reference

A precondition failed.

```
#include <debug.h>
```

Public Member Functions

- [Failure](#) ()
- void [operator\(\)](#) (const char *function, int line, const char *check)
- void [operator\(\)](#) (const char *function, const char *file, int line, const char *check)
- void [setErrorStream](#) (std::ostream &stream)
- std::ostream & [print](#) (std::ostream &o) const

Protected Attributes

- `std::ostream * _errorStream`

16.80.1 Detailed Description

A precondition failed.

The `throw` mechanism is usually used here as in

```
if (!check)
    failure(__func__, __LINE__, "this check just failed");
```

The parameters of the constructor help debugging.

16.80.2 Constructor & Destructor Documentation

16.80.2.1 Failure()

```
Failure ( ) [inline]
```

16.80.3 Member Function Documentation

16.80.3.1 operator>() [1/2]

```
void operator() (
    const char * function,
    int line,
    const char * check ) [inline]
```

A precondition failed.

Parameters

<i>function</i>	usually <code>__func__</code> , the function that threw the error
<i>line</i>	usually <code>__LINE__</code> , the line where it happened
<i>check</i>	a string telling what failed.

16.80.3.2 operator>() [2/2]

```
void operator() (
    const char * function,
    const char * file,
    int line,
    const char * check ) [inline]
```

A precondition failed. The parameter help debugging. This is not much different from the previous except we can digg faster in the file where the exception was triggered.

Parameters

<i>function</i>	usually <code>__func__</code> , the function that threw the error
<i>file</i>	usually <code>__FILE__</code> , the file where this function is
<i>line</i>	usually <code>__LINE__</code> , the line where it happened
<i>check</i>	a string telling what failed.

16.80.3.3 setErrorMessage()

```
void setErrorMessage (
    std::ostream & stream )
```

16.80.3.4 print()

```
std::ostream & print (
    std::ostream & o ) const [inline]
```

overload the virtual print of LinboxError.

Parameters

<i>o</i>	output stream
----------	---------------

16.80.4 Field Documentation**16.80.4.1 _errorMessage**

```
std::ostream* _errorMessage [protected]
```

The documentation for this class was generated from the following file:

- [debug.h](#)

16.81 FailureCharpolyCheck Class Reference

```
#include <checkers_ffpack.h>
```

The documentation for this class was generated from the following file:

- [checkers_ffpack.h](#)

16.82 FailureDetCheck Class Reference

```
#include <checkers_ffpack.h>
```

The documentation for this class was generated from the following file:

- [checkers_ffpack.h](#)

16.83 FailureFgemmCheck Class Reference

```
#include <checkers_fflas.h>
```

The documentation for this class was generated from the following file:

- [checkers_fflas.h](#)

16.84 FailureInvertCheck Class Reference

```
#include <checkers_ffpack.h>
```

The documentation for this class was generated from the following file:

- [checkers_ffpack.h](#)

16.85 FailurePLUQCheck Class Reference

```
#include <checkers_ffpack.h>
```

The documentation for this class was generated from the following file:

- [checkers_ffpack.h](#)

16.86 FailureTrsmCheck Class Reference

```
#include <checkers_fflas.h>
```

The documentation for this class was generated from the following file:

- [checkers_fflas.h](#)

16.87 FieldSimd< _Field > Class Template Reference

Public Types

- using [Field](#) = [_Field](#)
- using [Element](#) = typename [Field::Element](#)
- using [simd](#) = [Simd](#)< typename [_Field::Element](#) >
- using [vect_t](#) = typename [simd::vect_t](#)
- using [scalar_t](#) = typename [simd::scalar_t](#)

Public Member Functions

- [FieldSimd](#) (const [Field](#) &f)
- [FieldSimd](#) (const [Self](#) &)=default
- [FieldSimd](#) ([Self](#) &&)=default
- [Self](#) & operator= (const [Self](#) &)=default
- [Self](#) & operator= ([Self](#) &&)=default
- [INLINE vect_t init](#) ([vect_t](#) &x, const [vect_t](#) a) const
- [INLINE vect_t init](#) (const [vect_t](#) a) const
- [INLINE vect_t add](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- [INLINE vect_t add](#) (const [vect_t](#) a, const [vect_t](#) b)
- [INLINE vect_t addin](#) ([vect_t](#) &a, const [vect_t](#) b) const
- [INLINE vect_t add_r](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t add_r](#) (const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t addin_r](#) ([vect_t](#) &a, const [vect_t](#) b) const
- [INLINE vect_t sub](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- [INLINE vect_t sub](#) (const [vect_t](#) a, const [vect_t](#) b)
- [INLINE vect_t subin](#) ([vect_t](#) &a, const [vect_t](#) b) const
- [INLINE vect_t sub_r](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t sub_r](#) (const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t subin_r](#) ([vect_t](#) &a, const [vect_t](#) b) const
- [INLINE vect_t zero](#) ([vect_t](#) &x) const
- [INLINE vect_t zero](#) () const
- [INLINE vect_t mod](#) ([vect_t](#) &c) const
- [INLINE vect_t mul](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t mul](#) (const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t mulin](#) ([vect_t](#) &a, const [vect_t](#) b) const
- [INLINE vect_t mul_r](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t mul_r](#) (const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t axpy](#) ([vect_t](#) &r, const [vect_t](#) a, const [vect_t](#) b, const [vect_t](#) c) const
- [INLINE vect_t axpy](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b) const
- [INLINE vect_t axpyin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b) const

- `INLINE vect_t axpy_r (vect_t &r, const vect_t a, const vect_t b, const vect_t c) const`
- `INLINE vect_t axpy_r (const vect_t c, const vect_t a, const vect_t b) const`
- `INLINE vect_t axpyin_r (vect_t &c, const vect_t a, const vect_t b) const`
- `INLINE vect_t maxpy (vect_t &r, const vect_t a, const vect_t b, const vect_t c) const`
- `INLINE vect_t maxpy (const vect_t c, const vect_t a, const vect_t b) const`
- `INLINE vect_t maxpyin (vect_t &c, const vect_t a, const vect_t b) const`

Static Public Attributes

- static const constexpr size_t `vect_size` = `simd::vect_size`
- static const constexpr size_t `alignment` = `simd::alignment`

16.87.1 Member Typedef Documentation

16.87.1.1 Field

using `Field` = `_Field`

16.87.1.2 Element

using `Element` = `typename Field::Element`

16.87.1.3 simd

using `simd` = `Simd<typename _Field::Element>`

16.87.1.4 vect_t

using `vect_t` = `typename simd::vect_t`

16.87.1.5 scalar_t

using `scalar_t` = `typename simd::scalar_t`

16.87.2 Constructor & Destructor Documentation

16.87.2.1 FieldSimd() [1/3]

```
FieldSimd (
    const Field & f ) [inline]
```

16.87.2.2 FieldSimd() [2/3]

```
FieldSimd (
    const Self & ) [default]
```

16.87.2.3 FieldSimd() [3/3]

```
FieldSimd (
    Self && ) [default]
```

16.87.3 Member Function Documentation

16.87.3.1 operator=() [1/2]

```
Self & operator= (
    const Self & ) [default]
```

16.87.3.2 operator=() [2/2]

```
Self & operator= (
    Self && ) [default]
```

16.87.3.3 init() [1/2]

```
INLINE vect_t init (
    vect_t & x,
    const vect_t a ) const [inline]
```

16.87.3.4 init() [2/2]

```
INLINE vect_t init (
    const vect_t a ) const [inline]
```

16.87.3.5 add() [1/2]

```
INLINE vect_t add (
    vect_t & c,
    const vect_t a,
    const vect_t b ) [inline]
```

16.87.3.6 add() [2/2]

```
INLINE vect_t add (
    const vect_t a,
    const vect_t b ) [inline]
```

16.87.3.7 addin()

```
INLINE vect_t addin (
    vect_t & a,
    const vect_t b ) const [inline]
```

16.87.3.8 add_r() [1/2]

```
INLINE vect_t add_r (
    vect_t & c,
    const vect_t a,
    const vect_t b ) const [inline]
```

16.87.3.9 add_r() [2/2]

```
INLINE vect_t add_r (  
    const vect_t a,  
    const vect_t b ) const [inline]
```

16.87.3.10 addin_r()

```
INLINE vect_t addin_r (  
    vect_t & a,  
    const vect_t b ) const [inline]
```

16.87.3.11 sub() [1/2]

```
INLINE vect_t sub (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline]
```

16.87.3.12 sub() [2/2]

```
INLINE vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline]
```

16.87.3.13 subin()

```
INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) const [inline]
```

16.87.3.14 sub_r() [1/2]

```
INLINE vect_t sub_r (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) const [inline]
```

16.87.3.15 sub_r() [2/2]

```
INLINE vect_t sub_r (  
    const vect_t a,  
    const vect_t b ) const [inline]
```

16.87.3.16 subin_r()

```
INLINE vect_t subin_r (  
    vect_t & a,  
    const vect_t b ) const [inline]
```

16.87.3.17 zero() [1/2]

```
INLINE vect_t zero (
    vect_t & x ) const [inline]
```

16.87.3.18 zero() [2/2]

```
INLINE vect_t zero ( ) const [inline]
```

16.87.3.19 mod()

```
INLINE vect_t mod (
    vect_t & c ) const [inline]
```

16.87.3.20 mul() [1/2]

```
INLINE vect_t mul (
    vect_t & c,
    const vect_t a,
    const vect_t b ) const [inline]
```

16.87.3.21 mul() [2/2]

```
INLINE vect_t mul (
    const vect_t a,
    const vect_t b ) const [inline]
```

16.87.3.22 mulin()

```
INLINE vect_t mulin (
    vect_t & a,
    const vect_t b ) const [inline]
```

16.87.3.23 mul_r() [1/2]

```
INLINE vect_t mul_r (
    vect_t & c,
    const vect_t a,
    const vect_t b ) const [inline]
```

16.87.3.24 mul_r() [2/2]

```
INLINE vect_t mul_r (
    const vect_t a,
    const vect_t b ) const [inline]
```

16.87.3.25 axpy() [1/2]

```
INLINE vect_t axpy (
    vect_t & r,
    const vect_t a,
```

```
const vect_t b,  
const vect_t c ) const [inline]
```

16.87.3.26 axpy() [2/2]

```
INLINE vect_t axpy (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) const [inline]
```

16.87.3.27 axpyin()

```
INLINE vect_t axpyin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) const [inline]
```

16.87.3.28 axpy_r() [1/2]

```
INLINE vect_t axpy_r (  
    vect_t & r,  
    const vect_t a,  
    const vect_t b,  
    const vect_t c ) const [inline]
```

16.87.3.29 axpy_r() [2/2]

```
INLINE vect_t axpy_r (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) const [inline]
```

16.87.3.30 axpyin_r()

```
INLINE vect_t axpyin_r (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) const [inline]
```

16.87.3.31 maxpy() [1/2]

```
INLINE vect_t maxpy (  
    vect_t & r,  
    const vect_t a,  
    const vect_t b,  
    const vect_t c ) const [inline]
```

16.87.3.32 maxpy() [2/2]

```
INLINE vect_t maxpy (  
    const vect_t c,
```

```
const vect_t a,
const vect_t b ) const [inline]
```

16.87.3.33 maxpyin()

```
INLINE vect_t maxpyin (
    vect_t & c,
    const vect_t a,
    const vect_t b ) const [inline]
```

16.87.4 Field Documentation

16.87.4.1 vect_size

```
const constexpr size_t vect_size = simd::vect_size [static], [constexpr]
```

16.87.4.2 alignment

```
const constexpr size_t alignment = simd::alignment [static], [constexpr]
```

The documentation for this class was generated from the following file:

- [simd_modular.inl](#)

16.88 FieldTraits< Field > Struct Template Reference

FieldTrait.

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::GenericTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.88.1 Detailed Description

```
template<class Field>
struct FFLAS::FieldTraits< Field >
```

FieldTrait.

16.88.2 Member Typedef Documentation

16.88.2.1 category

```
typedef FieldCategories::GenericTag category
```

16.88.3 Field Documentation

16.88.3.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.89 FieldTraits< FFPACK::RNSInteger< T > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.89.1 Member Typedef Documentation

16.89.1.1 category

```
typedef FieldCategories::UnparametricTag category
```

16.89.2 Field Documentation

16.89.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.90 FieldTraits< FFPACK::RNSIntegerMod< T > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::ModularTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.90.1 Member Typedef Documentation

16.90.1.1 category

```
typedef FieldCategories::ModularTag category
```

16.90.2 Field Documentation

16.90.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.91 FieldTraits< Givaro::Modular< Element > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::ModularTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.91.1 Member Typedef Documentation

16.91.1.1 category

```
typedef FieldCategories::ModularTag category
```

16.91.2 Field Documentation

16.91.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.92 FieldTraits< Givaro::ModularBalanced< Element > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::ModularTag](#) category

Static Public Attributes

- static const bool [balanced](#) = true

16.92.1 Member Typedef Documentation

16.92.1.1 category

typedef [FieldCategories::ModularTag](#) category

16.92.2 Field Documentation

16.92.2.1 balanced

```
const bool balanced = true [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.93 FieldTraits< Givaro::ZRing< double > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.93.1 Member Typedef Documentation

16.93.1.1 category

typedef [FieldCategories::UnparametricTag](#) category

16.93.2 Field Documentation

16.93.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.94 FieldTraits< Givaro::ZRing< float > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.94.1 Member Typedef Documentation

16.94.1.1 category

typedef [FieldCategories::UnparametricTag](#) category

16.94.2 Field Documentation

16.94.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.95 FieldTraits< Givaro::ZRing< Givaro::Integer > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.95.1 Member Typedef Documentation

16.95.1.1 category

typedef [FieldCategories::UnparametricTag](#) category

16.95.2 Field Documentation

16.95.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.96 FieldTraits< Givaro::ZRing< int16_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.96.1 Member Typedef Documentation

16.96.1.1 category

```
typedef FieldCategories::UnparametricTag category
```

16.96.2 Field Documentation

16.96.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.97 FieldTraits< Givaro::ZRing< int32_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.97.1 Member Typedef Documentation

16.97.1.1 category

```
typedef FieldCategories::UnparametricTag category
```

16.97.2 Field Documentation

16.97.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.98 FieldTraits< Givaro::ZRing< int64_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.98.1 Member Typedef Documentation**16.98.1.1 category**

```
typedef FieldCategories::UnparametricTag category
```

16.98.2 Field Documentation**16.98.2.1 balanced**

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.99 FieldTraits< Givaro::ZRing< Reclnt::ruint< K > > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.99.1 Member Typedef Documentation**16.99.1.1 category**

```
typedef FieldCategories::UnparametricTag category
```

16.99.2 Field Documentation

16.99.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.100 FieldTraits< Givaro::ZRing< uint16_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.100.1 Member Typedef Documentation

16.100.1.1 category

```
typedef FieldCategories::UnparametricTag category
```

16.100.2 Field Documentation

16.100.2.1 balanced

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.101 FieldTraits< Givaro::ZRing< uint32_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.101.1 Member Typedef Documentation

16.101.1.1 category

```
typedef FieldCategories::UnparametricTag category
```

16.101.2 Field Documentation**16.101.2.1 balanced**

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.102 FieldTraits< Givaro::ZRing< uint64_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [FieldCategories::UnparametricTag](#) category

Static Public Attributes

- static const bool [balanced](#) = false

16.102.1 Member Typedef Documentation**16.102.1.1 category**

```
typedef FieldCategories::UnparametricTag category
```

16.102.2 Field Documentation**16.102.2.1 balanced**

```
const bool balanced = false [static]
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.103 Fixed Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.104 FixedPrecIntTag Struct Reference

Fixed precision integers above machine precision: Givaro::reclnt.

```
#include <field-traits.h>
```


16.104.1 Detailed Description

Fixed precision integers above machine precision: Givaro::reclnt.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.105 ForStrategy1D< blocksize_t, Cut, Param > Struct Template Reference

Public Member Functions

- [ForStrategy1D](#) (const blocksize_t n, const [ParSeqHelper::Parallel](#)< Cut, Param > H)
- [ForStrategy1D](#) (const blocksize_t b, const blocksize_t e, const [ParSeqHelper::Parallel](#)< Cut, Param > H)
- void [build](#) (const blocksize_t n, const [ParSeqHelper::Parallel](#)< Cut, Param > H)
- blocksize_t [initialize](#) ()
- bool [isTerminated](#) () const
- blocksize_t [begin](#) () const
- blocksize_t [end](#) () const
- blocksize_t [numblocks](#) () const
- blocksize_t [blockindex](#) () const
- blocksize_t [operator++](#) ()

Protected Attributes

- blocksize_t [ibeg](#)
- blocksize_t [iend](#)
- blocksize_t [current](#)
- blocksize_t [firstBlockSize](#)
- blocksize_t [lastBlockSize](#)
- blocksize_t [changeBS](#)
- blocksize_t [numBlock](#)

16.105.1 Constructor & Destructor Documentation

16.105.1.1 ForStrategy1D() [1/2]

```
ForStrategy1D (
    const blocksize_t n,
    const ParSeqHelper::Parallel< Cut, Param > H ) [inline]
```

16.105.1.2 ForStrategy1D() [2/2]

```
ForStrategy1D (
    const blocksize_t b,
    const blocksize_t e,
    const ParSeqHelper::Parallel< Cut, Param > H ) [inline]
```

16.105.2 Member Function Documentation

16.105.2.1 build()

```
void build (
    const blocksize_t n,
    const ParSeqHelper::Parallel< Cut, Param > H ) [inline]
```

16.105.2.2 initialize()

```
blocksize_t initialize ( ) [inline]
```

16.105.2.3 isTerminated()

```
bool isTerminated ( ) const [inline]
```

16.105.2.4 begin()

```
blocksize_t begin ( ) const [inline]
```

16.105.2.5 end()

```
blocksize_t end ( ) const [inline]
```

16.105.2.6 numblocks()

```
blocksize_t numblocks ( ) const [inline]
```

16.105.2.7 blockindex()

```
blocksize_t blockindex ( ) const [inline]
```

16.105.2.8 operator++()

```
blocksize_t operator++ ( ) [inline]
```

16.105.3 Field Documentation

16.105.3.1 ibeg

```
blocksize_t ibeg [protected]
```

16.105.3.2 iend

```
blocksize_t iend [protected]
```

16.105.3.3 current

```
blocksize_t current [protected]
```

16.105.3.4 firstBlockSize

```
blocksize_t firstBlockSize [protected]
```

16.105.3.5 lastBlockSize

```
blocksize_t lastBlockSize [protected]
```

16.105.3.6 changeBS

```
blocksize_t changeBS [protected]
```

16.105.3.7 numBlock

```
blocksize_t numBlock [protected]
```

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.106 ForStrategy2D< blocksize_t, Cut, Param > Struct Template Reference

Public Member Functions

- [ForStrategy2D](#) (const blocksize_t m, const blocksize_t n, const [ParSeqHelper::Parallel](#)< Cut, Param > H)
- blocksize_t [initialize](#) ()
- bool [isTerminated](#) () const
- blocksize_t [ibegin](#) () const
- blocksize_t [jbegin](#) () const
- blocksize_t [iend](#) () const
- blocksize_t [jend](#) () const
- blocksize_t [operator++](#) ()
- blocksize_t [rownumblocks](#) () const
- blocksize_t [colnumblocks](#) () const
- blocksize_t [blockindex](#) () const
- blocksize_t [rowblockindex](#) () const
- blocksize_t [colblockindex](#) () const

Protected Attributes

- blocksize_t [_ibeg](#)
- blocksize_t [_iend](#)
- blocksize_t [_jbeg](#)
- blocksize_t [_jend](#)
- blocksize_t [rowBlockSize](#)
- blocksize_t [colBlockSize](#)
- blocksize_t [current](#)
- blocksize_t [lastRBS](#)
- blocksize_t [lastCBS](#)
- blocksize_t [changeRBS](#)
- blocksize_t [changeCBS](#)
- blocksize_t [numRowBlock](#)
- blocksize_t [numColBlock](#)
- blocksize_t [BLOCKS](#)

Friends

- `std::ostream & operator<< (std::ostream &out, const ForStrategy2D &FS2D)`

16.106.1 Constructor & Destructor Documentation

16.106.1.1 ForStrategy2D()

```
ForStrategy2D (
    const blocksize_t m,
    const blocksize_t n,
    const ParSeqHelper::Parallel< Cut, Param > H ) [inline]
```

16.106.2 Member Function Documentation

16.106.2.1 initialize()

```
blocksize_t initialize ( ) [inline]
```

16.106.2.2 isTerminated()

```
bool isTerminated ( ) const [inline]
```

16.106.2.3 ibegin()

```
blocksize_t ibegin ( ) const [inline]
```

16.106.2.4 jbegin()

```
blocksize_t jbegin ( ) const [inline]
```

16.106.2.5 iend()

```
blocksize_t iend ( ) const [inline]
```

16.106.2.6 jend()

```
blocksize_t jend ( ) const [inline]
```

16.106.2.7 operator++()

```
blocksize_t operator++ ( ) [inline]
```

16.106.2.8 rownumblocks()

```
blocksize_t rownumblocks ( ) const [inline]
```

16.106.2.9 colnumblocks()

```
blocksize_t colnumblocks ( ) const [inline]
```

16.106.2.10 blockindex()

```
blocksize_t blockindex ( ) const [inline]
```

16.106.2.11 rowblockindex()

```
blocksize_t rowblockindex ( ) const [inline]
```

16.106.2.12 colblockindex()

```
blocksize_t colblockindex ( ) const [inline]
```

16.106.3 Friends And Related Function Documentation

16.106.3.1 operator<<

```
std::ostream & operator<< (
    std::ostream & out,
    const ForStrategy2D< blocksize_t, Cut, Param > & FS2D ) [friend]
```

16.106.4 Field Documentation

16.106.4.1 _ibeg

```
blocksize_t _ibeg [protected]
```

16.106.4.2 _iend

```
blocksize_t _iend [protected]
```

16.106.4.3 _jbeg

```
blocksize_t _jbeg [protected]
```

16.106.4.4 _jend

```
blocksize_t _jend [protected]
```

16.106.4.5 rowBlockSize

```
blocksize_t rowBlockSize [protected]
```

16.106.4.6 colBlockSize

blocksize_t colBlockSize [protected]

16.106.4.7 current

blocksize_t current [protected]

16.106.4.8 lastRBS

blocksize_t lastRBS [protected]

16.106.4.9 lastCBS

blocksize_t lastCBS [protected]

16.106.4.10 changeRBS

blocksize_t changeRBS [protected]

16.106.4.11 changeCBS

blocksize_t changeCBS [protected]

16.106.4.12 numRowsBlock

blocksize_t numRowsBlock [protected]

16.106.4.13 numColBlock

blocksize_t numColBlock [protected]

16.106.4.14 BLOCKS

blocksize_t BLOCKS [protected]

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.107 ftrmmLeftLowerNoTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.108 ftrmmLeftLowerNoTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.109 ftrmmLeftLowerTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.110 ftrmmLeftLowerTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.111 ftrmmLeftUpperNoTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.112 ftrmmLeftUpperNoTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.113 ftrmmLeftUpperTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.114 ftrmmLeftUpperTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.115 ftrmmRightLowerNoTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.116 ftrmmRightLowerNoTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.117 **ftrmmRightLowerTransNonUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.118 **ftrmmRightLowerTransUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.119 **ftrmmRightUpperNoTransNonUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.120 **ftrmmRightUpperNoTransUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.121 **ftrmmRightUpperTransNonUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.122 **ftrmmRightUpperTransUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.123 **ftrsmLeftLowerNoTransNonUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.124 **ftrsmLeftLowerNoTransUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.125 ftrsmLeftLowerTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.126 ftrsmLeftLowerTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.127 ftrsmLeftUpperNoTransNonUnit< Element > Class Template Reference

Computes the maximal size for delaying the modular reduction in a triangular system resolution.

16.127.1 Detailed Description

```
template<class Element>
```

```
class FFLAS::Protected::ftrsmLeftUpperNoTransNonUnit< Element >
```

Computes the maximal size for delaying the modular reduction in a triangular system resolution.

Compute the maximal dimension k , such that a unit diagonal triangular system of dimension k can be solved over \mathbb{Z} without overflow of the underlying floating point representation.

Bibliography • Dumas, Giorgi, Pernet 06, arXiv:cs/0601133.

Parameters

F	Finite Field/Ring of the computation
-----	--------------------------------------

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.128 ftrsmLeftUpperNoTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.129 ftrsmLeftUpperTransNonUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.130 ftrsmLeftUpperTransUnit< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.131 **ftsmRightLowerNoTransNonUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.132 **ftsmRightLowerNoTransUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.133 **ftsmRightLowerTransNonUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.134 **ftsmRightLowerTransUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.135 **ftsmRightUpperNoTransNonUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.136 **ftsmRightUpperNoTransUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.137 **ftsmRightUpperTransNonUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.138 **ftsmRightUpperTransUnit**< Element > Class Template Reference

The documentation for this class was generated from the following file:

- [fflas_level3.inl](#)

16.139 GenericTag Struct Reference

default is generic

```
#include <field-traits.h>
```

16.139.1 Detailed Description

default is generic

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.140 GenericTag Struct Reference

generic ring.

```
#include <field-traits.h>
```

16.140.1 Detailed Description

generic ring.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.141 Grain Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.142 has_minus_eq_impl< C > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Static Public Attributes

- static constexpr bool [value](#) = type::value

16.142.1 Field Documentation

16.142.1.1 value

```
constexpr bool value = type::value [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.143 has_minus_impl< C > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Static Public Attributes

- static constexpr bool [value](#) = type::value

16.143.1 Field Documentation

16.143.1.1 value

`constexpr bool value = type::value [static], [constexpr]`

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.144 has_mul_eq_impl< C > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Static Public Attributes

- static constexpr bool [value](#) = type::value

16.144.1 Field Documentation

16.144.1.1 value

`constexpr bool value = type::value [static], [constexpr]`

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.145 has_mul_impl< C > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Static Public Attributes

- static constexpr bool [value](#) = type::value

16.145.1 Field Documentation

16.145.1.1 value

`constexpr bool value = type::value [static], [constexpr]`

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.146 has_operation< T > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Static Public Attributes

- static constexpr bool [value](#)

16.146.1 Field Documentation

16.146.1.1 value

constexpr bool value [static], [constexpr]

Initial value:

```
= (has_plus<T>::value && has_minus<T>::value && has_equal<T>::value &&
    has_plus_eq<T>::value && has_minus_eq<T>::value && has_mul<T>::value
    && has_mul_eq<T>::value)
```

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.147 has_plus_eq_impl< C > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Static Public Attributes

- static constexpr bool [value](#) = type::value

16.147.1 Field Documentation

16.147.1.1 value

constexpr bool value = type::value [static], [constexpr]

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.148 has_plus_impl< C > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Static Public Attributes

- static constexpr bool [value](#) = type::value

16.148.1 Field Documentation

16.148.1.1 value

constexpr bool value = type::value [static], [constexpr]

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.149 HelperFlag Struct Reference

```
#include <fflas_sparse.h>
```

Static Public Attributes

- static constexpr [uint64_t none](#) = 0_ui64
- static constexpr [uint64_t coo](#) = 1_ui64
- static constexpr [uint64_t csr](#) = 1_ui64 << 1
- static constexpr [uint64_t ell](#) = 1_ui64 << 2
- static constexpr [uint64_t aut](#) = 1_ui64 << 32
- static constexpr [uint64_t pm1](#) = 1_ui64 << 33

16.149.1 Field Documentation

16.149.1.1 none

constexpr [uint64_t none](#) = 0_ui64 [static], [constexpr]

16.149.1.2 coo

constexpr [uint64_t coo](#) = 1_ui64 [static], [constexpr]

16.149.1.3 csr

constexpr [uint64_t csr](#) = 1_ui64 << 1 [static], [constexpr]

16.149.1.4 ell

constexpr [uint64_t ell](#) = 1_ui64 << 2 [static], [constexpr]

16.149.1.5 aut

constexpr [uint64_t aut](#) = 1_ui64 << 32 [static], [constexpr]

16.149.1.6 pm1

constexpr [uint64_t pm1](#) = 1_ui64 << 33 [static], [constexpr]

The documentation for this struct was generated from the following file:

- [fflas_sparse.h](#)

16.150 HelperMod< Field, ElementTraits > Struct Template Reference

The documentation for this struct was generated from the following file:

- [fflas_freduce.inl](#)

16.151 HelperMod< Field, ElementCategories::MachineIntTag > Struct Template Reference

Public Member Functions

- [HelperMod](#) ()
- [HelperMod](#) (const [Field](#) &F)

Data Fields

- [Field::Element p](#)
- double [invp](#)
- double [min](#)
- double [max](#)
- [int64_t pow50rem](#)

16.151.1 Constructor & Destructor Documentation

16.151.1.1 HelperMod() [1/2]

```
HelperMod ( ) [inline]
```

16.151.1.2 HelperMod() [2/2]

```
HelperMod (
    const Field & F ) [inline]
```

16.151.2 Field Documentation

16.151.2.1 p

```
Field::Element p
```

16.151.2.2 invp

```
double invp
```

16.151.2.3 min

```
double min
```

16.151.2.4 max

```
double max
```

16.151.2.5 pow50rem

```
int64\_t pow50rem
```

The documentation for this struct was generated from the following file:

- [fflas_freduce.inl](#)

16.152 `HelperMod< Field, FFLAS::ElementCategories::ArbitraryPrecIntTag > Struct` Template Reference

Public Member Functions

- [HelperMod\(\)](#)
- [HelperMod\(const Field &F\)](#)

Data Fields

- [Field::Element p](#)

16.152.1 Constructor & Destructor Documentation

16.152.1.1 `HelperMod()` [1/2]

`HelperMod () [inline]`

16.152.1.2 `HelperMod()` [2/2]

`HelperMod (const Field & F) [inline]`

16.152.2 Field Documentation

16.152.2.1 `p`

`Field::Element p`

The documentation for this struct was generated from the following file:

- [fflas_freduce.inl](#)

16.153 `HelperMod< Field, FFLAS::ElementCategories::FixedPrecIntTag > Struct` Template Reference

Public Member Functions

- [HelperMod\(\)](#)
- [HelperMod\(const Field &F\)](#)

Data Fields

- [Field::Element p](#)

16.153.1 Constructor & Destructor Documentation

16.153.1.1 `HelperMod()` [1/2]

`HelperMod () [inline]`

16.153.1.2 HelperMod() [2/2]

```
HelperMod (
    const Field & F ) [inline]
```

16.153.2 Field Documentation**16.153.2.1 p**

Field::Element p

The documentation for this struct was generated from the following file:

- [fflas_freduce.inl](#)

16.154 HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag > Struct Template Reference

Public Member Functions

- [HelperMod\(\)](#)
- [HelperMod](#) (const [Field](#) &F)

Data Fields

- [Field::Element](#) p
- [Field::Element](#) invp
- [Field::Element](#) min
- [Field::Element](#) max

16.154.1 Constructor & Destructor Documentation**16.154.1.1 HelperMod()** [1/2]

```
HelperMod ( ) [inline]
```

16.154.1.2 HelperMod() [2/2]

```
HelperMod (
    const Field & F ) [inline]
```

16.154.2 Field Documentation**16.154.2.1 p**

Field::Element p

16.154.2.2 invp

Field::Element invp

16.154.2.3 min

`Field::Element` min

16.154.2.4 max

`Field::Element` max

The documentation for this struct was generated from the following file:

- [fflas_freduce.inl](#)

16.155 Hybrid Struct Reference

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.156 Info Struct Reference**Public Member Functions**

- [Info](#) ([uint64_t](#) it, [uint64_t](#) s, [uint64_t](#) p)
- [Info](#) ()=default
- [Info](#) (const [Info](#) &)=default
- [Info](#) ([Info](#) &&)=default
- [Info](#) & [operator=](#) (const [Info](#) &)=default
- [Info](#) & [operator=](#) ([Info](#) &&)=default

Data Fields

- [uint64_t](#) size = 0
- [uint64_t](#) perm = 0
- [uint64_t](#) begin = 0

16.156.1 Constructor & Destructor Documentation**16.156.1.1 Info() [1/4]**

```
Info (
    uint64_t it,
    uint64_t s,
    uint64_t p ) [inline]
```

16.156.1.2 Info() [2/4]

```
Info ( ) [default]
```

16.156.1.3 Info() [3/4]

```
Info (
    const Info & ) [default]
```

16.156.1.4 Info() [4/4]

```
Info (
    Info && ) [default]
```

16.156.2 Member Function Documentation

16.156.2.1 operator=() [1/2]

```
Info & operator= (
    const Info & ) [default]
```

16.156.2.2 operator=() [2/2]

```
Info & operator= (
    Info && ) [default]
```

16.156.3 Field Documentation

16.156.3.1 size

```
uint64_t size = 0
```

16.156.3.2 perm

```
uint64_t perm = 0
```

16.156.3.3 begin

```
uint64_t begin = 0
```

The documentation for this struct was generated from the following file:

- [csr_hyb_utils.inl](#)

16.157 Info Struct Reference

Public Member Functions

- [Info](#) (uint64_t it, uint64_t s, uint64_t p)
- [Info](#) ()=default
- [Info](#) (const [Info](#) &)=default
- [Info](#) ([Info](#) &&)=default
- [Info](#) & [operator=](#) (const [Info](#) &)=default
- [Info](#) & [operator=](#) ([Info](#) &&)=default

Data Fields

- [uint64_t](#) size = 0
- [uint64_t](#) perm = 0
- [uint64_t](#) begin = 0

16.157.1 Constructor & Destructor Documentation

16.157.1.1 Info() [1/4]

```
Info (
    uint64_t it,
    uint64_t s,
    uint64_t p ) [inline]
```

16.157.1.2 Info() [2/4]

```
Info ( ) [default]
```

16.157.1.3 Info() [3/4]

```
Info (
    const Info & ) [default]
```

16.157.1.4 Info() [4/4]

```
Info (
    Info && ) [default]
```

16.157.2 Member Function Documentation

16.157.2.1 operator=() [1/2]

```
Info & operator= (
    const Info & ) [default]
```

16.157.2.2 operator=() [2/2]

```
Info & operator= (
    Info && ) [default]
```

16.157.3 Field Documentation

16.157.3.1 size

```
uint64_t size = 0
```

16.157.3.2 perm

```
uint64_t perm = 0
```

16.157.3.3 begin

```
uint64_t begin = 0
```

The documentation for this struct was generated from the following file:

- [sell_utils.inl](#)

16.158 is_simd< T > Struct Template Reference

```
#include <fflas_simd.h>
```

Public Types

- using [type](#) = std::integral_constant< bool, false >

Static Public Attributes

- static const constexpr bool [value](#) = false

16.158.1 Member Typedef Documentation

16.158.1.1 type

```
using type = std::integral_constant<bool, false>
```

16.158.2 Field Documentation

16.158.2.1 value

```
const constexpr bool value = false [static], [constexpr]
```

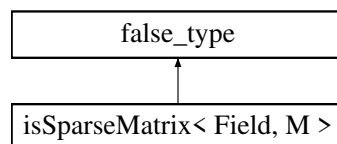
The documentation for this struct was generated from the following file:

- [fflas_simd.h](#)

16.159 isSparseMatrix< Field, M > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, M >:



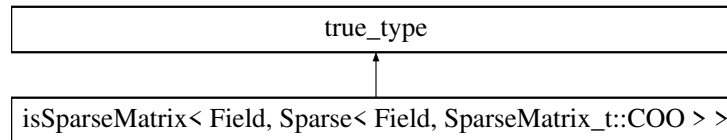
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.160 `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO > >` Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO > >`:



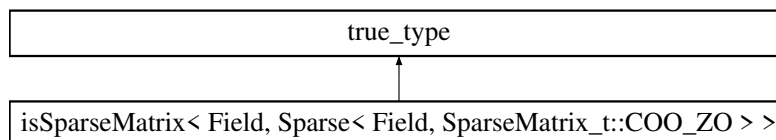
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.161 `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >` Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >`:



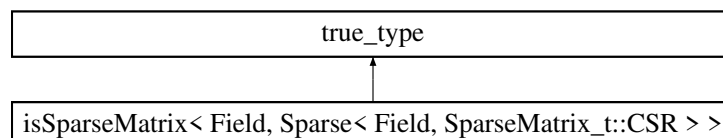
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.162 `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR > >` Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR > >`:



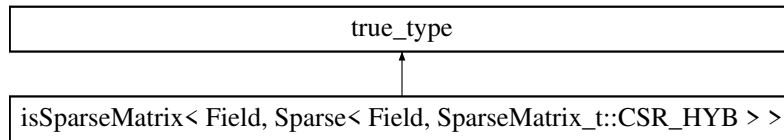
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.163 `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_HYB > >` Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for `isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_HYB > >`:



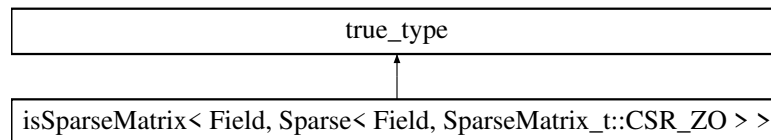
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.164 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >:



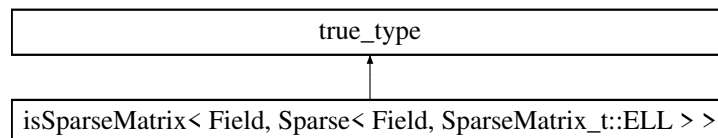
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.165 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL > >:



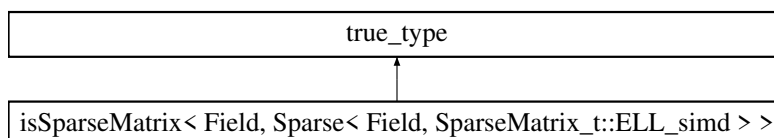
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.166 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd > >:



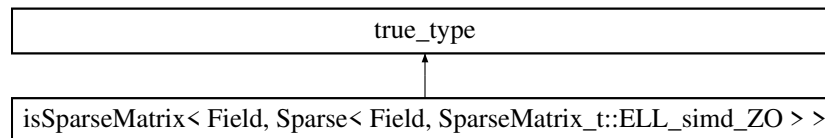
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.167 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >:



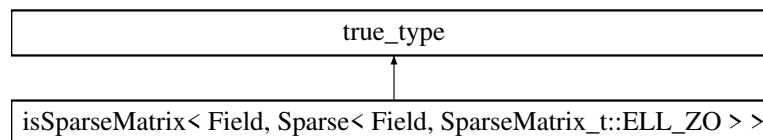
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.168 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >:



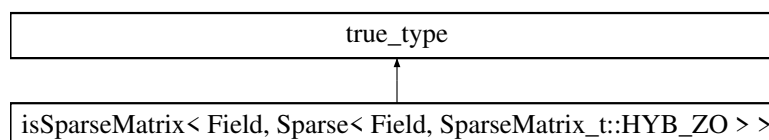
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.169 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::HYB_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::HYB_ZO > >:



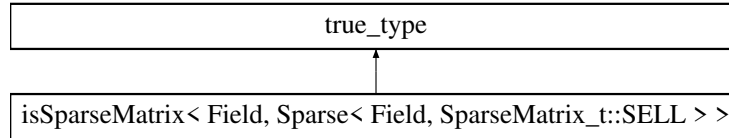
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.170 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL > >:



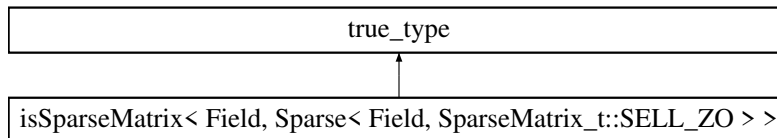
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.171 isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >:



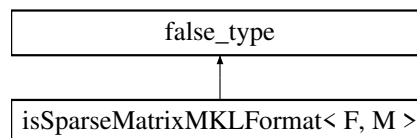
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.172 isSparseMatrixMKLFormat< F, M > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrixMKLFormat< F, M >:



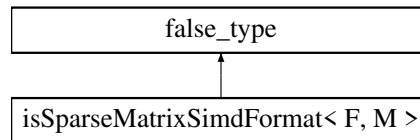
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.173 isSparseMatrixSimdFormat< F, M > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isSparseMatrixSimdFormat< F, M >:



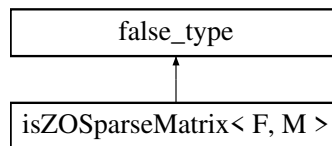
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.174 isZOSparseMatrix< F, M > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< F, M >:



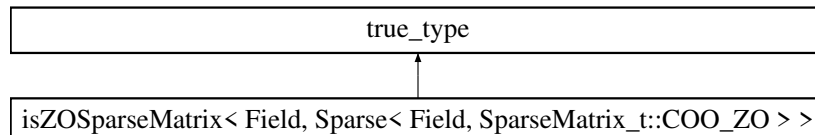
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.175 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >:



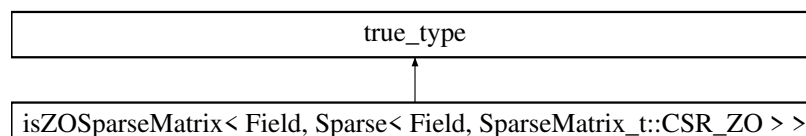
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.176 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >:



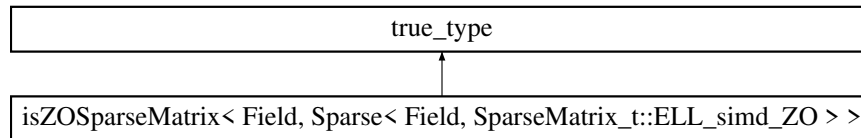
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.177 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >:



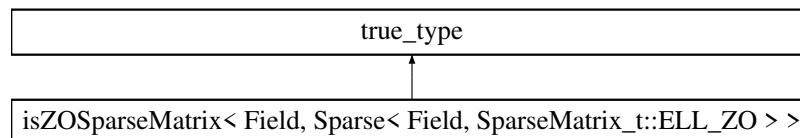
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.178 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >:



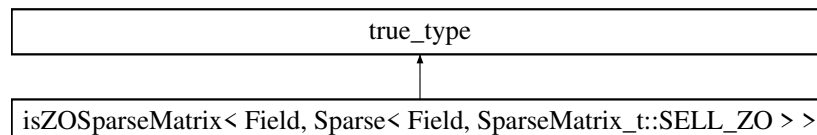
The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.179 isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > > Struct Template Reference

```
#include <sparse_matrix_traits.h>
```

Inheritance diagram for isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >:



The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.180 Iterative Struct Reference

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.181 LazyTag Struct Reference

Performs field operations with delayed mod only when necessary. Result may not be reduced.

```
#include <field-traits.h>
```

16.181.1 Detailed Description

Performs field operations with delayed mod only when necessary. Result may not be reduced.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.182 limits< T > Struct Template Reference

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.183 limits< char > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef char [T](#)

Static Public Member Functions

- static constexpr char [max](#) () noexcept
- static constexpr char [min](#) () noexcept
- static constexpr [int32_t](#) [digits](#) () noexcept

16.183.1 Member Typedef Documentation

16.183.1.1 T

```
typedef char T
```

16.183.2 Member Function Documentation

16.183.2.1 max()

```
static constexpr char max ( ) [inline], [static], [constexpr], [noexcept]
```

16.183.2.2 min()

```
static constexpr char min ( ) [inline], [static], [constexpr], [noexcept]
```

16.183.2.3 digits()

```
static constexpr int32\_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.184 limits< double > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef double [T](#)

Static Public Member Functions

- static constexpr [int64_t](#) [max](#) () noexcept
- static constexpr [int64_t](#) [min](#) () noexcept
- static constexpr [int32_t](#) [digits](#) () noexcept

16.184.1 Member Typedef Documentation

16.184.1.1 T

```
typedef double T
```

16.184.2 Member Function Documentation

16.184.2.1 max()

```
static constexpr int64\_t max ( ) [inline], [static], [constexpr], [noexcept]
```

16.184.2.2 min()

```
static constexpr int64\_t min ( ) [inline], [static], [constexpr], [noexcept]
```

16.184.2.3 digits()

```
static constexpr int32\_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.185 limits< float > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef float [T](#)

Static Public Member Functions

- static constexpr [int32_t](#) [max](#) () noexcept
- static constexpr [int32_t](#) [min](#) () noexcept
- static constexpr [int32_t](#) [digits](#) () noexcept

16.185.1 Member Typedef Documentation

16.185.1.1 T

```
typedef float T
```

16.185.2 Member Function Documentation

16.185.2.1 max()

```
static constexpr int32_t max ( ) [inline], [static], [constexpr], [noexcept]
```

16.185.2.2 min()

```
static constexpr int32_t min ( ) [inline], [static], [constexpr], [noexcept]
```

16.185.2.3 digits()

```
static constexpr int32_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.186 limits< Givaro::Integer > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef Givaro::Integer T

Static Public Member Functions

- static constexpr int [max](#) () noexcept
- static constexpr int [min](#) () noexcept

16.186.1 Member Typedef Documentation

16.186.1.1 T

```
typedef Givaro::Integer T
```

16.186.2 Member Function Documentation

16.186.2.1 max()

```
static constexpr int max ( ) [inline], [static], [constexpr], [noexcept]
```

16.186.2.2 min()

```
static constexpr int min ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.187 limits< int > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef int [T](#)

Static Public Member Functions

- static constexpr int [max](#) () noexcept
- static constexpr int [min](#) () noexcept
- static constexpr [int32_t](#) [digits](#) () noexcept

16.187.1 Member Typedef Documentation

16.187.1.1 T

```
typedef int T
```

16.187.2 Member Function Documentation

16.187.2.1 max()

```
static constexpr int max ( ) [inline], [static], [constexpr], [noexcept]
```

16.187.2.2 min()

```
static constexpr int min ( ) [inline], [static], [constexpr], [noexcept]
```

16.187.2.3 digits()

```
static constexpr int32\_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.188 limits< long > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef long [T](#)

Static Public Member Functions

- static constexpr long [max](#) () noexcept
- static constexpr long [min](#) () noexcept
- static constexpr [int32_t](#) [digits](#) () noexcept

16.188.1 Member Typedef Documentation

16.188.1.1 T

```
typedef long T
```

16.188.2 Member Function Documentation

16.188.2.1 max()

```
static constexpr long max ( ) [inline], [static], [constexpr], [noexcept]
```

16.188.2.2 min()

```
static constexpr long min ( ) [inline], [static], [constexpr], [noexcept]
```

16.188.2.3 digits()

```
static constexpr int32\_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.189 limits< long long > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef long long [T](#)

Static Public Member Functions

- static constexpr long long [max](#) () noexcept
- static constexpr long long [min](#) () noexcept
- static constexpr [int32_t](#) [digits](#) () noexcept

16.189.1 Member Typedef Documentation

16.189.1.1 T

```
typedef long long T
```


16.189.2 Member Function Documentation

16.189.2.1 max()

```
static constexpr long long max ( ) [inline], [static], [constexpr], [noexcept]
```

16.189.2.2 min()

```
static constexpr long long min ( ) [inline], [static], [constexpr], [noexcept]
```

16.189.2.3 digits()

```
static constexpr int32_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.190 limits< RecInt::rint< K > > Struct Template Reference

```
#include <flimits.h>
```

Public Types

- typedef [RecInt::ruint](#)< K > [T](#)

Static Public Member Functions

- static constexpr [RecInt::rint](#)< K > [max](#) () noexcept
- static constexpr [RecInt::rint](#)< K > [min](#) () noexcept

16.190.1 Member Typedef Documentation

16.190.1.1 T

```
typedef RecInt::ruint<K> T
```

16.190.2 Member Function Documentation

16.190.2.1 max()

```
static constexpr RecInt::rint< K > max ( ) [inline], [static], [constexpr], [noexcept]
```

16.190.2.2 min()

```
static constexpr RecInt::rint< K > min ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.191 limits< RecInt::ruint< K > > Struct Template Reference

```
#include <flimits.h>
```

Public Types

- typedef [RecInt::ruint](#)< K > [T](#)

Static Public Member Functions

- static constexpr [RecInt::ruint](#)< K > [max](#) () noexcept
- static constexpr [RecInt::ruint](#)< K > [min](#) () noexcept

16.191.1 Member Typedef Documentation

16.191.1.1 T

```
typedef RecInt::ruint<K> T
```

16.191.2 Member Function Documentation

16.191.2.1 max()

```
static constexpr RecInt::ruint< K > max ( ) [inline], [static], [constexpr], [noexcept]
```

16.191.2.2 min()

```
static constexpr RecInt::ruint< K > min ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.192 limits< short int > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef short int [T](#)

Static Public Member Functions

- static constexpr short int [max](#) () noexcept
- static constexpr short int [min](#) () noexcept
- static constexpr [int32_t](#) [digits](#) () noexcept

16.192.1 Member Typedef Documentation

16.192.1.1 T

```
typedef short int T
```

16.192.2 Member Function Documentation

16.192.2.1 max()

```
static constexpr short int max ( ) [inline], [static], [constexpr], [noexcept]
```

16.192.2.2 min()

```
static constexpr short int min ( ) [inline], [static], [constexpr], [noexcept]
```

16.192.2.3 digits()

```
static constexpr int32_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.193 limits< signed char > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef signed char [T](#)

Static Public Member Functions

- static constexpr signed char [max](#) () noexcept
- static constexpr signed char [min](#) () noexcept
- static constexpr [int32_t](#) [digits](#) () noexcept

16.193.1 Member Typedef Documentation

16.193.1.1 T

```
typedef signed char T
```

16.193.2 Member Function Documentation

16.193.2.1 max()

```
static constexpr signed char max ( ) [inline], [static], [constexpr], [noexcept]
```

16.193.2.2 min()

```
static constexpr signed char min ( ) [inline], [static], [constexpr], [noexcept]
```

16.193.2.3 digits()

```
static constexpr int32\_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.194 limits< unsigned char > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef unsigned char [T](#)

Static Public Member Functions

- static constexpr unsigned char [max](#) () noexcept
- static constexpr unsigned char [min](#) () noexcept
- static constexpr [int32_t](#) [digits](#) () noexcept

16.194.1 Member Typedef Documentation**16.194.1.1 T**

```
typedef unsigned char T
```

16.194.2 Member Function Documentation**16.194.2.1 max()**

```
static constexpr unsigned char max ( ) [inline], [static], [constexpr], [noexcept]
```

16.194.2.2 min()

```
static constexpr unsigned char min ( ) [inline], [static], [constexpr], [noexcept]
```

16.194.2.3 digits()

```
static constexpr int32\_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.195 limits< unsigned int > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef unsigned int [T](#)

Static Public Member Functions

- static constexpr unsigned int [max](#) () noexcept
- static constexpr unsigned int [min](#) () noexcept
- static constexpr [int32_t](#) [digits](#) () noexcept

16.195.1 Member Typedef Documentation

16.195.1.1 T

```
typedef unsigned int T
```

16.195.2 Member Function Documentation

16.195.2.1 max()

```
static constexpr unsigned int max ( ) [inline], [static], [constexpr], [noexcept]
```

16.195.2.2 min()

```
static constexpr unsigned int min ( ) [inline], [static], [constexpr], [noexcept]
```

16.195.2.3 digits()

```
static constexpr int32\_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.196 limits< unsigned long > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef unsigned long [T](#)

Static Public Member Functions

- static constexpr unsigned long [max](#) () noexcept
- static constexpr unsigned long [min](#) () noexcept
- static constexpr [int32_t](#) [digits](#) () noexcept

16.196.1 Member Typedef Documentation

16.196.1.1 T

```
typedef unsigned long T
```

16.196.2 Member Function Documentation

16.196.2.1 max()

```
static constexpr unsigned long max ( ) [inline], [static], [constexpr], [noexcept]
```

16.196.2.2 min()

```
static constexpr unsigned long min ( ) [inline], [static], [constexpr], [noexcept]
```

16.196.2.3 digits()

```
static constexpr int32_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.197 limits< unsigned long long > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef unsigned long long [T](#)

Static Public Member Functions

- static constexpr unsigned long long [max](#) () noexcept
- static constexpr unsigned long long [min](#) () noexcept
- static constexpr [int32_t](#) [digits](#) () noexcept

16.197.1 Member Typedef Documentation

16.197.1.1 T

```
typedef unsigned long long T
```

16.197.2 Member Function Documentation

16.197.2.1 max()

```
static constexpr unsigned long long max ( ) [inline], [static], [constexpr], [noexcept]
```

16.197.2.2 min()

```
static constexpr unsigned long long min ( ) [inline], [static], [constexpr], [noexcept]
```

16.197.2.3 digits()

```
static constexpr int32_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.198 limits< unsigned short int > Struct Reference

```
#include <flimits.h>
```

Public Types

- typedef unsigned short int [T](#)

Static Public Member Functions

- static constexpr unsigned short int [max](#) () noexcept
- static constexpr unsigned short int [min](#) () noexcept
- static constexpr [int32_t digits](#) () noexcept

16.198.1 Member Typedef Documentation

16.198.1.1 T

```
typedef unsigned short int T
```

16.198.2 Member Function Documentation

16.198.2.1 max()

```
static constexpr unsigned short int max ( ) [inline], [static], [constexpr], [noexcept]
```

16.198.2.2 min()

```
static constexpr unsigned short int min ( ) [inline], [static], [constexpr], [noexcept]
```

16.198.2.3 digits()

```
static constexpr int32_t digits ( ) [inline], [static], [constexpr], [noexcept]
```

The documentation for this struct was generated from the following file:

- [flimits.h](#)

16.199 MachineFloatTag Struct Reference

float or double

```
#include <field-traits.h>
```

16.199.1 Detailed Description

float or double

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.200 MachineIntTag Struct Reference

short, int, long, long long, and unsigned variants

```
#include <field-traits.h>
```

16.200.1 Detailed Description

short, int, long, long long, and unsigned variants

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.201 MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait > Struct Template Reference

Public Types

- typedef [MMHelper](#)< [Field](#), [AlgoTrait](#), [ModeTrait](#), [ParSeqTrait](#) > [Self_t](#)
- typedef [associatedDelayedField](#)< constField >::type [DelayedField_t](#)
- typedef [associatedDelayedField](#)< constField >::field [DelayedField](#)
- typedef [DelayedField::Element](#) [DFElt](#)

Public Member Functions

- void [initC](#) ()
- void [initA](#) ()
- void [initB](#) ()
- void [initOut](#) ()
- size_t [MaxDelayedDim](#) ([DFElt](#) beta)
- bool [Aunfit](#) ()
- bool [Bunfit](#) ()
- void [setOutBounds](#) (const size_t k, const [DFElt](#) alpha, const [DFElt](#) beta)
- bool [checkA](#) (const [Field](#) &F, const [FFLAS::FFLAS_TRANSPOSE](#) ta, const size_t M, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda)
- bool [checkB](#) (const [Field](#) &F, const [FFLAS::FFLAS_TRANSPOSE](#) tb, const size_t M, const size_t N, typename [Field::ConstElement_ptr](#) B, const size_t ldb)
- bool [checkOut](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda)
- [MMHelper](#) ()
- [MMHelper](#) (const [Field](#) &F, size_t m, size_t k, size_t n, [ParSeqTrait](#) _PS)
- [MMHelper](#) (const [Field](#) &F, int w, [ParSeqTrait](#) _PS=[ParSeqTrait](#)())
- template<class F2, typename AlgoT2, typename FT2, typename PS2 >
[MMHelper](#) ([MMHelper](#)< F2, AlgoT2, FT2, PS2 > &WH)
- [MMHelper](#) (const [Field](#) &F, int w, [DFElt](#) _Amin, [DFElt](#) _Amax, [DFElt](#) _Bmin, [DFElt](#) _Bmax, [DFElt](#) _Cmin, [DFElt](#) _Cmax, [ParSeqTrait](#) _PS=[ParSeqTrait](#)())

Data Fields

- int [recLevel](#)
- [DFElt](#) FieldMin
- [DFElt](#) FieldMax
- [DFElt](#) Amin
- [DFElt](#) Amax
- [DFElt](#) Bmin
- [DFElt](#) Bmax
- [DFElt](#) Cmin
- [DFElt](#) Cmax
- [DFElt](#) Outmin
- [DFElt](#) Outmax
- [DFElt](#) MaxStorableValue
- const [DelayedField_t](#) delayedField
- [ParSeqTrait](#) [parseq](#)

Friends

- std::ostream & [operator<<](#) (std::ostream &out, const [Self_t](#) &M)

16.201.1 Member Typedef Documentation

16.201.1.1 Self_t

```
typedef MMHelper<Field,AlgoTrait,ModeTrait,ParSeqTrait> Self_t
```

16.201.1.2 DelayedField_t

```
typedef associatedDelayedField<constField>::type DelayedField_t
```

16.201.1.3 DelayedField

```
typedef associatedDelayedField<constField>::field DelayedField
```

16.201.1.4 DFElt

```
typedef DelayedField::Element DFElt
```

16.201.2 Constructor & Destructor Documentation

16.201.2.1 MMHelper() [1/5]

```
MMHelper ( ) [inline]
```

16.201.2.2 MMHelper() [2/5]

```
MMHelper (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    ParSeqTrait _PS ) [inline]
```

16.201.2.3 MMHelper() [3/5]

```
MMHelper (
    const Field & F,
    int w,
    ParSeqTrait _PS = ParSeqTrait() ) [inline]
```

16.201.2.4 MMHelper() [4/5]

```
MMHelper (
    MMHelper< F2, AlgoT2, FT2, PS2 > & WH ) [inline]
```

16.201.2.5 MMHelper() [5/5]

```
MMHelper (
    const Field & F,
    int w,
    DFelt _Amin,
    DFelt _Amax,
    DFelt _Bmin,
    DFelt _Bmax,
    DFelt _Cmin,
    DFelt _Cmax,
    ParSeqTrait _PS = ParSeqTrait() ) [inline]
```

16.201.3 Member Function Documentation**16.201.3.1 initC()**

```
void initC ( ) [inline]
```

16.201.3.2 initA()

```
void initA ( ) [inline]
```

16.201.3.3 initB()

```
void initB ( ) [inline]
```

16.201.3.4 initOut()

```
void initOut ( ) [inline]
```

16.201.3.5 MaxDelayedDim()

```
size_t MaxDelayedDim (
    DFElt beta ) [inline]
```

16.201.3.6 Aunfit()

```
bool Aunfit ( ) [inline]
```

16.201.3.7 Bunfit()

```
bool Bunfit ( ) [inline]
```

16.201.3.8 setOutBounds()

```
void setOutBounds (
    const size_t k,
    const DFElt alpha,
    const DFElt beta ) [inline]
```

16.201.3.9 checkA()

```
bool checkA (
    const Field & F,
    const FFLAS::FFLAS_TRANSPOSE ta,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda ) [inline]
```

16.201.3.10 checkB()

```
bool checkB (
    const Field & F,
    const FFLAS::FFLAS_TRANSPOSE tb,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr B,
    const size_t ldb ) [inline]
```

16.201.3.11 checkOut()

```
bool checkOut (
    const Field & F,
    const size_t M,
    const size_t N,
    typename Field::ConstElement_ptr A,
    const size_t lda ) [inline]
```

16.201.4 Friends And Related Function Documentation

16.201.4.1 operator<<

```
std::ostream & operator<< (  
    std::ostream & out,  
    const Self_t & M ) [friend]
```

16.201.5 Field Documentation**16.201.5.1 recLevel**

```
int recLevel
```

16.201.5.2 FieldMin

```
DFElt FieldMin
```

16.201.5.3 FieldMax

```
DFElt FieldMax
```

16.201.5.4 Amin

```
DFElt Amin
```

16.201.5.5 Amax

```
DFElt Amax
```

16.201.5.6 Bmin

```
DFElt Bmin
```

16.201.5.7 Bmax

```
DFElt Bmax
```

16.201.5.8 Cmin

```
DFElt Cmin
```

16.201.5.9 Cmax

```
DFElt Cmax
```

16.201.5.10 Outmin

```
DFElt Outmin
```

16.201.5.11 Outmax

[DFelt](#) Outmax

16.201.5.12 MaxStorableValue

[DFelt](#) MaxStorableValue

16.201.5.13 delayedField

const [DelayedField_t](#) delayedField

16.201.5.14 parseq

[ParSeqTrait](#) parseq

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.202 MMHelper< FFPACK::RNSInteger< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait > Struct Template Reference

Public Types

- typedef [MMHelper](#)< [FFPACK::RNSInteger](#)< E >, [AlgoTrait](#), [ModeCategories::DefaultTag](#), [ParSeqTrait](#) > [Self_t](#)

Public Member Functions

- [MMHelper](#) ()
- [MMHelper](#) (Givaro::Integer [Amax](#), Givaro::Integer [Bmax](#))
- [MMHelper](#) (const [FFPACK::RNSInteger](#)< E > &F, size_t m, size_t n, size_t k, [ParSeqTrait](#) PS=[ParSeqTrait](#)())
- [MMHelper](#) (const [FFPACK::RNSInteger](#)< E > &F, int wino, [ParSeqTrait](#) PS=[ParSeqTrait](#)())
- template<class F2 , class A2 , class M2 , class PS2 >
[MMHelper](#) ([MMHelper](#)< F2, A2, M2, PS2 > H2)
- void [setNorm](#) (Givaro::Integer p)

Data Fields

- Givaro::Integer [normA](#)
- Givaro::Integer [normB](#)
- int [recLevel](#)
- [ParSeqTrait](#) [parseq](#)

Friends

- std::ostream & [operator<<](#) (std::ostream &out, const [Self_t](#) &M)

16.202.1 Member Typedef Documentation

16.202.1.1 Self_t

```
typedef MMHelper<FFPACK::RNSInteger<E>, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait>
Self_t
```

16.202.2 Constructor & Destructor Documentation

16.202.2.1 MMHelper() [1/5]

```
MMHelper ( ) [inline]
```

16.202.2.2 MMHelper() [2/5]

```
MMHelper (
    Givaro::Integer Amax,
    Givaro::Integer Bmax ) [inline]
```

16.202.2.3 MMHelper() [3/5]

```
MMHelper (
    const FFPACK::RNSInteger< E > & F,
    size_t m,
    size_t n,
    size_t k,
    ParSeqTrait PS = ParSeqTrait() ) [inline]
```

16.202.2.4 MMHelper() [4/5]

```
MMHelper (
    const FFPACK::RNSInteger< E > & F,
    int wino,
    ParSeqTrait PS = ParSeqTrait() ) [inline]
```

16.202.2.5 MMHelper() [5/5]

```
MMHelper (
    MMHelper< F2, A2, M2, PS2 > H2 ) [inline]
```

16.202.3 Member Function Documentation

16.202.3.1 setNorm()

```
void setNorm (
    Givaro::Integer p ) [inline]
```

16.202.4 Friends And Related Function Documentation

16.202.4.1 operator<<

```
std::ostream & operator<< (
    std::ostream & out,
    const Self_t & M ) [friend]
```

16.202.5 Field Documentation

16.202.5.1 normA

Givaro::Integer normA

16.202.5.2 normB

Givaro::Integer normB

16.202.5.3 recLevel

int recLevel

16.202.5.4 parseq

ParSeqTrait parseq

The documentation for this struct was generated from the following file:

- [fgemm_classical_mp.inl](#)

16.203 MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait > Struct Template Reference

Public Types

- typedef MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, [ModeCategories::DefaultTag](#), ParSeqTrait > [Self_t](#)

Public Member Functions

- [MMHelper](#) ()
- [MMHelper](#) (Givaro::Integer [Amax](#), Givaro::Integer [Bmax](#))
- [MMHelper](#) (const [FFPACK::RNSIntegerMod](#)< E > &F, size_t m, size_t n, size_t k, ParSeqTrait PS=[ParSeqTrait](#)())
- [MMHelper](#) (const [FFPACK::RNSIntegerMod](#)< E > &F, int wino, ParSeqTrait PS=[ParSeqTrait](#)())
- template<class F2, typename AlgoT2, typename FT2, typename PS2 >
[MMHelper](#) ([MMHelper](#)< F2, AlgoT2, FT2, PS2 > &WH)
- void [setNorm](#) (Givaro::Integer p)

Data Fields

- Givaro::Integer [normA](#)
- Givaro::Integer [normB](#)
- int [recLevel](#)
- ParSeqTrait [parseq](#)

Friends

- `std::ostream & operator<< (std::ostream &out, const Self_t &M)`

16.203.1 Member Typedef Documentation

16.203.1.1 Self_t

```
typedef MMHelper<FFPACK::RNSIntegerMod<E>, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait>
Self_t
```

16.203.2 Constructor & Destructor Documentation

16.203.2.1 MMHelper() [1/5]

```
MMHelper ( ) [inline]
```

16.203.2.2 MMHelper() [2/5]

```
MMHelper (
    Givaro::Integer Amax,
    Givaro::Integer Bmax ) [inline]
```

16.203.2.3 MMHelper() [3/5]

```
MMHelper (
    const FFPACK::RNSIntegerMod< E > & F,
    size_t m,
    size_t n,
    size_t k,
    ParSeqTrait PS = ParSeqTrait() ) [inline]
```

16.203.2.4 MMHelper() [4/5]

```
MMHelper (
    const FFPACK::RNSIntegerMod< E > & F,
    int wino,
    ParSeqTrait PS = ParSeqTrait() ) [inline]
```

16.203.2.5 MMHelper() [5/5]

```
MMHelper (
    MMHelper< F2, AlgoT2, FT2, PS2 > & WH ) [inline]
```

16.203.3 Member Function Documentation

16.203.3.1 setNorm()

```
void setNorm (
    Givaro::Integer p ) [inline]
```


16.203.4 Friends And Related Function Documentation

16.203.4.1 operator<<

```
std::ostream & operator<< (
    std::ostream & out,
    const Self_t & M ) [friend]
```

16.203.5 Field Documentation

16.203.5.1 normA

Givaro::Integer normA

16.203.5.2 normB

Givaro::Integer normB

16.203.5.3 recLevel

int recLevel

16.203.5.4 parseq

ParSeqTrait parseq

The documentation for this struct was generated from the following file:

- [fgemm_classical_mp.inl](#)

16.204 MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< Dest >, ParSeqTrait > Struct Template Reference

Public Types

- typedef [MMHelper](#)< [Field](#), [AlgoTrait](#), [ModeCategories::ConvertTo](#)< Dest >, [ParSeqTrait](#) > [Self_t](#)

Public Member Functions

- [MMHelper](#) ()
- [MMHelper](#) (const [Field](#) &F, size_t m, size_t k, size_t n, ParSeqTrait _PS)
- [MMHelper](#) (const [Field](#) &F, int w, ParSeqTrait _PS=ParSeqTrait())
- template<class F2 , typename AlgoT2 , typename FT2 , typename PS2 >
[MMHelper](#) ([MMHelper](#)< F2, AlgoT2, FT2, PS2 > &WH)

Data Fields

- int [recLevel](#)
- ParSeqTrait [parseq](#)

Friends

- std::ostream & [operator<<](#) (std::ostream &out, const [Self_t](#) &M)

16.204.1 Member Typedef Documentation

16.204.1.1 Self_t

```
typedef MMHelper<Field,AlgoTrait, ModeCategories::ConvertTo<Dest>,ParSeqTrait> Self_t
```

16.204.2 Constructor & Destructor Documentation

16.204.2.1 MMHelper() [1/4]

```
MMHelper ( ) [inline]
```

16.204.2.2 MMHelper() [2/4]

```
MMHelper (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    ParSeqTrait _PS ) [inline]
```

16.204.2.3 MMHelper() [3/4]

```
MMHelper (
    const Field & F,
    int w,
    ParSeqTrait _PS = ParSeqTrait() ) [inline]
```

16.204.2.4 MMHelper() [4/4]

```
MMHelper (
    MMHelper< F2, AlgoT2, FT2, PS2 > & WH ) [inline]
```

16.204.3 Friends And Related Function Documentation

16.204.3.1 operator<<

```
std::ostream & operator<< (
    std::ostream & out,
    const Self_t & M ) [friend]
```

16.204.4 Field Documentation

16.204.4.1 recLevel

```
int recLevel
```

16.204.4.2 parseq

ParSeqTrait parseq

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.205 MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeqTrait > Struct Template Reference

Public Types

- typedef [MMHelper](#)< [Field](#), [AlgoTrait](#), [ModeCategories::ConvertTo](#)< [ElementCategories::RNSElementTag](#) >, [ParSeqTrait](#) > [Self_t](#)

Public Member Functions

- [MMHelper](#) ()
- template<class F2 , class A2 , class M2 , class PS2 >
[MMHelper](#) ([MMHelper](#)< F2, A2, M2, PS2 > H2)
- [MMHelper](#) (Givaro::Integer [Amax](#), Givaro::Integer [Bmax](#))
- [MMHelper](#) (const [Field](#) &F, size_t m, size_t n, size_t k, ParSeqTrait PS=ParSeqTrait())
- [MMHelper](#) (const [Field](#) &F, int wino, ParSeqTrait PS=ParSeqTrait())
- void [setNorm](#) (Givaro::Integer p)

Data Fields

- Givaro::Integer [normA](#)
- Givaro::Integer [normB](#)
- int [recLevel](#)
- ParSeqTrait [parseq](#)

Friends

- std::ostream & [operator<<](#) (std::ostream &out, const [Self_t](#) &M)

16.205.1 Member Typedef Documentation

16.205.1.1 Self_t

```
typedef MMHelper<Field, AlgoTrait,ModeCategories::ConvertTo<ElementCategories::RNSElementTag>,  
ParSeqTrait> Self\_t
```

16.205.2 Constructor & Destructor Documentation

16.205.2.1 MMHelper() [1/5]

```
MMHelper ( ) [inline]
```

16.205.2.2 MMHelper() [2/5]

```
MMHelper (
    MMHelper< F2, A2, M2, PS2 > H2 ) [inline]
```

16.205.2.3 MMHelper() [3/5]

```
MMHelper (
    Givaro::Integer Amax,
    Givaro::Integer Bmax ) [inline]
```

16.205.2.4 MMHelper() [4/5]

```
MMHelper (
    const Field & F,
    size_t m,
    size_t n,
    size_t k,
    ParSeqTrait PS = ParSeqTrait() ) [inline]
```

16.205.2.5 MMHelper() [5/5]

```
MMHelper (
    const Field & F,
    int wino,
    ParSeqTrait PS = ParSeqTrait() ) [inline]
```

16.205.3 Member Function Documentation**16.205.3.1 setNorm()**

```
void setNorm (
    Givaro::Integer p ) [inline]
```

16.205.4 Friends And Related Function Documentation**16.205.4.1 operator<<**

```
std::ostream & operator<< (
    std::ostream & out,
    const Self_t & M ) [friend]
```

16.205.5 Field Documentation**16.205.5.1 normA**

```
Givaro::Integer normA
```

16.205.5.2 normB

Givaro::Integer normB

16.205.5.3 recLevel

int recLevel

16.205.5.4 parseq

ParSeqTrait parseq

The documentation for this struct was generated from the following file:

- [fgemm_classical_mp.inl](#)

16.206 MMHelper< Field, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait > Struct Template Reference

FGEMM Helper for Default and ConvertTo modes of operation.

Public Types

- typedef [MMHelper](#)< [Field](#), [AlgoTrait](#), [ModeCategories::DefaultTag](#), [ParSeqTrait](#) > [Self_t](#)

Public Member Functions

- [MMHelper](#) ()
- [MMHelper](#) (const [Field](#) &F, size_t m, size_t k, size_t n, [ParSeqTrait](#) _PS)
- [MMHelper](#) (const [Field](#) &F, int w, [ParSeqTrait](#) _PS=[ParSeqTrait](#)())
- template<class F2 , typename AlgoT2 , typename FT2 , typename PS2 >
[MMHelper](#) ([MMHelper](#)< F2, AlgoT2, FT2, PS2 > &WH)

Data Fields

- int [recLevel](#)
- [ParSeqTrait](#) [parseq](#)

Friends

- std::ostream & [operator<<](#) (std::ostream &out, const [Self_t](#) &M)

16.206.1 Detailed Description

```
template<class Field, typename AlgoTrait, typename ParSeqTrait>
struct FFLAS::MMHelper< Field, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >
```

FGEMM Helper for Default and ConvertTo modes of operation.

16.206.2 Member Typedef Documentation

16.206.2.1 Self_t

```
typedef MMHelper<Field,AlgoTrait, ModeCategories::DefaultTag,ParSeqTrait> Self\_t
```

16.206.3 Constructor & Destructor Documentation

16.206.3.1 MMHelper() [1/4]

```
MMHelper ( ) [inline]
```

16.206.3.2 MMHelper() [2/4]

```
MMHelper (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    ParSeqTrait _PS ) [inline]
```

16.206.3.3 MMHelper() [3/4]

```
MMHelper (
    const Field & F,
    int w,
    ParSeqTrait _PS = ParSeqTrait() ) [inline]
```

16.206.3.4 MMHelper() [4/4]

```
MMHelper (
    MMHelper< F2, AlgoT2, FT2, PS2 > & WH ) [inline]
```

16.206.4 Friends And Related Function Documentation

16.206.4.1 operator<<

```
std::ostream & operator<< (
    std::ostream & out,
    const Self_t & M ) [friend]
```

16.206.5 Field Documentation

16.206.5.1 recLevel

```
int recLevel
```

16.206.5.2 parseq

```
ParSeqTrait parseq
```

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.207 ModeTraits< Field > Struct Template Reference

[ModeTraits.](#)

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::DefaultTag](#) value

16.207.1 Detailed Description

```
template<class Field>
```

```
struct FFLAS::ModeTraits< Field >
```

[ModeTraits.](#)

16.207.2 Member Typedef Documentation

16.207.2.1 value

```
typedef ModeCategories::DefaultTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.208 ModeTraits< Givaro::Modular< Element, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::DelayedTag](#) value

16.208.1 Member Typedef Documentation

16.208.1.1 value

```
typedef ModeCategories::DelayedTag value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.209 ModeTraits< Givaro::Modular< Givaro::Integer, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::RNSElementTag >](#) value

16.209.1 Member Typedef Documentation

16.209.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::RNSElementTag>](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.210 ModeTraits< Givaro::Modular< int16_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >](#) value

16.210.1 Member Typedef Documentation

16.210.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag>](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.211 ModeTraits< Givaro::Modular< int32_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >](#) value

16.211.1 Member Typedef Documentation

16.211.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag>](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.212 ModeTraits< Givaro::Modular< int8_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```


Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >](#) value

16.212.1 Member Typedef Documentation

16.212.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag>](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.213 ModeTraits< Givaro::Modular< RecInt::ruint< K >, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::RNSElementTag >](#) value

16.213.1 Member Typedef Documentation

16.213.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::RNSElementTag>](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.214 ModeTraits< Givaro::Modular< uint16_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >](#) value

16.214.1 Member Typedef Documentation

16.214.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag>](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.215 ModeTraits< Givaro::Modular< uint32_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > value](#)

16.215.1 Member Typedef Documentation

16.215.1.1 value

```
typedef ModeCategories::ConvertTo<ElementCategories::MachineFloatTag> value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.216 ModeTraits< Givaro::Modular< uint8_t, Compute > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > value](#)

16.216.1 Member Typedef Documentation

16.216.1.1 value

```
typedef ModeCategories::ConvertTo<ElementCategories::MachineFloatTag> value
```

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.217 ModeTraits< Givaro::ModularBalanced< Element > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::DelayedTag value](#)

16.217.1 Member Typedef Documentation

16.217.1.1 value

typedef [ModeCategories::DelayedTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.218 ModeTraits< Givaro::ModularBalanced< Givaro::Integer > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::RNSElementTag >](#) value

16.218.1 Member Typedef Documentation

16.218.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::RNSElementTag>](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.219 ModeTraits< Givaro::ModularBalanced< int16_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >](#) value

16.219.1 Member Typedef Documentation

16.219.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag>](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.220 ModeTraits< Givaro::ModularBalanced< int32_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >](#) value

16.220.1 Member Typedef Documentation

16.220.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag>](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.221 ModeTraits< Givaro::ModularBalanced< int8_t > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::MachineFloatTag >](#) value

16.221.1 Member Typedef Documentation

16.221.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::MachineFloatTag>](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.222 ModeTraits< Givaro::Montgomery< T > > Struct Template Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::DefaultBoundedTag](#) value

16.222.1 Member Typedef Documentation

16.222.1.1 value

typedef [ModeCategories::DefaultBoundedTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.223 ModeTraits< Givaro::ZRing< double > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::DefaultBoundedTag](#) value

16.223.1 Member Typedef Documentation

16.223.1.1 value

typedef [ModeCategories::DefaultBoundedTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.224 ModeTraits< Givaro::ZRing< float > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::DefaultBoundedTag](#) value

16.224.1 Member Typedef Documentation

16.224.1.1 value

typedef [ModeCategories::DefaultBoundedTag](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.225 ModeTraits< Givaro::ZRing< Givaro::Integer > > Struct Reference

```
#include <field-traits.h>
```

Public Types

- typedef [ModeCategories::ConvertTo< ElementCategories::RNSElementTag >](#) value

16.225.1 Member Typedef Documentation

16.225.1.1 value

typedef [ModeCategories::ConvertTo<ElementCategories::RNSElementTag>](#) value

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.226 ModularBalanced< T > Class Template Reference

The documentation for this class was generated from the following file:

- [field-traits.h](#)

16.227 ModularTag Struct Reference

This is a modular field like e.g. `Modular<T>` or `ModularBalanced<T>`
`#include <field-traits.h>`

16.227.1 Detailed Description

This is a modular field like e.g. `Modular<T>` or `ModularBalanced<T>`
 The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.228 Montgomery< T > Class Template Reference

The documentation for this class was generated from the following file:

- [field-traits.h](#)

16.229 need_field_characteristic< Field > Struct Template Reference

Static Public Attributes

- static constexpr bool [value](#) = false

16.229.1 Field Documentation

16.229.1.1 value

```
constexpr bool value = false [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

16.230 need_field_characteristic< Givaro::Modular< Field > > Struct Template Reference

Static Public Attributes

- static constexpr bool [value](#) = true

16.230.1 Field Documentation

16.230.1.1 value

```
constexpr bool value = true [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

16.231 need_field_characteristic< Givaro::ModularBalanced< Field > > Struct Template Reference

Static Public Attributes

- static constexpr bool [value](#) = true

16.231.1 Field Documentation

16.231.1.1 value

`constexpr bool value = true [static], [constexpr]`

The documentation for this struct was generated from the following file:

- [benchmark-fgemv.C](#)

16.232 NoSimd< T > Struct Template Reference

```
#include <fflas_simd.h>
```

Public Types

- using [vect_t](#) = T *
- using [scalar_t](#) = T

Static Public Member Functions

- static const std::string [type_string](#) ()
- template<class TT >
static constexpr bool [valid](#) (TT p)
- template<class TT >
static constexpr bool [compliant](#) (TT n)

Static Public Attributes

- static const constexpr size_t [vect_size](#) = 1

16.232.1 Member Typedef Documentation

16.232.1.1 vect_t

```
using vect\_t = T*
```

16.232.1.2 scalar_t

```
using scalar\_t = T
```

16.232.2 Member Function Documentation

16.232.2.1 type_string()

```
static const std::string type_string ( ) [inline], [static]
```

16.232.2.2 valid()

```
static constexpr bool valid (
    TT p ) [inline], [static], [constexpr]
```

16.232.2.3 compliant()

```
static constexpr bool compliant (
    TT n ) [inline], [static], [constexpr]
```

16.232.3 Field Documentation**16.232.3.1 vect_size**

```
const constexpr size_t vect_size = 1 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [fflas_simd.h](#)

16.233 Parallel< C, P > Struct Template Reference**Public Types**

- typedef C [Cut](#)
- typedef P [Param](#)

Public Member Functions

- [Parallel](#) (size_t n=[NUM_THREADS](#))
- size_t [numthreads](#) () const
- size_t & [set_numthreads](#) (size_t n)

Friends

- std::ostream & [operator<<](#) (std::ostream &out, const [Parallel](#) &p)

16.233.1 Member Typedef Documentation**16.233.1.1 Cut**

```
typedef C Cut
```

16.233.1.2 Param

```
typedef P Param
```

16.233.2 Constructor & Destructor Documentation**16.233.2.1 Parallel()**

```
Parallel (
    size_t n = NUM\_THREADS ) [inline]
```

16.233.3 Member Function Documentation

16.233.3.1 numthreads()

```
size_t numthreads ( ) const [inline]
```

16.233.3.2 set_numthreads()

```
size_t & set_numthreads (
    size_t n ) [inline]
```

16.233.4 Friends And Related Function Documentation

16.233.4.1 operator<<

```
std::ostream & operator<< (
    std::ostream & out,
    const Parallel< C, P > & p ) [friend]
```

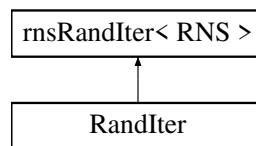
The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.234 RNSInteger< RNS >::RandIter Class Reference

```
#include <rns-integer.h>
```

Inheritance diagram for RNSInteger< RNS >::RandIter:



Public Member Functions

- [RandIter](#) (const [RNSInteger< RNS >](#) &F, size_t size=0, uint64_t seed=0)
- [RNS::Element & random](#) (typename [RNS::Element](#) &elt) const
RNS ring Element random assignement.
- [RNS::Element random](#) () const
- [RNS::Element & operator\(\)](#) (typename [RNS::Element](#) &elt) const
- [RNS::Element operator\(\)](#) () const
- const [RNS](#) & [ring](#) () const

16.234.1 Constructor & Destructor Documentation

16.234.1.1 RandIter()

```
RandIter (
    const RNSInteger< RNS > & F,
    size_t size = 0,
    uint64_t seed = 0 ) [inline]
```

16.234.2 Member Function Documentation

16.234.2.1 random() [1/2]

```
RNS::Element & random (
    typename RNS::Element & elt ) const [inline], [inherited]
```

RNS ring Element random assignment.
Element is supposed to be initialized

Returns

random ring Element

16.234.2.2 random() [2/2]

```
RNS::Element random ( ) const [inline], [inherited]
```

16.234.2.3 operator>() [1/2]

```
RNS::Element & operator() (
    typename RNS::Element & elt ) const [inline], [inherited]
```

16.234.2.4 operator>() [2/2]

```
RNS::Element operator() ( ) const [inline], [inherited]
```

16.234.2.5 ring()

```
const RNS & ring ( ) const [inline], [inherited]
```

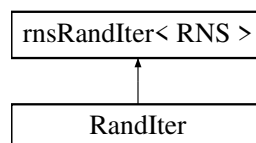
The documentation for this class was generated from the following file:

- [rns-integer.h](#)

16.235 RNSIntegerMod< RNS >::RandIter Class Reference

```
#include <rns-integer-mod.h>
```

Inheritance diagram for RNSIntegerMod< RNS >::RandIter:

**Public Member Functions**

- [RandIter](#) (const [RNSIntegerMod< RNS >](#) &F, [size_t](#) size=0, [uint64_t](#) seed=0)
- [RNS::Element & random](#) (typename [RNS::Element](#) &elt) const
- [RNS::Element random](#) () const
- [RNS::Element & operator\(\)](#) (typename [RNS::Element](#) &elt) const
- [RNS::Element operator\(\)](#) () const
- const [RNS](#) & [ring](#) () const

16.235.1 Constructor & Destructor Documentation

16.235.1.1 RandIter()

```
RandIter (
    const RNSIntegerMod< RNS > & F,
    size_t size = 0,
    uint64_t seed = 0 ) [inline]
```

16.235.2 Member Function Documentation**16.235.2.1 random() [1/2]**

```
RNS::Element & random (
    typename RNS::Element & elt ) const [inline]
```

16.235.2.2 random() [2/2]

```
RNS::Element random ( ) const [inline], [inherited]
```

16.235.2.3 operator>() [1/2]

```
RNS::Element & operator() (
    typename RNS::Element & elt ) const [inline], [inherited]
```

16.235.2.4 operator>() [2/2]

```
RNS::Element operator() ( ) const [inline], [inherited]
```

16.235.2.5 ring()

```
const RNS & ring ( ) const [inline], [inherited]
```

The documentation for this class was generated from the following file:

- [rns-integer-mod.h](#)

16.236 readMyMachineType< Field, T > Struct Template Reference

```
#include <read_sparse.h>
```

Public Types

- typedef [Field::Element](#) [Element](#)
- typedef [Field::Element_ptr](#) [Element_ptr](#)

Public Member Functions

- void [operator\(\)](#) (const [Field](#) &F, [Element](#) &modulo, [Element_ptr](#) val, std::ifstream &file, const [uint64_t](#) dims, const [mask_t](#) data_type, const [mask_t](#) field_desc)

16.236.1 Member Typedef Documentation

16.236.1.1 Element

```
typedef Field::Element Element
```

16.236.1.2 Element_ptr

```
typedef Field::Element_ptr Element_ptr
```

16.236.2 Member Function Documentation

16.236.2.1 operator>()

```
void operator() (
    const Field & F,
    Element & modulo,
    Element_ptr val,
    std::ifstream & file,
    const uint64_t dims,
    const mask_t data_type,
    const mask_t field_desc )
```

The documentation for this struct was generated from the following file:

- [read_sparse.h](#)

16.237 readMyMachineType< Field, mpz_t > Struct Template Reference

```
#include <read_sparse.h>
```

Public Types

- typedef [Field::Element](#) [Element](#)
- typedef [Field::Element_ptr](#) [Element_ptr](#)

Public Member Functions

- void [operator\(\)](#) (const [Field](#) &F, [Element](#) &modulo, [Element_ptr](#) val, std::ifstream &file, const [uint64_t](#) dims, const [mask_t](#) data_type, const [mask_t](#) field_desc)

16.237.1 Member Typedef Documentation

16.237.1.1 Element

```
typedef Field::Element Element
```

16.237.1.2 Element_ptr

```
typedef Field::Element_ptr Element_ptr
```

16.237.2 Member Function Documentation

16.237.2.1 operator()()

```
void operator() (
    const Field & F,
    typename Field::Element & modulo,
    typename Field::Element_ptr val,
    std::ifstream & file,
    const uint64_t dims,
    const mask_t data_type,
    const mask_t field_desc )
```

The documentation for this struct was generated from the following file:

- [read_sparse.h](#)

16.238 Recursive Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.239 Recursive Struct Reference

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.240 rint< K > Class Template Reference

The documentation for this class was generated from the following file:

- [field-traits.h](#)

16.241 rns_double Struct Reference

```
#include <rns-double.h>
```

Public Types

- typedef Givaro::Integer [integer](#)
- typedef Givaro::Modular< double > [ModField](#)
- typedef double [BasisElement](#)
- typedef [rns_double_elt](#) [Element](#)
- typedef [rns_double_elt_ptr](#) [Element_ptr](#)
- typedef [rns_double_elt_cstptr](#) [ConstElement_ptr](#)

Public Member Functions

- [rns_double](#) (const [integer](#) &bound, size_t pbits, bool rnsmod=false, long seed=time(NULL))
- [rns_double](#) (size_t pbits, size_t size, long seed=time(NULL))
- template<typename Vect >
 [rns_double](#) (const Vect &basis, bool rnsmod=false, long seed=time(NULL))
- [rns_double](#) (const [RNSIntegerMod](#)< [rns_double](#) > &basis, bool rnsmod=false, long seed=time(NULL))
- void [precompute_cst](#) (size_t K=0)
- template<typename T >
 void [init](#) (size_t m, size_t n, double *Arns, size_t rda, const T *A, size_t lda, const [integer](#) &maxA, bool RNS_MAJOR=false) const

- void `init` (size_t m, size_t n, double *Arns, size_t rda, const integer *A, size_t lda, size_t k, bool RNS_MAJOR=false) const
- void `init_transpose` (size_t m, size_t n, double *Arns, size_t rda, const integer *A, size_t lda, size_t k, bool RNS_MAJOR=false) const
- void `convert` (size_t m, size_t n, integer gamma, integer *A, size_t lda, const double *Arns, size_t rda, bool RNS_MAJOR=false) const
- void `convert_transpose` (size_t m, size_t n, integer gamma, integer *A, size_t lda, const double *Arns, size_t rda, bool RNS_MAJOR=false) const
- void `reduce` (size_t n, double *Arns, size_t rda, bool RNS_MAJOR=false) const
- template<size_t K>
void `init` (size_t m, size_t n, double *Arns, size_t rda, const Reclnt::ruint< K > *A, size_t lda, size_t k, bool RNS_MAJOR=false) const
- template<size_t K>
void `convert` (size_t m, size_t n, integer gamma, Reclnt::ruint< K > *A, size_t lda, const double *Arns, size_t rda, integer p=0, bool RNS_MAJOR=false) const

Data Fields

- std::vector< double, AlignedAllocator< double, Alignment::CACHE_LINE > > `_basis`
- std::vector< double, AlignedAllocator< double, Alignment::CACHE_LINE > > `_basisMax`
- std::vector< double, AlignedAllocator< double, Alignment::CACHE_LINE > > `_negbasis`
- std::vector< double, AlignedAllocator< double, Alignment::CACHE_LINE > > `_invbasis`
- std::vector< ModField > `_field_rns`
- integer `_M`
- std::vector< integer > `_Mi`
- std::vector< double > `_MMi`
- std::vector< double > `_crt_in`
- std::vector< double > `_crt_out`
- size_t `_size`
- size_t `_pbits`
- size_t `_ldm`
- integer `_mi_sum`

16.241.1 Member Typedef Documentation

16.241.1.1 integer

```
typedef Givaro::Integer integer
```

16.241.1.2 ModField

```
typedef Givaro::Modular<double> ModField
```

16.241.1.3 BasisElement

```
typedef double BasisElement
```

16.241.1.4 Element

```
typedef rns_double_elt Element
```

16.241.1.5 Element_ptr

```
typedef rns_double_elt_ptr Element_ptr
```

16.241.1.6 ConstElement_ptr

```
typedef rns_double_elt_cstptr ConstElement_ptr
```

16.241.2 Constructor & Destructor Documentation

16.241.2.1 rns_double() [1/4]

```
rns_double (
    const integer & bound,
    size_t pbits,
    bool rnsmod = false,
    long seed = time(NULL) ) [inline]
```

16.241.2.2 rns_double() [2/4]

```
rns_double (
    size_t pbits,
    size_t size,
    long seed = time(NULL) ) [inline]
```

16.241.2.3 rns_double() [3/4]

```
rns_double (
    const Vect & basis,
    bool rnsmod = false,
    long seed = time(NULL) ) [inline]
```

16.241.2.4 rns_double() [4/4]

```
rns_double (
    const RNSIntegerMod< rns_double > & basis,
    bool rnsmod = false,
    long seed = time(NULL) ) [inline]
```

16.241.3 Member Function Documentation

16.241.3.1 precompute_cst()

```
void precompute_cst (
    size_t K = 0 ) [inline]
```

16.241.3.2 init() [1/3]

```
void init (
    size_t m,
    size_t n,
```

```
double * Arns,  
size_t rda,  
const T * A,  
size_t lda,  
const integer & maxA,  
bool RNS_MAJOR = false ) const [inline]
```

16.241.3.3 init() [2/3]

```
void init (  
    size_t m,  
    size_t n,  
    double * Arns,  
    size_t rda,  
    const integer * A,  
    size_t lda,  
    size_t k,  
    bool RNS_MAJOR = false ) const [inline]
```

16.241.3.4 init_transpose()

```
void init_transpose (  
    size_t m,  
    size_t n,  
    double * Arns,  
    size_t rda,  
    const integer * A,  
    size_t lda,  
    size_t k,  
    bool RNS_MAJOR = false ) const [inline]
```

16.241.3.5 convert() [1/2]

```
void convert (  
    size_t m,  
    size_t n,  
    integer gamma,  
    integer * A,  
    size_t lda,  
    const double * Arns,  
    size_t rda,  
    bool RNS_MAJOR = false ) const [inline]
```

16.241.3.6 convert_transpose()

```
void convert_transpose (  
    size_t m,  
    size_t n,  
    integer gamma,  
    integer * A,  
    size_t lda,  
    const double * Arns,  
    size_t rda,  
    bool RNS_MAJOR = false ) const [inline]
```


16.241.3.7 reduce()

```
void reduce (
    size_t n,
    double * Arns,
    size_t rda,
    bool RNS_MAJOR = false ) const [inline]
```

16.241.3.8 init() [3/3]

```
void init (
    size_t m,
    size_t n,
    double * Arns,
    size_t rda,
    const RecInt::ruint< K > * A,
    size_t lda,
    size_t k,
    bool RNS_MAJOR = false ) const [inline]
```

16.241.3.9 convert() [2/2]

```
void convert (
    size_t m,
    size_t n,
    integer gamma,
    RecInt::ruint< K > * A,
    size_t lda,
    const double * Arns,
    size_t rda,
    integer p = 0,
    bool RNS_MAJOR = false ) const [inline]
```

16.241.4 Field Documentation**16.241.4.1 _basis**

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _basis
```

16.241.4.2 _basisMax

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _basisMax
```

16.241.4.3 _negbasis

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _negbasis
```

16.241.4.4 _invbasis

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _invbasis
```

16.241.4.5 `_field_rns`

```
std::vector<ModField> _field_rns
```

16.241.4.6 `_M`

```
integer _M
```

16.241.4.7 `_Mi`

```
std::vector<integer> _Mi
```

16.241.4.8 `_MMi`

```
std::vector<double> _MMi
```

16.241.4.9 `_crt_in`

```
std::vector<double> _crt_in
```

16.241.4.10 `_crt_out`

```
std::vector<double> _crt_out
```

16.241.4.11 `_size`

```
size_t _size
```

16.241.4.12 `_pbits`

```
size_t _pbits
```

16.241.4.13 `_ldm`

```
size_t _ldm
```

16.241.4.14 `_mi_sum`

```
integer _mi_sum
```

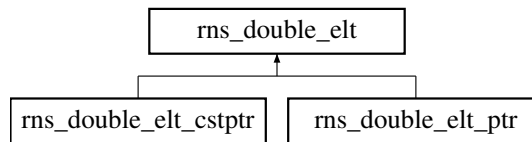
The documentation for this struct was generated from the following files:

- [rns-double.h](#)
- [rns-double-recint.inl](#)
- [rns-double.inl](#)

16.242 `rns_double_elt` Struct Reference

```
#include <rns-double-elt.h>
```

Inheritance diagram for `rns_double_elt`:



Public Member Functions

- [rns_double_elt](#) ()
- [~rns_double_elt](#) ()
- [rns_double_elt](#) (double *p, size_t r, size_t a=false)
- [rns_double_elt_ptr](#) operator& ()
- [rns_double_elt_cstptr](#) operator& () const
- [rns_double_elt](#) (const [rns_double_elt](#) &x)

Data Fields

- double * [_ptr](#)
- size_t [_stride](#)
- bool [_alloc](#)

16.242.1 Constructor & Destructor Documentation

16.242.1.1 [rns_double_elt](#)() [1/3]

```
rns\_double\_elt ( ) [inline]
```

16.242.1.2 [~rns_double_elt](#)()

```
~rns\_double\_elt ( ) [inline]
```

16.242.1.3 [rns_double_elt](#)() [2/3]

```
rns\_double\_elt (
    double * p,
    size_t r,
    size_t a = false ) [inline]
```

16.242.1.4 [rns_double_elt](#)() [3/3]

```
rns\_double\_elt (
    const rns\_double\_elt & x ) [inline]
```

16.242.2 Member Function Documentation

16.242.2.1 [operator&\(\)](#) [1/2]

```
rns\_double\_elt\_ptr operator& ( ) [inline]
```

16.242.2.2 operator&() [2/2]

```
rns_double_elt_cstptr operator& ( ) const [inline]
```

16.242.3 Field Documentation

16.242.3.1 _ptr

```
double* _ptr
```

16.242.3.2 _stride

```
size_t _stride
```

16.242.3.3 _alloc

```
bool _alloc
```

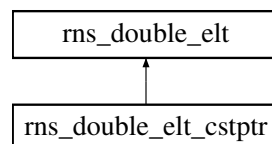
The documentation for this struct was generated from the following file:

- [rns-double-elt.h](#)

16.243 rns_double_elt_cstptr Struct Reference

```
#include <rns-double-elt.h>
```

Inheritance diagram for rns_double_elt_cstptr:



Public Member Functions

- [rns_double_elt_cstptr](#) ()
- [rns_double_elt_cstptr](#) (double *p, size_t r)
- [rns_double_elt_cstptr](#) (const [rns_double_elt_ptr](#) &x)
- [rns_double_elt_cstptr](#) (const [rns_double_elt_cstptr](#) &x)
- [rns_double_elt_cstptr](#) ([rns_double_elt_cstptr](#) &&)=default
- [rns_double_elt_cstptr](#) * [operator&](#) ()
- [rns_double_elt](#) & [operator*](#) () const
- [rns_double_elt](#) [operator\[\]](#) (size_t i) const
- [rns_double_elt](#) & [operator\[\]](#) (size_t i)
- [rns_double_elt_cstptr](#) [operator++](#) ()
- [rns_double_elt_cstptr](#) [operator--](#) ()
- [rns_double_elt_cstptr](#) [operator+](#) (size_t inc) const
- [rns_double_elt_cstptr](#) [operator-](#) (size_t inc) const
- [rns_double_elt_cstptr](#) & [operator+=](#) (size_t inc)
- [rns_double_elt_cstptr](#) & [operator-=](#) (size_t inc)
- [rns_double_elt_cstptr](#) & [operator=](#) (const [rns_double_elt_cstptr](#) &x)
- bool [operator<](#) (const [rns_double_elt_cstptr](#) &x)
- bool [operator!=](#) (const [rns_double_elt_cstptr](#) &x)
- [rns_double_elt_cstptr](#) [operator&](#) () const

Data Fields

- [rns_double_elt](#) other
- double * [_ptr](#)
- size_t [_stride](#)
- bool [_alloc](#)

16.243.1 Constructor & Destructor Documentation

16.243.1.1 rns_double_elt_cstptr() [1/5]

```
rns_double_elt_cstptr ( ) [inline]
```

16.243.1.2 rns_double_elt_cstptr() [2/5]

```
rns_double_elt_cstptr (
    double * p,
    size_t r ) [inline]
```

16.243.1.3 rns_double_elt_cstptr() [3/5]

```
rns_double_elt_cstptr (
    const rns_double_elt_ptr & x ) [inline]
```

16.243.1.4 rns_double_elt_cstptr() [4/5]

```
rns_double_elt_cstptr (
    const rns_double_elt_cstptr & x ) [inline]
```

16.243.1.5 rns_double_elt_cstptr() [5/5]

```
rns_double_elt_cstptr (
    rns_double_elt_cstptr && ) [default]
```

16.243.2 Member Function Documentation

16.243.2.1 operator&() [1/2]

```
rns_double_elt_cstptr * operator& ( ) [inline]
```

16.243.2.2 operator*()

```
rns_double_elt & operator* ( ) const [inline]
```

16.243.2.3 operator[]() [1/2]

```
rns_double_elt operator[] (
    size_t i ) const [inline]
```

16.243.2.4 operator[]() [2/2]

```
rns_double_elt & operator[] (
    size_t i ) [inline]
```

16.243.2.5 operator++()

```
rns_double_elt_cstptr operator++ ( ) [inline]
```

16.243.2.6 operator--()

```
rns_double_elt_cstptr operator-- ( ) [inline]
```

16.243.2.7 operator+()

```
rns_double_elt_cstptr operator+ (
    size_t inc ) const [inline]
```

16.243.2.8 operator-()

```
rns_double_elt_cstptr operator- (
    size_t inc ) const [inline]
```

16.243.2.9 operator+=()

```
rns_double_elt_cstptr & operator+= (
    size_t inc ) [inline]
```

16.243.2.10 operator-=()

```
rns_double_elt_cstptr & operator-= (
    size_t inc ) [inline]
```

16.243.2.11 operator=()

```
rns_double_elt_cstptr & operator= (
    const rns_double_elt_cstptr & x ) [inline]
```

16.243.2.12 operator<()

```
bool operator< (
    const rns_double_elt_cstptr & x ) [inline]
```

16.243.2.13 operator"!="()

```
bool operator!= (
    const rns_double_elt_cstptr & x ) [inline]
```

16.243.2.14 operator&() [2/2]

```
rns_double_elt_cstptr operator& ( ) const [inline], [inherited]
```

16.243.3 Field Documentation

16.243.3.1 other

`rns_double_elt` other

16.243.3.2 _ptr

`double* _ptr` [inherited]

16.243.3.3 _stride

`size_t _stride` [inherited]

16.243.3.4 _alloc

`bool _alloc` [inherited]

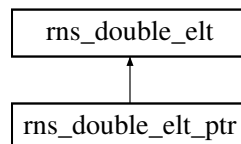
The documentation for this struct was generated from the following file:

- [rns-double-elt.h](#)

16.244 rns_double_elt_ptr Struct Reference

```
#include <rns-double-elt.h>
```

Inheritance diagram for `rns_double_elt_ptr`:



Public Member Functions

- [rns_double_elt_ptr](#) ()
- [rns_double_elt_ptr](#) (double *p, size_t r)
- [rns_double_elt_ptr](#) (const [rns_double_elt_ptr](#) &x)
- [rns_double_elt_ptr](#) (const [rns_double_elt_cstptr](#) &x)
- [rns_double_elt_ptr](#) ([rns_double_elt_ptr](#) &&)=default
- [rns_double_elt_ptr](#) * [operator&](#) ()
- [rns_double_elt](#) & [operator*](#) ()
- [rns_double_elt](#) [operator\[\]](#) (size_t i) const
- [rns_double_elt](#) & [operator\[\]](#) (size_t i)
- [rns_double_elt_ptr](#) [operator++](#) ()
- [rns_double_elt_ptr](#) [operator--](#) ()
- [rns_double_elt_ptr](#) [operator+](#) (size_t inc)
- [rns_double_elt_ptr](#) [operator-](#) (size_t inc)
- [rns_double_elt_ptr](#) & [operator+=](#) (size_t inc)
- [rns_double_elt_ptr](#) & [operator-=](#) (size_t inc)
- [rns_double_elt_ptr](#) & [operator=](#) (const [rns_double_elt_ptr](#) &x)
- bool [operator<](#) (const [rns_double_elt_ptr](#) &x)
- bool [operator!=](#) (const [rns_double_elt_ptr](#) &x)
- [rns_double_elt_cstptr](#) [operator&](#) () const

Data Fields

- [rns_double_elt](#) other
- `double * _ptr`
- `size_t _stride`
- `bool _alloc`

16.244.1 Constructor & Destructor Documentation

16.244.1.1 `rns_double_elt_ptr()` [1/5]

```
rns_double_elt_ptr ( ) [inline]
```

16.244.1.2 `rns_double_elt_ptr()` [2/5]

```
rns_double_elt_ptr (
    double * p,
    size_t r ) [inline]
```

16.244.1.3 `rns_double_elt_ptr()` [3/5]

```
rns_double_elt_ptr (
    const rns\_double\_elt\_ptr & x ) [inline]
```

16.244.1.4 `rns_double_elt_ptr()` [4/5]

```
rns_double_elt_ptr (
    const rns\_double\_elt\_cstptr & x ) [inline]
```

16.244.1.5 `rns_double_elt_ptr()` [5/5]

```
rns_double_elt_ptr (
    rns\_double\_elt\_ptr && ) [default]
```

16.244.2 Member Function Documentation

16.244.2.1 `operator&()` [1/2]

```
rns\_double\_elt\_ptr * operator& ( ) [inline]
```

16.244.2.2 `operator*()`

```
rns\_double\_elt & operator* ( ) [inline]
```

16.244.2.3 `operator[]()` [1/2]

```
rns\_double\_elt operator[] (
    size_t i ) const [inline]
```


16.244.2.4 operator[]() [2/2]

```
rns_double_elt & operator[] (
    size_t i ) [inline]
```

16.244.2.5 operator++()

```
rns_double_elt_ptr operator++ ( ) [inline]
```

16.244.2.6 operator--()

```
rns_double_elt_ptr operator-- ( ) [inline]
```

16.244.2.7 operator+()

```
rns_double_elt_ptr operator+ (
    size_t inc ) [inline]
```

16.244.2.8 operator-()

```
rns_double_elt_ptr operator- (
    size_t inc ) [inline]
```

16.244.2.9 operator+=()

```
rns_double_elt_ptr & operator+= (
    size_t inc ) [inline]
```

16.244.2.10 operator-=()

```
rns_double_elt_ptr & operator-= (
    size_t inc ) [inline]
```

16.244.2.11 operator=()

```
rns_double_elt_ptr & operator= (
    const rns_double_elt_ptr & x ) [inline]
```

16.244.2.12 operator<()

```
bool operator< (
    const rns_double_elt_ptr & x ) [inline]
```

16.244.2.13 operator"!="()

```
bool operator!= (
    const rns_double_elt_ptr & x ) [inline]
```

16.244.2.14 operator&() [2/2]

```
rns_double_elt_cstptr operator& ( ) const [inline], [inherited]
```

16.244.3 Field Documentation

16.244.3.1 other

`rns_double_elt` other

16.244.3.2 _ptr

`double* _ptr` [inherited]

16.244.3.3 _stride

`size_t _stride` [inherited]

16.244.3.4 _alloc

`bool _alloc` [inherited]

The documentation for this struct was generated from the following file:

- [rns-double-elt.h](#)

16.245 rns_double_extended Struct Reference

```
#include <rns-double.h>
```

Public Types

- typedef Givaro::Integer [integer](#)
- typedef Givaro::ModularExtended< double > [ModField](#)
- typedef double [BasisElement](#)
- typedef [rns_double_elt](#) [Element](#)
- typedef [rns_double_elt_ptr](#) [Element_ptr](#)
- typedef [rns_double_elt_cstptr](#) [ConstElement_ptr](#)

Public Member Functions

- [rns_double_extended](#) (const [integer](#) &bound, size_t pbits, bool rnsmod=false, long seed=time(NULL))
- [rns_double_extended](#) (size_t pbits, size_t size, long seed=time(NULL))
- template<typename Vect >
 [rns_double_extended](#) (const Vect &basis, bool rnsmod=false, long seed=time(NULL))
- void [precompute_cst](#) ()
- void [init](#) (size_t m, size_t n, double *Arns, size_t rda, const [integer](#) *A, size_t lda, const [integer](#) &maxA, bool RNS_MAJOR=false) const
- void [init](#) (size_t m, size_t n, double *Arns, size_t rda, const [integer](#) *A, size_t lda, size_t k, bool RNS_MAJOR=false)
- void [convert](#) (size_t m, size_t n, [integer](#) gamma, [integer](#) *A, size_t lda, const double *Arns, size_t rda, bool RNS_MAJOR=false)
- void [init](#) (size_t m, double *Arns, const [integer](#) *A, size_t lda) const
- void [convert](#) (size_t m, [integer](#) *A, const double *Arns) const
- void [reduce](#) (size_t n, double *Arns, size_t rda, bool RNS_MAJOR=false) const

Data Fields

- `std::vector< double, AlignedAllocator< double, Alignment::CACHE_LINE > > _basis`
- `std::vector< double, AlignedAllocator< double, Alignment::CACHE_LINE > > _basisMax`
- `std::vector< double, AlignedAllocator< double, Alignment::CACHE_LINE > > _negbasis`
- `std::vector< double, AlignedAllocator< double, Alignment::CACHE_LINE > > _invbasis`
- `std::vector< ModField > _field_rns`
- `integer _M`
- `std::vector< integer > _Mi`
- `std::vector< double > _MMi`
- `std::vector< double > _crt_in`
- `std::vector< double > _crt_out`
- `size_t _size`
- `size_t _pbits`
- `size_t _ldm`

16.245.1 Member Typedef Documentation

16.245.1.1 integer

```
typedef Givaro::Integer integer
```

16.245.1.2 ModField

```
typedef Givaro::ModularExtended<double> ModField
```

16.245.1.3 BasisElement

```
typedef double BasisElement
```

16.245.1.4 Element

```
typedef rns_double_elt Element
```

16.245.1.5 Element_ptr

```
typedef rns_double_elt_ptr Element_ptr
```

16.245.1.6 ConstElement_ptr

```
typedef rns_double_elt_cstptr ConstElement_ptr
```

16.245.2 Constructor & Destructor Documentation

16.245.2.1 rns_double_extended() [1/3]

```
rns_double_extended (
    const integer & bound,
    size_t pbits,
    bool rnsmod = false,
    long seed = time(NULL) ) [inline]
```

16.245.2.2 rns_double_extended() [2/3]

```
rns_double_extended (
    size_t pbits,
    size_t size,
    long seed = time(NULL) ) [inline]
```

16.245.2.3 rns_double_extended() [3/3]

```
rns_double_extended (
    const Vect & basis,
    bool rnsmod = false,
    long seed = time(NULL) ) [inline]
```

16.245.3 Member Function Documentation**16.245.3.1 precompute_cst()**

```
void precompute_cst ( ) [inline]
```

16.245.3.2 init() [1/3]

```
void init (
    size_t m,
    size_t n,
    double * Arns,
    size_t rda,
    const integer * A,
    size_t lda,
    const integer & maxA,
    bool RNS_MAJOR = false ) const [inline]
```

16.245.3.3 init() [2/3]

```
void init (
    size_t m,
    size_t n,
    double * Arns,
    size_t rda,
    const integer * A,
    size_t lda,
    size_t k,
    bool RNS_MAJOR = false ) [inline]
```

16.245.3.4 convert() [1/2]

```
void convert (
    size_t m,
    size_t n,
    integer gamma,
    integer * A,
    size_t lda,
    const double * Arns,
    size_t rda,
    bool RNS_MAJOR = false ) [inline]
```

16.245.3.5 init() [3/3]

```
void init (
    size_t m,
    double * Arns,
    const integer * A,
    size_t lda ) const [inline]
```

16.245.3.6 convert() [2/2]

```
void convert (
    size_t m,
    integer * A,
    const double * Arns ) const [inline]
```

16.245.3.7 reduce()

```
void reduce (
    size_t n,
    double * Arns,
    size_t rda,
    bool RNS_MAJOR = false ) const [inline]
```

16.245.4 Field Documentation

16.245.4.1 _basis

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _basis
```

16.245.4.2 _basisMax

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _basisMax
```

16.245.4.3 _negbasis

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _negbasis
```

16.245.4.4 `_invbasis`

```
std::vector<double, AlignedAllocator<double, Alignment::CACHE_LINE> > _invbasis
```

16.245.4.5 `_field_rns`

```
std::vector<ModField> _field_rns
```

16.245.4.6 `_M`

```
integer _M
```

16.245.4.7 `_Mi`

```
std::vector<integer> _Mi
```

16.245.4.8 `_MMi`

```
std::vector<double> _MMi
```

16.245.4.9 `_crt_in`

```
std::vector<double> _crt_in
```

16.245.4.10 `_crt_out`

```
std::vector<double> _crt_out
```

16.245.4.11 `_size`

```
size_t _size
```

16.245.4.12 `_pbits`

```
size_t _pbits
```

16.245.4.13 `_ldm`

```
size_t _ldm
```

The documentation for this struct was generated from the following files:

- [rns-double.h](#)
- [rns-double.inl](#)

16.246 RNSElementTag Struct Reference

Representation in a Residue Number System.

```
#include <field-traits.h>
```

16.246.1 Detailed Description

Representation in a Residue Number System.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.247 RNSInteger< RNS > Class Template Reference

```
#include <rns-integer.h>
```

Data Structures

- class [RandIter](#)

Public Types

- typedef [RNS::Element](#) [Element](#)
- typedef [RNS::Element_ptr](#) [Element_ptr](#)
- typedef [RNS::ConstElement_ptr](#) [ConstElement_ptr](#)

Public Member Functions

- [RNSInteger](#) (const [RNS](#) &myrns)
- template<typename T >
 [RNSInteger](#) (const T &F)
- const [RNS](#) & [rns](#) () const
- size_t [size](#) () const
- bool [isOne](#) (const [Element](#) &x) const
- bool [isMOne](#) (const [Element](#) &x) const
- bool [isZero](#) (const [Element](#) &x) const
- integer [characteristic](#) ([integer](#) &p) const
- integer [cardinality](#) ([integer](#) &p) const
- [Element](#) & [init](#) ([Element](#) &x) const
- [Element](#) & [init](#) ([Element](#) &x, const Givaro::Integer &y) const
- [Element](#) & [reduce](#) ([Element](#) &x, const [Element](#) &y) const
- [Element](#) & [reduce](#) ([Element](#) &x) const
- Givaro::Integer [convert](#) (Givaro::Integer &x, const [Element](#) &y) const
- [Element](#) & [assign](#) ([Element](#) &x, const [Element](#) &y) const
- std::ostream & [write](#) (std::ostream &os, const [Element](#) &y) const
- std::ostream & [write](#) (std::ostream &os) const

Data Fields

- [Element](#) [one](#)
- [Element](#) [mOne](#)
- [Element](#) [zero](#)

Protected Types

- typedef [RNS::BasisElement](#) [BasisElement](#)
- typedef Givaro::Integer [integer](#)

Protected Attributes

- const [RNS](#) * [_rns](#)

16.247.1 Member Typedef Documentation

16.247.1.1 BasisElement

```
typedef RNS::BasisElement BasisElement [protected]
```

16.247.1.2 integer

```
typedef Givaro::Integer integer [protected]
```

16.247.1.3 Element

```
typedef RNS::Element Element
```

16.247.1.4 Element_ptr

```
typedef RNS::Element_ptr Element_ptr
```

16.247.1.5 ConstElement_ptr

```
typedef RNS::ConstElement_ptr ConstElement_ptr
```

16.247.2 Constructor & Destructor Documentation

16.247.2.1 RNSInteger() [1/2]

```
RNSInteger (
    const RNS & myrns ) [inline]
```

16.247.2.2 RNSInteger() [2/2]

```
RNSInteger (
    const T & F ) [inline]
```

16.247.3 Member Function Documentation

16.247.3.1 rns()

```
const RNS & rns ( ) const [inline]
```

16.247.3.2 size()

```
size_t size ( ) const [inline]
```


16.247.3.3 isOne()

```
bool isOne (
    const Element & x ) const [inline]
```

16.247.3.4 isMOne()

```
bool isMOne (
    const Element & x ) const [inline]
```

16.247.3.5 isZero()

```
bool isZero (
    const Element & x ) const [inline]
```

16.247.3.6 characteristic()

```
integer characteristic (
    integer & p ) const [inline]
```

16.247.3.7 cardinality()

```
integer cardinality (
    integer & p ) const [inline]
```

16.247.3.8 init() [1/2]

```
Element & init (
    Element & x ) const [inline]
```

16.247.3.9 init() [2/2]

```
Element & init (
    Element & x,
    const Givaro::Integer & y ) const [inline]
```

16.247.3.10 reduce() [1/2]

```
Element & reduce (
    Element & x,
    const Element & y ) const [inline]
```

16.247.3.11 reduce() [2/2]

```
Element & reduce (
    Element & x ) const [inline]
```

16.247.3.12 convert()

```
Givaro::Integer convert (
    Givaro::Integer & x,
    const Element & y ) const [inline]
```

16.247.3.13 assign()

```
Element & assign (
    Element & x,
    const Element & y ) const [inline]
```

16.247.3.14 write() [1/2]

```
std::ostream & write (
    std::ostream & os,
    const Element & y ) const [inline]
```

16.247.3.15 write() [2/2]

```
std::ostream & write (
    std::ostream & os ) const [inline]
```

16.247.4 Field Documentation**16.247.4.1 _rns**

```
const RNS* _rns [protected]
```

16.247.4.2 one

```
Element one
```

16.247.4.3 mOne

```
Element mOne
```

16.247.4.4 zero

```
Element zero
```

The documentation for this class was generated from the following files:

- [field-traits.h](#)
- [rns-integer.h](#)

16.248 RNSIntegerMod< RNS > Class Template Reference

```
#include <rns-integer-mod.h>
```

Data Structures

- class [RandIter](#)

Public Types

- typedef [RNS::Element](#) [Element](#)
- typedef [RNS::Element_ptr](#) [Element_ptr](#)
- typedef [RNS::ConstElement_ptr](#) [ConstElement_ptr](#)

Public Member Functions

- [RNSIntegerMod](#) (const [integer](#) &p, const [RNS](#) &myrns)
- const [rns_double](#) &[rns](#) () const
- const [RNSInteger](#)< [RNS](#) > &[delayed](#) () const
- [size_t](#) [size](#) () const
- bool [isOne](#) (const [Element](#) &x) const
- bool [isMOne](#) (const [Element](#) &x) const
- bool [isZero](#) (const [Element](#) &x) const
- [integer](#) &[characteristic](#) ([integer](#) &p) const
- [integer](#) [characteristic](#) () const
- [integer](#) &[cardinality](#) ([integer](#) &p) const
- [integer](#) [cardinality](#) () const
- [integer](#) [minElement](#) () const
- [integer](#) [maxElement](#) () const
- [Element](#) &[init](#) ([Element](#) &x) const
- [Element](#) &[init](#) ([Element](#) &x, const Givaro::Integer &y) const
- [Element](#) &[reduce](#) ([Element](#) &x, const [Element](#) &y) const
- [Element](#) &[reduce](#) ([Element](#) &x) const
- [Element](#) &[init](#) ([Element](#) &x, const [Element](#) &y) const
- Givaro::Integer [convert](#) (Givaro::Integer &x, const [Element](#) &y) const
- [Element](#) &[assign](#) ([Element](#) &x, const [Element](#) &y) const
- [Element](#) &[add](#) ([Element](#) &x, const [Element](#) &y, const [Element](#) &z) const
- [Element](#) &[sub](#) ([Element](#) &x, const [Element](#) &y, const [Element](#) &z) const
- [Element](#) &[neg](#) ([Element](#) &x, const [Element](#) &y) const
- [Element](#) &[mul](#) ([Element](#) &x, const [Element](#) &y, const [Element](#) &z) const
- [Element](#) &[axpyin](#) ([Element](#) &x, const [Element](#) &y, const [Element](#) &z) const
- [Element](#) &[inv](#) ([Element](#) &x, const [Element](#) &y) const
- bool [areEqual](#) (const [Element](#) &x, const [Element](#) &y) const
- std::ostream &[write](#) (std::ostream &os, const [Element](#) &y) const
- std::ostream &[write](#) (std::ostream &os) const
- void [reduce_modp](#) ([size_t](#) n, [Element_ptr](#) B) const
- std::ostream &[write_matrix](#) (std::ostream &c, const double *E, int n, int m, int lda) const
- std::ostream &[write_matrix_long](#) (std::ostream &c, const double *E, int n, int m, int lda) const
- void [reduce_modp](#) ([size_t](#) m, [size_t](#) n, [Element_ptr](#) B, [size_t](#) lda) const
- void [reduce_modp_rnsmajor](#) ([size_t](#) n, [Element_ptr](#) B) const

Data Fields

- [Element](#) [one](#)
- [Element](#) [mOne](#)
- [Element](#) [zero](#)

Protected Types

- typedef [RNS::BasisElement](#) [BasisElement](#)
- typedef Givaro::Modular< [BasisElement](#) > [ModField](#)
- typedef Givaro::Integer [integer](#)

Protected Attributes

- `integer _p`
- `std::vector< BasisElement, AlignedAllocator< BasisElement, Alignment::CACHE_LINE > > _Mi_modp_rns`
- `std::vector< BasisElement, AlignedAllocator< BasisElement, Alignment::CACHE_LINE > > _iM_modp_rns`
- `const RNS * _rns`
- `Givaro::Modular< Givaro::Integer > _F`
- `RNSInteger< RNS > _RNSdelayed`

16.248.1 Member Typedef Documentation

16.248.1.1 Element

```
typedef RNS::Element Element
```

16.248.1.2 Element_ptr

```
typedef RNS::Element\_ptr Element_ptr
```

16.248.1.3 ConstElement_ptr

```
typedef RNS::ConstElement\_ptr ConstElement_ptr
```

16.248.1.4 BasisElement

```
typedef RNS::BasisElement BasisElement [protected]
```

16.248.1.5 ModField

```
typedef Givaro::Modular<BasisElement> ModField [protected]
```

16.248.1.6 integer

```
typedef Givaro::Integer integer [protected]
```

16.248.2 Constructor & Destructor Documentation

16.248.2.1 RNSIntegerMod()

```
RNSIntegerMod (
    const integer & p,
    const RNS & myrns ) [inline]
```

16.248.3 Member Function Documentation

16.248.3.1 rns()

```
const rns\_double & rns ( ) const [inline]
```

16.248.3.2 delayed()

```
const RNSInteger< RNS > & delayed ( ) const [inline]
```

16.248.3.3 size()

```
size_t size ( ) const [inline]
```

16.248.3.4 isOne()

```
bool isOne (
    const Element & x ) const [inline]
```

16.248.3.5 isMOne()

```
bool isMOne (
    const Element & x ) const [inline]
```

16.248.3.6 isZero()

```
bool isZero (
    const Element & x ) const [inline]
```

16.248.3.7 characteristic() [1/2]

```
integer & characteristic (
    integer & p ) const [inline]
```

16.248.3.8 characteristic() [2/2]

```
integer characteristic ( ) const [inline]
```

16.248.3.9 cardinality() [1/2]

```
integer & cardinality (
    integer & p ) const [inline]
```

16.248.3.10 cardinality() [2/2]

```
integer cardinality ( ) const [inline]
```

16.248.3.11 minElement()

```
integer minElement ( ) const [inline]
```

16.248.3.12 maxElement()

```
integer maxElement ( ) const [inline]
```

16.248.3.13 init() [1/3]

```
Element & init (  
    Element & x ) const [inline]
```

16.248.3.14 init() [2/3]

```
Element & init (  
    Element & x,  
    const Givaro::Integer & y ) const [inline]
```

16.248.3.15 reduce() [1/2]

```
Element & reduce (  
    Element & x,  
    const Element & y ) const [inline]
```

16.248.3.16 reduce() [2/2]

```
Element & reduce (  
    Element & x ) const [inline]
```

16.248.3.17 init() [3/3]

```
Element & init (  
    Element & x,  
    const Element & y ) const [inline]
```

16.248.3.18 convert()

```
Givaro::Integer convert (  
    Givaro::Integer & x,  
    const Element & y ) const [inline]
```

16.248.3.19 assign()

```
Element & assign (  
    Element & x,  
    const Element & y ) const [inline]
```

16.248.3.20 add()

```
Element & add (  
    Element & x,  
    const Element & y,  
    const Element & z ) const [inline]
```

16.248.3.21 sub()

```
Element & sub (  
    Element & x,
```

```
const Element & y,
const Element & z ) const [inline]
```

16.248.3.22 neg()

```
Element & neg (
    Element & x,
    const Element & y ) const [inline]
```

16.248.3.23 mul()

```
Element & mul (
    Element & x,
    const Element & y,
    const Element & z ) const [inline]
```

16.248.3.24 axpyin()

```
Element & axpyin (
    Element & x,
    const Element & y,
    const Element & z ) const [inline]
```

16.248.3.25 inv()

```
Element & inv (
    Element & x,
    const Element & y ) const [inline]
```

16.248.3.26 areEqual()

```
bool areEqual (
    const Element & x,
    const Element & y ) const [inline]
```

16.248.3.27 write() [1/2]

```
std::ostream & write (
    std::ostream & os,
    const Element & y ) const [inline]
```

16.248.3.28 write() [2/2]

```
std::ostream & write (
    std::ostream & os ) const [inline]
```

16.248.3.29 reduce_modp() [1/2]

```
void reduce_modp (
    size_t n,
    Element_ptr B ) const [inline]
```

16.248.3.30 write_matrix()

```
std::ostream & write_matrix (
    std::ostream & c,
    const double * E,
    int n,
    int m,
    int lda ) const [inline]
```

16.248.3.31 write_matrix_long()

```
std::ostream & write_matrix_long (
    std::ostream & c,
    const double * E,
    int n,
    int m,
    int lda ) const [inline]
```

16.248.3.32 reduce_modp() [2/2]

```
void reduce_modp (
    size_t m,
    size_t n,
    Element_ptr B,
    size_t lda ) const [inline]
```

16.248.3.33 reduce_modp_rnsmajor()

```
void reduce_modp_rnsmajor (
    size_t n,
    Element_ptr B ) const [inline]
```

16.248.4 Field Documentation**16.248.4.1 _p**

```
integer _p [protected]
```

16.248.4.2 _Mi_modp_rns

```
std::vector<BasisElement, AlignedAllocator<BasisElement, Alignment::CACHE_LINE> > _Mi_modp_↵
rns [protected]
```

16.248.4.3 _iM_modp_rns

```
std::vector<BasisElement, AlignedAllocator<BasisElement, Alignment::CACHE_LINE> > _iM_modp_↵
rns [protected]
```

16.248.4.4 _rns

```
const RNS* _rns [protected]
```


16.248.4.5 `_F`

```
Givaro::Modular<Givaro::Integer> _F [protected]
```

16.248.4.6 `_RNSdelayed`

```
RNSInteger<RNS> _RNSdelayed [protected]
```

16.248.4.7 `one`

```
Element one
```

16.248.4.8 `mOne`

```
Element mOne
```

16.248.4.9 `zero`

```
Element zero
```

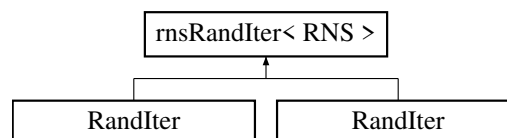
The documentation for this class was generated from the following files:

- [field-traits.h](#)
- [rns-integer-mod.h](#)

16.249 `rnsRandIter< RNS >` Class Template Reference

```
#include <rns-double.h>
```

Inheritance diagram for `rnsRandIter< RNS >`:



Public Member Functions

- `rnsRandIter` (const [RNS](#) &R, `size_t` size=0, `uint64_t` seed=0)
- `RNS::Element & random` (typename [RNS::Element](#) &elt) const
RNS ring Element random assignement.
- `RNS::Element & operator()` (typename [RNS::Element](#) &elt) const
- `RNS::Element operator()` () const
- `RNS::Element random` () const
- `const RNS & ring` () const

16.249.1 Constructor & Destructor Documentation

16.249.1.1 `rnsRandIter()`

```
rnsRandIter (
    const RNS & R,
    size_t size = 0,
    uint64_t seed = 0 ) [inline]
```

16.249.2 Member Function Documentation

16.249.2.1 random() [1/2]

```
RNS::Element & random (
    typename RNS::Element & elt ) const [inline]
```

RNS ring Element random assignment.

Element is supposed to be initialized

Returns

random ring Element

16.249.2.2 operator>() [1/2]

```
RNS::Element & operator() (
    typename RNS::Element & elt ) const [inline]
```

16.249.2.3 operator>() [2/2]

```
RNS::Element operator() ( ) const [inline]
```

16.249.2.4 random() [2/2]

```
RNS::Element random ( ) const [inline]
```

16.249.2.5 ring()

```
const RNS & ring ( ) const [inline]
```

The documentation for this class was generated from the following file:

- [rns-double.h](#)

16.250 Row Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.251 ruint< K > Class Template Reference

The documentation for this class was generated from the following file:

- [field-traits.h](#)

16.252 ScalFunctions< Element, Enable > Struct Template Reference

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

16.253 ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type > Struct Template Reference

Static Public Member Functions

- static Element [zero](#) ()
- static Element [vand](#) (Element x1, Element x2)
- static Element [vor](#) (Element x1, Element x2)
- static Element [vxor](#) (Element x1, Element x2)
- static Element [vandnot](#) (Element x1, Element x2)
- static Element [ceil](#) (Element x)
- static Element [floor](#) (Element x)
- static Element [round](#) (Element x)
- static Element [add](#) (Element x1, Element x2)
- static Element [addin](#) (Element &x1, Element x2)
- static Element [sub](#) (Element x1, Element x2)
- static Element [subin](#) (Element &x1, Element x2)
- static Element [mul](#) (Element x1, Element x2)
- static Element [mulin](#) (Element &x1, Element x2)
- static Element [div](#) (Element x1, Element x2)
- static Element [fmadd](#) (Element x1, Element x2, Element x3)
- static Element [fmaddin](#) (Element &x1, Element x2, Element x3)
- static Element [fmsub](#) (Element x1, Element x2, Element x3)
- static Element [fmsubin](#) (Element &x1, Element x2, Element x3)
- static Element [fnmadd](#) (Element x1, Element x2, Element x3)
- static Element [fnmaddin](#) (Element &x1, Element x2, Element x3)
- static Element [lesser](#) (Element x1, Element x2)
- static Element [lesser_eq](#) (Element x1, Element x2)
- static Element [greater](#) (Element x1, Element x2)
- static Element [greater_eq](#) (Element x1, Element x2)
- static Element [eq](#) (Element x1, Element x2)

16.253.1 Member Function Documentation

16.253.1.1 zero()

```
static Element zero ( ) [inline], [static]
```

16.253.1.2 vand()

```
static Element vand (
    Element x1,
    Element x2 ) [inline], [static]
```

16.253.1.3 vor()

```
static Element vor (
    Element x1,
    Element x2 ) [inline], [static]
```

16.253.1.4 vxor()

```
static Element vxor (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.253.1.5 vandnot()

```
static Element vandnot (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.253.1.6 ceil()

```
static Element ceil (  
    Element x ) [inline], [static]
```

16.253.1.7 floor()

```
static Element floor (  
    Element x ) [inline], [static]
```

16.253.1.8 round()

```
static Element round (  
    Element x ) [inline], [static]
```

16.253.1.9 add()

```
static Element add (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.253.1.10 addin()

```
static Element addin (  
    Element & x1,  
    Element x2 ) [inline], [static]
```

16.253.1.11 sub()

```
static Element sub (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.253.1.12 subin()

```
static Element subin (  
    Element & x1,  
    Element x2 ) [inline], [static]
```

16.253.1.13 mul()

```
static Element mul (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.253.1.14 mulin()

```
static Element mulin (  
    Element & x1,  
    Element x2 ) [inline], [static]
```

16.253.1.15 div()

```
static Element div (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.253.1.16 fmadd()

```
static Element fmadd (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.253.1.17 fmaddin()

```
static Element fmaddin (  
    Element & x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.253.1.18 fmsub()

```
static Element fmsub (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.253.1.19 fmsubin()

```
static Element fmsubin (  
    Element & x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.253.1.20 fnmadd()

```
static Element fnmadd (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.253.1.21 fnmaddin()

```
static Element fnmaddin (
    Element & x1,
    Element x2,
    Element x3 ) [inline], [static]
```

16.253.1.22 lesser()

```
static Element lesser (
    Element x1,
    Element x2 ) [inline], [static]
```

16.253.1.23 lesser_eq()

```
static Element lesser_eq (
    Element x1,
    Element x2 ) [inline], [static]
```

16.253.1.24 greater()

```
static Element greater (
    Element x1,
    Element x2 ) [inline], [static]
```

16.253.1.25 greater_eq()

```
static Element greater_eq (
    Element x1,
    Element x2 ) [inline], [static]
```

16.253.1.26 eq()

```
static Element eq (
    Element x1,
    Element x2 ) [inline], [static]
```

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

16.254 ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type > Struct Template Reference

Static Public Member Functions

- static Element [zero](#) ()
- static Element [round](#) (Element x)
- static Element [vand](#) (Element x1, Element x2)
- static Element [vor](#) (Element x1, Element x2)
- static Element [vxor](#) (Element x1, Element x2)
- static Element [vandnot](#) (Element x1, Element x2)
- static Element [add](#) (Element x1, Element x2)
- static Element [addin](#) (Element &x1, Element x2)

- static Element [sub](#) (Element x1, Element x2)
- static Element [subin](#) (Element &x1, Element x2)
- static Element [mul](#) (Element x1, Element x2)
- static Element [mullo](#) (Element x1, Element x2)
- static Element [mulhi](#) (Element x1, Element x2)
- static Element [mulx](#) (Element x1, Element x2)
- static Element [fmadd](#) (Element x1, Element x2, Element x3)
- static Element [fmaddin](#) (Element &x1, Element x2, Element x3)
- static Element [fmaddx](#) (Element x1, Element x2, Element x3)
- static Element [fmaddxin](#) (Element &x1, Element x2, Element x3)
- static Element [fmsub](#) (Element x1, Element x2, Element x3)
- static Element [fmsubin](#) (Element &x1, Element x2, Element x3)
- static Element [fmsubx](#) (Element x1, Element x2, Element x3)
- static Element [fmsubxin](#) (Element &x1, Element x2, Element x3)
- static Element [fnmadd](#) (Element x1, Element x2, Element x3)
- static Element [fnmaddin](#) (Element &x1, Element x2, Element x3)
- static Element [fnmaddx](#) (Element x1, Element x2, Element x3)
- static Element [fnmaddxin](#) (Element &x1, Element x2, Element x3)
- template<int s, bool EnableTrue = true>
static enable_if<is_signed< Element >::value &&EnableTrue, Element >::type [sra](#) (Element x1)
- template<int s, bool EnableTrue = true>
static enable_if< is_signed< Element >::value &&EnableTrue, Element >::type [sra](#) (Element x1)
- template<int s>
static Element [srl](#) (Element x1)
- template<int s>
static Element [sll](#) (Element x1)
- static Element [lesser](#) (Element x1, Element x2)
- static Element [lesser_eq](#) (Element x1, Element x2)
- static Element [greater](#) (Element x1, Element x2)
- static Element [greater_eq](#) (Element x1, Element x2)
- static Element [eq](#) (Element x1, Element x2)

16.254.1 Member Function Documentation

16.254.1.1 zero()

```
static Element zero ( ) [inline], [static]
```

16.254.1.2 round()

```
static Element round (  
    Element x ) [inline], [static]
```

16.254.1.3 vand()

```
static Element vand (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.4 vor()

```
static Element vor (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.5 vxor()

```
static Element vxor (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.6 vandnot()

```
static Element vandnot (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.7 add()

```
static Element add (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.8 addin()

```
static Element addin (  
    Element & x1,  
    Element x2 ) [inline], [static]
```

16.254.1.9 sub()

```
static Element sub (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.10 subin()

```
static Element subin (  
    Element & x1,  
    Element x2 ) [inline], [static]
```

16.254.1.11 mul()

```
static Element mul (  
    Element x1,  
    Element x2 ) [inline], [static]
```


16.254.1.12 mullo()

```
static Element mullo (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.13 mulhi()

```
static Element mulhi (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.14 mulx()

```
static Element mulx (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.15 fmadd()

```
static Element fmadd (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.16 fmaddin()

```
static Element fmaddin (  
    Element & x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.17 fmaddx()

```
static Element fmaddx (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.18 fmaddxin()

```
static Element fmaddxin (  
    Element & x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.19 fmsub()

```
static Element fmsub (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.20 fmsubin()

```
static Element fmsubin (  
    Element & x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.21 fmsubx()

```
static Element fmsubx (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.22 fmsubxin()

```
static Element fmsubxin (  
    Element & x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.23 fnmadd()

```
static Element fnmadd (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.24 fnmaddin()

```
static Element fnmaddin (  
    Element & x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.25 fnmaddx()

```
static Element fnmaddx (  
    Element x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.26 fnmaddxin()

```
static Element fnmaddxin (  
    Element & x1,  
    Element x2,  
    Element x3 ) [inline], [static]
```

16.254.1.27 sra() [1/2]

```
static enable_if<!is_signed< Element >::value &&EnableTrue, Element >::type sra (  
    Element x1 ) [inline], [static]
```

16.254.1.28 sra() [2/2]

```
static enable_if< is_signed< Element >::value &&EnableTrue, Element >::type sra (  
    Element x1 ) [inline], [static]
```

16.254.1.29 srl()

```
static Element srl (  
    Element x1 ) [inline], [static]
```

16.254.1.30 sll()

```
static Element sll (  
    Element x1 ) [inline], [static]
```

16.254.1.31 lesser()

```
static Element lesser (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.32 lesser_eq()

```
static Element lesser_eq (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.33 greater()

```
static Element greater (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.34 greater_eq()

```
static Element greater_eq (  
    Element x1,  
    Element x2 ) [inline], [static]
```

16.254.1.35 eq()

```
static Element eq (  
    Element x1,  
    Element x2 ) [inline], [static]
```

The documentation for this struct was generated from the following file:

- [test-simd.C](#)

16.255 Sequential Struct Reference

Public Member Functions

- [Sequential](#) ()
- [Sequential](#) (size_t nth)
- template<class Cut, class Param >
[Sequential](#) ([Parallel](#)< Cut, Param > &)
- size_t [numthreads](#) () const

Friends

- std::ostream & [operator<<](#) (std::ostream &out, const [Sequential](#) &)

16.255.1 Constructor & Destructor Documentation

16.255.1.1 Sequential() [1/3]

```
Sequential ( ) [inline]
```

16.255.1.2 Sequential() [2/3]

```
Sequential (
    size_t nth ) [inline]
```

16.255.1.3 Sequential() [3/3]

```
Sequential (
    Parallel< Cut, Param > & ) [inline]
```

16.255.2 Member Function Documentation

16.255.2.1 numthreads()

```
size_t numthreads ( ) const [inline]
```

16.255.3 Friends And Related Function Documentation

16.255.3.1 operator<<

```
std::ostream & operator<< (
    std::ostream & out,
    const Sequential & ) [friend]
```

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

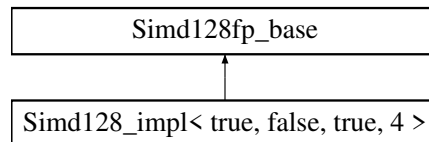
16.256 Simd128_impl< ArithType, Int, Signed, Size > Struct Template Reference

The documentation for this struct was generated from the following file:

- [simd128.inl](#)

16.257 Simd128_impl< true, false, true, 4 > Struct Reference

Inheritance diagram for Simd128_impl< true, false, true, 4 >:



Static Public Member Functions

- static const std::string [type_string](#) ()

16.257.1 Member Function Documentation

16.257.1.1 type_string()

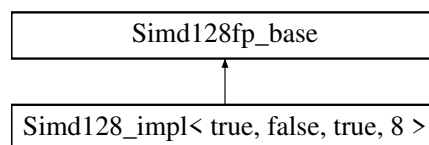
```
static const std::string type_string ( ) [inline], [static], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd128_float.inl](#)

16.258 Simd128_impl< true, false, true, 8 > Struct Reference

Inheritance diagram for Simd128_impl< true, false, true, 8 >:



Static Public Member Functions

- static const std::string [type_string](#) ()

16.258.1 Member Function Documentation

16.258.1.1 type_string()

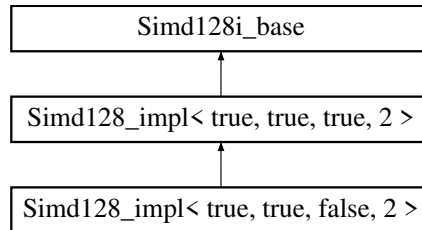
```
static const std::string type_string ( ) [inline], [static], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd128_double.inl](#)

16.259 Simd128_impl< true, true, false, 2 > Struct Reference

Inheritance diagram for Simd128_impl< true, true, false, 2 >:



Data Structures

- union [Converter](#)

Public Types

- using [scalar_t](#) = [uint16_t](#)
- using [vect_t](#) = [__m128i](#)

Static Public Member Functions

- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1, const [scalar_t](#) x2, const [scalar_t](#) x3, const [scalar_t](#) x4, const [scalar_t](#) x5, const [scalar_t](#) x6, const [scalar_t](#) x7)
- template<class T >
static [INLINE PURE vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- static [INLINE PURE vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE void store](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST vect_t sra](#) (const [vect_t](#) a)
- static [INLINE CONST vect_t greater](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t lesser](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t greater_eq](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t lesser_eq](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t mulhi](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t mulx](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fmaddx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fmaddxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fnmaddx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fnmaddxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fmsubx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fmsubxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST scalar_t hadd_to_scal](#) (const [vect_t](#) a)
- template<class T >
static constexpr bool [valid](#) (T *p)
- template<class T >
static constexpr bool [compliant](#) (T n)
- template<int s>
static [INLINE CONST vect_t sll](#) (const [vect_t](#) a)
- template<int s>
static [INLINE CONST vect_t srl](#) (const [vect_t](#) a)

- `template<uint32_t s>`
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- `template<uint8_t s>`
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmadddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `__m64` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()
- `template<uint8_t s>`
static `INLINE CONST vect_t sll128` (const `vect_t` a)
- `template<uint8_t s>`
static `INLINE CONST vect_t srl128` (const `vect_t` a)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)

Static Public Attributes

- static const constexpr size_t `vect_size` = 8
- static const constexpr size_t `alignment` = 16

16.259.1 Member Typedef Documentation

16.259.1.1 scalar_t

```
using scalar_t = uint16_t
```

16.259.1.2 vect_t

```
using vect_t = __m128i [inherited]
```

16.259.2 Member Function Documentation

16.259.2.1 set1()

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.259.2.2 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4,  
    const scalar_t x5,  
    const scalar_t x6,  
    const scalar_t x7 ) [inline], [static]
```

16.259.2.3 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.259.2.4 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.259.2.5 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.259.2.6 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.259.2.7 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.259.2.8 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```


16.259.2.9 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.259.2.10 greater()

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.259.2.11 lesser()

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.259.2.12 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.13 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.14 mulhi()

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.15 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.16 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.17 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,
```

```
const vect_t a,  
const vect_t b ) [inline], [static]
```

16.259.2.18 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.19 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.20 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.21 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.259.2.22 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.259.2.23 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr], [inherited]
```

16.259.2.24 compliant()

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr], [inherited]
```

16.259.2.25 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static], [inherited]
```

16.259.2.26 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static], [inherited]
```

16.259.2.27 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static], [inherited]
```

16.259.2.28 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.29 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.30 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.31 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.32 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.33 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.34 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.35 mullo()

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.36 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.37 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.38 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.39 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.40 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.41 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.42 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.43 eq()

```
static INLINE CONST vect_t eq (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.44 round()

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static], [inherited]
```

16.259.2.45 mod()

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const __m64 & INV_P,
    const vect_t & NEG_P,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T ) [inline], [static], [inherited]
```

16.259.2.46 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.259.2.47 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.259.2.48 sll128()

```
static INLINE CONST vect_t sll128 (
    const vect_t a ) [inline], [static], [inherited]
```

16.259.2.49 srl128()

```
static INLINE CONST vect_t srl128 (
    const vect_t a ) [inline], [static], [inherited]
```

16.259.2.50 vand()

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.51 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.52 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.259.2.53 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.259.3 Field Documentation**16.259.3.1 vect_size**

```
const constexpr size_t vect_size = 8 [static], [constexpr], [inherited]
```

16.259.3.2 alignment

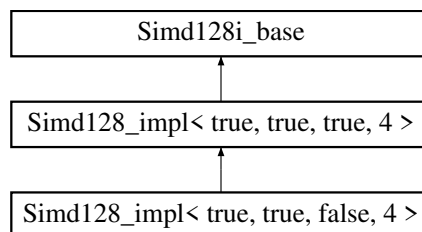
```
const constexpr size_t alignment = 16 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd128_int16.inl](#)

16.260 Simd128_impl< true, true, false, 4 > Struct Reference

Inheritance diagram for Simd128_impl< true, true, false, 4 >:

**Data Structures**

- union [Converter](#)

Public Types

- using [scalar_t](#) = uint32_t
- using [vect_t](#) = __m128i

Static Public Member Functions

- static `INLINE CONST vect_t set1` (const `scalar_t` x)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3)
- template<class T >
 - static `INLINE PURE vect_t gather` (const `scalar_t` *const p, const T *const idx)
- static `INLINE PURE vect_t load` (const `scalar_t` *const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` *const p)
- static `INLINE void store` (`scalar_t` *p, `vect_t` v)
- static `INLINE void storeu` (`scalar_t` *p, `vect_t` v)
- static `INLINE void stream` (`scalar_t` *p, const `vect_t` v)
- template<int s>
 - static `INLINE CONST vect_t sra` (const `vect_t` a)
- static `INLINE CONST vect_t greater` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t lesser` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- template<class T >
 - static constexpr bool `valid` (T *p)
- template<class T >
 - static constexpr bool `compliant` (T n)
- template<int s>
 - static `INLINE CONST vect_t sll` (const `vect_t` a)
- template<int s>
 - static `INLINE CONST vect_t srl` (const `vect_t` a)
- template<uint8_t s>
 - static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- template<uint8_t s>
 - static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `vect_t` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)

- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()
- template<uint8_t s>
static `INLINE CONST vect_t sll128` (const `vect_t` a)
- template<uint8_t s>
static `INLINE CONST vect_t srl128` (const `vect_t` a)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)

Static Public Attributes

- static const constexpr size_t `vect_size` = 4
- static const constexpr size_t `alignment` = 16

16.260.1 Member Typedef Documentation

16.260.1.1 scalar_t

```
using scalar_t = uint32_t
```

16.260.1.2 vect_t

```
using vect_t = __m128i [inherited]
```

16.260.2 Member Function Documentation

16.260.2.1 set1()

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.260.2.2 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3 ) [inline], [static]
```

16.260.2.3 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.260.2.4 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```


16.260.2.5 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.260.2.6 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.260.2.7 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.260.2.8 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.260.2.9 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.260.2.10 greater()

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.260.2.11 lesser()

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.260.2.12 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.13 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.14 mulhi()

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.15 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.16 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.17 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.18 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.19 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.20 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.21 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.260.2.22 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.260.2.23 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr], [inherited]
```

16.260.2.24 compliant()

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr], [inherited]
```

16.260.2.25 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static], [inherited]
```

16.260.2.26 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static], [inherited]
```

16.260.2.27 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static], [inherited]
```

16.260.2.28 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.29 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.30 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.31 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.32 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.33 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.34 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.35 mullo()

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.36 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.37 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.38 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.39 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.40 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.41 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.42 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.43 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.44 round()

```
static INLINE CONST vect_t round (  
    const vect_t a ) [inline], [static], [inherited]
```

16.260.2.45 mod()

```
static INLINE vect_t mod (  
    vect_t & C,  
    const vect_t & P,  
    const vect_t & INVP,  
    const vect_t & NEGP,  
    const vect_t & MIN,  
    const vect_t & MAX,  
    vect_t & Q,  
    vect_t & T ) [inline], [static], [inherited]
```

16.260.2.46 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.260.2.47 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.260.2.48 sll128()

```
static INLINE CONST vect_t sll128 (  
    const vect_t a ) [inline], [static], [inherited]
```

16.260.2.49 srl128()

```
static INLINE CONST vect_t srl128 (  
    const vect_t a ) [inline], [static], [inherited]
```

16.260.2.50 vand()

```
static INLINE CONST vect_t vand (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.51 vor()

```
static INLINE CONST vect_t vor (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.52 vxor()

```
static INLINE CONST vect_t vxor (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.2.53 vandnot()

```
static INLINE CONST vect_t vandnot (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.260.3 Field Documentation

16.260.3.1 vect_size

```
const constexpr size_t vect_size = 4 [static], [constexpr], [inherited]
```

16.260.3.2 alignment

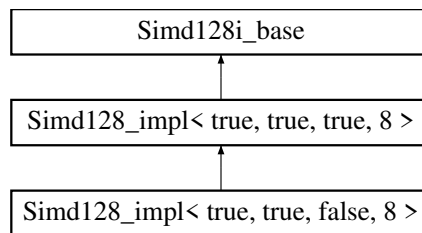
```
const constexpr size_t alignment = 16 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd128_int32.inl](#)

16.261 Simd128_impl< true, true, false, 8 > Struct Reference

Inheritance diagram for Simd128_impl< true, true, false, 8 >:



Data Structures

- union [Converter](#)

Public Types

- using [scalar_t](#) = [uint64_t](#)
- using [vect_t](#) = [__m128i](#)

Static Public Member Functions

- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1)
- template<class T >
static [INLINE PURE vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- static [INLINE PURE vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE void store](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST vect_t sra](#) (const [vect_t](#) a)
- static [INLINE CONST vect_t greater](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t lesser](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t greater_eq](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t lesser_eq](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t mullo](#) (const [vect_t](#) x0, const [vect_t](#) x1)
- static [INLINE CONST vect_t mulx](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fmaddx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fmaddxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fnmaddx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fnmaddxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fmsubx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fmsubxin](#) ([vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST scalar_t hadd_to_scal](#) (const [vect_t](#) a)
- template<class T >
static constexpr bool [valid](#) (T *p)

- `template<class T >`
`static constexpr bool compliant (T n)`
- `template<int idx>`
`static INLINE CONST scalar_t get (vect_t v)`
- `template<int s>`
`static INLINE CONST vect_t sll (const vect_t a)`
- `template<int s>`
`static INLINE CONST vect_t srl (const vect_t a)`
- `template<uint8_t s>`
`static INLINE CONST vect_t shuffle (const vect_t a)`
- `static INLINE CONST vect_t unpacklo (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t unpackhi (const vect_t a, const vect_t b)`
- `template<uint8_t s>`
`static INLINE CONST vect_t blend (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t add (const vect_t a, const vect_t b)`
- `static INLINE vect_t addin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t sub (const vect_t a, const vect_t b)`
- `static INLINE vect_t subin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t mul (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmadddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fnmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fnmaddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmsub (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t eq (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t round (const vect_t a)`
- `static INLINE CONST vect_t mask_high ()`
- `static INLINE CONST vect_t mulhi_fast (vect_t x, vect_t y)`
- `static INLINE vect_t mod (vect_t &C, const __m128d &P, const __m128d &INVP, const __m128d &NEGP, const vect_t &POW50REM, const __m128d &MIN, const __m128d &MAX, __m128d &Q, __m128d &T)`
- `static const std::string type_string ()`
- `static INLINE CONST vect_t zero ()`
- `template<uint8_t s>`
`static INLINE CONST vect_t sll128 (const vect_t a)`
- `template<uint8_t s>`
`static INLINE CONST vect_t srl128 (const vect_t a)`
- `static INLINE CONST vect_t vand (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vor (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vxor (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vandnot (const vect_t a, const vect_t b)`

Static Public Attributes

- `static const constexpr size_t vect_size = 2`
- `static const constexpr size_t alignment = 16`

Static Protected Member Functions

- `static INLINE CONST vect_t signbits (const vect_t x)`

16.261.1 Member Typedef Documentation

16.261.1.1 scalar_t

```
using scalar_t = uint64_t
```

16.261.1.2 vect_t

```
using vect_t = __m128i [inherited]
```

16.261.2 Member Function Documentation

16.261.2.1 set1()

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.261.2.2 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1 ) [inline], [static]
```

16.261.2.3 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.261.2.4 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.261.2.5 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.261.2.6 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.261.2.7 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.261.2.8 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.261.2.9 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.261.2.10 greater()

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.261.2.11 lesser()

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.261.2.12 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.261.2.13 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.261.2.14 mullo()

```
static INLINE CONST vect_t mullo (  
    const vect_t x0,  
    const vect_t x1 ) [inline], [static]
```

16.261.2.15 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.261.2.16 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,
```

```
const vect_t a,  
const vect_t b ) [inline], [static]
```

16.261.2.17 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.261.2.18 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.261.2.19 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.261.2.20 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.261.2.21 fmsubxin() [1/2]

```
static INLINE CONST vect_t fmsubxin (  
    vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.261.2.22 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.261.2.23 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr], [inherited]
```

16.261.2.24 compliant()

```
static constexpr bool compliant (
    T n ) [inline], [static], [constexpr], [inherited]
```

16.261.2.25 get()

```
static INLINE CONST scalar_t get (
    vect_t v ) [inline], [static], [inherited]
```

16.261.2.26 sll()

```
static INLINE CONST vect_t sll (
    const vect_t a ) [inline], [static], [inherited]
```

16.261.2.27 srl()

```
static INLINE CONST vect_t srl (
    const vect_t a ) [inline], [static], [inherited]
```

16.261.2.28 shuffle()

```
static INLINE CONST vect_t shuffle (
    const vect_t a ) [inline], [static], [inherited]
```

16.261.2.29 unpacklo()

```
static INLINE CONST vect_t unpacklo (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.30 unpackhi()

```
static INLINE CONST vect_t unpackhi (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.31 blend()

```
static INLINE CONST vect_t blend (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.32 add()

```
static INLINE CONST vect_t add (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.33 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.34 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.35 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.36 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.37 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.38 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.39 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.40 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.41 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.42 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.43 fmsubxin() [2/2]

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.44 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.45 round()

```
static INLINE CONST vect_t round (  
    const vect_t a ) [inline], [static], [inherited]
```

16.261.2.46 mask_high()

```
static INLINE CONST vect_t mask_high ( ) [inline], [static], [inherited]
```

16.261.2.47 mulhi_fast()

```
INLINE CONST vect_t mulhi_fast (  
    vect_t x,  
    vect_t y ) [static], [inherited]
```

16.261.2.48 mod()

```
INLINE vect_t mod (  
    vect_t & C,  
    const __m128d & P,  
    const __m128d & INVP,  
    const __m128d & NEGP,  
    const vect_t & POW50REM,  
    const __m128d & MIN,  
    const __m128d & MAX,
```

```
__m128d & Q,  
__m128d & T ) [static], [inherited]
```

16.261.2.49 signbits()

```
static INLINE CONST vect_t signbits (  
    const vect_t x ) [inline], [static], [protected], [inherited]
```

16.261.2.50 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.261.2.51 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.261.2.52 sll128()

```
static INLINE CONST vect_t sll128 (  
    const vect_t a ) [inline], [static], [inherited]
```

16.261.2.53 srl128()

```
static INLINE CONST vect_t srl128 (  
    const vect_t a ) [inline], [static], [inherited]
```

16.261.2.54 vand()

```
static INLINE CONST vect_t vand (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.55 vor()

```
static INLINE CONST vect_t vor (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.56 vxor()

```
static INLINE CONST vect_t vxor (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.2.57 vandnot()

```
static INLINE CONST vect_t vandnot (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.261.3 Field Documentation

16.261.3.1 vect_size

```
const constexpr size_t vect_size = 2 [static], [constexpr], [inherited]
```

16.261.3.2 alignment

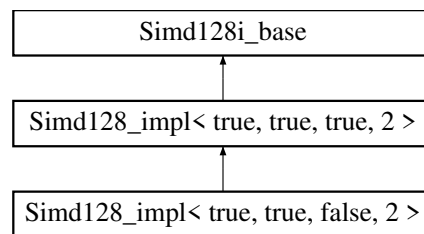
```
const constexpr size_t alignment = 16 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd128_int64.inl](#)

16.262 Simd128_impl< true, true, true, 2 > Struct Reference

Inheritance diagram for Simd128_impl< true, true, true, 2 >:



Data Structures

- union [Converter](#)

Public Types

- using [vect_t](#) = __m128i
- using [scalar_t](#) = int16_t

Static Public Member Functions

- template<class T >
static constexpr bool [valid](#) (T *p)
- template<class T >
static constexpr bool [compliant](#) (T n)
- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1, const [scalar_t](#) x2, const [scalar_t](#) x3, const [scalar_t](#) x4, const [scalar_t](#) x5, const [scalar_t](#) x6, const [scalar_t](#) x7)
- template<class T >
static [INLINE PURE vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- static [INLINE PURE vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE](#) void [store](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE](#) void [storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE](#) void [stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST vect_t sll](#) (const [vect_t](#) a)
- template<int s>
static [INLINE CONST vect_t srl](#) (const [vect_t](#) a)

- `template<int s>`
`static INLINE CONST vect_t sra (const vect_t a)`
- `template<uint32_t s>`
`static INLINE CONST vect_t shuffle (const vect_t a)`
- `static INLINE CONST vect_t unpacklo (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t unpackhi (const vect_t a, const vect_t b)`
- `template<uint8_t s>`
`static INLINE CONST vect_t blend (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t add (const vect_t a, const vect_t b)`
- `static INLINE vect_t addin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t sub (const vect_t a, const vect_t b)`
- `static INLINE vect_t subin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t mullo (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t mul (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t mulhi (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t mulx (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmaddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmadddx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmadddxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fnmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fnmaddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fnmaddx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fnmaddxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmsub (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmsubx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t eq (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t greater (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t lesser (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t greater_eq (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t lesser_eq (const vect_t a, const vect_t b)`
- `static INLINE CONST scalar_t hadd_to_scal (const vect_t a)`
- `static INLINE CONST vect_t round (const vect_t a)`
- `static INLINE vect_t mod (vect_t &C, const vect_t &P, const __m64 &INVP, const vect_t &NEGP, const vect_t &MIN, const vect_t &MAX, vect_t &Q, vect_t &T)`
- `static const std::string type_string ()`
- `static INLINE CONST vect_t zero ()`
- `template<uint8_t s>`
`static INLINE CONST vect_t sll128 (const vect_t a)`
- `template<uint8_t s>`
`static INLINE CONST vect_t srl128 (const vect_t a)`
- `static INLINE CONST vect_t vand (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vor (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vxor (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t vandnot (const vect_t a, const vect_t b)`

Static Public Attributes

- `static const constexpr size_t vect_size = 8`
- `static const constexpr size_t alignment = 16`

16.262.1 Member Typedef Documentation

16.262.1.1 vect_t

```
using vect_t = __m128i
```

16.262.1.2 scalar_t

```
using scalar_t = int16_t
```

16.262.2 Member Function Documentation

16.262.2.1 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr]
```

16.262.2.2 compliant()

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr]
```

16.262.2.3 set1()

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.262.2.4 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4,  
    const scalar_t x5,  
    const scalar_t x6,  
    const scalar_t x7 ) [inline], [static]
```

16.262.2.5 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.262.2.6 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.262.2.7 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.262.2.8 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.262.2.9 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.262.2.10 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.262.2.11 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static]
```

16.262.2.12 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static]
```

16.262.2.13 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.262.2.14 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.262.2.15 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.16 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.17 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.18 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.19 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.262.2.20 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.21 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.262.2.22 mullo()

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.23 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.24 mulhi()

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.25 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.26 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.27 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.28 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.29 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.30 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.31 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.32 fmmaddx()

```
static INLINE CONST vect_t fmmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.33 fmmaddxin()

```
static INLINE vect_t fmmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.34 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.35 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.36 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.37 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.38 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.39 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.40 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.41 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.42 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.262.2.43 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.262.2.44 round()

```
static INLINE CONST vect_t round (  
    const vect_t a ) [inline], [static]
```

16.262.2.45 mod()

```
static INLINE vect_t mod (  
    vect_t & C,  
    const vect_t & P,  
    const __m64 & INVP,  
    const vect_t & NEGP,  
    const vect_t & MIN,  
    const vect_t & MAX,  
    vect_t & Q,  
    vect_t & T ) [inline], [static]
```

16.262.2.46 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.262.2.47 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.262.2.48 sll128()

```
static INLINE CONST vect_t sll128 (
    const vect_t a ) [inline], [static], [inherited]
```

16.262.2.49 srl128()

```
static INLINE CONST vect_t srl128 (
    const vect_t a ) [inline], [static], [inherited]
```

16.262.2.50 vand()

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.262.2.51 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.262.2.52 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.262.2.53 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.262.3 Field Documentation**16.262.3.1 vect_size**

```
const constexpr size_t vect_size = 8 [static], [constexpr]
```

16.262.3.2 alignment

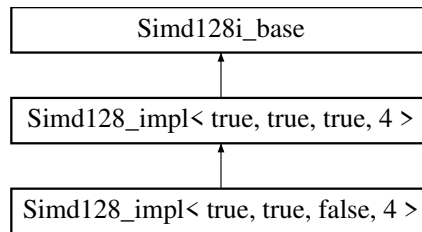
```
const constexpr size_t alignment = 16 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd128_int16.inl](#)

16.263 Simd128_impl< true, true, true, 4 > Struct Reference

Inheritance diagram for Simd128_impl< true, true, true, 4 >:



Data Structures

- union [Converter](#)

Public Types

- using [vect_t](#) = __m128i
- using [scalar_t](#) = int32_t

Static Public Member Functions

- template<class T >
static constexpr bool [valid](#) (T *p)
- template<class T >
static constexpr bool [compliant](#) (T n)
- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1, const [scalar_t](#) x2, const [scalar_t](#) x3)
- template<class T >
static [INLINE PURE vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- static [INLINE PURE vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE void store](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST vect_t sll](#) (const [vect_t](#) a)
- template<int s>
static [INLINE CONST vect_t srl](#) (const [vect_t](#) a)
- template<int s>
static [INLINE CONST vect_t sra](#) (const [vect_t](#) a)
- template<uint8_t s>
static [INLINE CONST vect_t shuffle](#) (const [vect_t](#) a)
- static [INLINE CONST vect_t unpacklo](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t unpackhi](#) (const [vect_t](#) a, const [vect_t](#) b)
- template<uint8_t s>
static [INLINE CONST vect_t blend](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t add](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t addin](#) ([vect_t](#) &a, const [vect_t](#) b)
- static [INLINE CONST vect_t sub](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t subin](#) ([vect_t](#) &a, const [vect_t](#) b)
- static [INLINE CONST vect_t mullo](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t mul](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t mulhi](#) (const [vect_t](#) a, const [vect_t](#) b)

- static `INLINE CONST vect_t mulx` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `vect_t` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()
- template<uint8_t s>
static `INLINE CONST vect_t sll128` (const `vect_t` a)
- template<uint8_t s>
static `INLINE CONST vect_t srl128` (const `vect_t` a)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)

Static Public Attributes

- static const constexpr size_t `vect_size` = 4
- static const constexpr size_t `alignment` = 16

16.263.1 Member Typedef Documentation

16.263.1.1 `vect_t`

```
using vect_t = __m128i
```

16.263.1.2 `scalar_t`

```
using scalar_t = int32_t
```

16.263.2 Member Function Documentation

16.263.2.1 valid()

```
static constexpr bool valid (
    T * p ) [inline], [static], [constexpr]
```

16.263.2.2 compliant()

```
static constexpr bool compliant (
    T n ) [inline], [static], [constexpr]
```

16.263.2.3 set1()

```
static INLINE CONST vect_t set1 (
    const scalar_t x ) [inline], [static]
```

16.263.2.4 set()

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3 ) [inline], [static]
```

16.263.2.5 gather()

```
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx ) [inline], [static]
```

16.263.2.6 load()

```
static INLINE PURE vect_t load (
    const scalar_t *const p ) [inline], [static]
```

16.263.2.7 loadu()

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p ) [inline], [static]
```

16.263.2.8 store()

```
static INLINE void store (
    scalar_t * p,
    vect_t v ) [inline], [static]
```

16.263.2.9 storeu()

```
static INLINE void storeu (
    scalar_t * p,
    vect_t v ) [inline], [static]
```

16.263.2.10 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.263.2.11 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static]
```

16.263.2.12 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static]
```

16.263.2.13 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.263.2.14 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.263.2.15 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.16 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.17 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.18 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.19 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.263.2.20 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.21 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.263.2.22 mullo()

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.23 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.24 mulhi()

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.25 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.26 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.27 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.28 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.29 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.30 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.31 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.32 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.33 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.34 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,
```

```
const vect_t a,  
const vect_t b ) [inline], [static]
```

16.263.2.35 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.36 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.37 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.38 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.39 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.40 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.41 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.42 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.263.2.43 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.263.2.44 round()

```
static INLINE CONST vect_t round (  
    const vect_t a ) [inline], [static]
```

16.263.2.45 mod()

```
static INLINE vect_t mod (  
    vect_t & C,  
    const vect_t & P,  
    const vect_t & INVP,  
    const vect_t & NEGP,  
    const vect_t & MIN,  
    const vect_t & MAX,  
    vect_t & Q,  
    vect_t & T ) [inline], [static]
```

16.263.2.46 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.263.2.47 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.263.2.48 sll128()

```
static INLINE CONST vect_t sll128 (  
    const vect_t a ) [inline], [static], [inherited]
```

16.263.2.49 srl128()

```
static INLINE CONST vect_t srl128 (  
    const vect_t a ) [inline], [static], [inherited]
```

16.263.2.50 vand()

```
static INLINE CONST vect_t vand (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```


16.263.2.51 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.263.2.52 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.263.2.53 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.263.3 Field Documentation**16.263.3.1 vect_size**

```
const constexpr size_t vect_size = 4 [static], [constexpr]
```

16.263.3.2 alignment

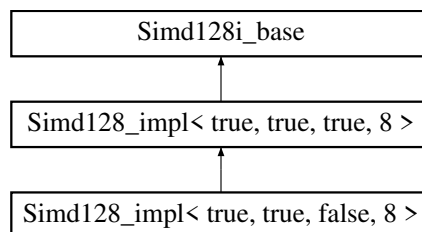
```
const constexpr size_t alignment = 16 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd128_int32.inl](#)

16.264 Simd128_impl< true, true, true, 8 > Struct Reference

Inheritance diagram for Simd128_impl< true, true, true, 8 >:

**Data Structures**

- union [Converter](#)

Public Types

- using [vect_t](#) = __m128i
- using [scalar_t](#) = int64_t

Static Public Member Functions

- `template<class T >`
`static constexpr bool valid (T *p)`
- `template<class T >`
`static constexpr bool compliant (T n)`
- `static INLINE CONST vect_t set1 (const scalar_t x)`
- `static INLINE CONST vect_t set (const scalar_t x0, const scalar_t x1)`
- `template<class T >`
`static INLINE PURE vect_t gather (const scalar_t *const p, const T *const idx)`
- `template<int idx>`
`static INLINE CONST scalar_t get (vect_t v)`
- `static INLINE PURE vect_t load (const scalar_t *const p)`
- `static INLINE PURE vect_t loadu (const scalar_t *const p)`
- `static INLINE void store (scalar_t *p, vect_t v)`
- `static INLINE void storeu (scalar_t *p, vect_t v)`
- `static INLINE void stream (scalar_t *p, const vect_t v)`
- `template<int s>`
`static INLINE CONST vect_t sll (const vect_t a)`
- `template<int s>`
`static INLINE CONST vect_t srl (const vect_t a)`
- `template<int s>`
`static INLINE CONST vect_t sra (const vect_t a)`
- `template<uint8_t s>`
`static INLINE CONST vect_t shuffle (const vect_t a)`
- `static INLINE CONST vect_t unpacklo (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t unpackhi (const vect_t a, const vect_t b)`
- `template<uint8_t s>`
`static INLINE CONST vect_t blend (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t add (const vect_t a, const vect_t b)`
- `static INLINE vect_t addin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t sub (const vect_t a, const vect_t b)`
- `static INLINE vect_t subin (vect_t &a, const vect_t b)`
- `static INLINE CONST vect_t mullo (const vect_t x0, const vect_t x1)`
- `static INLINE CONST vect_t mul (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t mulx (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmaddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmadddx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmadddxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fnmadd (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fnmaddin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fnmaddx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fnmaddxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmsub (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t fmsubx (const vect_t c, const vect_t a, const vect_t b)`
- `static INLINE vect_t fmsubxin (vect_t &c, const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t eq (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t greater (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t lesser (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t greater_eq (const vect_t a, const vect_t b)`
- `static INLINE CONST vect_t lesser_eq (const vect_t a, const vect_t b)`
- `static INLINE CONST scalar_t hadd_to_scal (const vect_t a)`
- `static INLINE CONST vect_t round (const vect_t a)`
- `static INLINE CONST vect_t mask_high ()`

- static `INLINE CONST vect_t mulhi_fast (vect_t x, vect_t y)`
- static `INLINE vect_t mod (vect_t &C, const __m128d &P, const __m128d &INVP, const __m128d &NEGP, const vect_t &POW50REM, const __m128d &MIN, const __m128d &MAX, __m128d &Q, __m128d &T)`
- static const std::string `type_string ()`
- static `INLINE CONST vect_t zero ()`
- `template<uint8_t s>`
static `INLINE CONST vect_t sll128 (const vect_t a)`
- `template<uint8_t s>`
static `INLINE CONST vect_t srl128 (const vect_t a)`
- static `INLINE CONST vect_t vand (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vor (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vxor (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vandnot (const vect_t a, const vect_t b)`

Static Public Attributes

- static const constexpr size_t `vect_size` = 2
- static const constexpr size_t `alignment` = 16

Static Protected Member Functions

- static `INLINE CONST vect_t signbits (const vect_t x)`

16.264.1 Member Typedef Documentation

16.264.1.1 vect_t

```
using vect_t = __m128i
```

16.264.1.2 scalar_t

```
using scalar_t = int64_t
```

16.264.2 Member Function Documentation

16.264.2.1 valid()

```
static constexpr bool valid (
    T * p ) [inline], [static], [constexpr]
```

16.264.2.2 compliant()

```
static constexpr bool compliant (
    T n ) [inline], [static], [constexpr]
```

16.264.2.3 set1()

```
static INLINE CONST vect_t set1 (
    const scalar_t x ) [inline], [static]
```

16.264.2.4 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1 ) [inline], [static]
```

16.264.2.5 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.264.2.6 get()

```
static INLINE CONST scalar_t get (  
    vect_t v ) [inline], [static]
```

16.264.2.7 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.264.2.8 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.264.2.9 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.264.2.10 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.264.2.11 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.264.2.12 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static]
```

16.264.2.13 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static]
```

16.264.2.14 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.264.2.15 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.264.2.16 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.17 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.18 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.19 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.20 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.264.2.21 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.22 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.264.2.23 mullo()

```
static INLINE CONST vect_t mullo (  
    const vect_t x0,  
    const vect_t x1 ) [inline], [static]
```

16.264.2.24 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.25 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.26 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.27 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.28 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.29 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.30 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.31 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.32 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.33 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.34 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.35 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.36 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.37 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,
```

```
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.38 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.39 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.40 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.41 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.42 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.264.2.43 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.264.2.44 round()

```
static INLINE CONST vect_t round (  
    const vect_t a ) [inline], [static]
```

16.264.2.45 mask_high()

```
static INLINE CONST vect_t mask_high ( ) [inline], [static]
```


16.264.2.46 mulhi_fast()

```

INLINE CONST vect_t mulhi_fast (
    vect_t x,
    vect_t y ) [static]

```

16.264.2.47 mod()

```

INLINE vect_t mod (
    vect_t & C,
    const __m128d & P,
    const __m128d & INVP,
    const __m128d & NEGP,
    const vect_t & POW50REM,
    const __m128d & MIN,
    const __m128d & MAX,
    __m128d & Q,
    __m128d & T ) [static]

```

16.264.2.48 signbits()

```

static INLINE CONST vect_t signbits (
    const vect_t x ) [inline], [static], [protected]

```

16.264.2.49 type_string()

```

static const std::string type_string ( ) [inline], [static], [inherited]

```

16.264.2.50 zero()

```

static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]

```

16.264.2.51 sll128()

```

static INLINE CONST vect_t sll128 (
    const vect_t a ) [inline], [static], [inherited]

```

16.264.2.52 srl128()

```

static INLINE CONST vect_t srl128 (
    const vect_t a ) [inline], [static], [inherited]

```

16.264.2.53 vand()

```

static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]

```

16.264.2.54 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.264.2.55 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.264.2.56 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.264.3 Field Documentation**16.264.3.1 vect_size**

```
const constexpr size_t vect_size = 2 [static], [constexpr]
```

16.264.3.2 alignment

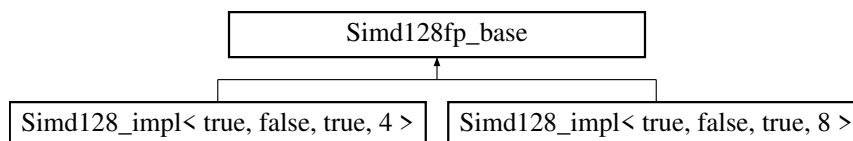
```
const constexpr size_t alignment = 16 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd128_int64.inl](#)

16.265 Simd128fp_base Struct Reference

Inheritance diagram for Simd128fp_base:

**Static Public Member Functions**

- static const std::string [type_string](#) ()

16.265.1 Member Function Documentation**16.265.1.1 type_string()**

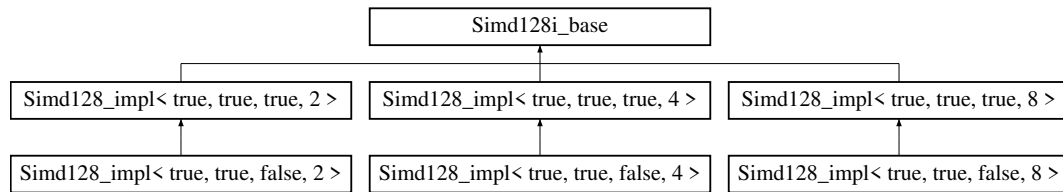
```
static const std::string type_string ( ) [inline], [static]
```

The documentation for this struct was generated from the following file:

- [simd128.inl](#)

16.266 Simd128i_base Struct Reference

Inheritance diagram for Simd128i_base:



Public Types

- using `vect_t` = `__m128i`

Static Public Member Functions

- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()
- template<uint8_t s>
static `INLINE CONST vect_t sll128` (const `vect_t` a)
- template<uint8_t s>
static `INLINE CONST vect_t srl128` (const `vect_t` a)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)

16.266.1 Member Typedef Documentation

16.266.1.1 vect_t

using `vect_t` = `__m128i`

16.266.2 Member Function Documentation

16.266.2.1 type_string()

```
static const std::string type_string ( ) [inline], [static]
```

16.266.2.2 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static]
```

16.266.2.3 sll128()

```
static INLINE CONST vect_t sll128 (
    const vect_t a ) [inline], [static]
```

16.266.2.4 srl128()

```
static INLINE CONST vect_t srl128 (
    const vect_t a ) [inline], [static]
```

16.266.2.5 vand()

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.266.2.6 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.266.2.7 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.266.2.8 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

The documentation for this struct was generated from the following file:

- [simd128.inl](#)

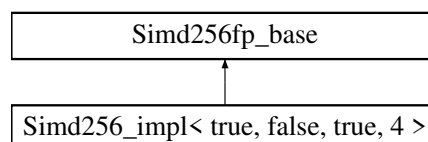
16.267 Simd256_impl< ArithType, Int, Signed, Size > Struct Template Reference

The documentation for this struct was generated from the following file:

- [simd256.inl](#)

16.268 Simd256_impl< true, false, true, 4 > Struct Reference

Inheritance diagram for Simd256_impl< true, false, true, 4 >:

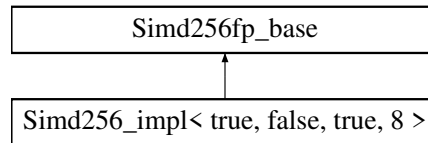


The documentation for this struct was generated from the following file:

- [simd256_float.inl](#)

16.269 Simd256_impl< true, false, true, 8 > Struct Reference

Inheritance diagram for Simd256_impl< true, false, true, 8 >:



Public Types

- using `vect_t` = `__m256d`
- using `scalar_t` = `double`

Static Public Member Functions

- `template<class T >`
static constexpr bool `valid` (T *p)
- `template<class T >`
static constexpr bool `compliant` (T n)
- static `INLINE CONST vect_t zero` ()
- static `INLINE CONST vect_t set1` (const `scalar_t` x)
- static `INLINE CONST vect_t set` (const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3, const `scalar_t` x4)
- `template<class T >`
static `INLINE PURE vect_t gather` (const `scalar_t` *const p, const T *const idx)
- static `INLINE PURE vect_t load` (const `scalar_t` *const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` *const p)
- static `INLINE void store` (const `scalar_t` *p, const `vect_t` v)
- static `INLINE void storeu` (const `scalar_t` *p, const `vect_t` v)
- static `INLINE void stream` (const `scalar_t` *p, const `vect_t` v)
- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- `template<uint8_t s>`
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t blendv` (const `vect_t` a, const `vect_t` b, const `vect_t` mask)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t div` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)

- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t floor` (const `vect_t` a)
- static `INLINE CONST vect_t ceil` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE CONST vect_t hadd` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `vect_t` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)

Static Public Attributes

- static const constexpr size_t `vect_size` = 4
- static const constexpr size_t `alignment` = 32

16.269.1 Member Typedef Documentation

16.269.1.1 vect_t

```
using vect_t = __m256d
```

16.269.1.2 scalar_t

```
using scalar_t = double
```

16.269.2 Member Function Documentation

16.269.2.1 valid()

```
static constexpr bool valid (
    T * p ) [inline], [static], [constexpr]
```

16.269.2.2 compliant()

```
static constexpr bool compliant (
    T n ) [inline], [static], [constexpr]
```

16.269.2.3 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static]
```

16.269.2.4 set1()

```
static INLINE CONST vect_t set1 (
    const scalar_t x ) [inline], [static]
```

16.269.2.5 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4 ) [inline], [static]
```

16.269.2.6 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.269.2.7 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.269.2.8 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.269.2.9 store()

```
static INLINE void store (  
    const scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.269.2.10 storeu()

```
static INLINE void storeu (  
    const scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.269.2.11 stream()

```
static INLINE void stream (  
    const scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.269.2.12 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.13 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.14 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.15 blendv()

```
static INLINE CONST vect_t blendv (  
    const vect_t a,  
    const vect_t b,  
    const vect_t mask ) [inline], [static]
```

16.269.2.16 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.17 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.269.2.18 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.19 subin()

```
static INLINE CONST vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.269.2.20 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```


16.269.2.21 mulin()

```
static INLINE CONST vect_t mulin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.269.2.22 div()

```
static INLINE CONST vect_t div (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.23 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.24 fmaddin()

```
static INLINE CONST vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.25 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.26 fnmaddin()

```
static INLINE CONST vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.27 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.28 fmsubin()

```
static INLINE CONST vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.29 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.30 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.31 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.32 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.33 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.34 vand()

```
static INLINE CONST vect_t vand (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.35 vor()

```
static INLINE CONST vect_t vor (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.36 vxor()

```
static INLINE CONST vect_t vxor (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.269.2.37 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.269.2.38 floor()

```
static INLINE CONST vect_t floor (
    const vect_t a ) [inline], [static]
```

16.269.2.39 ceil()

```
static INLINE CONST vect_t ceil (
    const vect_t a ) [inline], [static]
```

16.269.2.40 round()

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static]
```

16.269.2.41 hadd()

```
static INLINE CONST vect_t hadd (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.269.2.42 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a ) [inline], [static]
```

16.269.2.43 mod()

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T ) [inline], [static]
```

16.269.3 Field Documentation**16.269.3.1 vect_size**

```
const constexpr size_t vect_size = 4 [static], [constexpr]
```

16.269.3.2 alignment

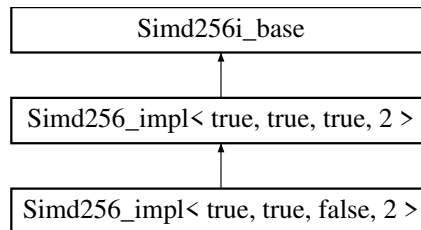
```
const constexpr size_t alignment = 32 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd256_double.inl](#)

16.270 Simd256_impl< true, true, false, 2 > Struct Reference

Inheritance diagram for Simd256_impl< true, true, false, 2 >:



Data Structures

- union [Converter](#)

Public Types

- using [scalar_t](#) = [uint16_t](#)
- using [simdHalf](#) = [Simd128](#)< [scalar_t](#) >
- using [vect_t](#) = [__m256i](#)
- using [half_t](#) = [__m128i](#)

Static Public Member Functions

- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1, const [scalar_t](#) x2, const [scalar_t](#) x3, const [scalar_t](#) x4, const [scalar_t](#) x5, const [scalar_t](#) x6, const [scalar_t](#) x7, const [scalar_t](#) x8, const [scalar_t](#) x9, const [scalar_t](#) x10, const [scalar_t](#) x11, const [scalar_t](#) x12, const [scalar_t](#) x13, const [scalar_t](#) x14, const [scalar_t](#) x15)
- template<class T >
static [INLINE PURE vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- static [INLINE PURE vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE void store](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST vect_t sra](#) (const [vect_t](#) a)
- static [INLINE CONST vect_t greater](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t lesser](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t greater_eq](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t lesser_eq](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t mulhi](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t mulx](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t fmaddx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fmaddxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fnmaddx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fnmaddxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)

- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- template<class T >
static constexpr bool `valid` (T *p)
- template<class T >
static constexpr bool `compliant` (T n)
- template<int s>
static `INLINE CONST vect_t sll` (const `vect_t` a)
- template<int s>
static `INLINE CONST vect_t srl` (const `vect_t` a)
- template<uint64_t s>
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &s1, `vect_t` &s2, const `vect_t` a, const `vect_t` b)
- template<uint8_t s>
static `INLINE CONST vect_t blend_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `vect_t` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()

Static Public Attributes

- static const constexpr size_t `vect_size` = 16
- static const constexpr size_t `alignment` = 32

16.270.1 Member Typedef Documentation

16.270.1.1 scalar_t

```
using scalar_t = uint16_t
```

16.270.1.2 simdHalf

```
using simdHalf = Simd128<scalar_t>
```

16.270.1.3 vect_t

```
using vect_t = __m256i [inherited]
```

16.270.1.4 half_t

```
using half_t = __m128i [inherited]
```

16.270.2 Member Function Documentation

16.270.2.1 set1()

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.270.2.2 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4,  
    const scalar_t x5,  
    const scalar_t x6,  
    const scalar_t x7,  
    const scalar_t x8,  
    const scalar_t x9,  
    const scalar_t x10,  
    const scalar_t x11,  
    const scalar_t x12,  
    const scalar_t x13,  
    const scalar_t x14,  
    const scalar_t x15 ) [inline], [static]
```

16.270.2.3 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.270.2.4 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.270.2.5 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.270.2.6 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.270.2.7 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.270.2.8 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.270.2.9 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.270.2.10 greater()

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.270.2.11 lesser()

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.270.2.12 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.270.2.13 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.270.2.14 mulhi()

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.270.2.15 mulx()

```
static INLINE CONST vect_t mulx (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.270.2.16 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.270.2.17 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.270.2.18 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.270.2.19 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.270.2.20 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.270.2.21 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```


16.270.2.22 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.270.2.23 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr], [inherited]
```

16.270.2.24 compliant()

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr], [inherited]
```

16.270.2.25 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static], [inherited]
```

16.270.2.26 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static], [inherited]
```

16.270.2.27 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static], [inherited]
```

16.270.2.28 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.29 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.30 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.31 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.32 unpacklohi()

```
static INLINE void unpacklohi (  
    vect_t & s1,  
    vect_t & s2,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.33 blend_twice()

```
static INLINE CONST vect_t blend_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.34 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.35 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.36 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.37 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.38 mullo()

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.39 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.40 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.41 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.42 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.43 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.44 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.45 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.46 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.270.2.47 round()

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static], [inherited]
```

16.270.2.48 mod()

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T ) [inline], [static], [inherited]
```

16.270.2.49 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.270.2.50 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.270.3 Field Documentation**16.270.3.1 vect_size**

```
const constexpr size_t vect_size = 16 [static], [constexpr], [inherited]
```

16.270.3.2 alignment

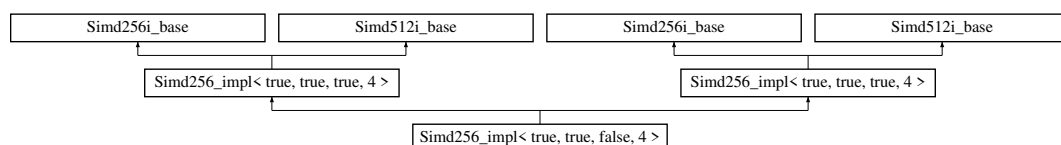
```
const constexpr size_t alignment = 32 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd256_int16.inl](#)

16.271 Simd256_impl< true, true, false, 4 > Struct Reference

Inheritance diagram for Simd256_impl< true, true, false, 4 >:

**Data Structures**

- union [Converter](#)

Public Types

- using `scalar_t` = `uint32_t`
- using `simdHalf` = `Simd128< scalar_t >`
- using `scalar_t` = `uint32_t`
- using `simdHalf` = `Simd128< scalar_t >`
- using `vect_t` = `__m256i`
- using `vect_t` = `__m512i`
- using `half_t` = `__m128i`
- using `half_t` = `__m256i`

Static Public Member Functions

- static `INLINE CONST vect_t set1` (const `scalar_t` x)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3, const `scalar_t` x4, const `scalar_t` x5, const `scalar_t` x6, const `scalar_t` x7)
- template<class T >
static `INLINE PURE vect_t gather` (const `scalar_t` *const p, const T *const idx)
- static `INLINE PURE vect_t load` (const `scalar_t` *const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` *const p)
- static `INLINE void store` (`scalar_t` *p, `vect_t` v)
- static `INLINE void storeu` (`scalar_t` *p, `vect_t` v)
- static `INLINE void stream` (`scalar_t` *p, const `vect_t` v)
- template<int s>
static `INLINE CONST vect_t sra` (const `vect_t` a)
- static `INLINE CONST vect_t greater` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t lesser` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t fmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t set1` (const `scalar_t` x)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3, const `scalar_t` x4, const `scalar_t` x5, const `scalar_t` x6, const `scalar_t` x7)
- template<class T >
static `INLINE PURE vect_t gather` (const `scalar_t` *const p, const T *const idx)
- static `INLINE PURE vect_t load` (const `scalar_t` *const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` *const p)
- static `INLINE void store` (`scalar_t` *p, `vect_t` v)
- static `INLINE void storeu` (`scalar_t` *p, `vect_t` v)
- static `INLINE void stream` (`scalar_t` *p, const `vect_t` v)
- template<int s>
static `INLINE CONST vect_t sra` (const `vect_t` a)
- static `INLINE CONST vect_t greater` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t lesser` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (`vect_t` a, `vect_t` b)

- static `INLINE CONST vect_t fmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- template<class T >
static constexpr bool `valid` (T *p)
- template<class T >
static constexpr bool `valid` (T *p)
- template<class T >
static constexpr bool `compliant` (T n)
- template<class T >
static constexpr bool `compliant` (T n)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3, const `scalar_t` x4, const `scalar_t` x5, const `scalar_t` x6, const `scalar_t` x7, const `scalar_t` x8, const `scalar_t` x9, const `scalar_t` x10, const `scalar_t` x11, const `scalar_t` x12, const `scalar_t` x13, const `scalar_t` x14, const `scalar_t` x15)
- template<int s>
static `INLINE CONST vect_t sll` (const `vect_t` a)
- template<int s>
static `INLINE CONST vect_t sll` (const `vect_t` a)
- template<int s>
static `INLINE CONST vect_t srl` (const `vect_t` a)
- template<int s>
static `INLINE CONST vect_t srl` (const `vect_t` a)
- template<uint8_t s>
static `INLINE CONST vect_t shuffle_twice` (const `vect_t` a)
- template<uint8_t s>
static `INLINE CONST vect_t shuffle_twice` (const `vect_t` a)
- template<uint32_t s>
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- template<uint64_t s>
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &s1, `vect_t` &s2, const `vect_t` a, const `vect_t` b)
- template<uint8_t s>
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)

- static `INLINE vect_t fmaddin (vect_t &c, const vect_t a, const vect_t b)`
- static `INLINE vect_t fmaddin (vect_t &c, const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t fnmadd (const vect_t c, const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t fnmadd (const vect_t c, const vect_t a, const vect_t b)`
- static `INLINE vect_t fnmaddin (vect_t &c, const vect_t a, const vect_t b)`
- static `INLINE vect_t fnmaddin (vect_t &c, const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t fmsub (const vect_t c, const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t fmsub (const vect_t c, const vect_t a, const vect_t b)`
- static `INLINE vect_t fmsubin (vect_t &c, const vect_t a, const vect_t b)`
- static `INLINE vect_t fmsubin (vect_t &c, const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t eq (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t eq (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t round (const vect_t a)`
- static `INLINE CONST vect_t round (const vect_t a)`
- static `INLINE vect_t mod (vect_t &C, const vect_t &P, const vect_t &INVP, const vect_t &NEGP, const vect_t &MIN, const vect_t &MAX, vect_t &Q, vect_t &T)`
- static `INLINE vect_t mod (vect_t &C, const vect_t &P, const vect_t &INVP, const vect_t &NEGP, const vect_t &MIN, const vect_t &MAX, vect_t &Q, vect_t &T)`
- static const std::string `type_string ()`
- static const std::string `type_string ()`
- static `INLINE CONST vect_t zero ()`
- static `INLINE CONST vect_t zero ()`
- static `INLINE CONST vect_t vor (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vxor (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vand (const vect_t a, const vect_t b)`
- static `INLINE CONST vect_t vandnot (const vect_t a, const vect_t b)`

Static Public Attributes

- static const constexpr size_t `vect_size` = 8
- static const constexpr size_t `alignment` = 32

16.271.1 Member Typedef Documentation

16.271.1.1 scalar_t [1/2]

```
using scalar_t = uint32_t
```

16.271.1.2 simdHalf [1/2]

```
using simdHalf = Simd128<scalar_t>
```

16.271.1.3 scalar_t [2/2]

```
using scalar_t = uint32_t
```

16.271.1.4 simdHalf [2/2]

```
using simdHalf = Simd128<scalar_t>
```

16.271.1.5 vect_t [1/2]

```
using vect_t = __m256i [inherited]
```

16.271.1.6 vect_t [2/2]

```
using vect_t = __m512i [inherited]
```

16.271.1.7 half_t [1/2]

```
using half_t = __m128i [inherited]
```

16.271.1.8 half_t [2/2]

```
using half_t = __m256i [inherited]
```

16.271.2 Member Function Documentation**16.271.2.1 set1() [1/2]**

```
static INLINE CONST vect_t set1 (
    const scalar_t x ) [inline], [static]
```

16.271.2.2 set() [1/3]

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7 ) [inline], [static]
```

16.271.2.3 gather() [1/2]

```
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx ) [inline], [static]
```

16.271.2.4 load() [1/2]

```
static INLINE PURE vect_t load (
    const scalar_t *const p ) [inline], [static]
```

16.271.2.5 loadu() [1/2]

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p ) [inline], [static]
```


16.271.2.6 store() [1/2]

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.271.2.7 storeu() [1/2]

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.271.2.8 stream() [1/2]

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.271.2.9 sra() [1/2]

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.271.2.10 greater() [1/2]

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.271.2.11 lesser() [1/2]

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.271.2.12 greater_eq() [1/2]

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.13 lesser_eq() [1/2]

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.14 mulhi() [1/2]

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.15 mulx() [1/2]

```
static INLINE CONST vect_t mulx (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.271.2.16 fmaddx() [1/2]

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.17 fmaddxin() [1/2]

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.18 fnmaddx() [1/2]

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.19 fnmaddxin() [1/2]

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.20 fmsubx() [1/2]

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.21 fmsubxin() [1/2]

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.22 hadd_to_scal() [1/2]

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.271.2.23 set1() [2/2]

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.271.2.24 set() [2/3]

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4,  
    const scalar_t x5,  
    const scalar_t x6,  
    const scalar_t x7 ) [inline], [static]
```

16.271.2.25 gather() [2/2]

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.271.2.26 load() [2/2]

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.271.2.27 loadu() [2/2]

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.271.2.28 store() [2/2]

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.271.2.29 storeu() [2/2]

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.271.2.30 stream() [2/2]

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.271.2.31 sra() [2/2]

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.271.2.32 greater() [2/2]

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.271.2.33 lesser() [2/2]

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.271.2.34 greater_eq() [2/2]

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.35 lesser_eq() [2/2]

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.36 mulhi() [2/2]

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.37 mulx() [2/2]

```
static INLINE CONST vect_t mulx (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.271.2.38 fmaddx() [2/2]

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,
```

```
const vect_t a,  
const vect_t b ) [inline], [static]
```

16.271.2.39 fmaddxin() [2/2]

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.40 fnmaddx() [2/2]

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.41 fnmaddxin() [2/2]

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.42 fmsubx() [2/2]

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.43 fmsubxin() [2/2]

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.271.2.44 hadd_to_scal() [2/2]

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.271.2.45 valid() [1/2]

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr], [inherited]
```

16.271.2.46 valid() [2/2]

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr], [inherited]
```

16.271.2.47 compliant() [1/2]

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr], [inherited]
```

16.271.2.48 compliant() [2/2]

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr], [inherited]
```

16.271.2.49 set() [3/3]

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4,  
    const scalar_t x5,  
    const scalar_t x6,  
    const scalar_t x7,  
    const scalar_t x8,  
    const scalar_t x9,  
    const scalar_t x10,  
    const scalar_t x11,  
    const scalar_t x12,  
    const scalar_t x13,  
    const scalar_t x14,  
    const scalar_t x15 ) [inline], [static], [inherited]
```

16.271.2.50 sll() [1/2]

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.51 sll() [2/2]

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.52 srl() [1/2]

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.53 srl() [2/2]

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.54 shuffle_twice() [1/2]

```
static INLINE CONST vect_t shuffle_twice (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.55 shuffle_twice() [2/2]

```
static INLINE CONST vect_t shuffle_twice (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.56 shuffle() [1/2]

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.57 shuffle() [2/2]

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.58 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.59 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.60 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.61 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.62 unpacklohi()

```
static INLINE void unpacklohi (  
    vect_t & s1,  
    vect_t & s2,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.63 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.64 add() [1/2]

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.65 add() [2/2]

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.66 addin() [1/2]

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.67 addin() [2/2]

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.68 sub() [1/2]

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.69 sub() [2/2]

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```


16.271.2.70 subin() [1/2]

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.71 subin() [2/2]

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.72 mullo() [1/2]

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.73 mullo() [2/2]

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.74 mul() [1/2]

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.75 mul() [2/2]

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.76 fmadd() [1/2]

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.77 fmadd() [2/2]

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.78 fmaddin() [1/2]

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.79 fmaddin() [2/2]

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.80 fnmadd() [1/2]

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.81 fnmadd() [2/2]

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.82 fnmaddin() [1/2]

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.83 fnmaddin() [2/2]

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.84 fmsub() [1/2]

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.85 fmsub() [2/2]

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,
```

```
const vect_t a,  
const vect_t b ) [inline], [static], [inherited]
```

16.271.2.86 fmsubin() [1/2]

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.87 fmsubin() [2/2]

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.88 eq() [1/2]

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.89 eq() [2/2]

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.90 round() [1/2]

```
static INLINE CONST vect_t round (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.91 round() [2/2]

```
static INLINE CONST vect_t round (  
    const vect_t a ) [inline], [static], [inherited]
```

16.271.2.92 mod() [1/2]

```
static INLINE vect_t mod (  
    vect_t & C,  
    const vect_t & P,  
    const vect_t & INVP,  
    const vect_t & NEGP,  
    const vect_t & MIN,  
    const vect_t & MAX,  
    vect_t & Q,  
    vect_t & T ) [inline], [static], [inherited]
```

16.271.2.93 mod() [2/2]

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T ) [inline], [static], [inherited]
```

16.271.2.94 type_string() [1/2]

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.271.2.95 type_string() [2/2]

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.271.2.96 zero() [1/2]

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.271.2.97 zero() [2/2]

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.271.2.98 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.99 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.100 vand()

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.271.2.101 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.271.3 Field Documentation

16.271.3.1 vect_size

```
static const constexpr size_t vect_size = 8 [static], [constexpr], [inherited]
```

16.271.3.2 alignment

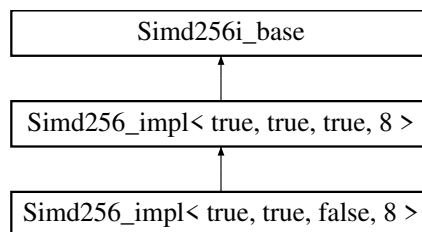
```
static const constexpr size_t alignment = 32 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following files:

- [simd256_int32.inl](#)
- [simd512_int32.inl](#)

16.272 Simd256_impl< true, true, false, 8 > Struct Reference

Inheritance diagram for Simd256_impl< true, true, false, 8 >:



Data Structures

- union [Converter](#)

Public Types

- using [scalar_t](#) = [uint64_t](#)
- using [simdHalf](#) = [Simd128](#)< [scalar_t](#) >
- using [vect_t](#) = [__m256i](#)
- using [half_t](#) = [__m128i](#)

Static Public Member Functions

- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1, const [scalar_t](#) x2, const [scalar_t](#) x3)
- template<class T >
static [INLINE PURE vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- static [INLINE PURE vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE void store](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST vect_t sra](#) (const [vect_t](#) a)
- static [INLINE CONST vect_t greater](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t lesser](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t greater_eq](#) (const [vect_t](#) a, const [vect_t](#) b)

- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t mulx` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- template<class T >
static constexpr bool `valid` (T *p)
- template<class T >
static constexpr bool `compliant` (T n)
- template<int idx>
static `INLINE CONST scalar_t get` (`vect_t` v)
- template<int s>
static `INLINE CONST vect_t sll` (const `vect_t` a)
- template<int s>
static `INLINE CONST vect_t srl` (const `vect_t` a)
- template<uint8_t s>
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &l, `vect_t` &h, const `vect_t` a, const `vect_t` b)
- template<uint8_t s>
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE CONST vect_t mask_high` ()
- static `INLINE CONST vect_t mulhi_fast` (`vect_t` x, `vect_t` y)
- static `INLINE vect_t mod` (`vect_t` &C, const __m256d &P, const __m256d &INVP, const __m256d &NEGP, const `vect_t` &POW50REM, const __m256d &MIN, const __m256d &MAX, __m256d &Q, __m256d &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()

Static Public Attributes

- static const constexpr size_t `vect_size` = 4
- static const constexpr size_t `alignment` = 32

Static Protected Member Functions

- static `INLINE CONST vect_t signbits` (const `vect_t` x)

16.272.1 Member Typedef Documentation

16.272.1.1 scalar_t

```
using scalar_t = uint64_t
```

16.272.1.2 simdHalf

```
using simdHalf = Simd128<scalar_t>
```

16.272.1.3 vect_t

```
using vect_t = __m256i [inherited]
```

16.272.1.4 half_t

```
using half_t = __m128i [inherited]
```

16.272.2 Member Function Documentation

16.272.2.1 set1()

```
static INLINE CONST vect_t set1 (
    const scalar_t x ) [inline], [static]
```

16.272.2.2 set()

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3 ) [inline], [static]
```

16.272.2.3 gather()

```
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx ) [inline], [static]
```

16.272.2.4 load()

```
static INLINE PURE vect_t load (
    const scalar_t *const p ) [inline], [static]
```

16.272.2.5 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.272.2.6 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.272.2.7 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.272.2.8 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.272.2.9 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.272.2.10 greater()

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.272.2.11 lesser()

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.272.2.12 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.272.2.13 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```


16.272.2.14 mullo()

```
static INLINE CONST vect_t mullo (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.272.2.15 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.272.2.16 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.272.2.17 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.272.2.18 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.272.2.19 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.272.2.20 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.272.2.21 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.272.2.22 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.272.2.23 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr], [inherited]
```

16.272.2.24 compliant()

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr], [inherited]
```

16.272.2.25 get()

```
static INLINE CONST scalar_t get (  
    vect_t v ) [inline], [static], [inherited]
```

16.272.2.26 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static], [inherited]
```

16.272.2.27 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static], [inherited]
```

16.272.2.28 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static], [inherited]
```

16.272.2.29 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.30 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.31 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.32 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.33 unpacklohi()

```
static INLINE void unpacklohi (  
    vect_t & l,  
    vect_t & h,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.34 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.35 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.36 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.37 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.38 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.39 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.40 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.41 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.42 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.43 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.44 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.45 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.46 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.272.2.47 round()

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static], [inherited]
```

16.272.2.48 mask_high()

```
static INLINE CONST vect_t mask_high ( ) [inline], [static], [inherited]
```

16.272.2.49 mulhi_fast()

```
INLINE CONST vect_t mulhi_fast (
    vect_t x,
    vect_t y ) [static], [inherited]
```

16.272.2.50 mod()

```
INLINE vect_t mod (
    vect_t & C,
    const __m256d & P,
    const __m256d & INV_P,
    const __m256d & NEG_P,
    const vect_t & POW50REM,
    const __m256d & MIN,
    const __m256d & MAX,
    __m256d & Q,
    __m256d & T ) [static], [inherited]
```

16.272.2.51 signbits()

```
static INLINE CONST vect_t signbits (
    const vect_t x ) [inline], [static], [protected], [inherited]
```

16.272.2.52 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.272.2.53 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.272.3 Field Documentation**16.272.3.1 vect_size**

```
const constexpr size_t vect_size = 4 [static], [constexpr], [inherited]
```

16.272.3.2 alignment

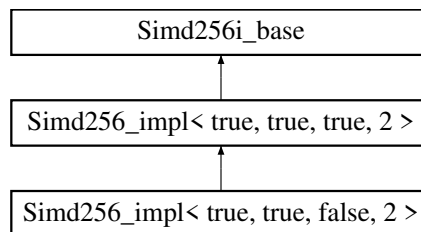
```
const constexpr size_t alignment = 32 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd256_int64.inl](#)

16.273 Simd256_impl< true, true, true, 2 > Struct Reference

Inheritance diagram for Simd256_impl< true, true, true, 2 >:



Data Structures

- union [Converter](#)

Public Types

- using [vect_t](#) = __m256i
- using [half_t](#) = __m128i
- using [scalar_t](#) = [int16_t](#)
- using [simdHalf](#) = [Simd128](#)< [scalar_t](#) >

Static Public Member Functions

- template<class T >
static constexpr bool [valid](#) (T *p)
- template<class T >
static constexpr bool [compliant](#) (T n)
- static [INLINE CONST](#) [vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST](#) [vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1, const [scalar_t](#) x2, const [scalar_t](#) x3, const [scalar_t](#) x4, const [scalar_t](#) x5, const [scalar_t](#) x6, const [scalar_t](#) x7, const [scalar_t](#) x8, const [scalar_t](#) x9, const [scalar_t](#) x10, const [scalar_t](#) x11, const [scalar_t](#) x12, const [scalar_t](#) x13, const [scalar_t](#) x14, const [scalar_t](#) x15)
- template<class T >
static [INLINE PURE](#) [vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- static [INLINE PURE](#) [vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE](#) [vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE](#) void [store](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE](#) void [storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE](#) void [stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST](#) [vect_t sll](#) (const [vect_t](#) a)
- template<int s>
static [INLINE CONST](#) [vect_t srl](#) (const [vect_t](#) a)
- template<int s>
static [INLINE CONST](#) [vect_t sra](#) (const [vect_t](#) a)
- template<uint64_t s>
static [INLINE CONST](#) [vect_t shuffle](#) (const [vect_t](#) a)

- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &s1, `vect_t` &s2, const `vect_t` a, const `vect_t` b)
- template<uint8_t s>
 - static `INLINE CONST vect_t blend_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t fmaddd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmadddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmadddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `vect_t` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()

Static Public Attributes

- static const constexpr size_t `vect_size` = 16
- static const constexpr size_t `alignment` = 32

16.273.1 Member Typedef Documentation

16.273.1.1 vect_t

```
using vect_t = __m256i
```

16.273.1.2 half_t

```
using half_t = __m128i
```

16.273.1.3 scalar_t

```
using scalar_t = int16_t
```

16.273.1.4 simdHalf

```
using simdHalf = Simd128<scalar_t>
```

16.273.2 Member Function Documentation**16.273.2.1 valid()**

```
static constexpr bool valid (
    T * p ) [inline], [static], [constexpr]
```

16.273.2.2 compliant()

```
static constexpr bool compliant (
    T n ) [inline], [static], [constexpr]
```

16.273.2.3 set1()

```
static INLINE CONST vect_t set1 (
    const scalar_t x ) [inline], [static]
```

16.273.2.4 set()

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7,
    const scalar_t x8,
    const scalar_t x9,
    const scalar_t x10,
    const scalar_t x11,
    const scalar_t x12,
    const scalar_t x13,
    const scalar_t x14,
    const scalar_t x15 ) [inline], [static]
```

16.273.2.5 gather()

```
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx ) [inline], [static]
```


16.273.2.6 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.273.2.7 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.273.2.8 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.273.2.9 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.273.2.10 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.273.2.11 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static]
```

16.273.2.12 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static]
```

16.273.2.13 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.273.2.14 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.273.2.15 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.16 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.17 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.18 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.19 unpacklohi()

```
static INLINE void unpacklohi (  
    vect_t & s1,  
    vect_t & s2,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.20 blend_twice()

```
static INLINE CONST vect_t blend_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.21 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.22 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.273.2.23 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.24 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.273.2.25 mullo()

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.26 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.27 mulhi()

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.28 mulx()

```
static INLINE CONST vect_t mulx (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.273.2.29 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.30 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.31 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.32 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.33 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.34 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.35 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.36 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.37 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.38 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,
```

```
const vect_t a,  
const vect_t b ) [inline], [static]
```

16.273.2.39 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.40 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.41 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.42 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.43 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.44 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.45 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.273.2.46 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.273.2.47 round()

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static]
```

16.273.2.48 mod()

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T ) [inline], [static]
```

16.273.2.49 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.273.2.50 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.273.3 Field Documentation**16.273.3.1 vect_size**

```
const constexpr size_t vect_size = 16 [static], [constexpr]
```

16.273.3.2 alignment

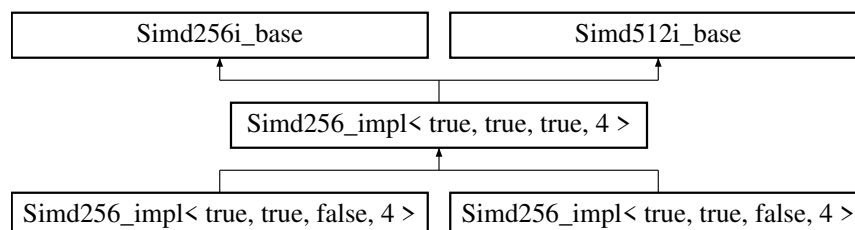
```
const constexpr size_t alignment = 32 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd256_int16.inl](#)

16.274 Simd256_impl< true, true, true, 4 > Struct Reference

Inheritance diagram for Simd256_impl< true, true, true, 4 >:

**Data Structures**

- union [Converter](#)

Public Types

- using `vect_t` = `__m256i`
- using `half_t` = `__m128i`
- using `scalar_t` = `int32_t`
- using `simdHalf` = `Simd128`< `scalar_t` >
- using `vect_t` = `__m512i`
- using `half_t` = `__m256i`
- using `scalar_t` = `int32_t`
- using `simdHalf` = `Simd256`< `scalar_t` >

Static Public Member Functions

- `template<class T >`
static constexpr bool `valid` (T *p)
- `template<class T >`
static constexpr bool `compliant` (T n)
- static `INLINE CONST vect_t set1` (const `scalar_t` x)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3, const `scalar_t` x4, const `scalar_t` x5, const `scalar_t` x6, const `scalar_t` x7)
- `template<class T >`
static `INLINE PURE vect_t gather` (const `scalar_t` *const p, const T *const idx)
- static `INLINE PURE vect_t load` (const `scalar_t` *const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` *const p)
- static `INLINE void store` (`scalar_t` *p, `vect_t` v)
- static `INLINE void storeu` (`scalar_t` *p, `vect_t` v)
- static `INLINE void stream` (`scalar_t` *p, const `vect_t` v)
- `template<int s>`
static `INLINE CONST vect_t sll` (const `vect_t` a)
- `template<int s>`
static `INLINE CONST vect_t srl` (const `vect_t` a)
- `template<int s>`
static `INLINE CONST vect_t sra` (const `vect_t` a)
- `template<uint8_t s>`
static `INLINE CONST vect_t shuffle_twice` (const `vect_t` a)
- `template<uint32_t s>`
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &s1, `vect_t` &s2, const `vect_t` a, const `vect_t` b)
- `template<uint8_t s>`
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmadddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)

- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `vect_t` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)
- template<class T >
static constexpr bool `valid` (T *p)
- template<class T >
static constexpr bool `compliant` (T n)
- static `INLINE CONST vect_t set1` (const `scalar_t` x)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3, const `scalar_t` x4, const `scalar_t` x5, const `scalar_t` x6, const `scalar_t` x7, const `scalar_t` x8, const `scalar_t` x9, const `scalar_t` x10, const `scalar_t` x11, const `scalar_t` x12, const `scalar_t` x13, const `scalar_t` x14, const `scalar_t` x15)
- template<class T >
static `INLINE PURE vect_t gather` (const `scalar_t` *const p, const T *const idx)
- static `INLINE PURE vect_t load` (const `scalar_t` *const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` *const p)
- static `INLINE void store` (`scalar_t` *p, `vect_t` v)
- static `INLINE void storeu` (`scalar_t` *p, `vect_t` v)
- static `INLINE void stream` (`scalar_t` *p, const `vect_t` v)
- template<int s>
static `INLINE CONST vect_t sll` (const `vect_t` a)
- template<int s>
static `INLINE CONST vect_t srl` (const `vect_t` a)
- template<int s>
static `INLINE CONST vect_t sra` (const `vect_t` a)
- template<uint8_t s>
static `INLINE CONST vect_t shuffle_twice` (const `vect_t` a)
- template<uint64_t s>
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)

- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE vect_t mod` (`vect_t` &C, const `vect_t` &P, const `vect_t` &INVP, const `vect_t` &NEGP, const `vect_t` &MIN, const `vect_t` &MAX, `vect_t` &Q, `vect_t` &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)

Static Public Attributes

- static const constexpr size_t `vect_size` = 8
- static const constexpr size_t `alignment` = 32

16.274.1 Member Typedef Documentation

16.274.1.1 `vect_t` [1/2]

```
using vect_t = __m256i
```

16.274.1.2 `half_t` [1/2]

```
using half_t = __m128i
```

16.274.1.3 `scalar_t` [1/2]

```
using scalar_t = int32_t
```

16.274.1.4 `simdHalf` [1/2]

```
using simdHalf = Simd128<scalar_t>
```

16.274.1.5 vect_t [2/2]

```
using vect_t = __m512i
```

16.274.1.6 half_t [2/2]

```
using half_t = __m256i
```

16.274.1.7 scalar_t [2/2]

```
using scalar_t = int32_t
```

16.274.1.8 simdHalf [2/2]

```
using simdHalf = Simd256<scalar_t>
```

16.274.2 Member Function Documentation**16.274.2.1 valid() [1/2]**

```
static constexpr bool valid (
    T * p ) [inline], [static], [constexpr]
```

16.274.2.2 compliant() [1/2]

```
static constexpr bool compliant (
    T n ) [inline], [static], [constexpr]
```

16.274.2.3 set1() [1/2]

```
static INLINE CONST vect_t set1 (
    const scalar_t x ) [inline], [static]
```

16.274.2.4 set() [1/2]

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7 ) [inline], [static]
```

16.274.2.5 gather() [1/2]

```
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx ) [inline], [static]
```

16.274.2.6 load() [1/2]

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.274.2.7 loadu() [1/2]

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.274.2.8 store() [1/2]

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.274.2.9 storeu() [1/2]

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.274.2.10 stream() [1/2]

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.274.2.11 sll() [1/2]

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static]
```

16.274.2.12 srl() [1/2]

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static]
```

16.274.2.13 sra() [1/2]

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.274.2.14 shuffle_twice() [1/2]

```
static INLINE CONST vect_t shuffle_twice (  
    const vect_t a ) [inline], [static]
```

16.274.2.15 shuffle() [1/2]

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.274.2.16 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.17 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.18 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.19 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.20 unpacklohi()

```
static INLINE void unpacklohi (  
    vect_t & s1,  
    vect_t & s2,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.21 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.22 add() [1/2]

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.23 addin() [1/2]

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.274.2.24 sub() [1/2]

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.25 subin() [1/2]

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.274.2.26 mullo() [1/2]

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.27 mul() [1/2]

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.28 mulhi() [1/2]

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.29 mulx() [1/2]

```
static INLINE CONST vect_t mulx (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.274.2.30 fmadd() [1/2]

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.31 fmaddin() [1/2]

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.32 fmaddx() [1/2]

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.33 fmaddxin() [1/2]

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.34 fnmadd() [1/2]

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.35 fnmaddin() [1/2]

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.36 fnmaddx() [1/2]

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.37 fnmaddxin() [1/2]

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.38 fmsub() [1/2]

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,
```

```
const vect_t a,  
const vect_t b ) [inline], [static]
```

16.274.2.39 fmsubin() [1/2]

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.40 fmsubx() [1/2]

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.41 fmsubxin() [1/2]

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.42 eq() [1/2]

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.43 greater() [1/2]

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.44 lesser() [1/2]

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.45 greater_eq() [1/2]

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.46 lesser_eq() [1/2]

```
static INLINE CONST vect_t lesser_eq (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.274.2.47 hadd_to_scal() [1/2]

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a ) [inline], [static]
```

16.274.2.48 round() [1/2]

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static]
```

16.274.2.49 mod() [1/2]

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T ) [inline], [static]
```

16.274.2.50 valid() [2/2]

```
static constexpr bool valid (
    T * p ) [inline], [static], [constexpr]
```

16.274.2.51 compliant() [2/2]

```
static constexpr bool compliant (
    T n ) [inline], [static], [constexpr]
```

16.274.2.52 set1() [2/2]

```
static INLINE CONST vect_t set1 (
    const scalar_t x ) [inline], [static]
```

16.274.2.53 set() [2/2]

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
```



```
const scalar_t x7,  
const scalar_t x8,  
const scalar_t x9,  
const scalar_t x10,  
const scalar_t x11,  
const scalar_t x12,  
const scalar_t x13,  
const scalar_t x14,  
const scalar_t x15 ) [inline], [static]
```

16.274.2.54 gather() [2/2]

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.274.2.55 load() [2/2]

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.274.2.56 loadu() [2/2]

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.274.2.57 store() [2/2]

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.274.2.58 storeu() [2/2]

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.274.2.59 stream() [2/2]

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.274.2.60 sll() [2/2]

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static]
```

16.274.2.61 srl() [2/2]

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static]
```

16.274.2.62 sra() [2/2]

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.274.2.63 shuffle_twice() [2/2]

```
static INLINE CONST vect_t shuffle_twice (  
    const vect_t a ) [inline], [static]
```

16.274.2.64 shuffle() [2/2]

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.274.2.65 add() [2/2]

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.66 addin() [2/2]

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.274.2.67 sub() [2/2]

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.68 subin() [2/2]

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.274.2.69 mullo() [2/2]

```
static INLINE CONST vect_t mullo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.70 mul() [2/2]

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.71 mulhi() [2/2]

```
static INLINE CONST vect_t mulhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.72 mulx() [2/2]

```
static INLINE CONST vect_t mulx (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.274.2.73 fmadd() [2/2]

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.74 fmaddin() [2/2]

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.75 fmaddx() [2/2]

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.76 fmaddxin() [2/2]

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.77 fnmadd() [2/2]

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.78 fnmaddin() [2/2]

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.79 fnmaddx() [2/2]

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.80 fnmaddxin() [2/2]

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.81 fmsub() [2/2]

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.82 fmsubin() [2/2]

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.83 fmsubx() [2/2]

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.84 fmsubxin() [2/2]

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.274.2.85 eq() [2/2]

```
static INLINE CONST vect_t eq (  
    const vect_t a,
```

```
const vect_t b ) [inline], [static]
```

16.274.2.86 greater() [2/2]

```
static INLINE CONST vect_t greater (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.274.2.87 lesser() [2/2]

```
static INLINE CONST vect_t lesser (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.274.2.88 greater_eq() [2/2]

```
static INLINE CONST vect_t greater_eq (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.274.2.89 lesser_eq() [2/2]

```
static INLINE CONST vect_t lesser_eq (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.274.2.90 hadd_to_scal() [2/2]

```
static INLINE CONST scalar_t hadd_to_scal (
    const vect_t a ) [inline], [static]
```

16.274.2.91 round() [2/2]

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static]
```

16.274.2.92 mod() [2/2]

```
static INLINE vect_t mod (
    vect_t & C,
    const vect_t & P,
    const vect_t & INVP,
    const vect_t & NEGP,
    const vect_t & MIN,
    const vect_t & MAX,
    vect_t & Q,
    vect_t & T ) [inline], [static]
```

16.274.2.93 type_string() [1/2]

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.274.2.94 zero() [1/2]

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.274.2.95 type_string() [2/2]

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.274.2.96 zero() [2/2]

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```

16.274.2.97 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.274.2.98 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.274.2.99 vand()

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.274.2.100 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.274.3 Field Documentation**16.274.3.1 vect_size**

```
static const constexpr size_t vect_size = 8 [static], [constexpr]
```

16.274.3.2 alignment

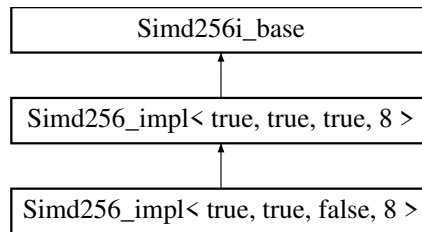
```
static const constexpr size_t alignment = 32 [static], [constexpr]
```

The documentation for this struct was generated from the following files:

- [simd256_int32.inl](#)
- [simd512_int32.inl](#)

16.275 Simd256_impl< true, true, true, 8 > Struct Reference

Inheritance diagram for Simd256_impl< true, true, true, 8 >:



Data Structures

- union [Converter](#)

Public Types

- using [vect_t](#) = __m256i
- using [half_t](#) = __m128i
- using [scalar_t](#) = int64_t
- using [simdHalf](#) = Simd128< [scalar_t](#) >

Static Public Member Functions

- template<class T >
static constexpr bool [valid](#) (T *p)
- template<class T >
static constexpr bool [compliant](#) (T n)
- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1, const [scalar_t](#) x2, const [scalar_t](#) x3)
- template<class T >
static [INLINE PURE vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- template<int idx>
static [INLINE CONST scalar_t get](#) ([vect_t](#) v)
- static [INLINE PURE vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE](#) void [store](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE](#) void [storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE](#) void [stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST vect_t sll](#) (const [vect_t](#) a)
- template<int s>
static [INLINE CONST vect_t srl](#) (const [vect_t](#) a)
- template<int s>
static [INLINE CONST vect_t sra](#) (const [vect_t](#) a)
- template<uint8_t s>
static [INLINE CONST vect_t shuffle](#) (const [vect_t](#) a)
- static [INLINE CONST vect_t unpacklo_twice](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t unpackhi_twice](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t unpacklo](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t unpackhi](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE](#) void [unpacklohi](#) ([vect_t](#) &l, [vect_t](#) &h, const [vect_t](#) a, const [vect_t](#) b)
- template<uint8_t s>
static [INLINE CONST vect_t blend](#) (const [vect_t](#) a, const [vect_t](#) b)

- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmadddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE CONST vect_t mask_high` ()
- static `INLINE CONST vect_t mulhi_fast` (`vect_t` x, `vect_t` y)
- static `INLINE vect_t mod` (`vect_t` &C, const `__m256d` &P, const `__m256d` &INVP, const `__m256d` &NEGP, const `vect_t` &POW50REM, const `__m256d` &MIN, const `__m256d` &MAX, `__m256d` &Q, `__m256d` &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()

Static Public Attributes

- static const constexpr size_t `vect_size` = 4
- static const constexpr size_t `alignment` = 32

Static Protected Member Functions

- static `INLINE CONST vect_t signbits` (const `vect_t` x)

16.275.1 Member Typedef Documentation

16.275.1.1 `vect_t`

```
using vect_t = __m256i
```

16.275.1.2 `half_t`

```
using half_t = __m128i
```


16.275.1.3 scalar_t

```
using scalar_t = int64_t
```

16.275.1.4 simdHalf

```
using simdHalf = Simd128<scalar_t>
```

16.275.2 Member Function Documentation

16.275.2.1 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr]
```

16.275.2.2 compliant()

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr]
```

16.275.2.3 set1()

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.275.2.4 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3 ) [inline], [static]
```

16.275.2.5 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.275.2.6 get()

```
static INLINE CONST scalar_t get (  
    vect_t v ) [inline], [static]
```

16.275.2.7 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.275.2.8 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.275.2.9 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.275.2.10 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.275.2.11 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.275.2.12 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static]
```

16.275.2.13 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static]
```

16.275.2.14 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.275.2.15 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.275.2.16 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.17 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.18 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.19 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.20 unpacklohi()

```
static INLINE void unpacklohi (  
    vect_t & l,  
    vect_t & h,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.21 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.22 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.23 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.275.2.24 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.25 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.275.2.26 mullo()

```
static INLINE CONST vect_t mullo (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.275.2.27 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.28 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.29 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.30 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.31 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.32 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.33 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.34 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.35 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.36 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.37 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.38 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.39 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.40 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,
```

```
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.41 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.42 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.43 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.44 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.45 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.275.2.46 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.275.2.47 round()

```
static INLINE CONST vect_t round (  
    const vect_t a ) [inline], [static]
```

16.275.2.48 mask_high()

```
static INLINE CONST vect_t mask_high ( ) [inline], [static]
```

16.275.2.49 mulhi_fast()

```

INLINE CONST vect_t mulhi_fast (
    vect_t x,
    vect_t y ) [static]

```

16.275.2.50 mod()

```

INLINE vect_t mod (
    vect_t & C,
    const __m256d & P,
    const __m256d & INV_P,
    const __m256d & NEG_P,
    const vect_t & POW50REM,
    const __m256d & MIN,
    const __m256d & MAX,
    __m256d & Q,
    __m256d & T ) [static]

```

16.275.2.51 signbits()

```

static INLINE CONST vect_t signbits (
    const vect_t x ) [inline], [static], [protected]

```

16.275.2.52 type_string()

```

static const std::string type_string ( ) [inline], [static], [inherited]

```

16.275.2.53 zero()

```

static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]

```

16.275.3 Field Documentation**16.275.3.1 vect_size**

```

const constexpr size_t vect_size = 4 [static], [constexpr]

```

16.275.3.2 alignment

```

const constexpr size_t alignment = 32 [static], [constexpr]

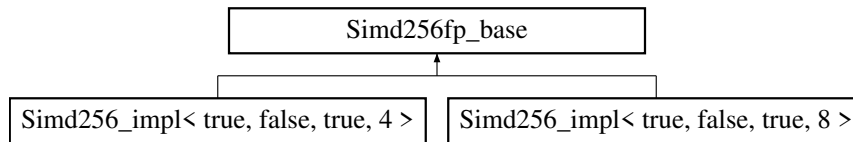
```

The documentation for this struct was generated from the following file:

- [simd256_int64.inl](#)

16.276 Simd256fp_base Struct Reference

Inheritance diagram for Simd256fp_base:

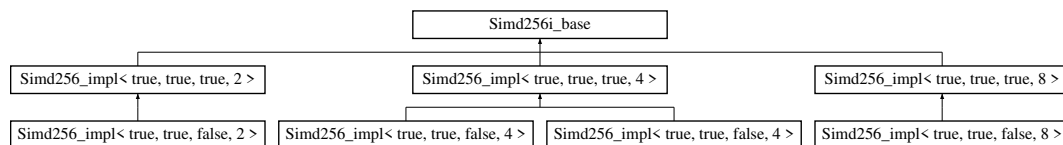


The documentation for this struct was generated from the following file:

- [simd256.inl](#)

16.277 Simd256i_base Struct Reference

Inheritance diagram for Simd256i_base:



Public Types

- using [vect_t](#) = __m256i

Static Public Member Functions

- static const std::string [type_string](#) ()
- static [INLINE CONST vect_t zero](#) ()

16.277.1 Member Typedef Documentation

16.277.1.1 vect_t

using [vect_t](#) = __m256i

16.277.2 Member Function Documentation

16.277.2.1 type_string()

```
static const std::string type_string ( ) [inline], [static]
```

16.277.2.2 zero()

```
static INLINE CONST vect\_t zero ( ) [inline], [static]
```

The documentation for this struct was generated from the following file:

- [simd256.inl](#)

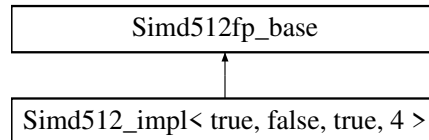
16.278 Simd512_impl< ArithType, Int, Signed, Size > Struct Template Reference

The documentation for this struct was generated from the following file:

- [simd512.inl](#)

16.279 Simd512_impl< true, false, true, 4 > Struct Reference

Inheritance diagram for Simd512_impl< true, false, true, 4 >:



Static Public Member Functions

- static const std::string [type_string](#) ()

16.279.1 Member Function Documentation

16.279.1.1 type_string()

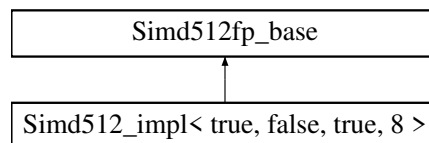
```
static const std::string type_string ( ) [inline], [static], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd512_float.inl](#)

16.280 Simd512_impl< true, false, true, 8 > Struct Reference

Inheritance diagram for Simd512_impl< true, false, true, 8 >:



Public Types

- using [vect_t](#) = __m512d
- using [scalar_t](#) = double

Static Public Member Functions

- template<class T >
static constexpr bool [valid](#) (T *p)
- template<class T >
static constexpr bool [compliant](#) (T n)
- static [INLINE CONST vect_t zero](#) ()
- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)

- static `INLINE CONST vect_t set` (const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3, const `scalar_t` x4, const `scalar_t` x5, const `scalar_t` x6, const `scalar_t` x7, const `scalar_t` x8)
- template<class T >
static `INLINE PURE vect_t gather` (const `scalar_t` *const p, const T *const idx)
- static `INLINE PURE vect_t load` (const `scalar_t` *const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` *const p)
- static `INLINE void store` (const `scalar_t` *p, const `vect_t` v)
- static `INLINE void storeu` (const `scalar_t` *p, const `vect_t` v)
- static `INLINE void stream` (const `scalar_t` *p, const `vect_t` v)
- template<uint8_t s>
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- template<uint8_t s>
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t blendv` (const `vect_t` a, const `vect_t` b, const `vect_t` mask)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t div` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t floor` (const `vect_t` a)
- static `INLINE CONST vect_t ceil` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE CONST vect_t hadd` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static const std::string `type_string` ()

Static Public Attributes

- static const constexpr size_t `vect_size` = 8
- static const constexpr size_t `alignment` = 64

16.280.1 Member Typedef Documentation

16.280.1.1 vect_t

using `vect_t` = __m512d

16.280.1.2 scalar_t

using scalar_t = double

16.280.2 Member Function Documentation

16.280.2.1 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr]
```

16.280.2.2 compliant()

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr]
```

16.280.2.3 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static]
```

16.280.2.4 set1()

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.280.2.5 set()

```
static INLINE CONST vect_t set (  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4,  
    const scalar_t x5,  
    const scalar_t x6,  
    const scalar_t x7,  
    const scalar_t x8 ) [inline], [static]
```

16.280.2.6 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.280.2.7 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.280.2.8 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.280.2.9 store()

```
static INLINE void store (  
    const scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.280.2.10 storeu()

```
static INLINE void storeu (  
    const scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.280.2.11 stream()

```
static INLINE void stream (  
    const scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.280.2.12 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.280.2.13 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.14 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.15 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.16 blendv()

```
static INLINE CONST vect_t blendv (  
    const vect_t a,  
    const vect_t b,  
    const vect_t mask ) [inline], [static]
```

16.280.2.17 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.18 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.280.2.19 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.20 subin()

```
static INLINE CONST vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.280.2.21 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.22 mulin()

```
static INLINE CONST vect_t mulin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.280.2.23 div()

```
static INLINE CONST vect_t div (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.24 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.25 fmaddin()

```
static INLINE CONST vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.26 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.27 fnmaddin()

```
static INLINE CONST vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.28 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.29 fmsubin()

```
static INLINE CONST vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.30 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.31 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.32 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.33 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.34 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.35 floor()

```
static INLINE CONST vect_t floor (  
    const vect_t a ) [inline], [static]
```

16.280.2.36 ceil()

```
static INLINE CONST vect_t ceil (  
    const vect_t a ) [inline], [static]
```

16.280.2.37 round()

```
static INLINE CONST vect_t round (  
    const vect_t a ) [inline], [static]
```

16.280.2.38 hadd()

```
static INLINE CONST vect_t hadd (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.280.2.39 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.280.2.40 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.280.3 Field Documentation

16.280.3.1 vect_size

```
const constexpr size_t vect_size = 8 [static], [constexpr]
```

16.280.3.2 alignment

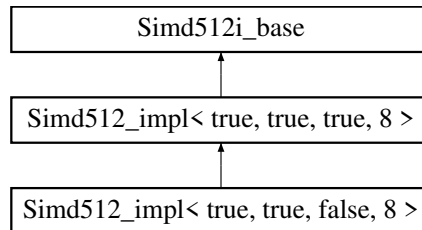
```
const constexpr size_t alignment = 64 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd512_double.inl](#)

16.281 Simd512_impl< true, true, false, 8 > Struct Reference

Inheritance diagram for Simd512_impl< true, true, false, 8 >:



Data Structures

- union [Converter](#)

Public Types

- using [scalar_t](#) = [uint64_t](#)
- using [simdHalf](#) = [Simd256](#)< [scalar_t](#) >
- using [vect_t](#) = [__m512i](#)
- using [half_t](#) = [__m256i](#)

Static Public Member Functions

- static [INLINE CONST vect_t set1](#) (const [scalar_t](#) x)
- static [INLINE CONST vect_t set](#) (const [scalar_t](#) x0, const [scalar_t](#) x1, const [scalar_t](#) x2, const [scalar_t](#) x3, const [scalar_t](#) x4, const [scalar_t](#) x5, const [scalar_t](#) x6, const [scalar_t](#) x7)
- template<class T >
static [INLINE PURE vect_t gather](#) (const [scalar_t](#) *const p, const T *const idx)
- static [INLINE PURE vect_t load](#) (const [scalar_t](#) *const p)
- static [INLINE PURE vect_t loadu](#) (const [scalar_t](#) *const p)
- static [INLINE void store](#) ([scalar_t](#) *p, [vect_t](#) v)
- template<[uint8_t](#) k>
static [INLINE void maskstore](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void storeu](#) ([scalar_t](#) *p, [vect_t](#) v)
- static [INLINE void stream](#) ([scalar_t](#) *p, const [vect_t](#) v)
- template<int s>
static [INLINE CONST vect_t sra](#) (const [vect_t](#) a)
- static [INLINE CONST vect_t greater](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t lesser](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t greater_eq](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t lesser_eq](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t mullo](#) ([vect_t](#) a, [vect_t](#) b)
- static [INLINE CONST vect_t mulx](#) (const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fmaddx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fmaddxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE CONST vect_t fnmaddx](#) (const [vect_t](#) c, const [vect_t](#) a, const [vect_t](#) b)
- static [INLINE vect_t fnmaddxin](#) ([vect_t](#) &c, const [vect_t](#) a, const [vect_t](#) b)

- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- template<class T >
static constexpr bool `valid` (T *p)
- template<class T >
static constexpr bool `compliant` (T n)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3)
- template<int s>
static `INLINE CONST vect_t sll` (const `vect_t` a)
- template<int s>
static `INLINE CONST vect_t srl` (const `vect_t` a)
- template<uint8_t s>
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &l, `vect_t` &h, const `vect_t` a, const `vect_t` b)
- template<uint8_t s>
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmadin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmadin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE CONST vect_t mask_high` ()
- static `INLINE CONST vect_t mulhi_fast` (`vect_t` x, `vect_t` y)
- static `INLINE vect_t mod` (`vect_t` &C, const __m512d &P, const __m512d &INVP, const __m512d &NEGP, const `vect_t` &POW50REM, const __m512d &MIN, const __m512d &MAX, __m512d &Q, __m512d &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)

Static Public Attributes

- static const constexpr size_t `vect_size` = 8
- static const constexpr size_t `alignment` = 64

Static Protected Member Functions

- static `INLINE CONST vect_t signbits` (const `vect_t` x)

16.281.1 Member Typedef Documentation

16.281.1.1 scalar_t

```
using scalar_t = uint64_t
```

16.281.1.2 simdHalf

```
using simdHalf = Simd256<scalar_t>
```

16.281.1.3 vect_t

```
using vect_t = __m512i [inherited]
```

16.281.1.4 half_t

```
using half_t = __m256i [inherited]
```

16.281.2 Member Function Documentation

16.281.2.1 set1()

```
static INLINE CONST vect_t set1 (  
    const scalar_t x ) [inline], [static]
```

16.281.2.2 set() [1/2]

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3,  
    const scalar_t x4,  
    const scalar_t x5,  
    const scalar_t x6,  
    const scalar_t x7 ) [inline], [static]
```

16.281.2.3 gather()

```
static INLINE PURE vect_t gather (  
    const scalar_t *const p,  
    const T *const idx ) [inline], [static]
```

16.281.2.4 load()

```
static INLINE PURE vect_t load (  
    const scalar_t *const p ) [inline], [static]
```

16.281.2.5 loadu()

```
static INLINE PURE vect_t loadu (  
    const scalar_t *const p ) [inline], [static]
```

16.281.2.6 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.281.2.7 maskstore()

```
static INLINE void maskstore (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.281.2.8 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.281.2.9 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.281.2.10 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.281.2.11 greater()

```
static INLINE CONST vect_t greater (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.281.2.12 lesser()

```
static INLINE CONST vect_t lesser (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.281.2.13 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.14 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.15 mullo()

```
static INLINE CONST vect_t mullo (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.281.2.16 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.17 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.18 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.19 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.20 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.21 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.22 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.281.2.23 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.281.2.24 valid()

```
static constexpr bool valid (  
    T * p ) [inline], [static], [constexpr], [inherited]
```

16.281.2.25 compliant()

```
static constexpr bool compliant (  
    T n ) [inline], [static], [constexpr], [inherited]
```

16.281.2.26 set() [2/2]

```
static INLINE CONST vect_t set (  
    const scalar_t x0,  
    const scalar_t x1,  
    const scalar_t x2,  
    const scalar_t x3 ) [inline], [static], [inherited]
```

16.281.2.27 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static], [inherited]
```

16.281.2.28 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static], [inherited]
```

16.281.2.29 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static], [inherited]
```

16.281.2.30 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.31 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.32 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.33 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.34 unpacklohi()

```
static INLINE void unpacklohi (  
    vect_t & l,  
    vect_t & h,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.35 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.36 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.37 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.38 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.39 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.40 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.41 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.42 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.43 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.44 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.45 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.46 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.47 eq()

```
static INLINE CONST vect_t eq (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.48 round()

```
static INLINE CONST vect_t round (
    const vect_t a ) [inline], [static], [inherited]
```

16.281.2.49 mask_high()

```
static INLINE CONST vect_t mask_high ( ) [inline], [static], [inherited]
```

16.281.2.50 mulhi_fast()

```
INLINE CONST vect_t mulhi_fast (
    vect_t x,
    vect_t y ) [static], [inherited]
```

16.281.2.51 mod()

```
INLINE vect_t mod (
    vect_t & C,
    const __m512d & P,
    const __m512d & INV_P,
    const __m512d & NEG_P,
    const vect_t & POW50REM,
    const __m512d & MIN,
    const __m512d & MAX,
    __m512d & Q,
    __m512d & T ) [static], [inherited]
```

16.281.2.52 signbits()

```
static INLINE CONST vect_t signbits (
    const vect_t x ) [inline], [static], [protected], [inherited]
```

16.281.2.53 type_string()

```
static const std::string type_string ( ) [inline], [static], [inherited]
```

16.281.2.54 zero()

```
static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]
```


16.281.2.55 vor()

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.56 vxor()

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.57 vand()

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.281.2.58 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.281.3 Field Documentation**16.281.3.1 vect_size**

```
const constexpr size_t vect_size = 8 [static], [constexpr], [inherited]
```

16.281.3.2 alignment

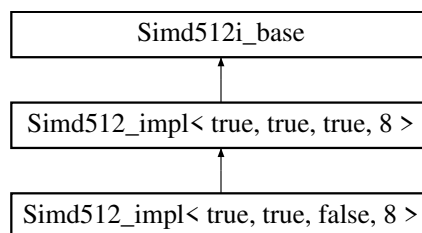
```
const constexpr size_t alignment = 64 [static], [constexpr], [inherited]
```

The documentation for this struct was generated from the following file:

- [simd512_int64.inl](#)

16.282 Simd512_impl< true, true, true, 8 > Struct Reference

Inheritance diagram for Simd512_impl< true, true, true, 8 >:

**Data Structures**

- union [Converter](#)

Public Types

- using `vect_t` = `__m512i`
- using `half_t` = `__m256i`
- using `scalar_t` = `int64_t`
- using `simdHalf` = `Simd256< scalar_t >`

Static Public Member Functions

- `template<class T >`
static constexpr bool `valid` (T *p)
- `template<class T >`
static constexpr bool `compliant` (T n)
- static `INLINE CONST vect_t set1` (const `scalar_t` x)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3, const `scalar_t` x4, const `scalar_t` x5, const `scalar_t` x6, const `scalar_t` x7)
- static `INLINE CONST vect_t set` (const `scalar_t` x0, const `scalar_t` x1, const `scalar_t` x2, const `scalar_t` x3)
- `template<class T >`
static `INLINE PURE vect_t gather` (const `scalar_t` *const p, const T *const idx)
- static `INLINE PURE vect_t load` (const `scalar_t` *const p)
- static `INLINE PURE vect_t loadu` (const `scalar_t` *const p)
- static `INLINE void store` (`scalar_t` *p, `vect_t` v)
- `template<uint8_t k>`
static `INLINE void maskstore` (`scalar_t` *p, `vect_t` v)
- static `INLINE void storeu` (`scalar_t` *p, `vect_t` v)
- static `INLINE void stream` (`scalar_t` *p, const `vect_t` v)
- `template<int s>`
static `INLINE CONST vect_t sll` (const `vect_t` a)
- `template<int s>`
static `INLINE CONST vect_t srl` (const `vect_t` a)
- `template<int s>`
static `INLINE CONST vect_t sra` (const `vect_t` a)
- `template<uint8_t s>`
static `INLINE CONST vect_t shuffle` (const `vect_t` a)
- static `INLINE CONST vect_t unpacklo_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi_twice` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpacklo` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t unpackhi` (const `vect_t` a, const `vect_t` b)
- static `INLINE void unpacklohi` (`vect_t` &l, `vect_t` &h, const `vect_t` a, const `vect_t` b)
- `template<uint8_t s>`
static `INLINE CONST vect_t blend` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t add` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t addin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t sub` (const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t subin` (`vect_t` &a, const `vect_t` b)
- static `INLINE CONST vect_t mullo` (`vect_t` a, `vect_t` b)
- static `INLINE CONST vect_t mul` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t mulx` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmadd` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fnmaddx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fnmaddxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)

- static `INLINE CONST vect_t fmsub` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t fmsubx` (const `vect_t` c, const `vect_t` a, const `vect_t` b)
- static `INLINE vect_t fmsubxin` (`vect_t` &c, const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t greater_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t lesser_eq` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST scalar_t hadd_to_scal` (const `vect_t` a)
- static `INLINE CONST vect_t round` (const `vect_t` a)
- static `INLINE CONST vect_t mask_high` ()
- static `INLINE CONST vect_t mulhi_fast` (`vect_t` x, `vect_t` y)
- static `INLINE vect_t mod` (`vect_t` &C, const `__m512d` &P, const `__m512d` &INVP, const `__m512d` &NEGP, const `vect_t` &POW50REM, const `__m512d` &MIN, const `__m512d` &MAX, `__m512d` &Q, `__m512d` &T)
- static const std::string `type_string` ()
- static `INLINE CONST vect_t zero` ()
- static `INLINE CONST vect_t vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t vandnot` (const `vect_t` a, const `vect_t` b)

Static Public Attributes

- static const constexpr size_t `vect_size` = 8
- static const constexpr size_t `alignment` = 64

Static Protected Member Functions

- static `INLINE CONST vect_t signbits` (const `vect_t` x)

16.282.1 Member Typedef Documentation

16.282.1.1 vect_t

```
using vect_t = __m512i
```

16.282.1.2 half_t

```
using half_t = __m256i
```

16.282.1.3 scalar_t

```
using scalar_t = int64_t
```

16.282.1.4 simdHalf

```
using simdHalf = Simd256<scalar_t>
```

16.282.2 Member Function Documentation

16.282.2.1 valid()

```
static constexpr bool valid (
    T * p ) [inline], [static], [constexpr]
```

16.282.2.2 compliant()

```
static constexpr bool compliant (
    T n ) [inline], [static], [constexpr]
```

16.282.2.3 set1()

```
static INLINE CONST vect_t set1 (
    const scalar_t x ) [inline], [static]
```

16.282.2.4 set() [1/2]

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3,
    const scalar_t x4,
    const scalar_t x5,
    const scalar_t x6,
    const scalar_t x7 ) [inline], [static]
```

16.282.2.5 set() [2/2]

```
static INLINE CONST vect_t set (
    const scalar_t x0,
    const scalar_t x1,
    const scalar_t x2,
    const scalar_t x3 ) [inline], [static]
```

16.282.2.6 gather()

```
static INLINE PURE vect_t gather (
    const scalar_t *const p,
    const T *const idx ) [inline], [static]
```

16.282.2.7 load()

```
static INLINE PURE vect_t load (
    const scalar_t *const p ) [inline], [static]
```

16.282.2.8 loadu()

```
static INLINE PURE vect_t loadu (
    const scalar_t *const p ) [inline], [static]
```

16.282.2.9 store()

```
static INLINE void store (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.282.2.10 maskstore()

```
static INLINE void maskstore (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.282.2.11 storeu()

```
static INLINE void storeu (  
    scalar_t * p,  
    vect_t v ) [inline], [static]
```

16.282.2.12 stream()

```
static INLINE void stream (  
    scalar_t * p,  
    const vect_t v ) [inline], [static]
```

16.282.2.13 sll()

```
static INLINE CONST vect_t sll (  
    const vect_t a ) [inline], [static]
```

16.282.2.14 srl()

```
static INLINE CONST vect_t srl (  
    const vect_t a ) [inline], [static]
```

16.282.2.15 sra()

```
static INLINE CONST vect_t sra (  
    const vect_t a ) [inline], [static]
```

16.282.2.16 shuffle()

```
static INLINE CONST vect_t shuffle (  
    const vect_t a ) [inline], [static]
```

16.282.2.17 unpacklo_twice()

```
static INLINE CONST vect_t unpacklo_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.18 unpackhi_twice()

```
static INLINE CONST vect_t unpackhi_twice (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.19 unpacklo()

```
static INLINE CONST vect_t unpacklo (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.20 unpackhi()

```
static INLINE CONST vect_t unpackhi (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.21 unpacklohi()

```
static INLINE void unpacklohi (  
    vect_t & l,  
    vect_t & h,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.22 blend()

```
static INLINE CONST vect_t blend (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.23 add()

```
static INLINE CONST vect_t add (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.24 addin()

```
static INLINE vect_t addin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.282.2.25 sub()

```
static INLINE CONST vect_t sub (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.26 subin()

```
static INLINE vect_t subin (  
    vect_t & a,  
    const vect_t b ) [inline], [static]
```

16.282.2.27 mullo()

```
static INLINE CONST vect_t mullo (  
    vect_t a,  
    vect_t b ) [inline], [static]
```

16.282.2.28 mul()

```
static INLINE CONST vect_t mul (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.29 mulx()

```
static INLINE CONST vect_t mulx (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.30 fmadd()

```
static INLINE CONST vect_t fmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.31 fmaddin()

```
static INLINE vect_t fmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.32 fmaddx()

```
static INLINE CONST vect_t fmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.33 fmaddxin()

```
static INLINE vect_t fmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.34 fnmadd()

```
static INLINE CONST vect_t fnmadd (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.35 fnmaddin()

```
static INLINE vect_t fnmaddin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.36 fnmaddx()

```
static INLINE CONST vect_t fnmaddx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.37 fnmaddxin()

```
static INLINE vect_t fnmaddxin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.38 fmsub()

```
static INLINE CONST vect_t fmsub (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.39 fmsubin()

```
static INLINE vect_t fmsubin (  
    vect_t & c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.40 fmsubx()

```
static INLINE CONST vect_t fmsubx (  
    const vect_t c,  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.41 fmsubxin()

```
static INLINE vect_t fmsubxin (  
    vect_t & c,
```



```
const vect_t a,  
const vect_t b ) [inline], [static]
```

16.282.2.42 eq()

```
static INLINE CONST vect_t eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.43 greater()

```
static INLINE CONST vect_t greater (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.44 lesser()

```
static INLINE CONST vect_t lesser (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.45 greater_eq()

```
static INLINE CONST vect_t greater_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.46 lesser_eq()

```
static INLINE CONST vect_t lesser_eq (  
    const vect_t a,  
    const vect_t b ) [inline], [static]
```

16.282.2.47 hadd_to_scal()

```
static INLINE CONST scalar_t hadd_to_scal (  
    const vect_t a ) [inline], [static]
```

16.282.2.48 round()

```
static INLINE CONST vect_t round (  
    const vect_t a ) [inline], [static]
```

16.282.2.49 mask_high()

```
static INLINE CONST vect_t mask_high ( ) [inline], [static]
```

16.282.2.50 mulhi_fast()

```

INLINE CONST vect_t mulhi_fast (
    vect_t x,
    vect_t y ) [static]

```

16.282.2.51 mod()

```

INLINE vect_t mod (
    vect_t & C,
    const __m512d & P,
    const __m512d & INV_P,
    const __m512d & NEG_P,
    const vect_t & POW50REM,
    const __m512d & MIN,
    const __m512d & MAX,
    __m512d & Q,
    __m512d & T ) [static]

```

16.282.2.52 signbits()

```

static INLINE CONST vect_t signbits (
    const vect_t x ) [inline], [static], [protected]

```

16.282.2.53 type_string()

```

static const std::string type_string ( ) [inline], [static], [inherited]

```

16.282.2.54 zero()

```

static INLINE CONST vect_t zero ( ) [inline], [static], [inherited]

```

16.282.2.55 vor()

```

static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]

```

16.282.2.56 vxor()

```

static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]

```

16.282.2.57 vand()

```

static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]

```

16.282.2.58 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static], [inherited]
```

16.282.3 Field Documentation**16.282.3.1 vect_size**

```
const constexpr size_t vect_size = 8 [static], [constexpr]
```

16.282.3.2 alignment

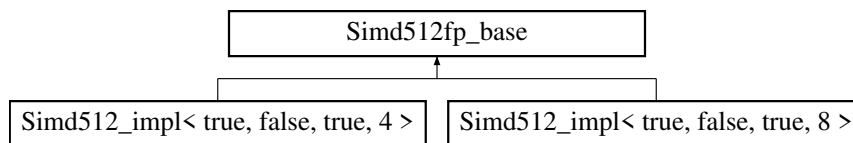
```
const constexpr size_t alignment = 64 [static], [constexpr]
```

The documentation for this struct was generated from the following file:

- [simd512_int64.inl](#)

16.283 Simd512fp_base Struct Reference

Inheritance diagram for Simd512fp_base:

**Static Public Member Functions**

- static const std::string [type_string](#) ()

16.283.1 Member Function Documentation**16.283.1.1 type_string()**

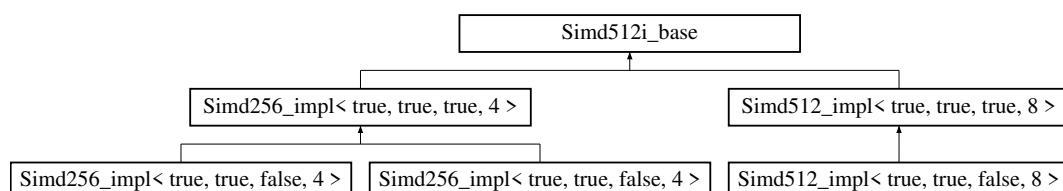
```
static const std::string type_string ( ) [inline], [static]
```

The documentation for this struct was generated from the following file:

- [simd512.inl](#)

16.284 Simd512i_base Struct Reference

Inheritance diagram for Simd512i_base:



Public Types

- using `vect_t` = `__m512i`

Static Public Member Functions

- static const std::string `type_string` ()
- static `INLINE CONST vect_t` `zero` ()
- static `INLINE CONST vect_t` `vor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t` `vxor` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t` `vand` (const `vect_t` a, const `vect_t` b)
- static `INLINE CONST vect_t` `vandnot` (const `vect_t` a, const `vect_t` b)

16.284.1 Member Typedef Documentation

16.284.1.1 `vect_t`

using `vect_t` = `__m512i`

16.284.2 Member Function Documentation

16.284.2.1 `type_string()`

```
static const std::string type_string ( ) [inline], [static]
```

16.284.2.2 `zero()`

```
static INLINE CONST vect_t zero ( ) [inline], [static]
```

16.284.2.3 `vor()`

```
static INLINE CONST vect_t vor (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.284.2.4 `vxor()`

```
static INLINE CONST vect_t vxor (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.284.2.5 `vand()`

```
static INLINE CONST vect_t vand (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

16.284.2.6 vandnot()

```
static INLINE CONST vect_t vandnot (
    const vect_t a,
    const vect_t b ) [inline], [static]
```

The documentation for this struct was generated from the following file:

- [simd512.inl](#)

16.285 SimdChooser< T, bool, bool > Struct Template Reference

```
#include <fflas_simd.h>
```

The documentation for this struct was generated from the following file:

- [fflas_simd.h](#)

16.286 SimdChooser< T, false, b > Struct Template Reference

```
#include <fflas_simd.h>
```

Public Types

- using [value](#) = [NoSimd](#)< T >

16.286.1 Member Typedef Documentation**16.286.1.1 value**

```
using value = NoSimd<T>
```

The documentation for this struct was generated from the following file:

- [fflas_simd.h](#)

16.287 SimdChooser< T, true, false > Struct Template Reference

```
#include <fflas_simd.h>
```

Public Types

- using [value](#) = [NoSimd](#)< T >

16.287.1 Member Typedef Documentation**16.287.1.1 value**

```
using value = NoSimd<T>
```

The documentation for this struct was generated from the following file:

- [fflas_simd.h](#)

16.288 SimdChooser< T, true, true > Struct Template Reference

```
#include <fflas_simd.h>
```

Public Types

- using [value](#) = [NoSimd](#)< T >

16.288.1 Member Typedef Documentation

16.288.1.1 value

using [value](#) = [NoSimd](#)<T>

The documentation for this struct was generated from the following file:

- [fflas_simd.h](#)

16.289 [simdToType](#)< T > Struct Template Reference

The documentation for this struct was generated from the following file:

- [fflas_simd.h](#)

16.290 Single Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.291 [Sparse](#)< [Field](#), [SparseMatrix_t](#), [IdxT](#), [PtrT](#) > Struct Template Reference

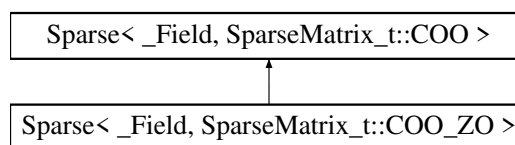
The documentation for this struct was generated from the following file:

- [fflas_sparse.h](#)

16.292 [Sparse](#)< [_Field](#), [SparseMatrix_t::COO](#) > Struct Template Reference

```
#include <coo.h>
```

Inheritance diagram for [Sparse](#)< [_Field](#), [SparseMatrix_t::COO](#) >:



Public Types

- using [Field](#) = [_Field](#)

Data Fields

- [index_t](#) * [col](#) = nullptr
- [index_t](#) * [row](#) = nullptr
- [_Field::Element_ptr](#) dat

- bool `delayed` = false
- `uint64_t` `kmax` = 0
- `index_t` `m` = 0
- `index_t` `n` = 0
- `uint64_t` `nnz` = 0
- `uint64_t` `nElements` = 0
- `uint64_t` `maxrow` = 0

16.292.1 Member Typedef Documentation

16.292.1.1 Field

using `Field` = `_Field`

16.292.2 Field Documentation

16.292.2.1 col

`index_t*` `col` = `nullptr`

16.292.2.2 row

`index_t*` `row` = `nullptr`

16.292.2.3 dat

`_Field::Element_ptr` `dat`

16.292.2.4 delayed

bool `delayed` = false

16.292.2.5 kmax

`uint64_t` `kmax` = 0

16.292.2.6 m

`index_t` `m` = 0

16.292.2.7 n

`index_t` `n` = 0

16.292.2.8 nnz

`uint64_t` `nnz` = 0

16.292.2.9 nElements

```
uint64_t nElements = 0
```

16.292.2.10 maxrow

```
uint64_t maxrow = 0
```

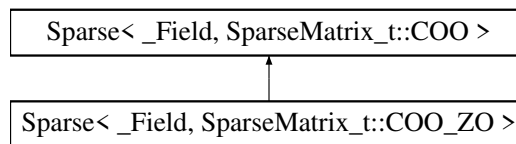
The documentation for this struct was generated from the following file:

- [coo.h](#)

16.293 Sparse<_Field, SparseMatrix_t::COO_ZO> Struct Template Reference

```
#include <coo.h>
```

Inheritance diagram for Sparse<_Field, SparseMatrix_t::COO_ZO>:



Public Types

- using [Field](#) = _Field

Data Fields

- _Field::Element [cst](#) = 1
- [index_t](#) * [col](#) = nullptr
- [index_t](#) * [row](#) = nullptr
- _Field::Element_ptr [dat](#)
- bool [delayed](#) = false
- [uint64_t](#) [kmax](#) = 0
- [index_t](#) [m](#) = 0
- [index_t](#) [n](#) = 0
- [uint64_t](#) [nnz](#) = 0
- [uint64_t](#) [nElements](#) = 0
- [uint64_t](#) [maxrow](#) = 0

16.293.1 Member Typedef Documentation

16.293.1.1 Field

```
using Field = _Field
```

16.293.2 Field Documentation

16.293.2.1 cst

```
_Field::Element cst = 1
```


16.293.2.2 col

```
index_t* col = nullptr [inherited]
```

16.293.2.3 row

```
index_t* row = nullptr [inherited]
```

16.293.2.4 dat

```
_Field::Element_ptr dat [inherited]
```

16.293.2.5 delayed

```
bool delayed = false [inherited]
```

16.293.2.6 kmax

```
uint64_t kmax = 0 [inherited]
```

16.293.2.7 m

```
index_t m = 0 [inherited]
```

16.293.2.8 n

```
index_t n = 0 [inherited]
```

16.293.2.9 nnz

```
uint64_t nnz = 0 [inherited]
```

16.293.2.10 nElements

```
uint64_t nElements = 0 [inherited]
```

16.293.2.11 maxrow

```
uint64_t maxrow = 0 [inherited]
```

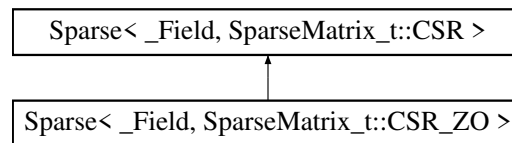
The documentation for this struct was generated from the following file:

- [coo.h](#)

16.294 Sparse<_Field, SparseMatrix_t::CSR> Struct Template Reference

```
#include <csr.h>
```

Inheritance diagram for Sparse<_Field, SparseMatrix_t::CSR>:



Public Types

- using `Field` = `_Field`

Data Fields

- bool `delayed` = false
- `uint64_t` `kmax` = 0
- `index_t` `m` = 0
- `index_t` `n` = 0
- `uint64_t` `nnz` = 0
- `uint64_t` `nElements` = 0
- `uint64_t` `maxrow` = 0
- `index_t` * `col` = nullptr
- `index_t` * `st` = nullptr
- `index_t` * `stend` = nullptr
- `_Field::Element_ptr` `dat`

16.294.1 Member Typedef Documentation

16.294.1.1 Field

using `Field` = `_Field`

16.294.2 Field Documentation

16.294.2.1 delayed

bool `delayed` = false

16.294.2.2 kmax

`uint64_t` `kmax` = 0

16.294.2.3 m

`index_t` `m` = 0

16.294.2.4 n

`index_t` `n` = 0

16.294.2.5 nnz

```
uint64_t nnz = 0
```

16.294.2.6 nElements

```
uint64_t nElements = 0
```

16.294.2.7 maxrow

```
uint64_t maxrow = 0
```

16.294.2.8 col

```
index_t* col = nullptr
```

16.294.2.9 st

```
index_t* st = nullptr
```

16.294.2.10 stend

```
index_t* stend = nullptr
```

16.294.2.11 dat

```
_Field::Element_ptr dat
```

The documentation for this struct was generated from the following file:

- [csr.h](#)

16.295 Sparse< _Field, SparseMatrix_t::CSR_HYB > Struct Template Reference

```
#include <csr_hyb.h>
```

Public Types

- using [Field](#) = _Field

Data Fields

- bool [delayed](#) = false
- [index_t](#) * [col](#) = nullptr
- [index_t](#) * [st](#) = nullptr
- [_Field::Element_ptr](#) [dat](#)
- [uint64_t](#) [kmax](#) = 0
- [index_t](#) [m](#) = 0
- [index_t](#) [n](#) = 0
- [uint64_t](#) [nnz](#) = 0
- [uint64_t](#) [nElements](#) = 0
- [uint64_t](#) [maxrow](#) = 0

- `uint64_t nOnes = 0`
- `uint64_t nMOnes = 0`
- `uint64_t nOthers = 0`

16.295.1 Member Typedef Documentation

16.295.1.1 Field

```
using Field = _Field
```

16.295.2 Field Documentation

16.295.2.1 delayed

```
bool delayed = false
```

16.295.2.2 col

```
index_t* col = nullptr
```

16.295.2.3 st

```
index_t* st = nullptr
```

16.295.2.4 dat

```
_Field::Element_ptr dat
```

16.295.2.5 kmax

```
uint64_t kmax = 0
```

16.295.2.6 m

```
index_t m = 0
```

16.295.2.7 n

```
index_t n = 0
```

16.295.2.8 nnz

```
uint64_t nnz = 0
```

16.295.2.9 nElements

```
uint64_t nElements = 0
```

16.295.2.10 maxrow

```
uint64_t maxrow = 0
```

16.295.2.11 nOnes

```
uint64_t nOnes = 0
```

16.295.2.12 nMOnes

```
uint64_t nMOnes = 0
```

16.295.2.13 nOthers

```
uint64_t nOthers = 0
```

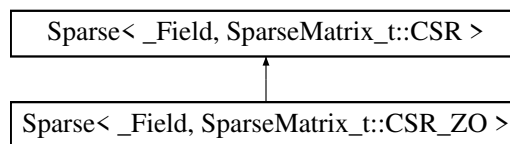
The documentation for this struct was generated from the following file:

- [csr_hyb.h](#)

16.296 Sparse<_Field, SparseMatrix_t::CSR_ZO > Struct Template Reference

```
#include <csr.h>
```

Inheritance diagram for Sparse<_Field, SparseMatrix_t::CSR_ZO >:

**Public Types**

- using [Field](#) = [_Field](#)

Data Fields

- [int64_t](#) [cst](#) = 1
- bool [delayed](#) = false
- [uint64_t](#) [kmax](#) = 0
- [index_t](#) [m](#) = 0
- [index_t](#) [n](#) = 0
- [uint64_t](#) [nnz](#) = 0
- [uint64_t](#) [nElements](#) = 0
- [uint64_t](#) [maxrow](#) = 0
- [index_t](#) * [col](#) = nullptr
- [index_t](#) * [st](#) = nullptr
- [index_t](#) * [stend](#) = nullptr
- [_Field::Element_ptr](#) [dat](#)

16.296.1 Member Typedef Documentation

16.296.1.1 Field

```
using Field = _Field
```

16.296.2 Field Documentation

16.296.2.1 cst

```
int64_t cst = 1
```

16.296.2.2 delayed

```
bool delayed = false
```

16.296.2.3 kmax

```
uint64_t kmax = 0 [inherited]
```

16.296.2.4 m

```
index_t m = 0 [inherited]
```

16.296.2.5 n

```
index_t n = 0 [inherited]
```

16.296.2.6 nnz

```
uint64_t nnz = 0 [inherited]
```

16.296.2.7 nElements

```
uint64_t nElements = 0 [inherited]
```

16.296.2.8 maxrow

```
uint64_t maxrow = 0 [inherited]
```

16.296.2.9 col

```
index_t* col = nullptr [inherited]
```

16.296.2.10 st

```
index_t* st = nullptr [inherited]
```

16.296.2.11 stend

```
index_t* stend = nullptr [inherited]
```

16.296.2.12 dat

```
_Field::Element_ptr dat [inherited]
```

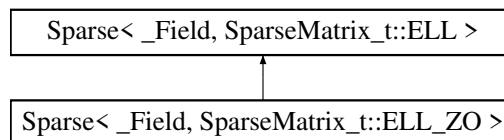
The documentation for this struct was generated from the following file:

- [csr.h](#)

16.297 Sparse< _Field, SparseMatrix_t::ELL > Struct Template Reference

```
#include <ell.h>
```

Inheritance diagram for Sparse< _Field, SparseMatrix_t::ELL >:

**Public Types**

- using [Field](#) = _Field

Data Fields

- bool [delayed](#) = false
- [uint64_t](#) [kmax](#) = 0
- [index_t](#) [m](#) = 0
- [index_t](#) [n](#) = 0
- [index_t](#) [ld](#) = 0
- [uint64_t](#) [nnz](#) = 0
- [uint64_t](#) [nElements](#) = 0
- [uint64_t](#) [maxrow](#) = 0
- [index_t](#)* [col](#) = nullptr
- [_Field::Element_ptr](#) [dat](#)

16.297.1 Member Typedef Documentation**16.297.1.1 Field**

```
using Field = _Field
```

16.297.2 Field Documentation**16.297.2.1 delayed**

```
bool delayed = false
```

16.297.2.2 kmax

```
uint64_t kmax = 0
```

16.297.2.3 m

```
index_t m = 0
```

16.297.2.4 n

```
index_t n = 0
```

16.297.2.5 ld

```
index_t ld = 0
```

16.297.2.6 nnz

```
uint64_t nnz = 0
```

16.297.2.7 nElements

```
uint64_t nElements = 0
```

16.297.2.8 maxrow

```
uint64_t maxrow = 0
```

16.297.2.9 col

```
index_t* col = nullptr
```

16.297.2.10 dat

```
_Field::Element_ptr dat
```

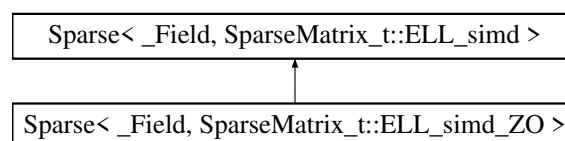
The documentation for this struct was generated from the following file:

- [ell.h](#)

16.298 Sparse<_Field, SparseMatrix_t::ELL_simd> Struct Template Reference

```
#include <ell_simd.h>
```

Inheritance diagram for Sparse<_Field, SparseMatrix_t::ELL_simd>:



Data Fields

- bool `delayed` = false
- int `chunk` = 0
- `index_t` `m` = 0
- `index_t` `n` = 0
- `index_t` `ld` = 0
- `uint64_t` `kmax` = 0
- `uint64_t` `nnz` = 0
- `uint64_t` `nElements` = 0
- `uint64_t` `maxrow` = 0
- `uint64_t` `nChunks` = 0
- `index_t` * `col` = nullptr
- `_Field::Element_ptr` `dat`

16.298.1 Field Documentation

16.298.1.1 `delayed`

```
bool delayed = false
```

16.298.1.2 `chunk`

```
int chunk = 0
```

16.298.1.3 `m`

```
index_t m = 0
```

16.298.1.4 `n`

```
index_t n = 0
```

16.298.1.5 `ld`

```
index_t ld = 0
```

16.298.1.6 `kmax`

```
uint64_t kmax = 0
```

16.298.1.7 `nnz`

```
uint64_t nnz = 0
```

16.298.1.8 `nElements`

```
uint64_t nElements = 0
```

16.298.1.9 maxrow

```
uint64_t maxrow = 0
```

16.298.1.10 nChunks

```
uint64_t nChunks = 0
```

16.298.1.11 col

```
index_t* col = nullptr
```

16.298.1.12 dat

```
_Field::Element_ptr dat
```

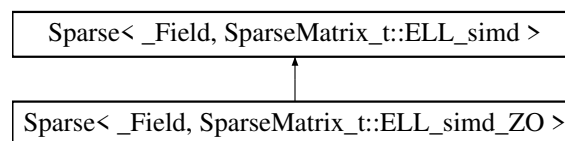
The documentation for this struct was generated from the following file:

- [ell_simd.h](#)

16.299 Sparse< _Field, SparseMatrix_t::ELL_simd_ZO > Struct Template Reference

```
#include <ell_simd.h>
```

Inheritance diagram for Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >:

**Data Fields**

- _Field::Element [cst](#) = 1
- bool [delayed](#) = false
- int [chunk](#) = 0
- [index_t](#) [m](#) = 0
- [index_t](#) [n](#) = 0
- [index_t](#) [ld](#) = 0
- [uint64_t](#) [kmax](#) = 0
- [uint64_t](#) [nnz](#) = 0
- [uint64_t](#) [nElements](#) = 0
- [uint64_t](#) [maxrow](#) = 0
- [uint64_t](#) [nChunks](#) = 0
- [index_t](#) * [col](#) = nullptr
- _Field::Element_ptr [dat](#)

16.299.1 Field Documentation**16.299.1.1 cst**

```
_Field::Element cst = 1
```

16.299.1.2 delayed

```
bool delayed = false [inherited]
```

16.299.1.3 chunk

```
int chunk = 0 [inherited]
```

16.299.1.4 m

```
index_t m = 0 [inherited]
```

16.299.1.5 n

```
index_t n = 0 [inherited]
```

16.299.1.6 ld

```
index_t ld = 0 [inherited]
```

16.299.1.7 kmax

```
uint64_t kmax = 0 [inherited]
```

16.299.1.8 nnz

```
uint64_t nnz = 0 [inherited]
```

16.299.1.9 nElements

```
uint64_t nElements = 0 [inherited]
```

16.299.1.10 maxrow

```
uint64_t maxrow = 0 [inherited]
```

16.299.1.11 nChunks

```
uint64_t nChunks = 0 [inherited]
```

16.299.1.12 col

```
index_t* col = nullptr [inherited]
```

16.299.1.13 dat

```
_Field::Element_ptr dat [inherited]
```

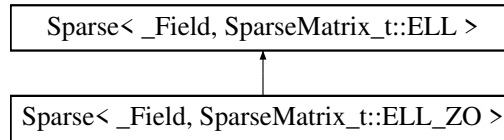
The documentation for this struct was generated from the following file:

- [ell_simd.h](#)

16.300 Sparse< _Field, SparseMatrix_t::ELL_ZO > Struct Template Reference

```
#include <ell.h>
```

Inheritance diagram for Sparse< _Field, SparseMatrix_t::ELL_ZO >:



Public Types

- using [Field](#) = _Field

Data Fields

- _Field::Element [cst](#) = 1
- bool [delayed](#) = false
- [uint64_t](#) [kmax](#) = 0
- [index_t](#) [m](#) = 0
- [index_t](#) [n](#) = 0
- [index_t](#) [ld](#) = 0
- [uint64_t](#) [nnz](#) = 0
- [uint64_t](#) [nElements](#) = 0
- [uint64_t](#) [maxrow](#) = 0
- [index_t](#) * [col](#) = nullptr
- _Field::Element_ptr [dat](#)

16.300.1 Member Typedef Documentation

16.300.1.1 Field

```
using Field = _Field
```

16.300.2 Field Documentation

16.300.2.1 cst

```
_Field::Element cst = 1
```

16.300.2.2 delayed

```
bool delayed = false [inherited]
```

16.300.2.3 kmax

```
uint64\_t kmax = 0 [inherited]
```

16.300.2.4 m

`index_t m = 0` [inherited]

16.300.2.5 n

`index_t n = 0` [inherited]

16.300.2.6 ld

`index_t ld = 0` [inherited]

16.300.2.7 nnz

`uint64_t nnz = 0` [inherited]

16.300.2.8 nElements

`uint64_t nElements = 0` [inherited]

16.300.2.9 maxrow

`uint64_t maxrow = 0` [inherited]

16.300.2.10 col

`index_t* col = nullptr` [inherited]

16.300.2.11 dat

`_Field::Element_ptr dat` [inherited]

The documentation for this struct was generated from the following file:

- [ell.h](#)

16.301 Sparse<_Field, SparseMatrix_t::HYB_ZO > Struct Template Reference

```
#include <hyb_zo.h>
```

Public Types

- using [Field](#) = [_Field](#)
- typedef [Sparse](#)< [_Field](#), [SparseMatrix_t::HYB_ZO](#) > [Self_t](#)

Data Fields

- bool [delayed](#) = false
- [uint64_t](#) [kmax](#) = 0
- [index_t](#) [m](#) = 0
- [index_t](#) [n](#) = 0

- `uint64_t nnz = 0`
- `uint64_t maxrow = 0`
- `uint64_t nElements = 0`
- `Sparse<_Field, SparseMatrix_t::CSR> * dat = nullptr`
- `Sparse<_Field, SparseMatrix_t::CSR_ZO> * one = nullptr`
- `Sparse<_Field, SparseMatrix_t::CSR_ZO> * mone = nullptr`

16.301.1 Member Typedef Documentation

16.301.1.1 Field

using `Field` = `_Field`

16.301.1.2 Self_t

typedef `Sparse<_Field, SparseMatrix_t::HYB_ZO>` `Self_t`

16.301.2 Field Documentation

16.301.2.1 delayed

`bool delayed = false`

16.301.2.2 kmax

`uint64_t kmax = 0`

16.301.2.3 m

`index_t m = 0`

16.301.2.4 n

`index_t n = 0`

16.301.2.5 nnz

`uint64_t nnz = 0`

16.301.2.6 maxrow

`uint64_t maxrow = 0`

16.301.2.7 nElements

`uint64_t nElements = 0`

16.301.2.8 dat

```
Sparse<_Field, SparseMatrix_t::CSR>* dat = nullptr
```

16.301.2.9 one

```
Sparse<_Field, SparseMatrix_t::CSR_ZO>* one = nullptr
```

16.301.2.10 mone

```
Sparse<_Field, SparseMatrix_t::CSR_ZO>* mone = nullptr
```

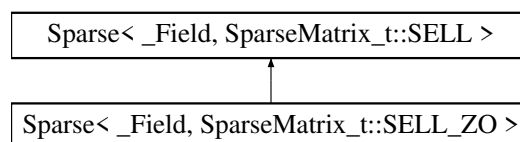
The documentation for this struct was generated from the following file:

- [hyb_zo.h](#)

16.302 Sparse< _Field, SparseMatrix_t::SELL > Struct Template Reference

```
#include <sell.h>
```

Inheritance diagram for Sparse< _Field, SparseMatrix_t::SELL >:

**Public Types**

- using [Field](#) = [_Field](#)

Data Fields

- bool [delayed](#) = false
- int [chunk](#) = 0
- [index_t](#) [kmax](#) = 0
- [index_t](#) [m](#) = 0
- [index_t](#) [n](#) = 0
- [index_t](#) [maxrow](#) = 0
- [index_t](#) [sigma](#) = 0
- [index_t](#) [nChunks](#) = 0
- [uint64_t](#) [nnz](#) = 0
- [uint64_t](#) [nElements](#) = 0
- [index_t](#) * [perm](#) = nullptr
- [uint64_t](#) * [st](#) = nullptr
- [index_t](#) * [chunkSize](#) = nullptr
- [index_t](#) * [col](#) = nullptr
- [_Field::Element_ptr](#) [dat](#)

16.302.1 Member Typedef Documentation

16.302.1.1 Field

```
using Field = _Field
```

16.302.2 Field Documentation

16.302.2.1 delayed

```
bool delayed = false
```

16.302.2.2 chunk

```
int chunk = 0
```

16.302.2.3 kmax

```
index_t kmax = 0
```

16.302.2.4 m

```
index_t m = 0
```

16.302.2.5 n

```
index_t n = 0
```

16.302.2.6 maxrow

```
index_t maxrow = 0
```

16.302.2.7 sigma

```
index_t sigma = 0
```

16.302.2.8 nChunks

```
index_t nChunks = 0
```

16.302.2.9 nnz

```
uint64_t nnz = 0
```

16.302.2.10 nElements

```
uint64_t nElements = 0
```


16.302.2.11 perm

```
index_t* perm = nullptr
```

16.302.2.12 st

```
uint64_t* st = nullptr
```

16.302.2.13 chunkSize

```
index_t* chunkSize = nullptr
```

16.302.2.14 col

```
index_t* col = nullptr
```

16.302.2.15 dat

```
_Field::Element_ptr dat
```

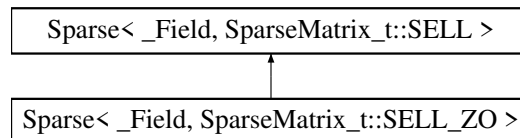
The documentation for this struct was generated from the following file:

- [sell.h](#)

16.303 Sparse< _Field, SparseMatrix_t::SELL_ZO > Struct Template Reference

```
#include <sell.h>
```

Inheritance diagram for Sparse< _Field, SparseMatrix_t::SELL_ZO >:

**Public Types**

- using [Field](#) = _Field

Data Fields

- _Field::Element [cst](#) = 1
- bool [delayed](#) = false
- int [chunk](#) = 0
- [index_t](#) [kmax](#) = 0
- [index_t](#) [m](#) = 0
- [index_t](#) [n](#) = 0
- [index_t](#) [maxrow](#) = 0
- [index_t](#) [sigma](#) = 0
- [index_t](#) [nChunks](#) = 0
- [uint64_t](#) [nnz](#) = 0
- [uint64_t](#) [nElements](#) = 0
- [index_t](#) * [perm](#) = nullptr

- `uint64_t * st = nullptr`
- `index_t * chunkSize = nullptr`
- `index_t * col = nullptr`
- `_Field::Element_ptr dat`

16.303.1 Member Typedef Documentation

16.303.1.1 Field

using `Field` = `_Field`

16.303.2 Field Documentation

16.303.2.1 cst

`_Field::Element cst = 1`

16.303.2.2 delayed

`bool delayed = false [inherited]`

16.303.2.3 chunk

`int chunk = 0 [inherited]`

16.303.2.4 kmax

`index_t kmax = 0 [inherited]`

16.303.2.5 m

`index_t m = 0 [inherited]`

16.303.2.6 n

`index_t n = 0 [inherited]`

16.303.2.7 maxrow

`index_t maxrow = 0 [inherited]`

16.303.2.8 sigma

`index_t sigma = 0 [inherited]`

16.303.2.9 nChunks

```
index_t nChunks = 0 [inherited]
```

16.303.2.10 nnz

```
uint64_t nnz = 0 [inherited]
```

16.303.2.11 nElements

```
uint64_t nElements = 0 [inherited]
```

16.303.2.12 perm

```
index_t* perm = nullptr [inherited]
```

16.303.2.13 st

```
uint64_t* st = nullptr [inherited]
```

16.303.2.14 chunkSize

```
index_t* chunkSize = nullptr [inherited]
```

16.303.2.15 col

```
index_t* col = nullptr [inherited]
```

16.303.2.16 dat

```
_Field::Element_ptr dat [inherited]
```

The documentation for this struct was generated from the following file:

- [sell.h](#)

16.304 SpMat< Field, flag > Struct Template Reference

```
#include <fflas_sparse.h>
```

Data Fields

- [FFLAS::CooMat< Field > * _coo](#) = nullptr
- [FFLAS::CsrMat< Field > * _csr](#) = nullptr
- [FFLAS::EliMat< Field > * _eli](#) = nullptr

16.304.1 Field Documentation**16.304.1.1 _coo**

```
FFLAS::CooMat<Field>* _coo = nullptr
```

16.304.1.2 _csr

```
FFLAS::CsrMat<Field>* _csr = nullptr
```

16.304.1.3 _ell

```
FFLAS::EllMat<Field>* _ell = nullptr
```

The documentation for this struct was generated from the following file:

- [fflas_sparse.h](#)

16.305 Static_error_check< bool > Class Template Reference

```
#include <instrset.h>
```

Public Member Functions

- [Static_error_check\(\)](#)

16.305.1 Constructor & Destructor Documentation**16.305.1.1 Static_error_check()**

```
Static_error_check ( ) [inline]
```

The documentation for this class was generated from the following file:

- [instrset.h](#)

16.306 Static_error_check< false > Class Reference

```
#include <instrset.h>
```

The documentation for this class was generated from the following file:

- [instrset.h](#)

16.307 StatsMatrix Struct Reference

```
#include <utils.h>
```

Data Fields

- [uint64_t rowdim](#) = 0
- [uint64_t coldim](#) = 0
- [uint64_t nOnes](#) = 0
- [uint64_t nMOnes](#) = 0
- [uint64_t nOthers](#) = 0
- [uint64_t nnz](#) = 0
- [uint64_t maxRow](#) = 0
- [uint64_t minRow](#) = 0
- [uint64_t averageRow](#) = 0
- [uint64_t deviationRow](#) = 0
- [uint64_t maxCol](#) = 0
- [uint64_t minCol](#) = 0
- [uint64_t averageCol](#) = 0

- `uint64_t` `deviationCol` = 0
- `uint64_t` `minColDifference` = 0
- `uint64_t` `maxColDifference` = 0
- `uint64_t` `averageColDifference` = 0
- `uint64_t` `deviationColDifference` = 0
- `uint64_t` `minRowDifference` = 0
- `uint64_t` `maxRowDifference` = 0
- `uint64_t` `averageRowDifference` = 0
- `uint64_t` `deviationRowDifference` = 0
- `uint64_t` `nDenseRows` = 0
- `uint64_t` `nDenseCols` = 0
- `uint64_t` `nEmptyRows` = 0
- `uint64_t` `nEmptyCols` = 0
- `uint64_t` `nEmptyColsEnd` = 0
- `std::vector< uint64_t >` `denseRows`
- `std::vector< uint64_t >` `denseCols`

16.307.1 Field Documentation

16.307.1.1 rowdim

`uint64_t` `rowdim` = 0

16.307.1.2 coldim

`uint64_t` `coldim` = 0

16.307.1.3 nOnes

`uint64_t` `nOnes` = 0

16.307.1.4 nMOnes

`uint64_t` `nMOnes` = 0

16.307.1.5 nOthers

`uint64_t` `nOthers` = 0

16.307.1.6 nnz

`uint64_t` `nnz` = 0

16.307.1.7 maxRow

`uint64_t` `maxRow` = 0

16.307.1.8 minRow

```
uint64_t minRow = 0
```

16.307.1.9 averageRow

```
uint64_t averageRow = 0
```

16.307.1.10 deviationRow

```
uint64_t deviationRow = 0
```

16.307.1.11 maxCol

```
uint64_t maxCol = 0
```

16.307.1.12 minCol

```
uint64_t minCol = 0
```

16.307.1.13 averageCol

```
uint64_t averageCol = 0
```

16.307.1.14 deviationCol

```
uint64_t deviationCol = 0
```

16.307.1.15 minColDifference

```
uint64_t minColDifference = 0
```

16.307.1.16 maxColDifference

```
uint64_t maxColDifference = 0
```

16.307.1.17 averageColDifference

```
uint64_t averageColDifference = 0
```

16.307.1.18 deviationColDifference

```
uint64_t deviationColDifference = 0
```

16.307.1.19 minRowDifference

```
uint64_t minRowDifference = 0
```

16.307.1.20 maxRowDifference

```
uint64_t maxRowDifference = 0
```

16.307.1.21 averageRowDifference

```
uint64_t averageRowDifference = 0
```

16.307.1.22 deviationRowDifference

```
uint64_t deviationRowDifference = 0
```

16.307.1.23 nDenseRows

```
uint64_t nDenseRows = 0
```

16.307.1.24 nDenseCols

```
uint64_t nDenseCols = 0
```

16.307.1.25 nEmptyRows

```
uint64_t nEmptyRows = 0
```

16.307.1.26 nEmptyCols

```
uint64_t nEmptyCols = 0
```

16.307.1.27 nEmptyColsEnd

```
uint64_t nEmptyColsEnd = 0
```

16.307.1.28 denseRows

```
std::vector<uint64_t> denseRows
```

16.307.1.29 denseCols

```
std::vector<uint64_t> denseCols
```

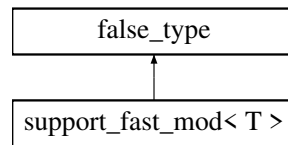
The documentation for this struct was generated from the following file:

- [utils.h](#)

16.308 support_fast_mod< T > Struct Template Reference

```
#include <fflas_freduce.h>
```

Inheritance diagram for support_fast_mod< T >:



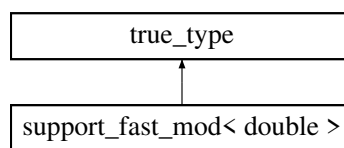
The documentation for this struct was generated from the following file:

- [fflas_freduce.h](#)

16.309 support_fast_mod< double > Struct Reference

```
#include <fflas_freduce.h>
```

Inheritance diagram for support_fast_mod< double >:



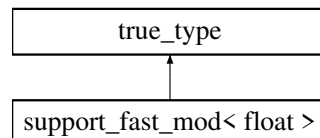
The documentation for this struct was generated from the following file:

- [fflas_freduce.h](#)

16.310 support_fast_mod< float > Struct Reference

```
#include <fflas_freduce.h>
```

Inheritance diagram for support_fast_mod< float >:



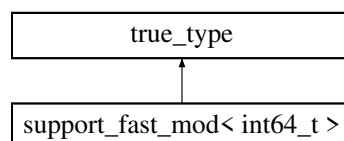
The documentation for this struct was generated from the following file:

- [fflas_freduce.h](#)

16.311 support_fast_mod< int64_t > Struct Reference

```
#include <fflas_freduce.h>
```

Inheritance diagram for support_fast_mod< int64_t >:



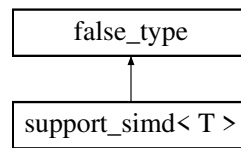
The documentation for this struct was generated from the following file:

- [fflas_freduce.h](#)

16.312 support_simd< T > Struct Template Reference

```
#include <fflas_simd.h>
```

Inheritance diagram for support_simd< T >:



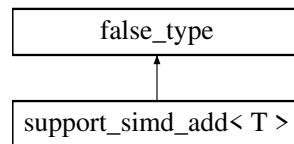
The documentation for this struct was generated from the following file:

- [fflas_simd.h](#)

16.313 support_simd_add< T > Struct Template Reference

```
#include <fflas_fadd.h>
```

Inheritance diagram for support_simd_add< T >:



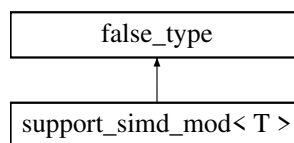
The documentation for this struct was generated from the following file:

- [fflas_fadd.h](#)

16.314 support_simd_mod< T > Struct Template Reference

```
#include <fflas_freduce.h>
```

Inheritance diagram for support_simd_mod< T >:



The documentation for this struct was generated from the following file:

- [fflas_freduce.h](#)

16.315 tfn_minus Struct Reference

```
#include <sparse_matrix_traits.h>
```

Public Member Functions

- `template<typename... Args>`
`auto operator\(\)(Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

16.315.1 Member Function Documentation

16.315.1.1 operator>()()

```
auto operator() (
    Args &&... args ) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.316 tfn_minus_eq Struct Reference

```
#include <sparse_matrix_traits.h>
```

Public Member Functions

- `template<typename... Args>`
`auto operator\(\) (Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

16.316.1 Member Function Documentation

16.316.1.1 operator>()()

```
auto operator() (
    Args &&... args ) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.317 tfn_mul Struct Reference

```
#include <sparse_matrix_traits.h>
```

Public Member Functions

- `template<typename... Args>`
`auto operator\(\) (Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

16.317.1 Member Function Documentation

16.317.1.1 operator>()()

```
auto operator() (
    Args &&... args ) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.318 tfn_mul_eq Struct Reference

```
#include <sparse_matrix_traits.h>
```

Public Member Functions

- `template<typename... Args>`
`auto operator\(\) (Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

16.318.1 Member Function Documentation

16.318.1.1 operator>()()

```
auto operator() (
    Args &&... args ) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.319 tfn_plus Struct Reference

```
#include <sparse_matrix_traits.h>
```

Public Member Functions

- `template<typename... Args>`
`auto operator\(\) (Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

16.319.1 Member Function Documentation

16.319.1.1 operator>()()

```
auto operator() (
    Args &&... args ) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.320 tfn_plus_eq Struct Reference

```
#include <sparse_matrix_traits.h>
```

Public Member Functions

- `template<typename... Args>`
`auto operator\(\) (Args &&... args) const -> decltype(operator+(std::forward< Args >(args)...))`

16.320.1 Member Function Documentation

16.320.1.1 operator>()

```
auto operator() (
    Args &&... args ) const -> decltype(operator+(std::forward<Args>(args)...))
[inline]
```

The documentation for this struct was generated from the following file:

- [sparse_matrix_traits.h](#)

16.321 Threads Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.322 ThreeD Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.323 ThreeDAdaptive Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.324 ThreeDInPlace Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.325 TRSMHelper< ReclterTrait, ParSeqTrait > Struct Template Reference

TRSM Helper.

Public Member Functions

- `template<class Cut , class Param >`
[TRSMHelper](#) ([ParSeqHelper::Parallel](#)< Cut, Param > _PS)
- `TRSMHelper` ([ParSeqHelper::Sequential](#) _PS)
- `template<typename RIT , typename PST >`
[TRSMHelper](#) ([TRSMHelper](#)< RIT, PST > &_TH)
- `template<class Dom , class Algo = FFLAS::MMHelperAlgo::Winograd, class ModeT = typename FFLAS::ModeTraits<Dom>::value>`
[FFLAS::MMHelper](#)< Dom, Algo, ModeT, ParSeqTrait > [pMMH](#) (Dom &D, size_t m, size_t k, size_t n, ParSeqTrait p) const
- `template<class Dom , class Algo = FFLAS::MMHelperAlgo::Winograd, class ModeT = typename FFLAS::ModeTraits<Dom>::value>`
[FFLAS::MMHelper](#)< Dom, Algo, ModeT, ParSeqTrait > [pMMH](#) (Dom &D, size_t m, size_t k, size_t n) const

Data Fields

- ParSeqTrait [parseq](#)

16.325.1 Detailed Description

```
template<typename ReclterTrait = StructureHelper::Recursive, typename ParSeqTrait = ParSeqHelper::Sequential>
struct FFLAS::TRSMHelper< ReclterTrait, ParSeqTrait >
```

TRSM Helper.

16.325.2 Constructor & Destructor Documentation

16.325.2.1 TRSMHelper() [1/3]

```
TRSMHelper (
    ParSeqHelper::Parallel< Cut, Param > _PS ) [inline]
```

16.325.2.2 TRSMHelper() [2/3]

```
TRSMHelper (
    ParSeqHelper::Sequential _PS ) [inline]
```

16.325.2.3 TRSMHelper() [3/3]

```
TRSMHelper (
    TRSMHelper< RIT, PST > & _TH ) [inline]
```

16.325.3 Member Function Documentation

16.325.3.1 pMMH() [1/2]

```
FFLAS::MMHelper< Dom, Algo, ModeT, ParSeqTrait > pMMH (
    Dom & D,
    size_t m,
    size_t k,
    size_t n,
    ParSeqTrait p ) const [inline]
```

16.325.3.2 pMMH() [2/2]

```
FFLAS::MMHelper< Dom, Algo, ModeT, ParSeqTrait > pMMH (
    Dom & D,
    size_t m,
    size_t k,
    size_t n ) const [inline]
```

16.325.4 Field Documentation

16.325.4.1 parseq

ParSeqTrait parseq

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.326 TwoD Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.327 TwoDAdaptive Struct Reference

The documentation for this struct was generated from the following file:

- [blockcuts.inl](#)

16.328 UnparametricTag Struct Reference

If the field uses a representation with infix operators.

```
#include <field-traits.h>
```

16.328.1 Detailed Description

If the field uses a representation with infix operators.

The documentation for this struct was generated from the following file:

- [field-traits.h](#)

16.329 Winograd Struct Reference

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

16.330 WinogradPar Struct Reference

The documentation for this struct was generated from the following file:

- [fflas_helpers.inl](#)

Chapter 17

File Documentation

17.1 arithprog.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include <ctime>
```

Macros

- `#define CUBE(x) ((x)*(x)*(x))`
- `#define GFOPS(m, n, r, t) (2.7*CUBE(double(n)/1000.0))/t`

Typedefs

- `typedef Givaro::Timer TTimer`

Functions

- `int main (int argc, char **argv)`

17.1.1 Macro Definition Documentation

17.1.1.1 CUBE

```
#define CUBE(  
    x )  ( (x) * (x) * (x) )
```

17.1.1.2 GFOPS

```
#define GFOPS(  
    m,  
    n,  
    r,  
    t )  ( 2.7*CUBE(double(n)/1000.0) ) / t
```

17.1.2 Typedef Documentation

17.1.2.1 TTimer

```
typedef Givaro::Timer TTimer
```

17.1.3 Function Documentation

17.1.3.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.2 charpoly.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include <ctime>
```

Macros

- #define CUBE(x) ((x)*(x)*(x))
- #define GFOPS(m, n, r, t) (2.7*CUBE(double(n)/1000.0))/t

Typedefs

- typedef Givaro::Timer TTimer

Functions

- int main ()

17.2.1 Macro Definition Documentation

17.2.1.1 CUBE

```
#define CUBE(
    x ) ((x)*(x)*(x))
```

17.2.1.2 GFOPS

```
#define GFOPS(
    m,
    n,
    r,
    t ) (2.7*CUBE(double(n)/1000.0))/t
```


17.2.2 Typedef Documentation

17.2.2.1 TTimer

```
typedef Givaro::Timer TTimer
```

17.2.3 Function Documentation

17.2.3.1 main()

```
int main (
    void )
```

17.3 charpoly.C File Reference

```
#include <iostream>
#include "fflas-ffpack/fflas-ffpack.h"
```

Functions

- int [main](#)(int argc, char **argv)

This example computes the characteristic polynomial of a matrix over a defined finite field.

17.3.1 Function Documentation

17.3.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

This example computes the characteristic polynomial of a matrix over a defined finite field. Outputs the characteristic polynomial.

17.4 fsyrk.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utis/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utis/fflas_randommatrix.h"
#include <ctime>
```

Macros

- #define [CUBE](#)(x) ((x)*(x)*(x))
- #define [GFOPS](#)(n, t) ([CUBE](#)(double(n)/1000.0)/(3.0*t))

Typedefs

- typedef Givaro::Timer [TTimer](#)

Functions

- int [main](#) ()

17.4.1 Macro Definition Documentation

17.4.1.1 CUBE

```
#define CUBE(  
    x )  ((x)*(x)*(x))
```

17.4.1.2 GFOPS

```
#define GFOPS(  
    n,  
    t )  (CUBE(double(n)/1000.0)/(3.0*t))
```

17.4.2 Typedef Documentation

17.4.2.1 TTimer

```
typedef Givaro::Timer TTimer
```

17.4.3 Function Documentation

17.4.3.1 main()

```
int main (  
    void )
```

17.5 fsytrf.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include <iostream>  
#include <givaro/modular-balanced.h>  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/ffpack/ffpack.h"  
#include "fflas-ffpack/utils/fflas_randommatrix.h"  
#include <ctime>
```

Macros

- #define [CUBE](#)(x) ((x)*(x)*(x))
- #define [GFOPS](#)(n, t) ([CUBE](#)(double(n)/1000.0)/(3.0*t))

Typedefs

- typedef Givaro::Timer [TTimer](#)

Functions

- int [main](#) ()

17.5.1 Macro Definition Documentation

17.5.1.1 CUBE

```
#define CUBE(  
    x )  ((x)*(x)*(x))
```

17.5.1.2 GFOPS

```
#define GFOPS(  
    n,  
    t )  (CUBE(double(n)/1000.0)/(3.0*t))
```

17.5.2 Typedef Documentation

17.5.2.1 TTimer

```
typedef Givaro::Timer TTimer
```

17.5.3 Function Documentation

17.5.3.1 main()

```
int main (  
    void )
```

17.6 ftrtri.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include "fflas-ffpack/utils/fflas_randommatrix.h"  
#include <iostream>  
#include <givaro/modular-balanced.h>  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/ffpack/ffpack.h"  
#include <ctime>
```

Macros

- #define [CUBE](#)(x) ((x)*(x)*(x))
- #define [GFOPS](#)(n, t) ([CUBE](#)(double(n)/1000.0)/(3.0*t))

Typedefs

- typedef Givaro::Timer [TTimer](#)

Functions

- int [main](#) ()

17.6.1 Macro Definition Documentation

17.6.1.1 CUBE

```
#define CUBE(  
    x )  ((x)*(x)*(x))
```

17.6.1.2 GFOPS

```
#define GFOPS(  
    n,  
    t )  (CUBE(double(n)/1000.0)/(3.0*t))
```

17.6.2 Typedef Documentation

17.6.2.1 TTimer

```
typedef Givaro::Timer TTimer
```

17.6.3 Function Documentation

17.6.3.1 main()

```
int main (  
    void )
```

17.7 pluq.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include "fflas-ffpack/utils/fflas_randommatrix.h"  
#include <iostream>  
#include <givaro/modular-balanced.h>  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/ffpack/ffpack.h"  
#include <ctime>
```

Macros

- #define [CUBE](#)(x) ((x)*(x)*(x))
- #define [GFOPS](#)(m, n, r, t) (2.0/3.0*[CUBE](#)(double(n)/1000.0) +2*m/1000.0*n/1000.0*double(r)/1000.0 - double(r)/1000.0*double(r)/1000.0*(m+n)/1000)/t

Typedefs

- typedef Givaro::Timer [TTimer](#)

Functions

- int [main](#) ()

17.7.1 Macro Definition Documentation

17.7.1.1 CUBE

```
#define CUBE(  
    x )  ((x)*(x)*(x))
```

17.7.1.2 GFOPS

```
#define GFOPS(  
    m,  
    n,  
    r,  
    t )  (2.0/3.0*CUBE(double(n)/1000.0) +2*m/1000.0*n/1000.0*double(r)/1000.0 - double(r)/1000.0←  
0*double(r)/1000.0*(m+n)/1000)/t
```

17.7.2 Typedef Documentation

17.7.2.1 TTimer

```
typedef Givaro::Timer TTimer
```

17.7.3 Function Documentation

17.7.3.1 main()

```
int main (  
    void )
```

17.8 pluq.C File Reference

```
#include <iostream>  
#include <givaro/modular.h>  
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include "fflas-ffpack/fflas-ffpack.h"  
#include "fflas-ffpack/utils/fflas_io.h"
```

Functions

- int [main](#) (int argc, char **argv)

17.8.1 Function Documentation

17.8.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.9 winograd.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <iostream>
#include <fstream>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include <ctime>
```

Macros

- `#define DOUBLE_TO_FLOAT_CROSSOVER 0`
- `#define GFOPS(n, t) (2.0/t*(double)n/1000.0*(double)n/1000.0*(double)n/1000.0)`

Typedefs

- `typedef Givaro::Timer TTimer`

Functions

- `template<class Field >`
`bool balanced (const Field &)`
- `template<class T >`
`bool balanced (const Givaro::ModularBalanced< T > &)`
- `int main ()`

17.9.1 Macro Definition Documentation

17.9.1.1 DOUBLE_TO_FLOAT_CROSSOVER

```
#define DOUBLE_TO_FLOAT_CROSSOVER 0
```

17.9.1.2 GFOPS

```
#define GFOPS(
    n,
    t ) (2.0/t*(double)n/1000.0*(double)n/1000.0*(double)n/1000.0)
```

17.9.2 Typedef Documentation

17.9.2.1 TTimer

```
typedef Givaro::Timer TTimer
```

17.9.3 Function Documentation

17.9.3.1 balanced() [1/2]

```
bool balanced (
    const Field & )
```

17.9.3.2 balanced() [2/2]

```
bool balanced (
    const Givaro::ModularBalanced< T > & )
```

17.9.3.3 main()

```
int main (
    void )
```

17.10 benchmark-charpoly-mp.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/Matio.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- #define `__FFLASFFPACK_FORCE_SEQ`

Functions

- int `main` (int argc, char **argv)

17.10.1 Macro Definition Documentation

17.10.1.1 __FFLASFFPACK_FORCE_SEQ

```
#define __FFLASFFPACK_FORCE_SEQ
```

17.10.2 Function Documentation

17.10.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.11 benchmark-charpoly.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include <givaro/givpoly1.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Functions

- `template<class Field >`
`void run_with_field (int q, size_t bits, size_t n, size_t d, size_t iter, std::string file, int variant)`
- `int main (int argc, char **argv)`

17.11.1 Macro Definition Documentation

17.11.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.11.2 Function Documentation

17.11.2.1 run_with_field()

```
void run_with_field (
    int q,
    size_t bits,
    size_t n,
    size_t d,
    size_t iter,
    std::string file,
    int variant )
```

17.11.2.2 main()

```
int main (
    int argc,
    char ** argv )
```


17.12 benchmark-checkers.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <stdlib.h>
#include <time.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/checkers/checkers_fflas.h"
#include "fflas-ffpack/checkers/checkers_ffpack.h"
#include <fstream>
```

Macros

- #define [ENABLE_ALL_CHECKINGS](#) 1
- #define [_NR_TESTS](#) 5
- #define [_MAX_SIZE_MATRICES](#) 1000
- #define [CUBE](#)(x) ((x)*(x)*(x))

Functions

- int [main](#) (int argc, char **argv)

17.12.1 Macro Definition Documentation

17.12.1.1 [ENABLE_ALL_CHECKINGS](#)

```
#define ENABLE_ALL_CHECKINGS 1
```

17.12.1.2 [_NR_TESTS](#)

```
#define _NR_TESTS 5
```

17.12.1.3 [_MAX_SIZE_MATRICES](#)

```
#define _MAX_SIZE_MATRICES 1000
```

17.12.1.4 [CUBE](#)

```
#define CUBE(  
    x ) ((x)*(x)*(x))
```

17.12.2 Function Documentation

17.12.2.1 [main\(\)](#)

```
int main (  
    int argc,  
    char ** argv )
```

17.13 benchmark-dgemm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- #define [CBLAS_GEMM](#) `cblas_dgemm`

Typedefs

- typedef [FFLAS::Timer](#) `TTimer`
- typedef double [Floats](#)

Functions

- int [main](#) (int argc, char **argv)

17.13.1 Macro Definition Documentation

17.13.1.1 CBLAS_GEMM

```
#define CBLAS_GEMM cblas_dgemm
```

17.13.2 Typedef Documentation

17.13.2.1 TTimer

```
typedef FFLAS::Timer TTimer
```

17.13.2.2 Floats

```
typedef double Floats
```

17.13.3 Function Documentation

17.13.3.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.14 benchmark-dgetrf.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <vector>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_HAVE_DGETRF 1`

Typedefs

- `typedef FFLAS::Timer TTimer`

Functions

- `int main (int argc, char **argv)`

17.14.1 Macro Definition Documentation

17.14.1.1 __FFLASFFPACK_HAVE_DGETRF

```
#define __FFLASFFPACK_HAVE_DGETRF 1
```

17.14.2 Typedef Documentation

17.14.2.1 TTimer

```
typedef FFLAS::Timer TTimer
```

17.14.3 Function Documentation

17.14.3.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.15 benchmark-dgetri.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <vector>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
```

```
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Typedefs

- typedef [FFLAS::Timer](#) [TTimer](#)

Functions

- int [main](#) (int argc, char **argv)

17.15.1 Typedef Documentation

17.15.1.1 TTimer

```
typedef FFLAS::Timer TTimer
```

17.15.2 Function Documentation

17.15.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.16 benchmark-dsytrf.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <vector>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- #define [EFFGFF](#)(n, t, i) ((double(n)/1000.*double(n)/1000.*double(n)/1000.0) / double(t) * double(i) / 3.)

Typedefs

- typedef [FFLAS::Timer](#) [TTimer](#)

Functions

- int [main](#) (int argc, char **argv)

17.16.1 Macro Definition Documentation

17.16.1.1 EFGFF

```
#define EFGFF(  
    n,  
    t,  
    i ) ( (double(n)/1000.*double(n)/1000.*double(n)/1000.0) / double(t) * double(i)  
/ 3.)
```

17.16.2 Typedef Documentation

17.16.2.1 TTimer

```
typedef FFLAS::Timer TTimer
```

17.16.3 Function Documentation

17.16.3.1 main()

```
int main (  
    int argc,  
    char ** argv )
```

17.17 benchmark-dtrsm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include <iostream>  
#include <givaro/modular.h>  
#include "fflas-ffpack/fflas-ffpack.h"  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/utils/fflas_io.h"  
#include "fflas-ffpack/utils/args-parser.h"
```

Typedefs

- typedef [FFLAS::Timer](#) TTimer

Functions

- int [main](#) (int argc, char **argv)

17.17.1 Typedef Documentation

17.17.1.1 TTimer

```
typedef FFLAS::Timer TTimer
```

17.17.2 Function Documentation

17.17.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.18 benchmark-dtrtri.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_HAVE_DTRTRI 1`

Typedefs

- `typedef FFLAS::Timer TTimer`

Functions

- `int main (int argc, char **argv)`

17.18.1 Macro Definition Documentation

17.18.1.1 [__FFLASFFPACK_HAVE_DTRTRI](#)

```
#define \_\_FFLASFFPACK\_HAVE\_DTRTRI 1
```

17.18.2 Typedef Documentation

17.18.2.1 [TTimer](#)

```
typedef FFLAS::Timer TTimer
```

17.18.3 Function Documentation

17.18.3.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.19 benchmark-fadd-lvl2.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Functions

- `int main (int argc, char **argv)`

17.19.1 Macro Definition Documentation

17.19.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.19.2 Function Documentation

17.19.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.20 benchmark-fdot.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include <givaro/givrational.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/paladin/parallel.h"
#include "fflas-ffpack/paladin/fflas_plevel1.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Functions

- `template<class Field >`
`Field::Element run_with_field` (int q, size_t iter, size_t N, const size_t BS, const size_t p, const size_t threads)
- `int main` (int argc, char **argv)

17.20.1 Macro Definition Documentation

17.20.1.1 `__FFLASFFPACK_OPENBLAS_NT_ALREADY_SET`

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.20.2 Function Documentation

17.20.2.1 `run_with_field()`

```
Field::Element run_with_field (
    int q,
    size_t iter,
    size_t N,
    const size_t BS,
    const size_t p,
    const size_t threads )
```

17.20.2.2 `main()`

```
int main (
    int argc,
    char ** argv )
```

17.21 benchmark-fgemm-mp.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <typeinfo>
#include <vector>
#include <string>
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "givaro/modular-integer.h"
#include "givaro/givcaster.h"
#include "fflas-ffpack/paladin/parallel.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`
- `#define MG_DEFAULT MG_ACTIVE`
- `#define STD_RECINT_SIZE 8`

Functions

- `template<typename Ints >`
`int tmain ()`
- `int main (int argc, char **argv)`

17.21.1 Macro Definition Documentation

17.21.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.21.1.2 MG_DEFAULT

```
#define MG_DEFAULT MG_ACTIVE
```

17.21.1.3 STD_RECINT_SIZE

```
#define STD_RECINT_SIZE 8
```

17.21.2 Function Documentation

17.21.2.1 tmain()

```
int tmain ( )
```

17.21.2.2 main()

```
int main (
    int argc,
    char ** argv )
```

17.22 benchmark-fgemm-rns.C File Reference

```
#include "fflas-ffpack/fflas/fflas.h"
#include <iostream>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Typedefs

- `typedef FFPACK::rns_double RNS`
- `typedef FFPACK::RNSInteger< RNS > Field`
- `typedef Field::Element_ptr Element_ptr`
- `typedef Field::ConstElement_ptr ConstElement_ptr`
- `typedef StrategyParameter::Threads THREADS`

- typedef [StrategyParameter::Grain](#) GRAIN
- typedef [StrategyParameter::TwoD](#) TWOD
- typedef [StrategyParameter::TwoDAdaptive](#) TWODA
- typedef [StrategyParameter::ThreeD](#) THREED
- typedef [StrategyParameter::ThreeDAdaptive](#) THREEDA
- typedef [StrategyParameter::ThreeDInPlace](#) THREEDIP
- typedef [ParSeqHelper::Sequential](#) PSeq

Functions

- int [main](#) (int argc, char *argv[])

17.22.1 Macro Definition Documentation

17.22.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.22.2 Typedef Documentation

17.22.2.1 RNS

```
typedef FFPACK::rns\_double RNS
```

17.22.2.2 Field

```
typedef FFPACK::RNSInteger<RNS> Field
```

17.22.2.3 Element_ptr

```
typedef Field::Element\_ptr Element\_ptr
```

17.22.2.4 ConstElement_ptr

```
typedef Field::ConstElement\_ptr ConstElement\_ptr
```

17.22.2.5 THREADS

```
typedef StrategyParameter::Threads THREADS
```

17.22.2.6 GRAIN

```
typedef StrategyParameter::Grain GRAIN
```

17.22.2.7 TWOD

```
typedef StrategyParameter::TwoD TWOD
```

17.22.2.8 TWODA

```
typedef StrategyParameter::TwoDAdaptive TWODA
```

17.22.2.9 THREED

```
typedef StrategyParameter::ThreeD THREED
```

17.22.2.10 THREEDA

```
typedef StrategyParameter::ThreeDAdaptive THREEDA
```

17.22.2.11 THREEDIP

```
typedef StrategyParameter::ThreeDInPlace THREEDIP
```

17.22.2.12 PSeq

```
typedef ParSeqHelper::Sequential PSeq
```

17.22.3 Function Documentation**17.22.3.1 main()**

```
int main (
    int argc,
    char * argv[] )
```

17.23 benchmark-fgemm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- #define [CLASSIC_HYBRID](#)

Functions

- int [main](#) (int argc, char **argv)

17.23.1 Macro Definition Documentation

17.23.1.1 CLASSIC_HYBRID

```
#define CLASSIC_HYBRID
```

17.23.2 Function Documentation

17.23.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.24 benchmark-fgemv-mp.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <typeinfo>
#include <vector>
#include <string>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "givaro/modular-integer.h"
#include "givaro/givcaster.h"
#include "fflas-ffpack/paladin/parallel.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`
- `#define MG_DEFAULT MG_ACTIVE`
- `#define STD_RECINT_SIZE 8`

Functions

- `template<typename T >`
`std::ostream & write_matrix (std::ostream &out, Givaro::Integer p, size_t m, size_t n, T *C, size_t ldc)`
- `template<typename Ints >`
`int tmain ()`
- `int main (int argc, char **argv)`

17.24.1 Macro Definition Documentation

17.24.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.24.1.2 MG_DEFAULT

```
#define MG_DEFAULT MG_ACTIVE
```

17.24.1.3 STD_RECINT_SIZE

```
#define STD_RECINT_SIZE 8
```

17.24.2 Function Documentation

17.24.2.1 write_matrix()

```
std::ostream & write_matrix (
    std::ostream & out,
    Givaro::Integer p,
    size_t m,
    size_t n,
    T * C,
    size_t ldc )
```

17.24.2.2 tmain()

```
int tmain ( )
```

17.24.2.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.25 benchmark-fgemv.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "givaro/modular-integer.h"
#include "givaro/givcaster.h"
```

Data Structures

- struct [need_field_characteristic< Field >](#)
- struct [need_field_characteristic< Givaro::Modular< Field > >](#)
- struct [need_field_characteristic< Givaro::ModularBalanced< Field > >](#)
- struct [compatible_data_type< Field >](#)
- struct [compatible_data_type< Givaro::ZRing< float > >](#)
- struct [compatible_data_type< Givaro::ZRing< double > >](#)

Macros

- [#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1](#)

Functions

- `template<class Field, class RandIter, class Matrix, class Vector >`
`void fill_value (Field &F, RandIter &Rand, Matrix &A, Vector &X, Vector &Y, size_t m, size_t k, size_t incX, size_t incY, size_t lda, int NBK)`
- `template<class Field, class Matrix, class Vector >`
`void genData (Field &F, Matrix &A, Vector &X, Vector &Y, size_t m, size_t k, size_t incX, size_t incY, size_t lda, int NBK, int bitsize, uint64_t seed)`
- `template<class Field, class Matrix, class Vector >`
`bool check_result (Field &F, size_t m, size_t lda, Matrix &A, Vector &X, size_t incX, Vector &Y, size_t incY)`
- `template<class Field, class Matrix, class Vector >`
`bool benchmark_with_timer (Field &F, int p, Matrix &A, Vector &X, Vector &Y, size_t m, size_t k, size_t incX, size_t incY, size_t lda, size_t iters, int t, double &time, size_t GrainSize)`
- `template<class Field, class arg >`
`void benchmark_disp (Field &F, bool pass, double &time, size_t iters, int p, size_t m, size_t k, arg &as)`
- `template<class Field, class arg >`
`void benchmark_in_Field (Field &F, int p, size_t m, size_t k, int NBK, int bitsize, uint64_t seed, size_t iters, int t, arg &as, size_t GrainSize)`
- `template<class Field, class arg >`
`void benchmark_with_field (int p, size_t m, size_t k, int NBK, int bitsize, uint64_t seed, size_t iters, int t, arg &as, size_t GrainSize)`
- `template<class Field, class arg >`
`void benchmark_with_field (const Givaro::Integer &q, int p, size_t m, size_t k, int NBK, int bitsize, uint64_t seed, size_t iters, int t, arg &as, size_t GrainSize)`
- `int main (int argc, char **argv)`

17.25.1 Macro Definition Documentation

17.25.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.25.2 Function Documentation

17.25.2.1 fill_value()

```
void fill_value (
    Field & F,
    RandIter & Rand,
    Matrix & A,
    Vector & X,
    Vector & Y,
    size_t m,
    size_t k,
    size_t incX,
    size_t incY,
    size_t lda,
    int NBK )
```

17.25.2.2 genData()

```
void genData (
    Field & F,
    Matrix & A,
```

```
Vector & X,  
Vector & Y,  
size_t m,  
size_t k,  
size_t incX,  
size_t incY,  
size_t lda,  
int NBK,  
int bitsize,  
uint64_t seed )
```

17.25.2.3 check_result()

```
bool check_result (   
    Field & F,  
    size_t m,  
    size_t lda,  
    Matrix & A,  
    Vector & X,  
    size_t incX,  
    Vector & Y,  
    size_t incY )
```

17.25.2.4 benchmark_with_timer()

```
bool benchmark_with_timer (   
    Field & F,  
    int p,  
    Matrix & A,  
    Vector & X,  
    Vector & Y,  
    size_t m,  
    size_t k,  
    size_t incX,  
    size_t incY,  
    size_t lda,  
    size_t iters,  
    int t,  
    double & time,  
    size_t GrainSize )
```

17.25.2.5 benchmark_disp()

```
void benchmark_disp (   
    Field & F,  
    bool pass,  
    double & time,  
    size_t iters,  
    int p,  
    size_t m,  
    size_t k,  
    arg & as )
```

17.25.2.6 benchmark_in_Field()

```
void benchmark_in_Field (
    Field & F,
    int p,
    size_t m,
    size_t k,
    int NBK,
    int bitsize,
    uint64_t seed,
    size_t iters,
    int t,
    arg & as,
    size_t GrainSize )
```

17.25.2.7 benchmark_with_field() [1/2]

```
void benchmark_with_field (
    int p,
    size_t m,
    size_t k,
    int NBK,
    int bitsize,
    uint64_t seed,
    size_t iters,
    int t,
    arg & as,
    size_t GrainSize )
```

17.25.2.8 benchmark_with_field() [2/2]

```
void benchmark_with_field (
    const Givaro::Integer & q,
    int p,
    size_t m,
    size_t k,
    int NBK,
    int bitsize,
    uint64_t seed,
    size_t iters,
    int t,
    arg & as,
    size_t GrainSize )
```

17.25.2.9 main()

```
int main (
    int argc,
    char ** argv )
```

17.26 benchmark-fgesv.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
```



```
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Functions

- `int main (int argc, char **argv)`

17.26.1 Macro Definition Documentation

17.26.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.26.2 Function Documentation

17.26.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.27 benchmark-fsyrc.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`
- `#define CUBE(x) ((x)*(x)*(x))`

Functions

- `int main (int argc, char **argv)`

17.27.1 Macro Definition Documentation

17.27.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.27.1.2 CUBE

```
#define CUBE(  
    x )  ((x)*(x)*(x))
```

17.27.2 Function Documentation**17.27.2.1 main()**

```
int main (  
    int argc,  
    char ** argv )
```

17.28 benchmark-fsytrf.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include <iostream>  
#include <givaro/modular.h>  
#include "fflas-ffpack/fflas-ffpack.h"  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/utils/fflas_io.h"  
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- [#define __FFPACK_FSYTRF_BC_CROUT](#)
- [#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1](#)
- [#define CUBE\(x\) \(\(x\)*\(x\)*\(x\)\)](#)

Functions

- int [main](#) (int argc, char **argv)

17.28.1 Macro Definition Documentation**17.28.1.1 __FFPACK_FSYTRF_BC_CROUT**

```
#define __FFPACK_FSYTRF_BC_CROUT
```

17.28.1.2 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.28.1.3 CUBE

```
#define CUBE(  
    x )  ((x)*(x)*(x))
```

17.28.2 Function Documentation

17.28.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.29 benchmark-fftrsm-mp.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <vector>
#include <string>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "givaro/modular-integer.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Functions

- `int main (int argc, char **argv)`

17.29.1 Macro Definition Documentation

17.29.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.29.2 Function Documentation

17.29.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.30 benchmark-fftrsm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Functions

- `int main (int argc, char **argv)`

17.30.1 Macro Definition Documentation

17.30.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.30.2 Function Documentation

17.30.2.1 main()

```
int main (  
    int argc,  
    char ** argv )
```

17.31 benchmark-fftrsv.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include <iostream>  
#include <givaro/modular.h>  
#include "fflas-ffpack/fflas-ffpack.h"  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`

Functions

- `int main (int argc, char **argv)`

17.31.1 Macro Definition Documentation

17.31.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.31.2 Function Documentation

17.31.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.32 benchmark-fftrtri.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1`
- `#define CUBE(x) ((x)*(x)*(x))`

Functions

- `int main (int argc, char **argv)`

17.32.1 Macro Definition Documentation**17.32.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET**

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.32.1.2 CUBE

```
#define CUBE(
    x ) ( (x)*(x)*(x) )
```

17.32.2 Function Documentation**17.32.2.1 main()**

```
int main (
    int argc,
    char ** argv )
```

17.33 benchmark-inverse.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
```

```
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- `#define CUBE(x) ((x)*(x)*(x))`

Functions

- `int main (int argc, char **argv)`

17.33.1 Macro Definition Documentation

17.33.1.1 CUBE

```
#define CUBE(  
    x )  ( (x)*(x)*(x) )
```

17.33.2 Function Documentation

17.33.2.1 main()

```
int main (  
    int  argc,  
    char ** argv )
```

17.34 benchmark-lqup-mp.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include <iostream>  
#include <vector>  
#include <string>  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/ffpack/ffpack.h"  
#include "fflas-ffpack/utils/args-parser.h"  
#include "givaro/modular-integer.h"
```

Functions

- `int main (int argc, char **argv)`

17.34.1 Function Documentation

17.34.1.1 main()

```
int main (  
    int  argc,  
    char ** argv )
```

17.35 benchmark-lqup.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- #define [CUBE](#)(x) ((x)*(x)*(x))

Functions

- int [main](#) (int argc, char **argv)

17.35.1 Macro Definition Documentation

17.35.1.1 CUBE

```
#define CUBE(  
    x )  ((x)*(x)*(x))
```

17.35.2 Function Documentation

17.35.2.1 main()

```
int main (  
    int argc,  
    char ** argv )
```

17.36 benchmark-pluq.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular.h>
#include <givaro/givranditer.h>
#include <iostream>
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/ffpack/ffpack.h"
```

Macros

- #define [__FFLASFFPACK_OPENBLAS_NT_ALREADY_SET](#) 1
- #define [CUBE](#)(x) ((x)*(x)*(x))

Typedefs

- typedef [Givaro::ModularBalanced](#)< double > [Field](#)

Functions

- void [verification_PLUQ](#) (const [Field](#) &F, typename [Field::Element](#) *B, typename [Field::Element](#) *A, size_t *P, size_t *Q, size_t m, size_t n, size_t R)
- void [Rec_Initialize](#) ([Field](#) &F, [Field::Element](#) *C, size_t m, size_t n, size_t ldc)
- int [main](#) (int argc, char **argv)

17.36.1 Macro Definition Documentation

17.36.1.1 __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET

```
#define __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET 1
```

17.36.1.2 CUBE

```
#define CUBE(  
    x ) ((x)*(x)*(x))
```

17.36.2 Typedef Documentation

17.36.2.1 Field

```
typedef Givaro::ModularBalanced<double> Field
```

17.36.3 Function Documentation

17.36.3.1 verification_PLUQ()

```
void verification_PLUQ (  
    const Field & F,  
    typename Field::Element * B,  
    typename Field::Element * A,  
    size_t * P,  
    size_t * Q,  
    size_t m,  
    size_t n,  
    size_t R )
```

17.36.3.2 Rec_Initialize()

```
void Rec_Initialize (  
    Field & F,  
    Field::Element * C,  
    size_t m,  
    size_t n,  
    size_t ldc )
```


17.36.3.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.37 benchmark-wino.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <fstream>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Macros

- #define [CUBE](#)(x) ((x)*(x)*(x))

Functions

- template<class [Field](#) >
void [launch_wino](#) (const [Field](#) &F, const size_t &n, const size_t &NB, const size_t &wino, const bool &asmax, const size_t &seed, const bool compare)
- int [main](#) (int argc, char **argv)

17.37.1 Macro Definition Documentation

17.37.1.1 CUBE

```
#define CUBE(  
    x ) ((x)*(x)*(x))
```

17.37.2 Function Documentation

17.37.2.1 launch_wino()

```
void launch_wino (
    const Field & F,
    const size_t & n,
    const size_t & NB,
    const size_t & wino,
    const bool & asmax,
    const size_t & seed,
    const bool compare )
```

17.37.2.2 main()

```
int main (
    int argc,
    char ** argv )
```

17.38 config.h File Reference

Macros

- #define [HAVE_BLAS](#) 1
- #define [HAVE_CBLAS](#) 1
- #define [HAVE_CXX11](#) 1
- #define [HAVE_DLFCN_H](#) 1
- #define [HAVE_FLOAT_H](#) 1
- #define [HAVE_INT128](#) 1
- #define [HAVE_INTPYPES_H](#) 1
- #define [HAVE_LAPACK](#) 1
- #define [HAVE_LIMITS_H](#) 1
- #define [HAVE_LITTLE_ENDIAN](#) 1
- #define [HAVE_PTHREAD_H](#) 1
- #define [HAVE_STDDEF_H](#) 1
- #define [HAVE_STDINT_H](#) 1
- #define [HAVE_STDIO_H](#) 1
- #define [HAVE_STDLIB_H](#) 1
- #define [HAVE_STRINGS_H](#) 1
- #define [HAVE_STRING_H](#) 1
- #define [HAVE_SYS_STAT_H](#) 1
- #define [HAVE_SYS_TIME_H](#) 1
- #define [HAVE_SYS_TYPES_H](#) 1
- #define [HAVE_UNISTD_H](#) 1
- #define [LT_OBJDIR](#) ".libs/"
- #define [OPENBLAS_NUM_THREADS](#) 1
- #define [PACKAGE](#) "fflas-ffpack"
- #define [PACKAGE_BUGREPORT](#) "ffpack-devel@googlegroups.com"
- #define [PACKAGE_NAME](#) "FFLAS-FFPACK"
- #define [PACKAGE_STRING](#) "FFLAS-FFPACK 2.4.3"
- #define [PACKAGE_TARNAME](#) "fflas-ffpack"
- #define [PACKAGE_URL](#) "https://github.com/linbox-team/fflas-ffpack"
- #define [PACKAGE_VERSION](#) "2.4.3"
- #define [SIZEOF_CHAR](#) 1
- #define [SIZEOF_INT](#) 4
- #define [SIZEOF_LONG](#) 8
- #define [SIZEOF_LONG_LONG](#) 8
- #define [SIZEOF_SHORT](#) 2
- #define [SIZEOF___INT64](#) 0
- #define [STDC_HEADERS](#) 1
- #define [USE_OPENMP](#) 1
- #define [VERSION](#) "2.4.3"

17.38.1 Macro Definition Documentation

17.38.1.1 HAVE_BLAS

```
#define HAVE_BLAS 1
```

17.38.1.2 HAVE_CBLAS

```
#define HAVE_CBLAS 1
```

17.38.1.3 HAVE_CXX11

```
#define HAVE_CXX11 1
```

17.38.1.4 HAVE_DLFCN_H

```
#define HAVE_DLFCN_H 1
```

17.38.1.5 HAVE_FLOAT_H

```
#define HAVE_FLOAT_H 1
```

17.38.1.6 HAVE_INT128

```
#define HAVE_INT128 1
```

17.38.1.7 HAVE_INTTYPES_H

```
#define HAVE_INTTYPES_H 1
```

17.38.1.8 HAVE_LAPACK

```
#define HAVE_LAPACK 1
```

17.38.1.9 HAVE_LIMITS_H

```
#define HAVE_LIMITS_H 1
```

17.38.1.10 HAVE_LITTLE_ENDIAN

```
#define HAVE_LITTLE_ENDIAN 1
```

17.38.1.11 HAVE_PTHREAD_H

```
#define HAVE_PTHREAD_H 1
```

17.38.1.12 HAVE_STDDEF_H

```
#define HAVE_STDDEF_H 1
```

17.38.1.13 HAVE_STDINT_H

```
#define HAVE_STDINT_H 1
```

17.38.1.14 HAVE_STDIO_H

```
#define HAVE_STDIO_H 1
```

17.38.1.15 HAVE_STDLIB_H

```
#define HAVE_STDLIB_H 1
```

17.38.1.16 HAVE_STRINGS_H

```
#define HAVE_STRINGS_H 1
```

17.38.1.17 HAVE_STRING_H

```
#define HAVE_STRING_H 1
```

17.38.1.18 HAVE_SYS_STAT_H

```
#define HAVE_SYS_STAT_H 1
```

17.38.1.19 HAVE_SYS_TIME_H

```
#define HAVE_SYS_TIME_H 1
```

17.38.1.20 HAVE_SYS_TYPES_H

```
#define HAVE_SYS_TYPES_H 1
```

17.38.1.21 HAVE_UNISTD_H

```
#define HAVE_UNISTD_H 1
```

17.38.1.22 LT_OBJDIR

```
#define LT_OBJDIR ".libs/"
```

17.38.1.23 OPENBLAS_NUM_THREADS

```
#define OPENBLAS_NUM_THREADS 1
```

17.38.1.24 PACKAGE

```
#define PACKAGE "fflas-ffpack"
```

17.38.1.25 PACKAGE_BUGREPORT

```
#define PACKAGE_BUGREPORT "ffpack-devel@googlegroups.com"
```

17.38.1.26 PACKAGE_NAME

```
#define PACKAGE_NAME "FFLAS-FFPACK"
```

17.38.1.27 PACKAGE_STRING

```
#define PACKAGE_STRING "FFLAS-FFPACK 2.4.3"
```

17.38.1.28 PACKAGE_TARNAME

```
#define PACKAGE_TARNAME "fflas-ffpack"
```

17.38.1.29 PACKAGE_URL

```
#define PACKAGE_URL "https://github.com/linbox-team/fflas-ffpack"
```

17.38.1.30 PACKAGE_VERSION

```
#define PACKAGE_VERSION "2.4.3"
```

17.38.1.31 SIZEOF_CHAR

```
#define SIZEOF_CHAR 1
```

17.38.1.32 SIZEOF_INT

```
#define SIZEOF_INT 4
```

17.38.1.33 SIZEOF_LONG

```
#define SIZEOF_LONG 8
```

17.38.1.34 SIZEOF_LONG_LONG

```
#define SIZEOF_LONG_LONG 8
```

17.38.1.35 SIZEOF_SHORT

```
#define SIZEOF_SHORT 2
```

17.38.1.36 SIZEOF___INT64

```
#define SIZEOF___INT64 0
```

17.38.1.37 STDC_HEADERS

```
#define STDC_HEADERS 1
```

17.38.1.38 USE_OPENMP

```
#define USE_OPENMP 1
```

17.38.1.39 VERSION

```
#define VERSION "2.4.3"
```

17.39 config.h File Reference

Macros

- [#define __FFLASFFPACK_HAVE_BLAS 1](#)
- [#define __FFLASFFPACK_HAVE_CBLAS 1](#)
- [#define __FFLASFFPACK_HAVE_CXX11 1](#)
- [#define __FFLASFFPACK_HAVE_DLFCN_H 1](#)
- [#define __FFLASFFPACK_HAVE_FLOAT_H 1](#)
- [#define __FFLASFFPACK_HAVE_INT128 1](#)
- [#define __FFLASFFPACK_HAVE_INTTYPES_H 1](#)
- [#define __FFLASFFPACK_HAVE_LAPACK 1](#)
- [#define __FFLASFFPACK_HAVE_LIMITS_H 1](#)
- [#define __FFLASFFPACK_HAVE_LITTLE_ENDIAN 1](#)
- [#define __FFLASFFPACK_HAVE_PTHREAD_H 1](#)
- [#define __FFLASFFPACK_HAVE_STDDEF_H 1](#)
- [#define __FFLASFFPACK_HAVE_STDINT_H 1](#)
- [#define __FFLASFFPACK_HAVE_STDIO_H 1](#)
- [#define __FFLASFFPACK_HAVE_STDLIB_H 1](#)
- [#define __FFLASFFPACK_HAVE_STRINGS_H 1](#)
- [#define __FFLASFFPACK_HAVE_STRING_H 1](#)
- [#define __FFLASFFPACK_HAVE_SYS_STAT_H 1](#)
- [#define __FFLASFFPACK_HAVE_SYS_TIME_H 1](#)
- [#define __FFLASFFPACK_HAVE_SYS_TYPES_H 1](#)
- [#define __FFLASFFPACK_HAVE_UNISTD_H 1](#)
- [#define __FFLASFFPACK_LT_OBJDIR ".libs/"](#)
- [#define __FFLASFFPACK_OPENBLAS_NUM_THREADS 1](#)
- [#define __FFLASFFPACK_PACKAGE "fflas-ffpack"](#)
- [#define __FFLASFFPACK_PACKAGE_BUGREPORT "ffpack-devel@googlegroups.com"](#)
- [#define __FFLASFFPACK_PACKAGE_NAME "FFLAS-FFPACK"](#)
- [#define __FFLASFFPACK_PACKAGE_STRING "FFLAS-FFPACK 2.4.3"](#)
- [#define __FFLASFFPACK_PACKAGE_TARNAME "fflas-ffpack"](#)
- [#define __FFLASFFPACK_PACKAGE_URL "https://github.com/linbox-team/fflas-ffpack"](#)
- [#define __FFLASFFPACK_PACKAGE_VERSION "2.4.3"](#)
- [#define __FFLASFFPACK_SIZEOF_CHAR 1](#)
- [#define __FFLASFFPACK_SIZEOF_INT 4](#)
- [#define __FFLASFFPACK_SIZEOF_LONG 8](#)
- [#define __FFLASFFPACK_SIZEOF_LONG_LONG 8](#)
- [#define __FFLASFFPACK_SIZEOF_SHORT 2](#)
- [#define __FFLASFFPACK_SIZEOF__INT64 0](#)
- [#define __FFLASFFPACK_STDC_HEADERS 1](#)
- [#define __FFLASFFPACK_USE_OPENMP 1](#)
- [#define __FFLASFFPACK_VERSION "2.4.3"](#)

17.39.1 Macro Definition Documentation

17.39.1.1 __FFLASFFPACK_HAVE_BLAS

```
#define __FFLASFFPACK_HAVE_BLAS 1
```

17.39.1.2 __FFLASFFPACK_HAVE_CBLAS

```
#define __FFLASFFPACK_HAVE_CBLAS 1
```

17.39.1.3 __FFLASFFPACK_HAVE_CXX11

```
#define __FFLASFFPACK_HAVE_CXX11 1
```

17.39.1.4 __FFLASFFPACK_HAVE_DLFCN_H

```
#define __FFLASFFPACK_HAVE_DLFCN_H 1
```

17.39.1.5 __FFLASFFPACK_HAVE_FLOAT_H

```
#define __FFLASFFPACK_HAVE_FLOAT_H 1
```

17.39.1.6 __FFLASFFPACK_HAVE_INT128

```
#define __FFLASFFPACK_HAVE_INT128 1
```

17.39.1.7 __FFLASFFPACK_HAVE_INTPYPES_H

```
#define __FFLASFFPACK_HAVE_INTPYPES_H 1
```

17.39.1.8 __FFLASFFPACK_HAVE_LAPACK

```
#define __FFLASFFPACK_HAVE_LAPACK 1
```

17.39.1.9 __FFLASFFPACK_HAVE_LIMITS_H

```
#define __FFLASFFPACK_HAVE_LIMITS_H 1
```

17.39.1.10 __FFLASFFPACK_HAVE_LITTLE_ENDIAN

```
#define __FFLASFFPACK_HAVE_LITTLE_ENDIAN 1
```

17.39.1.11 __FFLASFFPACK_HAVE_PTHREAD_H

```
#define __FFLASFFPACK_HAVE_PTHREAD_H 1
```

17.39.1.12 __FFLASFFPACK_HAVE_STDDEF_H

```
#define __FFLASFFPACK_HAVE_STDDEF_H 1
```

17.39.1.13 __FFLASFFPACK_HAVE_STDINT_H

```
#define __FFLASFFPACK_HAVE_STDINT_H 1
```

17.39.1.14 __FFLASFFPACK_HAVE_STDIO_H

```
#define __FFLASFFPACK_HAVE_STDIO_H 1
```

17.39.1.15 __FFLASFFPACK_HAVE_STDLIB_H

```
#define __FFLASFFPACK_HAVE_STDLIB_H 1
```

17.39.1.16 __FFLASFFPACK_HAVE_STRINGS_H

```
#define __FFLASFFPACK_HAVE_STRINGS_H 1
```

17.39.1.17 __FFLASFFPACK_HAVE_STRING_H

```
#define __FFLASFFPACK_HAVE_STRING_H 1
```

17.39.1.18 __FFLASFFPACK_HAVE_SYS_STAT_H

```
#define __FFLASFFPACK_HAVE_SYS_STAT_H 1
```

17.39.1.19 __FFLASFFPACK_HAVE_SYS_TIME_H

```
#define __FFLASFFPACK_HAVE_SYS_TIME_H 1
```

17.39.1.20 __FFLASFFPACK_HAVE_SYS_TYPES_H

```
#define __FFLASFFPACK_HAVE_SYS_TYPES_H 1
```

17.39.1.21 __FFLASFFPACK_HAVE_UNISTD_H

```
#define __FFLASFFPACK_HAVE_UNISTD_H 1
```

17.39.1.22 __FFLASFFPACK_LT_OBJDIR

```
#define __FFLASFFPACK_LT_OBJDIR ".libs/"
```

17.39.1.23 __FFLASFFPACK_OPENBLAS_NUM_THREADS

```
#define __FFLASFFPACK_OPENBLAS_NUM_THREADS 1
```

17.39.1.24 __FFLASFFPACK_PACKAGE

```
#define __FFLASFFPACK_PACKAGE "fflas-ffpack"
```

17.39.1.25 __FFLASFFPACK_PACKAGE_BUGREPORT

```
#define __FFLASFFPACK_PACKAGE_BUGREPORT "ffpack-devel@googlegroups.com"
```


17.39.1.26 __FFLASFFPACK_PACKAGE_NAME

```
#define __FFLASFFPACK_PACKAGE_NAME "FFLAS-FFPACK"
```

17.39.1.27 __FFLASFFPACK_PACKAGE_STRING

```
#define __FFLASFFPACK_PACKAGE_STRING "FFLAS-FFPACK 2.4.3"
```

17.39.1.28 __FFLASFFPACK_PACKAGE_TARNAME

```
#define __FFLASFFPACK_PACKAGE_TARNAME "fflas-ffpack"
```

17.39.1.29 __FFLASFFPACK_PACKAGE_URL

```
#define __FFLASFFPACK_PACKAGE_URL "https://github.com/linbox-team/fflas-ffpack"
```

17.39.1.30 __FFLASFFPACK_PACKAGE_VERSION

```
#define __FFLASFFPACK_PACKAGE_VERSION "2.4.3"
```

17.39.1.31 __FFLASFFPACK_SIZEOF_CHAR

```
#define __FFLASFFPACK_SIZEOF_CHAR 1
```

17.39.1.32 __FFLASFFPACK_SIZEOF_INT

```
#define __FFLASFFPACK_SIZEOF_INT 4
```

17.39.1.33 __FFLASFFPACK_SIZEOF_LONG

```
#define __FFLASFFPACK_SIZEOF_LONG 8
```

17.39.1.34 __FFLASFFPACK_SIZEOF_LONG_LONG

```
#define __FFLASFFPACK_SIZEOF_LONG_LONG 8
```

17.39.1.35 __FFLASFFPACK_SIZEOF_SHORT

```
#define __FFLASFFPACK_SIZEOF_SHORT 2
```

17.39.1.36 __FFLASFFPACK_SIZEOF__INT64

```
#define __FFLASFFPACK_SIZEOF__INT64 0
```

17.39.1.37 __FFLASFFPACK_STDC_HEADERS

```
#define __FFLASFFPACK_STDC_HEADERS 1
```

17.39.1.38 __FFLASFFPACK_USE_OPENMP

```
#define __FFLASFFPACK_USE_OPENMP 1
```

17.39.1.39 __FFLASFFPACK_VERSION

```
#define __FFLASFFPACK_VERSION "2.4.3"
```

17.40 mainpage.doxy File Reference**17.41 det.C File Reference**

```
#include <givaro/modular.h>
#include <iostream>
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/fflas_io.h"
```

Functions

- int [main](#) (int argc, char **argv)

This example computes the determinant of a matrix over a defined finite field.

17.41.1 Function Documentation**17.41.1.1 main()**

```
int main (
    int argc,
    char ** argv )
```

This example computes the determinant of a matrix over a defined finite field.
Outputs the determinant.

17.42 matmul.C File Reference

```
#include <iostream>
#include "fflas-ffpack/fflas-ffpack.h"
```

Functions

- int [main](#) (int argc, char **argv)

This example computes the matrix multiplication over a defined finite field.

17.42.1 Function Documentation

17.42.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

This example computes the matrix multiplication over a defined finite field.
Outputs the product of the matrix given as input.

17.43 rank.C File Reference

```
#include <iostream>
#include "fflas-ffpack/fflas-ffpack.h"
```

Functions

- int [main](#) (int argc, char **argv)

This example computes the rank of a matrix over a defined finite field.

17.43.1 Function Documentation

17.43.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

This example computes the rank of a matrix over a defined finite field.
Outputs the rank.

17.44 solve.C File Reference

```
#include <iostream>
#include "fflas-ffpack/fflas-ffpack.h"
```

Functions

- int [main](#) (int argc, char **argv)

This example solve the quare system defined by the input over a defined finite field.

17.44.1 Function Documentation

17.44.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

This example solve the quare system defined by the input over a defined finite field.

17.45 checker_charpoly.inl File Reference

```
#include "fflas-ffpack/ffpack/ffpack.h"
```

Data Structures

- class [CheckerImplem_charpoly](#)< Field, Polynomial >

Namespaces

- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_checker_charpoly_INL](#)

17.45.1 Macro Definition Documentation

17.45.1.1 [__FFLASFFPACK_checker_charpoly_INL](#)

```
#define __FFLASFFPACK_checker_charpoly_INL
```

17.46 checker_det.inl File Reference

```
#include "fflas-ffpack/ffpack/ffpack.h"
```

Data Structures

- class [CheckerImplem_Det](#)< Field >

Namespaces

- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_checker_det_INL](#)

17.46.1 Macro Definition Documentation

17.46.1.1 [__FFLASFFPACK_checker_det_INL](#)

```
#define __FFLASFFPACK_checker_det_INL
```

17.47 checker_empty.h File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
```

Data Structures

- struct [Checker_Empty](#)< Field >

Namespaces

- namespace [FFLAS](#)

17.48 checker_fgemm.inl File Reference

Data Structures

- class [CheckerImplem_fgemm](#)< Field >

Namespaces

- namespace [FFLAS](#)

Macros

- #define [__FFLASFFPACK_checker_fgemm_INL](#)

17.48.1 Macro Definition Documentation

17.48.1.1 __FFLASFFPACK_checker_fgemm_INL

```
#define __FFLASFFPACK_checker_fgemm_INL
```

17.49 checker_ftrsm.inl File Reference

Data Structures

- class [CheckerImplem_ftrsm](#)< Field >

Namespaces

- namespace [FFLAS](#)

Macros

- #define [__FFLASFFPACK_checker_ftrsm_INL](#)

17.49.1 Macro Definition Documentation

17.49.1.1 __FFLASFFPACK_checker_ftrsm_INL

```
#define __FFLASFFPACK_checker_ftrsm_INL
```

17.50 checker_invert.inl File Reference

Data Structures

- class [CheckerImplem_invert](#)< Field >

Namespaces

- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define __FFLASFFPACK_checker_invert_INL`

17.50.1 Macro Definition Documentation

17.50.1.1 __FFLASFFPACK_checker_invert_INL

```
#define __FFLASFFPACK_checker_invert_INL
```

17.51 checker_pluq.inl File Reference

```
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/fflas_io.h"
```

Data Structures

- class [CheckerImplem_PLUQ< Field >](#)

Namespaces

- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define __FFLASFFPACK_checker_pluq_INL`

17.51.1 Macro Definition Documentation

17.51.1.1 __FFLASFFPACK_checker_pluq_INL

```
#define __FFLASFFPACK_checker_pluq_INL
```

17.52 checkers.doxy File Reference

17.53 checkers_fflas.h File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "checker_empty.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_enum.h"
#include "fflas-ffpack/utils/fflas_memory.h"
```

Data Structures

- class [FailureFgemmCheck](#)
- class [FailureTrsmCheck](#)

Namespaces

- namespace [FFLAS](#)

Typedefs

- template<class [Field](#) >
using [Checker_fgemm](#) = [FFLAS::Checker_Empty](#)< [Field](#) >
- template<class [Field](#) >
using [Checker_ftrsm](#) = [FFLAS::Checker_Empty](#)< [Field](#) >

17.54 checkers_fflas.inl File Reference

```
#include "checker_fgemm.inl"
#include "checker_ftrsm.inl"
```

Namespaces

- namespace [FFLAS](#)

Macros

- #define [FFLASFFPACK_checkers_fflas_inl_H](#)

Typedefs

- template<class [Field](#) >
using [ForceCheck_fgemm](#) = [CheckerImplem_fgemm](#)< [Field](#) >
- template<class [Field](#) >
using [ForceCheck_ftrsm](#) = [CheckerImplem_ftrsm](#)< [Field](#) >

17.54.1 Macro Definition Documentation

17.54.1.1 FFLASFFPACK_checkers_fflas_inl_H

```
#define FFLASFFPACK_checkers_fflas_inl_H
```

17.55 checkers_ffpack.h File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "checker_empty.h"
#include "fflas-ffpack/ffpack/ffpack.h"
```

Data Structures

- class [FailurePLUQCheck](#)
- class [FailureDetCheck](#)
- class [FailureInvertCheck](#)
- class [FailureCharpolyCheck](#)

Namespaces

- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Typedefs

- `template<class Field >`
using [Checker_PLUQ](#) = [FFLAS::Checker_Empty](#)< [Field](#) >
- `template<class Field >`
using [Checker_Det](#) = [FFLAS::Checker_Empty](#)< [Field](#) >
- `template<class Field >`
using [Checker_invert](#) = [FFLAS::Checker_Empty](#)< [Field](#) >
- `template<class Field , class Polynomial >`
using [Checker_charpoly](#) = [FFLAS::Checker_Empty](#)< [Field](#) >

17.56 checkers_ffpack.inl File Reference

```
#include "checker_pluq.inl"
#include "checker_det.inl"
#include "checker_invert.inl"
#include "checker_charpoly.inl"
```

Namespaces

- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define FFLASFFPACK_checkers_ffpack_inl_H`

Typedefs

- `template<class Field >`
using [ForceCheck_PLUQ](#) = [CheckerImplem_PLUQ](#)< [Field](#) >
- `template<class Field >`
using [ForceCheck_Det](#) = [CheckerImplem_Det](#)< [Field](#) >
- `template<class Field >`
using [ForceCheck_invert](#) = [CheckerImplem_invert](#)< [Field](#) >
- `template<class Field , class Polynomial >`
using [ForceCheck_charpoly](#) = [CheckerImplem_charpoly](#)< [Field](#), Polynomial >

17.56.1 Macro Definition Documentation

17.56.1.1 FFLASFFPACK_checkers_ffpack_inl_H

```
#define FFLASFFPACK_checkers_ffpack_inl_H
```


17.57 config-blas.h File Reference

Macros

- #define `CBLAS_INT` int
- #define `CBLAS_ENUM_DEFINED_H`
- #define `CBLAS_EXTERNALS`
- #define `blas_enum` enum

Enumerations

- enum `CBLAS_ORDER` { `CblasRowMajor` =101 , `CblasColMajor` =102 }
- enum `CBLAS_TRANSPOSE` { `CblasNoTrans` =111 , `CblasTrans` =112 , `CblasConjTrans` =113 , `AtlasConj` =114 }
- enum `CBLAS_UPLO` { `CblasUpper` =121 , `CblasLower` =122 }
- enum `CBLAS_DIAG` { `CblasNonUnit` =131 , `CblasUnit` =132 }
- enum `CBLAS_SIDE` { `CblasLeft` =141 , `CblasRight` =142 }

Functions

- void `daxpy_` (const int *, const double *, const double *, const int *, double *, const int *)
- void `saxpy_` (const int *, const float *, const float *, const int *, float *, const int *)
- double `ddot_` (const int *, const double *, const int *, const double *, const int *)
- float `sdot_` (const int *, const float *, const int *, const float *, const int *)
- double `dasum_` (const int *, const double *, const int *)
- int `idamax_` (const int *, const double *, const int *)
- double `dnrm2_` (const int *, const double *, const int *)
- void `dgemv_` (const char *, const int *, const int *, const double *, const double *, const int *, const double *, const int *, const double *, double *, const int *)
- void `sgemv_` (const char *, const int *, const int *, const float *, const float *, const int *, const float *, const int *, const float *, float *, const int *)
- void `dger_` (const int *, const int *, const double *, const double *, const int *, const double *, const int *, double *, const int *)
- void `sger_` (const int *, const int *, const float *, const float *, const int *, const float *, const int *, float *, const int *)
- void `dcopy_` (const int *, const double *, const int *, double *, const int *)
- void `scopy_` (const int *, const float *, const int *, float *, const int *)
- void `dscal_` (const int *, const double *, double *, const int *)
- void `sscal_` (const int *, const float *, float *, const int *)
- void `dtrsm_` (const char *, const char *, const char *, const char *, const int *, const int *, const double *, const double *, const int *, double *, const int *)
- void `strsm_` (const char *, const char *, const char *, const char *, const int *, const int *, const float *, const float *, const int *, float *, const int *)
- void `dtrmm_` (const char *, const char *, const char *, const char *, const int *, const int *, const double *, const double *, const int *, double *, const int *)
- void `strmm_` (const char *, const char *, const char *, const char *, const int *, const int *, const float *, const float *, const int *, float *, const int *)
- void `sgemm_` (const char *, const char *, const int *, const int *, const int *, const float *, const float *, const int *, const float *, const int *, const float *, float *, const int *)
- void `dgemm_` (const char *, const char *, const int *, const int *, const int *, const double *, const double *, const int *, const double *, const int *, const double *, double *, const int *)

17.57.1 Macro Definition Documentation

17.57.1.1 CBLAS_INT

```
#define CBLAS_INT int
```

17.57.1.2 CBLAS_ENUM_DEFINED_H

```
#define CBLAS_ENUM_DEFINED_H
```

17.57.1.3 CBLAS_EXTERNALS

```
#define CBLAS_EXTERNALS
```

17.57.1.4 blas_enum

```
#define blas_enum enum
```

17.57.2 Enumeration Type Documentation**17.57.2.1 CBLAS_ORDER**

```
enum CBLAS_ORDER
```

Enumerator

CblasRowMajor	
CblasColMajor	

17.57.2.2 CBLAS_TRANSPOSE

```
enum CBLAS_TRANSPOSE
```

Enumerator

CblasNoTrans	
CblasTrans	
CblasConjTrans	
AtlasConj	

17.57.2.3 CBLAS_UPLO

```
enum CBLAS_UPLO
```

Enumerator

CblasUpper	
CblasLower	

17.57.2.4 CBLAS_DIAG

enum [CBLAS_DIAG](#)

Enumerator

CblasNonUnit	
CblasUnit	

17.57.2.5 CBLAS_SIDE

enum [CBLAS_SIDE](#)

Enumerator

CblasLeft	
CblasRight	

17.57.3 Function Documentation

17.57.3.1 daxpy_()

```
void daxpy_ (
    const int * ,
    const double * ,
    const double * ,
    const int * ,
    double * ,
    const int * )
```

17.57.3.2 saxpy_()

```
void saxpy_ (
    const int * ,
    const float * ,
    const float * ,
    const int * ,
    float * ,
    const int * )
```

17.57.3.3 ddot_()

```
double ddot_ (
    const int * ,
    const double * ,
    const int * ,
    const double * ,
    const int * )
```

17.57.3.4 `sdot_()`

```
float sdot_ (
    const int * ,
    const float * ,
    const int * ,
    const float * ,
    const int * )
```

17.57.3.5 `dasum_()`

```
double dasum_ (
    const int * ,
    const double * ,
    const int * )
```

17.57.3.6 `idamax_()`

```
int idamax_ (
    const int * ,
    const double * ,
    const int * )
```

17.57.3.7 `dnrm2_()`

```
double dnrm2_ (
    const int * ,
    const double * ,
    const int * )
```

17.57.3.8 `dgemv_()`

```
void dgemv_ (
    const char * ,
    const int * ,
    const int * ,
    const double * ,
    const double * ,
    const int * ,
    const double * ,
    const int * ,
    const double * ,
    double * ,
    const int * )
```

17.57.3.9 `sgemv_()`

```
void sgemv_ (
    const char * ,
    const int * ,
    const int * ,
    const float * ,
    const float * ,
    const int * ,
```

```
const float * ,  
const int * ,  
const float * ,  
float * ,  
const int * )
```

17.57.3.10 dger_()

```
void dger_ (  
    const int * ,  
    const int * ,  
    const double * ,  
    const double * ,  
    const int * ,  
    const double * ,  
    const int * ,  
    double * ,  
    const int * )
```

17.57.3.11 sger_()

```
void sger_ (  
    const int * ,  
    const int * ,  
    const float * ,  
    const float * ,  
    const int * ,  
    const float * ,  
    const int * ,  
    float * ,  
    const int * )
```

17.57.3.12 dcopy_()

```
void dcopy_ (  
    const int * ,  
    const double * ,  
    const int * ,  
    double * ,  
    const int * )
```

17.57.3.13 scopy_()

```
void scopy_ (  
    const int * ,  
    const float * ,  
    const int * ,  
    float * ,  
    const int * )
```

17.57.3.14 dscal_()

```
void dscal_ (  
    const int * ,
```

```
    const double * ,  
    double * ,  
    const int * )
```

17.57.3.15 sscal_()

```
void sscal_ (  
    const int * ,  
    const float * ,  
    float * ,  
    const int * )
```

17.57.3.16 dtrsm_()

```
void dtrsm_ (  
    const char * ,  
    const char * ,  
    const char * ,  
    const char * ,  
    const int * ,  
    const int * ,  
    const double * ,  
    const double * ,  
    const int * ,  
    double * ,  
    const int * )
```

17.57.3.17 strsm_()

```
void strsm_ (  
    const char * ,  
    const char * ,  
    const char * ,  
    const char * ,  
    const int * ,  
    const int * ,  
    const float * ,  
    const float * ,  
    const int * ,  
    float * ,  
    const int * )
```

17.57.3.18 dtrmm_()

```
void dtrmm_ (  
    const char * ,  
    const char * ,  
    const char * ,  
    const char * ,  
    const int * ,  
    const int * ,  
    const double * ,  
    const double * ,  
    const int * ,
```

```
double * ,
const int * )
```

17.57.3.19 strmm_()

```
void strmm_ (
    const char * ,
    const char * ,
    const char * ,
    const char * ,
    const int * ,
    const int * ,
    const float * ,
    const float * ,
    const int * ,
    float * ,
    const int * )
```

17.57.3.20 sgemm_()

```
void sgemm_ (
    const char * ,
    const char * ,
    const int * ,
    const int * ,
    const int * ,
    const float * ,
    const float * ,
    const int * ,
    const float * ,
    const int * ,
    const float * ,
    float * ,
    const int * )
```

17.57.3.21 dgemm_()

```
void dgemm_ (
    const char * ,
    const char * ,
    const int * ,
    const int * ,
    const int * ,
    const double * ,
    const double * ,
    const int * ,
    const double * ,
    const int * ,
    const double * ,
    double * ,
    const int * )
```

17.58 fflas-ffpack-config.h File Reference

Defaults for optimised values.

```
#include "fflas-ffpack/config.h"
#include "fflas-ffpack/fflas-ffpack-thresholds.h"
#include "fflas-ffpack/fflas-ffpack-default-thresholds.h"
#include "givaro/givconfig.h"
```

Macros

- #define [GCC_VERSION](#) (`__GNUC__` * 10000 + `__GNUC_MINOR__` * 100 + `__GNUC_PATCHLEVEL__`)

17.58.1 Detailed Description

Defaults for optimised values.

While `fflas-ffpack-optimise.h` is created by `configure` script, (either left blank or filled by optimiser), this file produces the defaults for the optimised values. If `fflas-ffpack-optimise.h` is not empty, then its values preceeds the defaults here.

17.58.2 Macro Definition Documentation

17.58.2.1 GCC_VERSION

```
#define GCC_VERSION ( __GNUC__ * 10000 + __GNUC_MINOR__ * 100 + __GNUC_PATCHLEVEL__ )
```

17.59 fflas-ffpack-default-thresholds.h File Reference

Macros

- #define [__FFLASFFPACK_WINOTHRESHOLD](#) 1000
- #define [__FFLASFFPACK_WINOTHRESHOLD_FLT](#) 2000
- #define [__FFLASFFPACK_WINOTHRESHOLD_BAL](#) 1000
- #define [__FFLASFFPACK_WINOTHRESHOLD_BAL_FLT](#) 2000
- #define [__FFLASFFPACK_PLUQ_THRESHOLD](#) 256
- #define [__FFLASFFPACK_CHARPOLY_LUKrylov_ArithProg_THRESHOLD](#) 1000
- #define [__FFLASFFPACK_CHARPOLY_Danilevskii_LUKrylov_THRESHOLD](#) 16
- #define [__FFLASFFPACK_ARITHPROG_THRESHOLD](#) 30
- #define [__FFLASFFPACK_FTRTRI_THRESHOLD](#) 32
- #define [__FFLASFFPACK_FSYTRF_THRESHOLD](#) 64
- #define [__FFLASFFPACK_FSYRK_THRESHOLD](#) 3000

17.59.1 Macro Definition Documentation

17.59.1.1 __FFLASFFPACK_WINOTHRESHOLD

```
#define __FFLASFFPACK_WINOTHRESHOLD 1000
```

17.59.1.2 __FFLASFFPACK_WINOTHRESHOLD_FLT

```
#define __FFLASFFPACK_WINOTHRESHOLD_FLT 2000
```


17.59.1.3 __FFLASFFPACK_WINOTHRESHOLD_BAL

```
#define __FFLASFFPACK_WINOTHRESHOLD_BAL 1000
```

17.59.1.4 __FFLASFFPACK_WINOTHRESHOLD_BAL_FLT

```
#define __FFLASFFPACK_WINOTHRESHOLD_BAL_FLT 2000
```

17.59.1.5 __FFLASFFPACK_PLUQ_THRESHOLD

```
#define __FFLASFFPACK_PLUQ_THRESHOLD 256
```

17.59.1.6 __FFLASFFPACK_CHARPOLY_LUKrylov_ArithProg_THRESHOLD

```
#define __FFLASFFPACK_CHARPOLY_LUKrylov_ArithProg_THRESHOLD 1000
```

17.59.1.7 __FFLASFFPACK_CHARPOLY_Danilevskii_LUKrylov_THRESHOLD

```
#define __FFLASFFPACK_CHARPOLY_Danilevskii_LUKrylov_THRESHOLD 16
```

17.59.1.8 __FFLASFFPACK_ARITHPROG_THRESHOLD

```
#define __FFLASFFPACK_ARITHPROG_THRESHOLD 30
```

17.59.1.9 __FFLASFFPACK_FTRTRI_THRESHOLD

```
#define __FFLASFFPACK_FTRTRI_THRESHOLD 32
```

17.59.1.10 __FFLASFFPACK_FSYTRF_THRESHOLD

```
#define __FFLASFFPACK_FSYTRF_THRESHOLD 64
```

17.59.1.11 __FFLASFFPACK_FSYRK_THRESHOLD

```
#define __FFLASFFPACK_FSYRK_THRESHOLD 3000
```

17.60 fflas-ffpack-thresholds.h File Reference**17.61 fflas-ffpack.dox File Reference****17.62 fflas-ffpack.h File Reference**

Includes [FFLAS](#) and [FFPACK](#).

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas/fflas.h"
#include "ffpack/ffpack.h"
```

17.62.1 Detailed Description

Includes [FFLAS](#) and [FFPACK](#).

17.63 fflas.doxy File Reference

17.64 fflas.h File Reference

Finite Field Linear Algebra Subroutines

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/config.h"
#include "fflas-ffpack/config-blas.h"
#include <cmath>
#include <cstring>
#include <float.h>
#include <algorithm>
#include "fflas_enum.h"
#include "fflas-ffpack/utils/fflas_memory.h"
#include "fflas-ffpack/paladin/parallel.h"
#include "fflas_level1.inl"
#include "fflas_level2.inl"
#include "fflas_level3.inl"
#include "fflas-ffpack/checkers/checkers_fflas.h"
#include "fflas_freduce.h"
#include "fflas_fadd.h"
#include "fflas_fscal.h"
#include "fflas_fassign.h"
#include "fflas_fgemm.inl"
#include "fflas_pfgemm.inl"
#include "fflas_fgmv.inl"
#include "fflas-ffpack/paladin/pfgmv.inl"
#include "fflas_freivalds.inl"
#include "fflas_fger.inl"
#include "fflas_fsyrk.inl"
#include "fflas_fsyr2k.inl"
#include "fflas_ftrsm.inl"
#include "fflas_pftsm.inl"
#include "fflas_ftrmm.inl"
#include "fflas_ftrsv.inl"
#include "fflas_faxpy.inl"
#include "fflas_fdot.inl"
#include "fflas-ffpack/field/rns.h"
#include "fflas_fscal_mp.inl"
#include "fflas_freduce_mp.inl"
#include "fflas-ffpack/fflas/fflas_fger_mp.inl"
#include "fflas_fgemm/fgemm_classical_mp.inl"
#include "fflas_ftrsm_mp.inl"
#include "fflas_fgmv_mp.inl"
#include "fflas-ffpack/field/rns.inl"
#include "fflas-ffpack/paladin/fflas_plevel1.h"
#include "fflas_sparse.h"
#include "fflas-ffpack/checkers/checkers_fflas.inl"
```

Macros

- `#define WINOTHRESHOLD __FFLASFFPACK_WINOTHRESHOLD`
- `#define DOUBLE_TO_FLOAT_CROSSOVER 800`

Thresholds determining which floating point representation to use, depending on the cardinality of the finite field.

17.64.1 Detailed Description

Finite Field Linear Algebra Subroutines

Author

Clément Pernet.

17.64.2 Macro Definition Documentation

17.64.2.1 WINOTHRESHOLD

```
#define WINOTHRESHOLD __FFLASFFPACK_WINOTHRESHOLD
```

17.64.2.2 DOUBLE_TO_FLOAT_CROSSOVER

```
#define DOUBLE_TO_FLOAT_CROSSOVER 800
```

Thresholds determining which floating point representation to use, depending on the cardinality of the finite field. This is only used when the element representation is not a floating point type.

Bug to be benchmarked.

17.65 fflas_bounds.inl File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/flimits.h"
#include <givaro/udl.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
```

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::Protected](#)

Macros

- #define [__FFLASFFPACK_fflas_bounds_INL](#)
- #define [FFLAS_INT_TYPE](#) uint64_t

Functions

- template<class [Field](#) >
double [computeFactorClassic](#) (const [Field](#) &F)
- template<> double [computeFactorClassic](#) (const [Givaro::ModularBalanced](#)< double > &F)
- template<> double [computeFactorClassic](#) (const [Givaro::ModularBalanced](#)< float > &F)
- template<class [Field](#) >
size_t [DotProdBoundClassic](#) (const [Field](#) &F, const typename [Field::Element](#) &beta)
- [Givaro::Integer](#) [InfNorm](#) (const size_t M, const size_t N, const [Givaro::Integer](#) *A, const size_t lda)
- template<class [Field](#) >
size_t [TRSMBound](#) (const [Field](#) &)
TRSMBound.
- template<class [Element](#) >
size_t [TRSMBound](#) (const [Givaro::Modular](#)< [Element](#) > &F)

Specialization for positive modular representation over float.

- `template<class Element >`
`size_t TRSMBound (const Givaro::ModularBalanced< Element > &F)`

Specialization for balanced modular representation over double.

17.65.1 Macro Definition Documentation

17.65.1.1 __FFLASFFPACK_fflas_bounds_INL

```
#define __FFLASFFPACK_fflas_bounds_INL
```

17.65.1.2 FFLAS_INT_TYPE

```
#define FFLAS_INT_TYPE uint64_t
```

17.66 fflas_enum.h File Reference

```
#include <algorithm>
```

Data Structures

- class [AreEqual< X, Y >](#)
- class [AreEqual< X, X >](#)

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::Protected](#)

Enumerations

- enum [FFLAS_ORDER](#) { [FflasRowMajor](#) = 101 , [FflasColMajor](#) = 102 }
- Storage by row or col ?*
- enum [FFLAS_TRANSPOSE](#) { [FflasNoTrans](#) = 111 , [FflasTrans](#) = 112 }
- Is matrix transposed ?*
- enum [FFLAS_UPLO](#) { [FflasUpper](#) = 121 , [FflasLower](#) = 122 }
- Is triangular matrix's shape upper ?*
- enum [FFLAS_DIAG](#) { [FflasNonUnit](#) = 131 , [FflasUnit](#) = 132 }
- Is the triangular matrix implicitly unit diagonal ?*
- enum [FFLAS_SIDE](#) { [FflasLeft](#) = 141 , [FflasRight](#) = 142 }
- On what side ?*
- enum [FFLAS_BASE](#) { [FflasDouble](#) = 151 , [FflasFloat](#) = 152 , [FflasGeneric](#) = 153 }
- FFLAS_BASE determines the type of the element representation for Matrix Mult kernel.*

Functions

- `template<class T >`
`const T & min3 (const T &m, const T &n, const T &k)`
- `template<class T >`
`const T & max3 (const T &m, const T &n, const T &k)`
- `template<class T >`
`const T & min4 (const T &m, const T &n, const T &k, const T &l)`

- `template<class T >`
`const T & max4 (const T &m, const T &n, const T &k, const T &l)`

17.67 fflas_fadd.h File Reference

```
#include "fflas-ffpack/fflas/fflas_simd.h"
#include "fflas_fadd.inl"
```

Data Structures

- struct `support_simd_add< T >`

Namespaces

- namespace `FFLAS`

Functions

- `template<class Field >`
`void fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void faddin (const Field &F, const size_t N, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void fsub (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void fsubin (const Field &F, const size_t N, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, const typename Field::Element alpha, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void pfadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, const size_t numths)`
- `template<class Field >`
`void pfsub (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, const size_t numths)`
- `template<class Field >`
`void pfaddin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`
- `template<class Field >`
`void pfsubin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`
- `template<class Field >`
`void fadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`
fadd : matrix addition.
- `template<class Field >`
`void fsub (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc)`

- fsub* : matrix subtraction.

 - template<class [Field](#) >
 void [faddin](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::ConstElement_ptr](#) B, const size_t ldb, typename [Field::Element_ptr](#) C, const size_t ldc)

faddin

 template<class [Field](#) >
 void [fsubin](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::ConstElement_ptr](#) B, const size_t ldb, typename [Field::Element_ptr](#) C, const size_t ldc)

fsubin $C = C - B$

 template<class [Field](#) >
 void [fadd](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) B, const size_t ldb, typename [Field::Element_ptr](#) C, const size_t ldc)

fadd : matrix addition with scaling.

17.68 fflas_fadd.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_simd.h"
```

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::vectorised](#)
- namespace [FFLAS::details](#)

Macros

- #define [__FFLASFFPACK_fadd_INL](#)

Functions

- template<class SimdT , class Element , bool positive>
 std::enable_if< [is_simd](#)< SimdT >::value, void >::type [VEC_ADD](#) (SimdT &C, SimdT &A, SimdT &B, SimdT &Q, SimdT &T, SimdT &P, SimdT &NEGP, SimdT &MIN, SimdT &MAX)
- template<bool positive, class Element , class T1 , class T2 >
 std::enable_if< [FFLAS::support_simd_add](#)< Element >::value, void >::type [addp](#) (Element *T, const Element *TA, const Element *TB, size_t n, Element p, T1 min_, T2 max_)
- template<class SimdT , class Element , bool positive>
 std::enable_if< [is_simd](#)< SimdT >::value, void >::type [VEC_SUB](#) (SimdT &C, SimdT &A, SimdT &B, SimdT &Q, SimdT &T, SimdT &P, SimdT &NEGP, SimdT &MIN, SimdT &MAX)
- template<bool positive, class Element , class T1 , class T2 >
 std::enable_if< [FFLAS::support_simd_add](#)< Element >::value, void >::type [subp](#) (Element *T, const Element *TA, const Element *TB, const size_t n, const Element p, const T1 min_, const T2 max_)
- template<class Element >
 std::enable_if< [FFLAS::support_simd_add](#)< Element >::value, void >::type [add](#) (Element *T, const Element *TA, const Element *TB, size_t n)
- template<class Element >
 std::enable_if< [FFLAS::support_simd_add](#)< Element >::value, void >::type [sub](#) (Element *T, const Element *TA, const Element *TB, size_t n)
- template<class [Field](#) , bool ADD>
 std::enable_if< [FFLAS::support_simd_add](#)< typename [Field::Element](#) >::value, void >::type [fadd](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t inca, typename [Field::ConstElement_ptr](#) B, const size_t incb, typename [Field::Element_ptr](#) C, const size_t incc, [Field::Categories::ModularTag](#))

- template<class [Field](#), bool ADD>
std::enable_if<!FFLAS::support_simd_add< typenameField::Element >::value, void >::type [fadd](#)
(const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t inca, typename
[Field::ConstElement_ptr](#) B, const size_t incb, typename [Field::Element_ptr](#) C, const size_t incc, [Field](#)↔
Categories::ModularTag)
- template<class [Field](#), bool ADD>
void [fadd](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t inca, type-
name [Field::ConstElement_ptr](#) B, const size_t incb, typename [Field::Element_ptr](#) C, const size_t incc, [Field](#)↔
Categories::GenericTag)
- template<class [Field](#), bool ADD>
std::enable_if<!FFLAS::support_simd_add< typenameField::Element >::value, void >::type [fadd](#)
(const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t inca, typename
[Field::ConstElement_ptr](#) B, const size_t incb, typename [Field::Element_ptr](#) C, const size_t incc, [Field](#)↔
Categories::UnparametricTag)
- template<class [Field](#), bool ADD>
std::enable_if<[FFLAS::support_simd_add](#)< typenameField::Element >::value, void >::type [fadd](#)
(const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t inca, typename
[Field::ConstElement_ptr](#) B, const size_t incb, typename [Field::Element_ptr](#) C, const size_t incc, [Field](#)↔
Categories::UnparametricTag)

17.68.1 Macro Definition Documentation

17.68.1.1 __FFLASFFPACK_fadd_INL

```
#define __FFLASFFPACK_fadd_INL
```

17.69 fflas_fassign.h File Reference

```
#include "fflas_fassign.inl"
```

17.70 fflas_fassign.inl File Reference

```
#include <string.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <givaro/zring.h>
#include "fflas-ffpack/utils/debug.h"
```

Namespaces

- namespace [FFLAS](#)

Macros

- #define [__FFLASFFPACK_fassign_INL](#)

Functions

- template<class [Field](#) >
void [fassign](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) Y, const size_t incY, typename
[Field::Element_ptr](#) X, const size_t incX)

fassign : $x \leftarrow y$.

- `template<> void fassign (const Givaro::Modular< float > &F, const size_t N, const float *Y, const size_t incY, float *X, const size_t incX)`
- `template<> void fassign (const Givaro::ModularBalanced< float > &F, const size_t N, const float *Y, const size_t incY, float *X, const size_t incX)`
- `template<> void fassign (const Givaro::ZRing< float > &F, const size_t N, const float *Y, const size_t incY, float *X, const size_t incX)`
- `template<> void fassign (const Givaro::Modular< double > &F, const size_t N, const double *Y, const size_t incY, double *X, const size_t incX)`
- `template<> void fassign (const Givaro::ModularBalanced< double > &F, const size_t N, const double *Y, const size_t incY, double *X, const size_t incX)`
- `template<> void fassign (const Givaro::ZRing< double > &F, const size_t N, const double *Y, const size_t incY, double *X, const size_t incX)`
- `template<class Field >`
`void fassign (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr A, const size_t lda)`

$$fassign : A \leftarrow B.$$

17.70.1 Macro Definition Documentation

17.70.1.1 __FFLASFFPACK_fassign_INL

```
#define __FFLASFFPACK_fassign_INL
```

17.71 fflas_faxpy.inl File Reference

Namespaces

- namespace [FFLAS](#)

Macros

- #define [__FFLASFFPACK_faxpy_INL](#)

Functions

- `template<class Field >`
`void faxpy (const Field &F, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY)`

$$faxpy : y \leftarrow \alpha \cdot x + y.$$
- `template<> void faxpy (const Givaro::DoubleDomain &, const size_t N, const Givaro::DoubleDomain::Element a, Givaro::DoubleDomain::ConstElement_ptr x, const size_t incx, Givaro::DoubleDomain::Element_ptr y, const size_t incy)`
- `template<> void faxpy (const Givaro::FloatDomain &, const size_t N, const Givaro::FloatDomain::Element a, Givaro::FloatDomain::ConstElement_ptr x, const size_t incx, Givaro::FloatDomain::Element_ptr y, const size_t incy)`
- `template<class Field >`
`void faxpy (const Field &F, const size_t m, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr X, const size_t idx, typename Field::Element_ptr Y, const size_t ldy)`

$$faxpy : y \leftarrow \alpha \cdot x + y.$$

17.71.1 Macro Definition Documentation

17.71.1.1 __FFLASFFPACK_faxpy_INL

```
#define __FFLASFFPACK_faxpy_INL
```

17.72 fflas_fdot.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_helpers.inl"
```

Namespaces

- namespace [FFLAS](#)

Macros

- #define [__FFLASFFPACK_fdot_INL](#)

Functions

- template<class [Field](#) >
[Field::Element](#) fdot (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, ModeCategories::DefaultTag &MT)
- template<class [Field](#) >
[Field::Element](#) fdot (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, ModeCategories::DelayedTag &MT)
- template<> Givaro::DoubleDomain::Element [fdot](#) (const Givaro::DoubleDomain &, const size_t N, [Givaro::DoubleDomain::ConstElement_ptr](#) x, const size_t incx, [Givaro::DoubleDomain::ConstElement_ptr](#) y, const size_t incy, ModeCategories::DefaultTag &MT)
- template<> Givaro::FloatDomain::Element [fdot](#) (const Givaro::FloatDomain &, const size_t N, [Givaro::FloatDomain::ConstElement_ptr](#) x, const size_t incx, [Givaro::FloatDomain::ConstElement_ptr](#) y, const size_t incy, ModeCategories::DefaultTag &MT)
- template<class [Field](#) , class T >
[Field::Element](#) fdot (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, ModeCategories::ConvertTo< T > &MT)
- template<class [Field](#) >
[Field::Element](#) fdot (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, ModeCategories::DefaultBoundedTag &dbt)
- template<class [Field](#) >
[Field::Element](#) fdot (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, const ParSeqHelper::Sequential seq)
- template<class [Field](#) >
[Field::Element](#) fdot (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) X, const size_t incX, typename [Field::ConstElement_ptr](#) Y, const size_t incY)
fdot: dot product $x^T y$.

17.72.1 Macro Definition Documentation

17.72.1.1 __FFLASFFPACK_fdot_INL

```
#define __FFLASFFPACK_fdot_INL
```

17.73 fflas_fgemm.inl File Reference

```
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/debug.h"
#include "fflas_fgemm/fgemm_classical.inl"
#include "fflas_fgemm/fgemm_winograd.inl"
```

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::Protected](#)

Macros

- #define [__FFLASFFPACK_fgemm_INL](#)

Functions

- template<class NewField , class [Field](#) , class FieldMode >
[Field::Element_ptr fgemm_convert](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::Winograd, FieldMode > &H)
- template<class [Field](#) , class Element , class AlgoT , class ParSeqTrait >
bool [NeedPreAddReduction](#) (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, MMHelper< [Field](#), AlgoT, ModeCategories::LazyTag, ParSeqTrait > &WH)
- template<class [Field](#) , class Element , class AlgoT , class ModeT , class ParSeqTrait >
bool [NeedPreAddReduction](#) (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, MMHelper< [Field](#), AlgoT, ModeT, ParSeqTrait > &WH)
- template<class [Field](#) , class Element , class AlgoT , class ParSeqTrait >
bool [NeedPreSubReduction](#) (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, MMHelper< [Field](#), AlgoT, ModeCategories::LazyTag, ParSeqTrait > &WH)
- template<class [Field](#) , class Element , class AlgoT , class ModeT , class ParSeqTrait >
bool [NeedPreSubReduction](#) (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, MMHelper< [Field](#), AlgoT, ModeT, ParSeqTrait > &WH)
- template<class [Field](#) , class Element , class AlgoT , class ParSeqTrait >
bool [NeedDoublePreAddReduction](#) (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, Element beta, MMHelper< [Field](#), AlgoT, ModeCategories::LazyTag, ParSeqTrait > &WH)
- template<class [Field](#) , class Element , class AlgoT , class ModeT , class ParSeqTrait >
bool [NeedDoublePreAddReduction](#) (Element &Outmin, Element &Outmax, Element &Op1min, Element &Op1max, Element &Op2min, Element &Op2max, Element beta, MMHelper< [Field](#), AlgoT, ModeT, ParSeqTrait > &WH)
- template<class [Field](#) , class AlgoT , class ParSeqTrait >
void [ScalAndReduce](#) (const [Field](#) &F, const size_t N, const typename [Field::Element](#) alpha, typename [Field::Element_ptr](#) X, const size_t incX, const MMHelper< [Field](#), AlgoT, ModeCategories::LazyTag, ParSeqTrait > &H)
- template<class [Field](#) , class AlgoT , class ParSeqTrait >
void [ScalAndReduce](#) (const [Field](#) &F, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::Element_ptr](#) A, const size_t lda, const MMHelper< [Field](#), AlgoT, ModeCategories::LazyTag, ParSeqTrait > &H)

- `template<class Field >`
`Field::Element_ptr fgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, `MMHelper`< `Field`, `MMHelperAlgo::Winograd`, `ModeCategories::ConvertTo`< `ElementCategories::MachineFloatTag` >, `ParSeqHelper::Sequential` > &H)
- `template<typename Field >`
`Field::Element_ptr fgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, const `ParSeqHelper::Sequential` seq)
- `template<typename Field , class Cut , class Param >`
`Field::Element_ptr fgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, const `ParSeqHelper::Parallel`< `Cut`, `Param` > par)
- `template<typename Field >`
`Field::Element_ptr fgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc)
fgemm: Field GENERAL Matrix Multiply.
- `template<typename Field , class ModeT , class ParSeq >`
`Field::Element_ptr fgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, `MMHelper`< `Field`, `MMHelperAlgo::Auto`, `ModeT`, `ParSeq` > &H)
- `template<class Field >`
`Field::Element_ptr fgemm` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `FFLAS_TRANSPOSE` tb, const `size_t` m, const `size_t` n, const `size_t` k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` B, const `size_t` ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc, `MMHelper`< `Field`, `MMHelperAlgo::Winograd`, `ModeCategories::DelayedTag`, `ParSeqHelper::Sequential` > &H)
- `template<class Field >`
`Field::Element_ptr fsquare` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` n, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc)
fsquare: Squares a matrix.
- `template<class Field >`
`Field::Element_ptr fsquareCommon` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` n, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const `size_t` ldc)
- `template<> double * fsquare` (const `Givaro::ModularBalanced`< `double` > &F, const `FFLAS_TRANSPOSE` ta, const `size_t` n, const `double` alpha, const `double` *A, const `size_t` lda, const `double` beta, `double` *C, const `size_t` ldc)
- `template<> float * fsquare` (const `Givaro::ModularBalanced`< `float` > &F, const `FFLAS_TRANSPOSE` ta, const `size_t` n, const `float` alpha, const `float` *A, const `size_t` lda, const `float` beta, `float` *C, const `size_t` ldc)
- `template<> double * fsquare` (const `Givaro::Modular`< `double` > &F, const `FFLAS_TRANSPOSE` ta, const `size_t` n, const `double` alpha, const `double` *A, const `size_t` lda, const `double` beta, `double` *C, const `size_t` ldc)
- `template<> float * fsquare` (const `Givaro::Modular`< `float` > &F, const `FFLAS_TRANSPOSE` ta, const `size_t` n, const `float` alpha, const `float` *A, const `size_t` lda, const `float` beta, `float` *C, const `size_t` ldc)

17.73.1 Macro Definition Documentation

17.73.1.1 __FFLASFFPACK_fgemm_INL

```
#define __FFLASFFPACK_fgemm_INL
```

17.74 fgemm_classical.inl File Reference

```
#include <cmath>
#include "fflas-ffpack/field/field-traits.h"
```

Macros

- [#define __FFLASFFPACK_fflas_fflas_fgemm_classical_INL](#)

17.74.1 Macro Definition Documentation

17.74.1.1 __FFLASFFPACK_fflas_fflas_fgemm_classical_INL

```
#define __FFLASFFPACK_fflas_fflas_fgemm_classical_INL
```

17.75 fgemm_classical_mp.inl File Reference

matrix multiplication with multiprecision input (either over \mathbb{Z} or over $\mathbb{Z}/p\mathbb{Z}$)

```
#include <givaro/modular-integer.h>
#include <givaro/zring.h>
#include "fflas-ffpack/field/rns-double.h"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/field/rns-integer-mod.h"
#include "fflas-ffpack/field/field-traits.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas-ffpack/fflas/fflas_bounds.inl"
```

Data Structures

- struct [MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeqTrait >](#)
- struct [MMHelper< FFPACK::RNSInteger< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >](#)
- struct [MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >](#)

Namespaces

- namespace [FFLAS](#)

Macros

- [#define __FFPACK_fgemm_classical_INL](#)

Functions

- `template<typename RNS , typename ParSeqTrait >`
`FFPACK::RNSInteger< RNS >::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Compose< ParSeqHelper::Sequential, ParSeqTrait > > &H)`
- `template<typename RNS >`
`FFPACK::RNSInteger< RNS >::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Sequential > &H)`
- `template<typename RNS , typename ParSeqTrait >`
`FFPACK::RNSInteger< RNS >::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Compose< ParSeqHelper::Parallel< CuttingStrategy::RNSModulus, StrategyParameter::Threads >, ParSeqTrait > > &H)`
- `template<typename RNS , typename Cut , typename Param >`
`FFPACK::RNSInteger< RNS >::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename FFPACK::RNSInteger< RNS >::Element alpha, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Ad, const size_t lda, typename FFPACK::RNSInteger< RNS >::ConstElement_ptr Bd, const size_t ldb, const typename FFPACK::RNSInteger< RNS >::Element beta, typename FFPACK::RNSInteger< RNS >::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Classic, ModeCategories::DefaultTag, ParSeqHelper::Parallel< Cut, Param > > &H)`
- `template<class ParSeq >`
`Givaro::Integer * fgemm (const Givaro::ZRing< Givaro::Integer > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const Givaro::Integer alpha, const Givaro::Integer *A, const size_t lda, const Givaro::Integer *B, const size_t ldb, Givaro::Integer beta, Givaro::Integer *C, const size_t ldc, MMHelper< Givaro::ZRing< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > &H)`
- `template<typename RNS , class ModeT >`
`RNS::Element_ptr fgemm (const FFPACK::RNSInteger< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename RNS::Element alpha, typename RNS::ConstElement_ptr Ad, const size_t lda, typename RNS::ConstElement_ptr Bd, const size_t ldb, const typename RNS::Element beta, typename RNS::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSInteger< RNS >, MMHelperAlgo::Winograd, ModeT, ParSeqHelper::Sequential > &H)`
- `template<typename RNS >`
`RNS::Element_ptr fgemm (const FFPACK::RNSIntegerMod< RNS > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename RNS::Element alpha, typename RNS::ConstElement_ptr Ad, const size_t lda, typename RNS::ConstElement_ptr Bd, const size_t ldb, const typename RNS::Element beta, typename RNS::Element_ptr Cd, const size_t ldc, MMHelper< FFPACK::RNSIntegerMod< RNS >, MMHelperAlgo::Winograd > &H)`
- `Givaro::Integer * fgemm (const Givaro::Modular< Givaro::Integer > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const Givaro::Integer alpha, const Givaro::Integer *A, const size_t lda, const Givaro::Integer *B, const size_t ldb, const Givaro::Integer`

```
beta, Givaro::Integer *C, const size_t ldc, MMHelper< Givaro::Modular< Givaro::Integer >, MMHelper<
Algo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag > > &H)
```

- `template<class ParSeq >`
`Givaro::Integer * fgemm (const Givaro::Modular< Givaro::Integer > &F, const FFLAS_TRANSPOSE ta,`
`const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const Givaro::Integer alpha,`
`const Givaro::Integer *A, const size_t lda, const Givaro::Integer *B, const size_t ldb, const Givaro::Integer`
`beta, Givaro::Integer *C, const size_t ldc, MMHelper< Givaro::Modular< Givaro::Integer >, MMHelper<`
`Algo::Auto, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq > &H)`
- `template<size_t K1, size_t K2, class ParSeq >`
`Reclnt::ruint< K1 > * fgemm (const Givaro::Modular< Reclnt::ruint< K1 >, Reclnt::ruint< K2 > > &F,`
`const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t`
`k, const Reclnt::ruint< K1 > alpha, const Reclnt::ruint< K1 > *A, const size_t lda, const Reclnt::ruint< K1`
`> *B, const size_t ldb, Reclnt::ruint< K1 > beta, Reclnt::ruint< K1 > *C, const size_t ldc, MMHelper<`
`Givaro::Modular< Reclnt::ruint< K1 >, Reclnt::ruint< K2 > >, MMHelperAlgo::Classic, ModeCategories::`
`ConvertTo< ElementCategories::RNSElementTag >, ParSeq > &H)`

17.75.1 Detailed Description

matrix multiplication with multiprecision input (either over Z or over Z/pZ)

17.75.2 Macro Definition Documentation

17.75.2.1 __FFPACK_fgemm_classical_INL

```
#define __FFPACK_fgemm_classical_INL
```

17.76 fgemm_winograd.inl File Reference

```
#include <stdint.h>
#include <givaro/modular.h>
#include <givaro/zring.h>
#include "fgemm_classical.inl"
#include "schedule_winograd.inl"
#include "schedule_winograd_acc.inl"
#include "schedule_winograd_acc_ip.inl"
#include "schedule_winograd_ip.inl"
#include "fflas-ffpack/fflas-ffpack-config.h"
```

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::Protected](#)

Macros

- `#define` [__FFLASFFPACK_fflas_fflas_fgemm_winograd_INL](#)
- `#define` [NEWWINO](#)

Functions

- `template<class Field >`
`int WinogradThreshold (const Field &F)`
Computes the number of recursive levels to perform.
- `template<> int WinogradThreshold (const Givaro::Modular< float > &F)`

- template<> int [WinogradThreshold](#) (const [Givaro::ModularBalanced](#)< double > &F)
- template<> int [WinogradThreshold](#) (const [Givaro::ModularBalanced](#)< float > &F)
- template<class [Field](#) >
int [WinogradSteps](#) (const [Field](#) &F, const size_t &m)
Computes the number of recursive levels to perform.
- template<class [Field](#) , class [FieldMode](#) >
void [DynamicPeeling](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const size_t mr, const size_t nr, const size_t kr, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::Winograd, [FieldMode](#) > &H, const typename MMHelper< [Field](#), MMHelperAlgo::Winograd, [FieldMode](#) >::DelayedField::Element Cmin, const typename MMHelper< [Field](#), MMHelperAlgo::Winograd, [FieldMode](#) >::DelayedField::Element Cmax)
- template<class [Field](#) , class [FieldMode](#) >
void [DynamicPeeling2](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const size_t mr, const size_t nr, const size_t kr, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::Winograd, [FieldMode](#) > &H, const typename MMHelper< [Field](#), MMHelperAlgo::Winograd, [FieldMode](#) >::DelayedField::Element Cmin, const typename MMHelper< [Field](#), MMHelperAlgo::Winograd, [FieldMode](#) >::DelayedField::Element Cmax)
- template<class [Field](#) , class [FieldMode](#) >
void [WinogradCalc](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::Winograd, [FieldMode](#) > &H)
- template<class [Field](#) , class [ModeT](#) >
[Field::Element_ptr](#) [fgemm](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::Winograd, [ModeT](#) > &H)
- template<class [Field](#) , class [ModeT](#) , class [Cut](#) , class [Param](#) >
[Field::Element_ptr](#) [fgemm](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::WinogradPar, [ModeT](#), [ParSeqHelper::Parallel](#)< [Cut](#), [Param](#) > > &H)

17.76.1 Macro Definition Documentation

17.76.1.1 __FFLASFFPACK_fflas_fflas_fgemm_winograd_INL

```
#define __FFLASFFPACK_fflas_fflas_fgemm_winograd_INL
```

17.76.1.2 NEWWINO

```
#define NEWWINO
```

17.77 matmul.doxy File Reference

17.78 schedule_bini.inl File Reference

Bini implementation.

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::BLAS3](#)

Macros

- `#define` [__FFLASFFPACK_fgemm_bini_INL](#)

Functions

- `template<class Field >`
`void Bini (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, const typename Field::Element_ptr C, const size_t ldc, const size_t kmax, const size_t w, const FFLAS_BASE base, const size_t rec_level)`

17.78.1 Detailed Description

Bini implementation.

17.78.2 Macro Definition Documentation

17.78.2.1 __FFLASFFPACK_fgemm_bini_INL

```
#define __FFLASFFPACK_fgemm_bini_INL
```

17.79 schedule_winograd.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::BLAS3](#)

Macros

- `#define` [__FFLASFFPACK_fgemm_winograd_INL](#)

Functions

- `template<class Field , class FieldTrait , class Strat , class Param >`
`Field::Element_ptr WinoPar (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, const typename Field::Element_ptr C, const size_t ldc, MMHelper< Field, MMHelperAlgo::WinogradPar, FieldTrait, ParSeqHelper::Parallel< Strat, Param > > &WH)`
- `template<class Field , class FieldTrait >`
`void Winograd (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::ConstElement_ptr A, const size_t lda, const typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element`

beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::Winograd, [Field](#)↔
Trait > &WH)

17.79.1 Macro Definition Documentation

17.79.1.1 __FFLASFFPACK_fgemm_winograd_INL

```
#define __FFLASFFPACK_fgemm_winograd_INL
```

17.80 schedule_winograd_acc.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::BLAS3](#)

Macros

- #define [__FFLASFFPACK_fgemm_winograd_acc_INL](#)

Functions

- template<class [Field](#) , class FieldTrait >
void [WinogradAcc_3_23](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::Winograd, FieldTrait > &WH)
- template<class [Field](#) , class FieldTrait >
void [WinogradAcc_3_21](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::Winograd, FieldTrait > &WH)
- template<class [Field](#) , class FieldTrait >
void [WinogradAcc_2_24](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename [Field::Element](#) alpha, const typename [Field::Element_ptr](#) A, const size_t lda, const typename [Field::Element_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::↔Winograd, FieldTrait > &WH)
- template<class [Field](#) , class FieldTrait >
void [WinogradAcc_2_27](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename [Field::Element](#) alpha, const typename [Field::Element_ptr](#) A, const size_t lda, const typename [Field::Element_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), MMHelperAlgo::↔Winograd, FieldTrait > &WH)

17.80.1 Macro Definition Documentation

17.80.1.1 __FFLASFFPACK_fgemm_winograd_acc_INL

```
#define __FFLASFFPACK_fgemm_winograd_acc_INL
```

17.81 `schedule_winograd_acc_ip.inl` File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::BLAS3](#)

Macros

- `#define` [__FFLASFFPACK_fgemm_winograd_acc_ip_INL](#)

Functions

- `template<class Field , class FieldTrait >`
`void WinogradAcc_LR (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, Field↔Trait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_R_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, const typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`
- `template<class Field , class FieldTrait >`
`void WinogradAcc_L_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, const typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const MMHelper< Field, MMHelperAlgo::Winograd, FieldTrait > &WH)`

17.81.1 Macro Definition Documentation

17.81.1.1 `__FFLASFFPACK_fgemm_winograd_acc_ip_INL`

```
#define __FFLASFFPACK_fgemm_winograd_acc_ip_INL
```

17.82 `schedule_winograd_ip.inl` File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::BLAS3](#)

Macros

- `#define` [__FFLASFFPACK_fgemm_winograd_ip_INL](#)

Functions

- `template<class Field , class FieldTrait >`
`void Winograd_LR_S (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t mr, const size_t nr, const size_t kr, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const typename Field::Element beta,`

typename [Field::Element_ptr](#) C, const size_t ldc, const MMHelper< [Field](#), MMHelperAlgo::Winograd, [Field](#)↵
Trait > &WH)

- template<class [Field](#) , class FieldTrait >
void [Winograd_L_S](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const
size_t mr, const size_t nr, const size_t kr, const typename [Field::Element](#) alpha, typename [Field::Element_ptr](#)
A, const size_t lda, const typename [Field::Element_ptr](#) B, const size_t ldb, const typename [Field::Element](#)
beta, typename [Field::Element_ptr](#) C, const size_t ldc, const MMHelper< [Field](#), MMHelperAlgo::Winograd,
FieldTrait > &WH)
- template<class [Field](#) , class FieldTrait >
void [Winograd_R_S](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb,
const size_t mr, const size_t nr, const size_t kr, const typename [Field::Element](#) alpha, const typename
[Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb, const typename
[Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, const MMHelper< [Field](#), MMHelper↵
Algo::Winograd, FieldTrait > &WH)

17.82.1 Macro Definition Documentation

17.82.1.1 __FFLASFFPACK_fgemm_winograd_ip_INL

```
#define __FFLASFFPACK_fgemm_winograd_ip_INL
```

17.83 fflas_fgmv.inl File Reference

```
#include <givaro/zring.h>
```

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::Protected](#)

Macros

- #define [__FFLASFFPACK_fgmv_INL](#)

Functions

- template<typename FloatElement , class [Field](#) >
[Field::Element_ptr fgmv_convert](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const size_t M, const
size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda,
typename [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename
[Field::Element_ptr](#) Y, const size_t incY)
- template<class [Field](#) >
[Field::Element_ptr fgmv](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t
N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, type-
name [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename
[Field::Element_ptr](#) Y, const size_t incY, MMHelper< [Field](#), MMHelperAlgo::Classic, ModeCategories::↵
ConvertTo< ElementCategories::MachineFloatTag > > &H)
- template<class [Field](#) >
[Field::Element_ptr fgmv](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const size_t M, const size_t
N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, type-
name [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename
[Field::Element_ptr](#) Y, const size_t incY, MMHelper< [Field](#), MMHelperAlgo::Classic, ModeCategories::↵
DelayedTag > &H)

- `template<class Field >`
`Field::Element_ptr fgemv` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` M, const `size_t` N, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` X, const `size_t` incX, const typename `Field::Element` beta, typename `Field::Element_ptr` Y, const `size_t` incY, `MMHelper`< `Field`, `MMHelperAlgo::Classic`, `ModeCategories::DefaultTag` > &H)
- `template<class Field >`
`Field::Element_ptr fgemv` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` M, const `size_t` N, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` X, const `size_t` incX, const typename `Field::Element` beta, typename `Field::Element_ptr` Y, const `size_t` incY, `MMHelper`< `Field`, `MMHelperAlgo::Classic`, `ModeCategories::LazyTag` > &H)
- `template<class Field >`
`Field::Element_ptr fgemv` (const `Field` &F, const `FFLAS_TRANSPOSE` TransA, const `size_t` M, const `size_t` N, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const `size_t` lda, typename `Field::ConstElement_ptr` X, const `size_t` incX, const typename `Field::Element` beta, typename `Field::Element_ptr` Y, const `size_t` incY)
finite prime Field GEneral Matrix Vector multiplication.
- `Givaro::ZRing< int64_t >::Element_ptr fgemv` (const `Givaro::ZRing< int64_t >` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` M, const `size_t` N, const `int64_t` alpha, const `int64_t` *A, const `size_t` lda, const `int64_t` *X, const `size_t` incX, const `int64_t` beta, `int64_t` *Y, const `size_t` incY, `MMHelper`< `Givaro::ZRing< int64_t >`, `MMHelperAlgo::Classic`, `ModeCategories::DefaultTag` > &H)
- `Givaro::DoubleDomain::Element_ptr fgemv` (const `Givaro::DoubleDomain` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` M, const `size_t` N, const `Givaro::DoubleDomain::Element` alpha, const `Givaro::DoubleDomain::ConstElement_ptr` A, const `size_t` lda, const `Givaro::DoubleDomain::ConstElement_ptr` X, const `size_t` incX, const `Givaro::DoubleDomain::Element` beta, `Givaro::DoubleDomain::Element_ptr` Y, const `size_t` incY, `MMHelper`< `Givaro::DoubleDomain`, `MMHelperAlgo::Classic`, `ModeCategories::DefaultTag` > &H)
- `template<class Field >`
`Field::Element_ptr fgemv` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` M, const `size_t` N, const typename `Field::Element` alpha, const typename `Field::ConstElement_ptr` A, const `size_t` lda, const typename `Field::ConstElement_ptr` X, const `size_t` incX, const typename `Field::Element` beta, typename `Field::Element_ptr` Y, const `size_t` incY, `MMHelper`< `Field`, `MMHelperAlgo::Classic`, `ModeCategories::DefaultBoundedTag` > &H)
- `Givaro::FloatDomain::Element_ptr fgemv` (const `Givaro::FloatDomain` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` M, const `size_t` N, const `Givaro::FloatDomain::Element` alpha, const `Givaro::FloatDomain::ConstElement_ptr` A, const `size_t` lda, const `Givaro::FloatDomain::ConstElement_ptr` X, const `size_t` incX, const `Givaro::FloatDomain::Element` beta, `Givaro::FloatDomain::Element_ptr` Y, const `size_t` incY, `MMHelper`< `Givaro::FloatDomain`, `MMHelperAlgo::Classic`, `ModeCategories::DefaultTag` > &H)
- `template<class Field , class Cut , class Param >`
`Field::Element_ptr fgemv` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` m, const `size_t` n, const typename `Field::Element` alpha, const typename `Field::ConstElement_ptr` A, const `size_t` lda, const typename `Field::ConstElement_ptr` X, const `size_t` incX, const typename `Field::Element` beta, typename `Field::Element_ptr` Y, const `size_t` incY, `ParSeqHelper::Parallel`< `Cut`, `Param` > &parH)
- `template<class Field >`
`Field::Element_ptr fgemv` (const `Field` &F, const `FFLAS_TRANSPOSE` ta, const `size_t` m, const `size_t` n, const typename `Field::Element` alpha, const typename `Field::ConstElement_ptr` A, const `size_t` lda, const typename `Field::ConstElement_ptr` X, const `size_t` incX, const typename `Field::Element` beta, typename `Field::Element_ptr` Y, const `size_t` incY, `ParSeqHelper::Sequential` &seqH)

17.83.1 Macro Definition Documentation

17.83.1.1 __FFLASFFPACK_fgemv_INL

```
#define __FFLASFFPACK_fgemv_INL
```

17.84 fflas_fgmv_mp.inl File Reference

```
#include "fflas-ffpack/field/rns-integer-mod.h"
```

Namespaces

- namespace [FFLAS](#)

Macros

- #define [__FFLASFFPACK_fgmv_mp_INL](#)

Functions

- [FFPACK::rns_double::Element_ptr fgmv](#) (const [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const size_t M, const size_t N, const [FFPACK::rns_double::Element](#) alpha, [FFPACK::rns_double::ConstElement_ptr](#) A, const size_t lda, [FFPACK::rns_double::ConstElement_ptr](#) X, const size_t incX, const [FFPACK::rns_double::Element](#) beta, [FFPACK::rns_double::Element_ptr](#) Y, const size_t incY, [MMHelper](#)< [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) >, [MMHelperAlgo::Classic](#), [ModeCategories::DefaultTag](#) > &H)
- [FFPACK::rns_double::Element_ptr fgmv](#) (const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const size_t M, const size_t N, const [FFPACK::rns_double::Element](#) alpha, [FFPACK::rns_double::ConstElement_ptr](#) A, const size_t lda, [FFPACK::rns_double::ConstElement_ptr](#) X, const size_t incX, const [FFPACK::rns_double::Element](#) beta, [FFPACK::rns_double::Element_ptr](#) Y, const size_t incY, [MMHelper](#)< [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) >, [MMHelperAlgo::Classic](#), [ModeCategories::DefaultTag](#) > &H)
- [Givaro::Integer * fgmv](#) (const [Givaro::ZRing](#)< [Givaro::Integer](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const size_t m, const size_t n, const [Givaro::Integer](#) alpha, [Givaro::Integer *A](#), const size_t lda, [Givaro::Integer *X](#), const size_t ldx, [Givaro::Integer](#) beta, [Givaro::Integer *Y](#), const size_t ldy, [MMHelper](#)< [Givaro::ZRing](#)< [Givaro::Integer](#) >, [MMHelperAlgo::Classic](#), [ModeCategories::ConvertTo](#)< [ElementCategories::RNSElementTag](#) > > &H)
- [Givaro::Integer * fgmv](#) (const [Givaro::Modular](#)< [Givaro::Integer](#) > &F, const [FFLAS_TRANSPOSE](#) ta, const size_t m, const size_t n, const [Givaro::Integer](#) alpha, [Givaro::Integer *A](#), const size_t lda, [Givaro::Integer *X](#), const size_t ldx, [Givaro::Integer](#) beta, [Givaro::Integer *Y](#), const size_t ldy, [MMHelper](#)< [Givaro::Modular](#)< [Givaro::Integer](#) >, [MMHelperAlgo::Classic](#), [ModeCategories::ConvertTo](#)< [ElementCategories::RNSElementTag](#) > > &H)
- [template<size_t K1, size_t K2, class ParSeq>](#)
[RecInt::ruint](#)< K1 > * [fgmv](#) (const [Givaro::Modular](#)< [RecInt::ruint](#)< K1 >, [RecInt::ruint](#)< K2 > > &F, const [FFLAS_TRANSPOSE](#) ta, const size_t m, const size_t n, const [RecInt::ruint](#)< K1 > alpha, const [RecInt::ruint](#)< K1 > *A, const size_t lda, const [RecInt::ruint](#)< K1 > *X, const size_t incx, [RecInt::ruint](#)< K1 > beta, [RecInt::ruint](#)< K1 > *Y, const size_t incy, [MMHelper](#)< [Givaro::Modular](#)< [RecInt::ruint](#)< K1 >, [RecInt::ruint](#)< K2 > >, [MMHelperAlgo::Classic](#), [ModeCategories::ConvertTo](#)< [ElementCategories::RNSElementTag](#) >, [ParSeq](#) > &H)

17.84.1 Macro Definition Documentation

17.84.1.1 __FFLASFFPACK_fgmv_mp_INL

```
#define __FFLASFFPACK_fgmv_mp_INL
```

17.85 fflas_fger.inl File Reference

Namespaces

- namespace [FFLAS](#)

- namespace [FFLAS::Protected](#)

Macros

- `#define __FFLASFFPACK_fger_INL`

Functions

- `template<class Field >`
`void fger (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element_ptr A, const size_t lda)`
fger: rank one update of a general matrix
- `template<class FloatElement , class Field >`
`void fger_convert (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element_ptr A, const size_t lda)`
- `template<class Field >`
`void fger (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::MachineFloatTag > > &H)`
- `template<class Field , class AnyTag >`
`void fger (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic, AnyTag > &H)`
- `void fger (const Givaro::DoubleDomain &F, const size_t M, const size_t N, const Givaro::DoubleDomain::Element alpha, const Givaro::DoubleDomain::ConstElement_ptr x, const size_t incx, const Givaro::DoubleDomain::ConstElement_ptr y, const size_t incy, Givaro::DoubleDomain::Element_ptr A, const size_t lda, MMHelper< Givaro::DoubleDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)`
- `template<class Field >`
`void fger (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, const typename Field::ConstElement_ptr x, const size_t incx, const typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DefaultBoundedTag > &H)`
- `void fger (const Givaro::FloatDomain &F, const size_t M, const size_t N, const Givaro::FloatDomain::Element alpha, const Givaro::FloatDomain::ConstElement_ptr x, const size_t incx, const Givaro::FloatDomain::ConstElement_ptr y, const size_t incy, Givaro::FloatDomain::Element_ptr A, const size_t lda, MMHelper< Givaro::FloatDomain, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)`
- `template<class Field >`
`void fger (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::LazyTag > &H)`
- `template<class Field >`
`void fger (const Field &F, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element_ptr A, const size_t lda, MMHelper< Field, MMHelperAlgo::Classic, ModeCategories::DelayedTag > &H)`

17.85.1 Macro Definition Documentation

17.85.1.1 __FFLASFFPACK_fger_INL

```
#define __FFLASFFPACK_fger_INL
```

17.86 fflas_fger_mp.inl File Reference

```
#include <givaro/modular-integer.h>
#include <givaro/zring.h>
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas-ffpack/fflas/fflas_fgemm/fgemm_classical_mp.inl"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/field/rns-integer-mod.h"
```

Namespaces

- namespace [FFLAS](#)

Macros

- #define [__FFPACK_fger_mp_INL](#)

Functions

- void [fger](#) (const Givaro::Modular< Givaro::Integer > &F, const size_t M, const size_t N, const typename Givaro::Integer alpha, typename Givaro::Integer *x, const size_t incx, typename Givaro::Integer *y, const size_t incy, typename Givaro::Integer *A, const size_t lda, MMHelper< Givaro::Modular< Givaro::Integer >, MMHelperAlgo::Classic, ModeCategories::ConvertTo< ElementCategories::RNSElementTag > > &H)
- template<typename [RNS](#) >
 void [fger](#) (const [FFPACK::RNSInteger](#)< [RNS](#) > &F, const size_t M, const size_t N, const typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element alpha, typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element_ptr x, const size_t incx, typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element_ptr y, const size_t incy, typename [FFPACK::RNSInteger](#)< [RNS](#) >::Element_ptr A, const size_t lda, MMHelper< [FFPACK::RNSInteger](#)< [RNS](#) >, MMHelperAlgo::Classic, ModeCategories::DefaultTag > &H)
- template<typename [RNS](#) >
 void [fger](#) (const [FFPACK::RNSIntegerMod](#)< [RNS](#) > &F, const size_t M, const size_t N, const typename [FFPACK::RNSIntegerMod](#)< [RNS](#) >::Element alpha, typename [FFPACK::RNSIntegerMod](#)< [RNS](#) >::Element_ptr x, const size_t incx, typename [FFPACK::RNSIntegerMod](#)< [RNS](#) >::Element_ptr y, const size_t incy, typename [FFPACK::RNSIntegerMod](#)< [RNS](#) >::Element_ptr A, const size_t lda, MMHelper< [FFPACK::RNSIntegerMod](#)< [RNS](#) >, MMHelperAlgo::Classic > &H)

17.86.1 Macro Definition Documentation

17.86.1.1 [__FFPACK_fger_mp_INL](#)

```
#define \_\_FFPACK\_fger\_mp\_INL
```

17.87 fflas_freduce.h File Reference

```
#include "fflas-ffpack/fflas/fflas_simd.h"
#include "fflas-ffpack/field/field-traits.h"
#include "fflas-ffpack/utils/cast.h"
#include "fflas-ffpack/fflas/fflas_freduce.inl"
```

Data Structures

- struct [support_simd_mod](#)< T >
- struct [support_fast_mod](#)< T >

- struct `support_fast_mod< float >`
- struct `support_fast_mod< double >`
- struct `support_fast_mod< int64_t >`

Namespaces

- namespace `FFLAS`

Functions

- template<class `Field` >
void `freduce` (const `Field` &F, const size_t n, typename `Field::ConstElement_ptr` Y, const size_t incY, typename `Field::Element_ptr` X, const size_t incX)
$$freduce\ x \leftarrow ymodF.$$
- template<class `Field` >
void `freduce` (const `Field` &F, const size_t n, typename `Field::Element_ptr` X, const size_t incX)
$$freduce\ x \leftarrow xmodF.$$
- template<class `Field` >
void `freduce_constoverride` (const `Field` &F, const size_t m, typename `Field::ConstElement_ptr` A, const size_t incX)
- template<class `Field`, class `ConstOtherElement_ptr` >
void `finit` (const `Field` &F, const size_t n, `ConstOtherElement_ptr` Y, const size_t incY, typename `Field::Element_ptr` X, const size_t incX)
- template<class `Field` >
void `finit` (const `Field` &F, const size_t n, typename `Field::Element_ptr` X, const size_t incX)
$$finit\ \text{Initializes } X \text{ in } F\$.$$
- template<class `Field` >
void `freduce` (const `Field` &F, const size_t m, const size_t n, typename `Field::Element_ptr` A, const size_t lda)
$$freduce\ A \leftarrow AmodF.$$
- template<class `Field` >
void `pfreduce` (const `Field` &F, const size_t m, const size_t n, typename `Field::Element_ptr` A, const size_t lda, const size_t numths)
- template<class `Field` >
void `freduce` (const `Field` &F, const size_t m, const size_t n, typename `Field::ConstElement_ptr` B, const size_t ldb, typename `Field::Element_ptr` A, const size_t lda)
$$freduce\ A \leftarrow BmodF.$$
- template<class `Field` >
void `freduce_constoverride` (const `Field` &F, const size_t m, const size_t n, typename `Field::ConstElement_ptr` A, const size_t lda)
- template<class `Field`, class `OtherElement_ptr` >
void `finit` (const `Field` &F, const size_t m, const size_t n, const `OtherElement_ptr` B, const size_t ldb, typename `Field::Element_ptr` A, const size_t lda)
$$finit\ A \leftarrow BmodF.$$
- template<class `Field` >
void `finit` (const `Field` &F, const size_t m, const size_t n, typename `Field::Element_ptr` A, const size_t lda)

17.88 fflas_freduce.inl File Reference

```
#include <givaro/udl.h>
#include "fflas-ffpack/fflas/fflas_fassign.h"
```


Data Structures

- struct [HelperMod](#)< Field, ElementCategories::MachineIntTag >
- struct [HelperMod](#)< Field, FFLAS::ElementCategories::MachineFloatTag >
- struct [HelperMod](#)< Field, FFLAS::ElementCategories::ArbitraryPrecIntTag >
- struct [HelperMod](#)< Field, FFLAS::ElementCategories::FixedPrecIntTag >

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::vectorised](#)
- namespace [FFLAS::vectorised::unswitch](#)
- namespace [FFLAS::details](#)

Macros

- `#define __FFLASFFPACK_fflas_freduce_INL`
- `#define FFLASFFPACK_COPY_REDUCE 32 /* TODO TO BENCHMARK LATER */`

Functions

- `template<class T >`
`std::enable_if<!std::is_integral< T >::value, T >::type reduce (T A, T B)`
- `template<class T >`
`std::enable_if< std::is_integral< T >::value, T >::type reduce (T A, T B)`
- `template<> Givaro::Integer reduce (Givaro::Integer A, Givaro::Integer B)`
- `float reduce (float A, float B, float invB, float min, float max)`
- `double reduce (double A, double B, double invB, double min, double max)`
- `int64_t reduce (int64_t A, int64_t p, double invp, double min, double max, int64_t pow50rem)`
- `template<class Field >`
`Field::Element reduce (typename Field::Element A, HelperMod< Field, ElementCategories::MachineIntTag > &H)`
- `template<class Field >`
`Field::Element reduce (typename Field::Element A, HelperMod< Field, ElementCategories::MachineFloatTag > &H)`
- `template<class Field >`
`Field::Element reduce (typename Field::Element A, HelperMod< Field, ElementCategories::ArbitraryPrecIntTag > &H)`
- `template<class Field >`
`std::enable_if< !FFLAS::support_simd_mod< typenameField::Element >::value &&FFLAS::support_fast_mod< typenameField::Element >::value, void >::type modp (const Field &F, typename Field::ConstElement_ptr U, const size_t &n, typename Field::Element_ptr T, HelperMod< Field > &H)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type modp (const Field &F, typename Field::ConstElement_ptr U, const size_t &n, const size_t &incX, typename Field::Element_ptr T, HelperMod< Field > &H)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type modp (const Field &F, typename Field::ConstElement_ptr U, const size_t &n, typename Field::Element_ptr T)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type modp (const Field &F, typename Field::ConstElement_ptr U, const size_t &n, const size_t &incX, typename Field::Element_ptr T)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type freduce (const Field &F, const size_t m, typename Field::Element_ptr A, const size_t incX, FieldCategories::ModularTag)`

- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type freduce`
`(const Field &F, const size_t m, typename Field::ConstElement_ptr B, const size_t incY, typename`
`Field::Element_ptr A, const size_t incX, FieldCategories::ModularTag)`
- `template<class Field, class FC >`
`void freduce (const Field &F, const size_t m, typename Field::Element_ptr A, const size_t incX, FC)`
- `template<class Field, class FC >`
`void freduce (const Field &F, const size_t m, typename Field::ConstElement_ptr B, const size_t incY, type-`
`name Field::Element_ptr A, const size_t incX, FC)`

17.88.1 Macro Definition Documentation

17.88.1.1 __FFLASFFPACK_fflas_freduce_INL

```
#define __FFLASFFPACK_fflas_freduce_INL
```

17.88.1.2 FFLASFFPACK_COPY_REDUCE

```
#define FFLASFFPACK_COPY_REDUCE 32 /* TODO TO BENCHMARK LATER */
```

17.89 fflas_freduce_mp.inl File Reference

```
#include "fflas-ffpack/field/rns-integer-mod.h"
```

Namespaces

- namespace [FFLAS](#)

Macros

- `#define __FFLASFFPACK_fflas_freduce_mp_INL`

Functions

- `template<> void freduce (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t n,`
`FFPACK::RNSIntegerMod< FFPACK::rns_double >::Element_ptr A, size_t inc)`
- `template<> void freduce (const FFPACK::RNSIntegerMod< FFPACK::rns_double > &F, const size_t m,`
`const size_t n, FFPACK::rns_double::Element_ptr A, size_t lda)`

17.89.1 Macro Definition Documentation

17.89.1.1 __FFLASFFPACK_fflas_freduce_mp_INL

```
#define __FFLASFFPACK_fflas_freduce_mp_INL
```

17.90 fflas_freivalds.inl File Reference

Namespaces

- namespace [FFLAS](#)

Macros

- #define [__FFLASFFPACK_freivalds_INL](#)

Functions

- template<class [Field](#) >
bool [freivalds](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, typename [Field::ConstElement_ptr](#) C, const size_t ldc)
*freivalds: Freivalds **GE**neral **M**atrix **M**ultiply **R**andom **C**heck.*

17.90.1 Macro Definition Documentation

17.90.1.1 [__FFLASFFPACK_freivalds_INL](#)

```
#define __FFLASFFPACK_freivalds_INL
```

17.91 fflas_fscal.h File Reference

```
#include "fflas_fscal.inl"
```

17.92 fflas_fscal.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::vectorised](#)
- namespace [FFLAS::vectorised::unswitch](#)
- namespace [FFLAS::details](#)

Macros

- #define [__FFLASFFPACK_fscal_INL](#)

Functions

- template<class [Field](#) >
std::enable_if<![FFLAS::support_simd_mod](#)< typename [Field::Element](#) >::value &&[FFLAS::support_fast_mod](#)< typename [Field::Element](#) >::value, void >::type [scalp](#) (const [Field](#) &F, typename [Field::Element_ptr](#) T, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) U, const size_t n, HelperMod< [Field](#) > &H)
- template<class [Field](#) >
std::enable_if< [FFLAS::support_fast_mod](#)< typename [Field::Element](#) >::value, void >::type [scalp](#) (const [Field](#) &F, typename [Field::Element_ptr](#) T, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) U, const size_t n, const size_t &incX, HelperMod< [Field](#) > &H)
- template<class [Field](#) >
std::enable_if< [FFLAS::support_fast_mod](#)< typename [Field::Element](#) >::value, void >::type [scalp](#) (const [Field](#) &F, typename [Field::Element_ptr](#) T, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) U, const size_t n)

- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type scalp`
`(const Field &F, typename Field::Element_ptr T, const typename Field::Element alpha, typename`
`Field::ConstElement_ptr U, const size_t n, const size_t &incX)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type fscaln`
`(const Field &F, const size_t N, const typename Field::Element a, typename Field::Element_ptr X, const size_t incX,`
`FieldCategories::ModularTag)`
- `template<class Field >`
`std::enable_if< FFLAS::support_fast_mod< typenameField::Element >::value, void >::type fscal`
`(const Field &F, const size_t N, const typename Field::Element a, typename Field::ConstElement_ptr X, const size_t incX,`
`typename Field::Element_ptr Y, const size_t incY, FieldCategories::ModularTag)`
- `template<class Field, class FC >`
`void fscaln`
`(const Field &F, const size_t n, const typename Field::Element a, typename Field::Element_ptr X,`
`const size_t incX, FC)`
- `template<class Field, class FC >`
`void fscal`
`(const Field &F, const size_t N, const typename Field::Element a, typename Field::ConstElement_ptr`
`X, const size_t incX, typename Field::Element_ptr Y, const size_t incY, FC)`
- `template<class Field >`
`void fscaln`
`(const Field &F, const size_t n, const typename Field::Element alpha, typename Field::Element_ptr`
`X, const size_t incX)`

$$fscaln\ x \leftarrow \alpha \cdot x.$$
- `template<class Field >`
`void fscal`
`(const Field &F, const size_t n, const typename Field::Element alpha, typename Field::ConstElement_ptr`
`X, const size_t incX, typename Field::Element_ptr Y, const size_t incY)`

$$fscal\ y \leftarrow \alpha \cdot x.$$
- `template<> void fscal`
`(const Givaro::DoubleDomain &, const size_t N, const Givaro::DoubleDomain::Element a,`
`Givaro::DoubleDomain::ConstElement_ptr x, const size_t incx, Givaro::DoubleDomain::Element_ptr`
`y, const size_t incy)`
- `template<> void fscal`
`(const Givaro::FloatDomain &, const size_t N, const Givaro::FloatDomain::Element`
`a, Givaro::FloatDomain::ConstElement_ptr x, const size_t incx, Givaro::FloatDomain::Element_ptr y, const`
`size_t incy)`
- `template<> void fscaln`
`(const Givaro::DoubleDomain &, const size_t N, const Givaro::DoubleDomain::Element a,`
`Givaro::DoubleDomain::Element_ptr y, const size_t incy)`
- `template<> void fscaln`
`(const Givaro::FloatDomain &, const size_t N, const Givaro::FloatDomain::Element`
`a, Givaro::FloatDomain::Element_ptr y, const size_t incy)`
- `template<class Field >`
`void fscaln`
`(const Field &F, const size_t m, const size_t n, const typename Field::Element alpha, typename`
`Field::Element_ptr A, const size_t lda)`

$$fscaln\ A \leftarrow a \cdot A.$$
- `template<class Field >`
`void fscal`
`(const Field &F, const size_t m, const size_t n, const typename Field::Element alpha, typename`
`Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)`

$$fscal\ B \leftarrow a \cdot A.$$

17.92.1 Macro Definition Documentation

17.92.1.1 __FFLASFFPACK_fscal_INL

```
#define __FFLASFFPACK_fscal_INL
```

17.93 fflas_fscal_mp.inl File Reference

```
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas_fscal.h"
#include "fflas_fgemm.inl"
#include "fflas-ffpack/fflas/fflas_freduce_mp.inl"
```

Namespaces

- namespace [FFLAS](#)

Macros

- #define [__FFLASFFPACK_fscal_mp_INL](#)

Functions

- template<> void [fscal](#)(const [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) > &F, const size_t n, const [FFPACK::rns_double::Element](#) alpha, [FFPACK::rns_double::Element_ptr](#) A, const size_t inc)
- template<> void [fscal](#)(const [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) > &F, const size_t n, const [FFPACK::rns_double::Element](#) alpha, [FFPACK::rns_double::ConstElement_ptr](#) A, const size_t Ainc, [FFPACK::rns_double::Element_ptr](#) B, const size_t Binc)
- template<> void [fscal](#)(const [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) > &F, const size_t m, const size_t n, const [FFPACK::rns_double::Element](#) alpha, [FFPACK::rns_double::Element_ptr](#) A, const size_t lda)
- template<> void [fscal](#)(const [FFPACK::RNSInteger](#)< [FFPACK::rns_double](#) > &F, const size_t m, const size_t n, const [FFPACK::rns_double::Element](#) alpha, [FFPACK::rns_double::ConstElement_ptr](#) A, const size_t lda, [FFPACK::rns_double::Element_ptr](#) B, const size_t ldb)
- template<> void [fscal](#)(const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) > &F, const size_t n, const typename [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) >::Element alpha, typename [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) >::Element_ptr A, const size_t inc)
- template<> void [fscal](#)(const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) > &F, const size_t n, const [FFPACK::rns_double::Element](#) alpha, [FFPACK::rns_double::ConstElement_ptr](#) A, const size_t Ainc, [FFPACK::rns_double::Element_ptr](#) B, const size_t Binc)
- template<> void [fscal](#)(const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) > &F, const size_t m, const size_t n, const [FFPACK::rns_double::Element](#) alpha, [FFPACK::rns_double::Element_ptr](#) A, const size_t lda)
- template<> void [fscal](#)(const [FFPACK::RNSIntegerMod](#)< [FFPACK::rns_double](#) > &F, const size_t m, const size_t n, const [FFPACK::rns_double::Element](#) alpha, [FFPACK::rns_double::ConstElement_ptr](#) A, const size_t lda, [FFPACK::rns_double::Element_ptr](#) B, const size_t ldb)

17.93.1 Macro Definition Documentation

17.93.1.1 [__FFLASFFPACK_fscal_mp_INL](#)

```
#define __FFLASFFPACK_fscal_mp_INL
```

17.94 fflas_fsyr2k.inl File Reference

Namespaces

- namespace [FFLAS](#)

Macros

- #define [__FFLASFFPACK_fflas_fsyr2k_INL](#)

Functions

- `template<class Field >`
`Field::Element_ptr fsyr2k` (const `Field` &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const size_t lda, typename `Field::ConstElement_ptr` B, const size_t ldb, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const size_t ldc)
fsyr2k: Symmetric Rank 2K update

17.94.1 Macro Definition Documentation

17.94.1.1 __FFLASFFPACK_fflas_fsyr2k_INL

```
#define __FFLASFFPACK_fflas_fsyr2k_INL
```

17.95 fflas_fsyrk.inl File Reference

Namespaces

- namespace `FFLAS`

Macros

- #define `__FFLASFFPACK_fflas_fsyrk_INL`

Functions

- `template<class Field >`
`Field::Element_ptr fsyrk` (const `Field` &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename `Field::Element` alpha, typename `Field::ConstElement_ptr` A, const size_t lda, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const size_t ldc)
fsyrk: Symmetric Rank K update
- `template<class Field >`
`Field::Element_ptr fsyrk` (const `Field` &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename `Field::Element` alpha, typename `Field::Element_ptr` A, const size_t lda, typename `Field::ConstElement_ptr` D, const size_t incD, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const size_t ldc, const size_t threshold=__FFLASFFPACK_FSYRK_THRESHOLD)
fsyrk: Symmetric Rank K update with diagonal scaling
- `template<class Field >`
`Field::Element_ptr fsyrk` (const `Field` &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t N, const size_t K, const typename `Field::Element` alpha, typename `Field::Element_ptr` A, const size_t lda, typename `Field::ConstElement_ptr` D, const size_t incD, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const size_t ldc, const ParSeqHelper::Sequential seq, const size_t threshold)
- `template<class Field , class Cut , class Param >`
`Field::Element_ptr fsyrk` (const `Field` &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t N, const size_t K, const typename `Field::Element` alpha, typename `Field::Element_ptr` A, const size_t lda, typename `Field::ConstElement_ptr` D, const size_t incD, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const size_t ldc, const ParSeqHelper::Parallel< Cut, Param > par, const size_t threshold)
- `template<class Field >`
`Field::Element_ptr fsyrk` (const `Field` &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename `Field::Element` alpha, typename `Field::Element_ptr` A, const size_t lda, typename `Field::ConstElement_ptr` D, const size_t incD, const std::vector< bool > &two←Block, const typename `Field::Element` beta, typename `Field::Element_ptr` C, const size_t ldc, const size_t threshold=__FFLASFFPACK_FSYRK_THRESHOLD)
fsyrk: Symmetric Rank K update with diagonal scaling

17.95.1 Macro Definition Documentation

17.95.1.1 __FFLASFFPACK_fflas_fsyrrk_INL

```
#define __FFLASFFPACK_fflas_fsyrrk_INL
```

17.96 fflas_ftrmm.inl File Reference

Namespaces

- namespace [FFLAS](#)

Macros

- #define [__FFLASFFPACK_ftrmm_INL](#)

Functions

- template<class [Field](#) >
void [ftrmm](#) (const [Field](#) &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb)
*ftrmm: **TR**angular **M**atrix **M**ultiply.*
- template<class [Field](#) >
void [ftrmm](#) (const [Field](#) &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc)
*ftrmm: **TR**angular **M**atrix **M**ultiply with 3 operands Computes $C \leftarrow \alpha \text{op}(A)B + \text{beta}C$ or $C \leftarrow \alpha B \text{op}(A) + \text{beta}C$.*

17.96.1 Macro Definition Documentation

17.96.1.1 __FFLASFFPACK_ftrmm_INL

```
#define __FFLASFFPACK_ftrmm_INL
```

17.97 fflas_ftrsm.inl File Reference

Namespaces

- namespace [FFLAS](#)

Macros

- #define [__FFLASFFPACK_ftrsm_INL](#)

Functions

- template<class [Field](#) >
void [ftrsm](#) (const [Field](#) &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb)

- `template<class Field >`
`void ftrsm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const ParSeqHelper::Sequential &PSH)`
- `template<class Field, class Cut, class Param >`
`void ftrsm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const ParSeqHelper::Parallel< Cut, Param > &PSH)`
- `template<class Field, class ParSeqTrait = ParSeqHelper::Sequential>`
`void ftrsm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, TRSMHelper< StructureHelper::Recursive, ParSeqTrait > &H)`

17.97.1 Macro Definition Documentation

17.97.1.1 __FFLASFFPACK_ftrsm_INL

```
#define __FFLASFFPACK_ftrsm_INL
```

17.98 fflas_ftrsm_mp.inl File Reference

triangular system with matrix right hand side over multiprecision domain (either over \mathbb{Z} or over $\mathbb{Z}/p\mathbb{Z}$)

```
#include <cmath>
#include <givaro/modular-integer.h>
#include <givaro/givinteger.h>
#include "fflas-ffpack/fflas/fflas_bounds.inl"
#include "fflas-ffpack/fflas/fflas_level3.inl"
#include "fflas-ffpack/field/rns-integer-mod.h"
#include "fflas-ffpack/field/rns-integer.h"
```

Namespaces

- namespace [FFLAS](#)

Macros

- `#define __FFPACK_ftrsm_mp_INL`

Functions

- `void ftrsm (const Givaro::Modular< Givaro::Integer > &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const Givaro::Integer alpha, const Givaro::Integer *A, const size_t lda, Givaro::Integer *B, const size_t ldb)`
- `void cblas_impftrsm (const enum FFLAS_ORDER Order, const enum FFLAS_SIDE Side, const enum FFLAS_UPLO Uplo, const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_DIAG Diag, const int M, const int N, const FFPACK::rns_double_elt alpha, FFPACK::rns_double_elt_cstptr A, const int lda, FFPACK::rns_double_elt_ptr B, const int ldb)`

17.98.1 Detailed Description

triangular system with matrix right hand side over multiprecision domain (either over \mathbb{Z} or over $\mathbb{Z}/p\mathbb{Z}$)

17.98.2 Macro Definition Documentation

17.98.2.1 __FFPACK_ftrsm_mp_INL

```
#define __FFPACK_ftrsm_mp_INL
```

17.99 fflas_ftrsv.inl File Reference

Namespaces

- namespace [FFLAS](#)

Macros

- #define [__FFLASFFPACK_ftrsv_INL](#)

Functions

- template<class [Field](#) >
void [ftrsv](#) (const [Field](#) &F, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) X, int incX)
ftrsv: TRIangular System solve with Vector Computes $X \leftarrow \text{op}(A^{-1})X$

17.99.1 Macro Definition Documentation

17.99.1.1 __FFLASFFPACK_ftrsv_INL

```
#define __FFLASFFPACK_ftrsv_INL
```

17.100 fflas_helpers.inl File Reference

```
#include "fflas-ffpack/field/field-traits.h"
#include "fflas-ffpack/paladin/parallel.h"
#include "fflas-ffpack/utils/flimits.h"
#include <algorithm>
```

Data Structures

- struct [Auto](#)
- struct [Classic](#)
- struct [Winograd](#)
- struct [WinogradPar](#)
- struct [Bini](#)
- struct [AlgoChooser](#)< [ModeT](#), [ParSeq](#) >
- struct [AlgoChooser](#)< [ModeCategories::ConvertTo](#)< [ElementCategories::RNSElementTag](#) >, [ParSeq](#) >
- struct [MMHelper](#)< [Field](#), [AlgoTrait](#), [ModeCategories::DefaultTag](#), [ParSeqTrait](#) >
FGEMM Helper for Default and ConvertTo modes of operation.
- struct [MMHelper](#)< [Field](#), [AlgoTrait](#), [ModeCategories::ConvertTo](#)< [Dest](#) >, [ParSeqTrait](#) >
- struct [MMHelper](#)< [Field](#), [AlgoTrait](#), [ModeTrait](#), [ParSeqTrait](#) >
- struct [Recursive](#)

- struct [Iterative](#)
- struct [Hybrid](#)
- struct [TRSMHelper](#)< [ReclterTrait](#), [ParSeqTrait](#) >

TRSM Helper.

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::Protected](#)
- namespace [FFLAS::MMHelperAlgo](#)
- namespace [FFLAS::StructureHelper](#)

StructureHelper for ftrsm.

Macros

- #define [__FFLASFFPACK_fflas_fflas_mmhelper_INL](#)

Functions

- template<class [Field](#) >
int [WinogradSteps](#) (const [Field](#) &F, const size_t &m)
Computes the number of recursive levels to perform.
- template<class DFE >
size_t [min_types](#) (const DFE &k)
- template<> size_t [min_types](#) (const [Reclnt::rint](#)< 6 > &k)
- template<> size_t [min_types](#) (const [Reclnt::rint](#)< 7 > &k)
- template<> size_t [min_types](#) (const [Reclnt::rint](#)< 8 > &k)
- template<> size_t [min_types](#) (const [Reclnt::rint](#)< 9 > &k)
- template<> size_t [min_types](#) (const [Reclnt::rint](#)< 10 > &k)
- template<> size_t [min_types](#) (const [Givaro::Integer](#) &k)
- template<class T >
bool [unfit](#) (T x)
- template<> bool [unfit](#) ([int64_t](#) x)
- template<size_t K>
bool [unfit](#) ([Reclnt::rint](#)< K > x)
- template<> bool [unfit](#) ([Reclnt::rint](#)< 6 > x)

17.100.1 Macro Definition Documentation

17.100.1.1 [__FFLASFFPACK_fflas_fflas_mmhelper_INL](#)

```
#define __FFLASFFPACK_fflas_fflas_mmhelper_INL
```

17.101 igemm.doxy File Reference

17.102 igemm.h File Reference

```
#include "igemm_kernels.h"
#include "igemm_tools.h"
#include "fflas-ffpack/utils/fflas_memory.h"
#include "igemm.inl"
```

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::Protected](#)

Enumerations

- enum [number_kind](#) { [zero](#) =0 , [one](#) =1 , [mone](#) =-1 , [other](#) =2 }

Functions

- template<enum FFLAS_TRANSPOSE tA, enum FFLAS_TRANSPOSE tB>
void [igemm_colmajor](#) (size_t rows, size_t cols, size_t depth, const [int64_t](#) alpha, const [int64_t](#) *A, size_t lda, const [int64_t](#) *B, size_t ldb, [int64_t](#) *C, size_t ldc)
- template<enum FFLAS_TRANSPOSE tA, enum FFLAS_TRANSPOSE tB, enum number_kind alpha_kind>
void [igemm_colmajor](#) (size_t rows, size_t cols, size_t depth, const [int64_t](#) alpha, const [int64_t](#) *A, size_t lda, const [int64_t](#) *B, size_t ldb, [int64_t](#) *C, size_t ldc)
- void [igemm](#) (const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_TRANSPOSE TransB, size_t rows, size_t cols, size_t depth, const [int64_t](#) alpha, const [int64_t](#) *A, size_t lda, const [int64_t](#) *B, size_t ldb, const [int64_t](#) beta, [int64_t](#) *C, size_t ldc)
- void [igemm_](#) (const enum FFLAS_ORDER Order, const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_TRANSPOSE TransB, const size_t M, const size_t N, const size_t K, const [int64_t](#) alpha, const [int64_t](#) *A, const size_t lda, const [int64_t](#) *B, const size_t ldb, const [int64_t](#) beta, [int64_t](#) *C, const size_t ldc)

17.103 igemm.inl File Reference

```
#include "fflas-ffpack/utils/fflas_memory.h"
```

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::Protected](#)

Macros

- #define [__FFLASFFPACK_fflas_igemm_igemm_INL](#)

Functions

- template<enum FFLAS_TRANSPOSE tA, enum FFLAS_TRANSPOSE tB>
void [igemm_colmajor](#) (size_t rows, size_t cols, size_t depth, const [int64_t](#) alpha, const [int64_t](#) *A, size_t lda, const [int64_t](#) *B, size_t ldb, [int64_t](#) *C, size_t ldc)
- template<enum FFLAS_TRANSPOSE tA, enum FFLAS_TRANSPOSE tB, enum number_kind alpha_kind>
void [igemm_colmajor](#) (size_t rows, size_t cols, size_t depth, const [int64_t](#) alpha, const [int64_t](#) *A, size_t lda, const [int64_t](#) *B, size_t ldb, [int64_t](#) *C, size_t ldc)
- void [igemm](#) (const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_TRANSPOSE TransB, size_t rows, size_t cols, size_t depth, const [int64_t](#) alpha, const [int64_t](#) *A, size_t lda, const [int64_t](#) *B, size_t ldb, const [int64_t](#) beta, [int64_t](#) *C, size_t ldc)
- void [igemm_](#) (const enum FFLAS_ORDER Order, const enum FFLAS_TRANSPOSE TransA, const enum FFLAS_TRANSPOSE TransB, const size_t M, const size_t N, const size_t K, const [int64_t](#) alpha, const [int64_t](#) *A, const size_t lda, const [int64_t](#) *B, const size_t ldb, const [int64_t](#) beta, [int64_t](#) *C, const size_t ldc)

17.103.1 Macro Definition Documentation

17.103.1.1 __FFLASFFPACK_fflas_igemm_igemm_INL

```
#define __FFLASFFPACK_fflas_igemm_igemm_INL
```

17.104 igemm_kernels.h File Reference

```
#include "igemm_kernels.inl"
```

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::details](#)

Functions

- template<enum number_kind K>
void [igebb44](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- template<enum number_kind K>
void [igebb24](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- template<enum number_kind K>
void [igebb14](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- template<enum number_kind K>
void [igebb41](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- template<enum number_kind K>
void [igebb21](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- template<enum number_kind K>
void [igebb11](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- template<enum number_kind K>
void [igebp](#) (size_t rows, size_t cols, size_t depth, const [int64_t](#) alpha, const [int64_t](#) *blockA, size_t lda, const [int64_t](#) *blockB, size_t ldb, [int64_t](#) *C, size_t ldc)

17.105 igemm_kernels.inl File Reference

```
#include "fflas-ffpack/utils/fflas_memory.h"
#include "igemm_tools.h"
```

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::details](#)

Macros

- #define [__FFLASFFPACK_fflas_igemm_igemm_kernels_INL](#)

Functions

- `template<enum number_kind K>`
void [igebb44](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- `template<enum number_kind K>`
void [igebb24](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- `template<enum number_kind K>`
void [igebb14](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- `template<enum number_kind K>`
void [igebb41](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- `template<enum number_kind K>`
void [igebb21](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- `template<enum number_kind K>`
void [igebb11](#) (size_t i, size_t j, size_t depth, size_t pdeth, const [int64_t](#) alpha, const [int64_t](#) *blA, const [int64_t](#) *blB, [int64_t](#) *C, size_t ldc)
- `template<enum number_kind K>`
void [igebp](#) (size_t rows, size_t cols, size_t depth, const [int64_t](#) alpha, const [int64_t](#) *blockA, size_t lda, const [int64_t](#) *blockB, size_t ldb, [int64_t](#) *C, size_t ldc)

17.105.1 Macro Definition Documentation

17.105.1.1 `__FFLASFFPACK_fflas_igemm_igemm_kernels_INL`

```
#define __FFLASFFPACK_fflas_igemm_igemm_kernels_INL
```

17.106 igemm_tools.h File Reference

```
#include "igemm_tools.inl"
```

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::details](#)

Functions

- `template<size_t k, bool transpose>`
void [pack_lhs](#) ([int64_t](#) *XX, const [int64_t](#) *X, size_t ldx, size_t rows, size_t cols)
- `template<size_t k, bool transpose>`
void [pack_rhs](#) ([int64_t](#) *XX, const [int64_t](#) *X, size_t ldx, size_t rows, size_t cols)
- void [gebp](#) (size_t rows, size_t cols, size_t depth, [int64_t](#) *C, size_t ldc, const [int64_t](#) *blockA, size_t lda, const [int64_t](#) *BlockB, size_t ldb, [int64_t](#) *BlockW)
- void [BlockingFactor](#) (size_t &m, size_t &n, size_t &k)

17.107 igemm_tools.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_simd.h"
```

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::details](#)

Macros

- `#define __FFLASFFPACK_fflas_igemm_igemm_tools_INL`

Functions

- `template<size_t k, bool transpose>`
void [pack_rhs](#) ([int64_t](#) *XX, const [int64_t](#) *X, size_t ldx, size_t rows, size_t cols)
- `template<size_t k, bool transpose>`
void [pack_lhs](#) ([int64_t](#) *XX, const [int64_t](#) *X, size_t ldx, size_t rows, size_t cols)
- void [BlockingFactor](#) (size_t &m, size_t &n, size_t &k)

17.107.1 Macro Definition Documentation

17.107.1.1 __FFLASFFPACK_fflas_igemm_igemm_tools_INL

```
#define __FFLASFFPACK_fflas_igemm_igemm_tools_INL
```

17.108 fflas_level1.inl File Reference

Namespaces

- namespace [FFLAS](#)

Macros

- `#define __FFLASFFPACK_fflas_fflas_level1_INL`

Functions

- `template<class Field >`
void [freduce](#) (const [Field](#) &F, const size_t n, typename [Field::Element_ptr](#) X, const size_t incX)
 $freduce\ x \leftarrow x mod F.$
- `template<class Field >`
void [freduce](#) (const [Field](#) &F, const size_t n, typename [Field::ConstElement_ptr](#) Y, const size_t incY, typename [Field::Element_ptr](#) X, const size_t incX)
 $freduce\ x \leftarrow y mod F.$
- `template<class Field, class OtherElement_ptr >`
void [finit](#) (const [Field](#) &F, const size_t n, const OtherElement_ptr Y, const size_t incY, typename [Field::Element_ptr](#) X, const size_t incX)
 $finit\ x \leftarrow y mod F.$
- `template<class Field >`
void [finit](#) (const [Field](#) &F, const size_t n, typename [Field::Element_ptr](#) X, const size_t incX)
 $finit\ \text{Initializes } X \text{ in } F\$.$
- `template<class Field, class OtherElement_ptr >`
void [fconvert](#) (const [Field](#) &F, const size_t n, OtherElement_ptr X, const size_t incX, typename [Field::ConstElement_ptr](#) Y, const size_t incY)
 $fconvert\ x \leftarrow y mod F.$
- `template<class Field >`
void [fnegin](#) (const [Field](#) &F, const size_t n, typename [Field::Element_ptr](#) X, const size_t incX)

- $f\text{negin } x \leftarrow -x.$
 - template<class [Field](#) >
void [fneg](#) (const [Field](#) &F, const size_t n, typename [Field::ConstElement_ptr](#) Y, const size_t incY, typename [Field::Element_ptr](#) X, const size_t incX)

 $f\text{neg } x \leftarrow -y.$
 - template<class [Field](#) >
void [fzero](#) (const [Field](#) &F, const size_t n, typename [Field::Element_ptr](#) X, const size_t incX)

 $f\text{zero} : A \leftarrow 0.$
 - template<class [Field](#) , class RandIter >
void [frand](#) (const [Field](#) &F, RandIter &G, const size_t n, typename [Field::Element_ptr](#) X, const size_t incX)

 $f\text{rand} : A \leftarrow \text{random}.$
 - template<class [Field](#) >
bool [fiszero](#) (const [Field](#) &F, const size_t n, typename [Field::ConstElement_ptr](#) X, const size_t incX)

 $f\text{iszero} : \text{test } X = 0.$
 - template<class [Field](#) >
bool [fequal](#) (const [Field](#) &F, const size_t n, typename [Field::ConstElement_ptr](#) X, const size_t incX, typename [Field::ConstElement_ptr](#) Y, const size_t incY)

 $f\text{equal} : \text{test } X = Y.$
 - template<class [Field](#) >
void [fassign](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) Y, const size_t incY, typename [Field::Element_ptr](#) X, const size_t incX)

 $f\text{assign} : x \leftarrow y.$
 - template<class [Field](#) >
void [fscaln](#) (const [Field](#) &F, const size_t n, const typename [Field::Element](#) alpha, typename [Field::Element_ptr](#) X, const size_t incX)

 $f\text{scaln } x \leftarrow \alpha \cdot x.$
 - template<class [Field](#) >
void [fscal](#) (const [Field](#) &F, const size_t n, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) X, const size_t incX, typename [Field::Element_ptr](#) Y, const size_t incY)

 $f\text{scal } y \leftarrow \alpha \cdot x.$
 - template<class [Field](#) >
void [faxpy](#) (const [Field](#) &F, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) X, const size_t incX, typename [Field::Element_ptr](#) Y, const size_t incY)

 $f\text{axpy} : y \leftarrow \alpha \cdot x + y.$
 - template<class [Field](#) >
void [faxpby](#) (const [Field](#) &F, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t incY)

 $f\text{axpby} : y \leftarrow \alpha \cdot x + \beta \cdot y.$
 - template<class [Field](#) >
[Field::Element](#) [fdot](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) X, const size_t incX, typename [Field::ConstElement_ptr](#) Y, const size_t incY)

 $f\text{dot} : \text{dot product } x^T y.$
 - template<class [Field](#) >
[Field::Element](#) [fdot](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, const ParSeqHelper::Sequential seq)
 - template<typename [Field](#) , class Cut , class Param >
[Field::Element](#) [fdot](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) X, const size_t incX, typename [Field::ConstElement_ptr](#) Y, const size_t incY, const ParSeqHelper::Parallel< Cut, Param > par)
 - template<class [Field](#) >
void [fswap](#) (const [Field](#) &F, const size_t N, typename [Field::Element_ptr](#) X, const size_t incX, typename [Field::Element_ptr](#) Y, const size_t incY)

 $f\text{swap} : X \leftrightarrow Y.$

- `template<class Field >`
`void pfadd (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, const size_t numths)`
- `template<class Field >`
`void pfsub (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, const size_t numths)`
- `template<class Field >`
`void pfaddin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`
- `template<class Field >`
`void pfsubin (const Field &F, const size_t M, const size_t N, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr C, const size_t ldc, size_t numths)`
- `template<class Field >`
`void fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void fsub (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void faddin (const Field &F, const size_t N, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void fsubin (const Field &F, const size_t N, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`
- `template<class Field >`
`void fadd (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t inca, const typename Field::Element alpha, typename Field::ConstElement_ptr B, const size_t incb, typename Field::Element_ptr C, const size_t incc)`

17.108.1 Macro Definition Documentation

17.108.1.1 __FFLASFFPACK_fflas_fflas_level1_INL

```
#define __FFLASFFPACK_fflas_fflas_level1_INL
```

17.109 fflas_level2.inl File Reference

```
#include "givarozring.h"
```

Namespaces

- namespace [FFLAS](#)

Macros

- `#define` [__FFLASFFPACK_fflas_fflas_level2_INL](#)

Functions

- `template<class Field >`
`void fassign (const Field &F, const size_t m, const size_t n, typename Field::ConstElement_ptr B, const size_t ldb, typename Field::Element_ptr A, const size_t lda)`

- $fassign : A \leftarrow B.$
- template<class [Field](#) >
 void [fzero](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda)
 $fzero : A \leftarrow 0.$
- template<class [Field](#) , class RandIter >
 void [frand](#) (const [Field](#) &F, RandIter &G, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda)
 $frand : A \leftarrow random.$
- template<class [Field](#) >
 bool [fequal](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb)
 $fequal : test A = B.$
- template<class [Field](#) >
 bool [fiszero](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::ConstElement_ptr](#) A, const size_t lda)
 $fiszero : test A = 0.$
- template<class [Field](#) >
 void [fidentity](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda, const typename [Field::Element](#) &d)
 $creates a diagonal matrix$
- template<class [Field](#) >
 void [fidentity](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda)
 $creates a diagonal matrix$
- template<class [Field](#) >
 void [freduce](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda)
 $freduce A \leftarrow AmodF.$
- template<class [Field](#) >
 void [freduce](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::ConstElement_ptr](#) B, const size_t ldb, typename [Field::Element_ptr](#) A, const size_t lda)
 $freduce A \leftarrow BmodF.$
- template<class [Field](#) , class OtherElement_ptr >
 void [finit](#) (const [Field](#) &F, const size_t m, const size_t n, const OtherElement_ptr B, const size_t ldb, typename [Field::Element_ptr](#) A, const size_t lda)
 $finit A \leftarrow BmodF.$
- template<class [Field](#) , class OtherElement_ptr >
 void [finit](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda)
 $finit Initializes A in F\$.$
- template<class [Field](#) , class OtherElement_ptr >
 void [fconvert](#) (const [Field](#) &F, const size_t m, const size_t n, OtherElement_ptr A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb)
 $fconvert A \leftarrow BmodF.$
- template<class [Field](#) >
 void [fnegin](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda)
 $fnegin A \leftarrow -A.$
- template<class [Field](#) >
 void [fneg](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::ConstElement_ptr](#) B, const size_t ldb, typename [Field::Element_ptr](#) A, const size_t lda)
 $fneg A \leftarrow -B.$
- template<class [Field](#) >
 void [fscal](#) (const [Field](#) &F, const size_t m, const size_t n, const typename [Field::Element](#) alpha, typename [Field::Element_ptr](#) A, const size_t lda)
 $fscal A \leftarrow a \cdot A.$
- template<class [Field](#) >
 void [fscal](#) (const [Field](#) &F, const size_t m, const size_t n, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb)

- $fscal\ B \leftarrow a \cdot A.$
- template<class [Field](#) >
void [faxpy](#) (const [Field](#) &F, const size_t m, const size_t n, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) X, const size_t ldx, typename [Field::Element_ptr](#) Y, const size_t ldy)
 $faxpy : y \leftarrow \alpha \cdot x + y.$
 - template<class [Field](#) >
void [faxpby](#) (const [Field](#) &F, const size_t m, const size_t n, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) X, const size_t ldx, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t ldy)
 $faxpby : y \leftarrow \alpha \cdot x + \beta \cdot y.$
 - template<class [Field](#) >
void [fmove](#) (const [Field](#) &F, const size_t m, const size_t n, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb)
 $fmove : A \leftarrow B \text{ and } B \leftarrow 0.$
 - template<class [Field](#) >
void [fadd](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, typename [Field::Element_ptr](#) C, const size_t ldc)
 $fadd : \text{matrix addition.}$
 - template<class [Field](#) >
void [fsub](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) B, const size_t ldb, typename [Field::Element_ptr](#) C, const size_t ldc)
 $fsub : \text{matrix subtraction.}$
 - template<class [Field](#) >
void [fsubin](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::ConstElement_ptr](#) B, const size_t ldb, typename [Field::Element_ptr](#) C, const size_t ldc)
 $fsubin\ C = C - B$
 - template<class [Field](#) >
void [fadd](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) B, const size_t ldb, typename [Field::Element_ptr](#) C, const size_t ldc)
 $fadd : \text{matrix addition with scaling.}$
 - template<class [Field](#) >
void [faddin](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::ConstElement_ptr](#) B, const size_t ldb, typename [Field::Element_ptr](#) C, const size_t ldc)
 $faddin$
 - template<class [Field](#) >
[Field::Element_ptr](#) [fgemv](#) (const [Field](#) &F, const FFLAS_TRANSPOSE TransA, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t incY)
 $\text{finite prime Field GEneral Matrix Vector multiplication.}$
 - template<class [Field](#) >
void [fger](#) (const [Field](#) &F, const size_t M, const size_t N, const typename [Field::Element](#) alpha, typename [Field::ConstElement_ptr](#) x, const size_t incx, typename [Field::ConstElement_ptr](#) y, const size_t incy, typename [Field::Element_ptr](#) A, const size_t lda)
 $fger : \text{rank one update of a general matrix}$
 - template<class [Field](#) >
void [ftrsv](#) (const [Field](#) &F, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) X, int incX)
 $ftrsv : \text{TRiangular System solve with Vector Computes } X \leftarrow \text{op}(A^{-1})X$
 - template<class [Field](#) >
size_t [bitsize](#) (const [Field](#) &F, size_t M, size_t N, const typename [Field::ConstElement_ptr](#) A, size_t lda)
 $\text{bitsize : Computes the largest bitsize of the matrix' coefficients.}$

- `template<> size_t bitsize< Givaro::ZRing< Givaro::Integer > > (const Givaro::ZRing< Givaro::Integer > &F, size_t M, size_t N, const Givaro::Integer *A, size_t lda)`
- `template<class Field >`
`void ftrmv (const Field &F, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr X, int incX)`

ftrsm: TRIangular Matrix Vector prodcut Computes $X \leftarrow \text{op}(A)X$

17.109.1 Macro Definition Documentation

17.109.1.1 __FFLASFFPACK_fflas_fflas_level2_INL

```
#define __FFLASFFPACK_fflas_fflas_level2_INL
```

17.110 fflas_level3.inl File Reference

```
#include "fflas_bounds.inl"
#include "fflas_helpers.inl"
#include "fflas-ffpack/paladin/parallel.h"
```

Namespaces

- namespace `FFLAS`
- namespace `FFLAS::Protected`

Macros

- `#define __FFLASFFPACK_fflas_fflas_level3_INL`
- `#define __FFLAS__TRSM_READONLY`

Functions

- `template<class Field >`
`void MatF2MatD_Triangular (const Field &F, Givaro::DoubleDomain::Element_ptr S, const size_t lds, typename Field::ConstElement_ptr const E, const size_t lde, const size_t m, const size_t n)`
- `template<class Field >`
`void MatF2MatFI_Triangular (const Field &F, Givaro::FloatDomain::Element_ptr S, const size_t lds, typename Field::ConstElement_ptr const E, const size_t lde, const size_t m, const size_t n)`
- `template<class Field >`
`void ftrsm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)`
ftrsm: TRIangular System solve with Matrix.
- `template<class Field >`
`void ftrmm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb)`
ftrmm: TRIangular Matrix Multiply.
- `template<class Field >`
`void ftrmm (const Field &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)`

ftmrm: TRIangular Matrix Multiply with 3 operands Computes $C \leftarrow \alpha \text{op}(A)B + \text{beta}C$ or $C \leftarrow \alpha B \text{op}(A) + \text{beta}C$.

- template<class Field >
Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)
fsyrk: Symmetric Rank K update
- template<class Field >
Field::Element_ptr fsyr2k (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)
fsyr2k: Symmetric Rank 2K update
- template<class Field >
Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::ConstElement_ptr D, const size_t incD, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const size_t threshold=__FFLASFFPACK_FSYRK_THRESHOLD)
fsyrk: Symmetric Rank K update with diagonal scaling
- template<class Field >
Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t N, const size_t K, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::ConstElement_ptr D, const size_t incD, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const ParSeqHelper::Sequential seq, const size_t threshold)
- template<class Field , class Cut , class Param >
Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t N, const size_t K, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::ConstElement_ptr D, const size_t incD, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const ParSeqHelper::Parallel< Cut, Param > par, const size_t threshold)
- template<class Field >
Field::Element_ptr fsyrk (const Field &F, const FFLAS_UPLO UpLo, const FFLAS_TRANSPOSE trans, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename Field::ConstElement_ptr D, const size_t incD, const std::vector< bool > &two← Block, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const size_t threshold=__FFLASFFPACK_FSYRK_THRESHOLD)
fsyrk: Symmetric Rank K update with diagonal scaling
- template<typename Field >
Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc)
fgemm: Field GENeral Matrix Multiply.
- template<typename Field >
Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const ParSeqHelper::← Sequential seq)
- template<typename Field , class Cut , class Param >
Field::Element_ptr fgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr C, const size_t ldc, const ParSeqHelper::← Parallel< Cut, Param > par)
- template<typename Field >
Field::Element_ptr pfgemm (const Field &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename Field::Element alpha, typename

`Field::ConstElement_ptr A`, `const size_t lda`, `typename Field::ConstElement_ptr B`, `const size_t ldb`, `const typename Field::Element beta`, `typename Field::Element_ptr C`, `const size_t ldc`, `size_t numthreads=0`)

- `template<class Field >`
`Field::Element * pfgemm_1D_rec` (`const Field &F`, `const FFLAS_TRANSPOSE ta`, `const FFLAS_TRANSPOSE tb`, `const size_t m`, `const size_t n`, `const size_t k`, `const typename Field::Element alpha`, `const typename Field::Element_ptr A`, `const size_t lda`, `const typename Field::Element_ptr B`, `const size_t ldb`, `const typename Field::Element beta`, `typename Field::Element *C`, `const size_t ldc`, `size_t seuil`)
- `template<class Field >`
`Field::Element * pfgemm_2D_rec` (`const Field &F`, `const FFLAS_TRANSPOSE ta`, `const FFLAS_TRANSPOSE tb`, `const size_t m`, `const size_t n`, `const size_t k`, `const typename Field::Element alpha`, `const typename Field::Element_ptr A`, `const size_t lda`, `const typename Field::Element_ptr B`, `const size_t ldb`, `const typename Field::Element beta`, `typename Field::Element *C`, `const size_t ldc`, `size_t seuil`)
- `template<class Field >`
`Field::Element * pfgemm_3D_rec` (`const Field &F`, `const FFLAS_TRANSPOSE ta`, `const FFLAS_TRANSPOSE tb`, `const size_t m`, `const size_t n`, `const size_t k`, `const typename Field::Element alpha`, `const typename Field::Element_ptr A`, `const size_t lda`, `const typename Field::Element_ptr B`, `const size_t ldb`, `const typename Field::Element beta`, `typename Field::Element_ptr C`, `const size_t ldc`, `size_t seuil`, `size_t *x`)
- `template<class Field >`
`Field::Element_ptr pfgemm_3D_rec2` (`const Field &F`, `const FFLAS_TRANSPOSE ta`, `const FFLAS_TRANSPOSE tb`, `const size_t m`, `const size_t n`, `const size_t k`, `const typename Field::Element alpha`, `const typename Field::Element_ptr A`, `const size_t lda`, `const typename Field::Element_ptr B`, `const size_t ldb`, `const typename Field::Element beta`, `typename Field::Element_ptr C`, `const size_t ldc`, `size_t seuil`, `size_t *x`)
- `template<class Field >`
`Field::Element_ptr fsquare` (`const Field &F`, `const FFLAS_TRANSPOSE ta`, `const size_t n`, `const typename Field::Element alpha`, `typename Field::ConstElement_ptr A`, `const size_t lda`, `const typename Field::Element beta`, `typename Field::Element_ptr C`, `const size_t ldc`)

fsquare: Squares a matrix.

17.110.1 Macro Definition Documentation

17.110.1.1 __FFLASFFPACK_fflas_fflas_level3_INL

```
#define __FFLASFFPACK_fflas_fflas_level3_INL
```

17.110.1.2 __FFLAS__TRSM_READONLY

```
#define __FFLAS__TRSM_READONLY
```

17.111 fflas_pfgemm.inl File Reference

```
#include "fflas-ffpack/paladin/blockcuts.inl"
#include "fflas-ffpack/paladin/parallel.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/paladin/pfgemm_variants.inl"
```

Namespaces

- namespace `FFLAS`

Macros

- `#define __FFLASFFPACK_fflas_pfgemm_INL`
- `#define __FFLASFFPACK_SEQPARTHRESHOLD 220`
- `#define __FFLASFFPACK_DIMKPENALTY 1`

Functions

- `template<class Field, class ModeTrait, class Strat, class Param>
std::enable_if<!std::is_same< ModeTrait, ModeCategories::ConvertTo< ElementCategories::RNSElement↵
Tag > >::value, typename Field::Element_ptr >::type fgemm (const Field &F, const FFLAS::FFLAS_TRANSPOSE
ta, const FFLAS::FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const
typename Field::Element alpha, typename Field::ConstElement_ptr A, const size_t lda, typename
Field::ConstElement_ptr B, const size_t ldb, const typename Field::Element beta, typename Field::Element_ptr
C, const size_t ldc, MMHelper< Field, MMHelperAlgo::Winograd, ModeTrait, ParSeqHelper::Parallel< Strat,
Param > > &H)`

17.111.1 Macro Definition Documentation

17.111.1.1 __FFLASFFPACK_fflas_pfgemm_INL

```
#define __FFLASFFPACK_fflas_pfgemm_INL
```

17.111.1.2 __FFLASFFPACK_SEQPARTHRESHOLD

```
#define __FFLASFFPACK_SEQPARTHRESHOLD 220
```

17.111.1.3 __FFLASFFPACK_DIMKPENALTY

```
#define __FFLASFFPACK_DIMKPENALTY 1
```

17.112 fflas_pftsm.inl File Reference

```
#include "fflas-ffpack/paladin/parallel.h"
```

Namespaces

- namespace [FFLAS](#)

Macros

- `#define __FFLASFFPACK_fflas_pftsm_INL`
- `#define PTRSM_HYBRID_THRESHOLD 256`

Functions

- `template<class Field, class Cut, class Param>
Field::Element_ptr ftrsm (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_UPLO
UpLo, const FFLAS::FFLAS_TRANSPOSE TA, const FFLAS::FFLAS_DIAG Diag, const size_t m, const
size_t n, const typename Field::Element alpha, typename Field::Element_ptr A, const size_t lda, typename
Field::Element_ptr B, const size_t ldb, TRSMHelper< StructureHelper::Iterative, ParSeqHelper::Parallel<
Cut, Param > > &H)`

- template<class [Field](#) , class Cut , class Param >
[Field::Element_ptr](#) ftrsm (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const [FFLAS::FFLAS_UPLO](#) UpLo, const [FFLAS::FFLAS_TRANSPOSE](#) TA, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t m, const size_t n, const typename [Field::Element](#) alpha, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb, TRSMHelper< StructureHelper::Hybrid, ParSeqHelper::Parallel< Cut, Param > > &H)

17.112.1 Macro Definition Documentation

17.112.1.1 __FFLASFFPACK_fflas_pftrsm_INL

```
#define __FFLASFFPACK_fflas_pftrsm_INL
```

17.112.1.2 PTRSM_HYBRID_THRESHOLD

```
#define PTRSM_HYBRID_THRESHOLD 256
```

17.113 fflas_simd.h File Reference

```
#include "fflas-ffpack/utils/fflas_intrinsic.h"
#include <iostream>
#include <type_traits>
#include <limits>
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/debug.h"
#include <fflas-ffpack/fflas/fflas_simd/simd_modular.inl>
```

Data Structures

- struct [support_simd](#)< T >
- struct [is_simd](#)< T >
- struct [NoSimd](#)< T >
- struct [SimdChooser](#)< T, bool, bool >
- struct [SimdChooser](#)< T, false, b >
- struct [SimdChooser](#)< T, true, false >
- struct [SimdChooser](#)< T, true, true >

Namespaces

- namespace [FFLAS](#)

Macros

- #define [SIMD_INT](#) 1
- #define [INLINE](#) inline
- #define [CONST](#)
- #define [PURE](#)
- #define [NORML_MOD](#)(C, P, NEGP, MIN, MAX, Q, T)
- #define [FLOAT_MOD](#)(C, P, INVP, Q)

Typedefs

- template<class T >
using [Simd](#) = typename [SimdChooser](#)< T >::value

17.113.1 Macro Definition Documentation

17.113.1.1 SIMD_INT

```
#define SIMD_INT 1
```

17.113.1.2 INLINE

```
#define INLINE inline
```

17.113.1.3 CONST

```
#define CONST
```

17.113.1.4 PURE

```
#define PURE
```

17.113.1.5 NORML_MOD

```
#define NORML_MOD(  
    C,  
    P,  
    NEGP,  
    MIN,  
    MAX,  
    Q,  
    T )
```

Value:

```
{  
    Q = greater(C, MAX);  
    T = lesser(C, MIN);  
    Q = vand(Q, NEGP);  
    T = vand(T, P);  
    Q = vor(Q, T);  
    C = add(C, Q);  
}
```

17.113.1.6 FLOAT_MOD

```
#define FLOAT_MOD(  
    C,  
    P,  
    INV_P,  
    Q )
```

Value:

```
{  
    Q = mul(C, INV_P);  
    Q = floor(Q);  
}
```



```

    C = fnmadd(C, Q, P);
}

```

17.113.2 Typedef Documentation

17.113.2.1 Simd

```
using Simd = typename SimdChooser<T>::value
```

17.114 simd.dox File Reference

17.115 simd128.inl File Reference

```

#include "simd128_float.inl"
#include "simd128_double.inl"

```

Data Structures

- struct [Simd128fp_base](#)
- struct [Simd128i_base](#)

Macros

- #define [__FFLASFFPACK_fflas_ffpack_utils_simd128_INL](#)

Typedefs

- template<class T>
using [Simd128](#) = [Simd128_impl](#)< std::is_arithmetic< T >::value, std::is_integral< T >::value, std::is_↵
signed< T >::value, sizeof(T)>

17.115.1 Macro Definition Documentation

17.115.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_INL
```

17.115.2 Typedef Documentation

17.115.2.1 Simd128

```
using Simd128 = Simd128_impl<std::is_arithmetic<T>::value, std::is_integral<T>::value, std↵  
::is_signed<T>::value, sizeof(T)>
```

17.116 simd128_double.inl File Reference

Data Structures

- struct [Simd128_impl](#)< true, false, true, 8 >

Macros

- [#define __FFLASFFPACK_fflas_ffpack_utils_simd128_double_INL](#)

17.116.1 Macro Definition Documentation

17.116.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_double_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_double_INL
```

17.117 simd128_float.inl File Reference

Data Structures

- struct [Simd128_impl](#)< true, false, true, 4 >

Macros

- [#define __FFLASFFPACK_fflas_ffpack_utils_simd128_float_INL](#)

17.117.1 Macro Definition Documentation

17.117.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_float_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_float_INL
```

17.118 simd128_int16.inl File Reference

Data Structures

- struct [Simd128_impl](#)< true, true, true, 2 >
- union [Simd128_impl](#)< true, true, true, 2 >::Converter
- struct [Simd128_impl](#)< true, true, false, 2 >
- union [Simd128_impl](#)< true, true, false, 2 >::Converter

Macros

- [#define __FFLASFFPACK_fflas_ffpack_utils_simd128_int16_INL](#)

17.118.1 Macro Definition Documentation

17.118.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_int16_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_int16_INL
```

17.119 simd128_int32.inl File Reference

Data Structures

- struct [Simd128_impl](#)< true, true, true, 4 >
- union [Simd128_impl](#)< true, true, true, 4 >::Converter

- struct [Simd128_impl< true, true, false, 4 >](#)
- union [Simd128_impl< true, true, false, 4 >::Converter](#)

Macros

- `#define __FFLASFFPACK_fflas_ffpack_utils_simd128_int32_INL`

17.119.1 Macro Definition Documentation

17.119.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_int32_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_int32_INL
```

17.120 simd128_int64.inl File Reference

Data Structures

- struct [Simd128_impl< true, true, true, 8 >](#)
- union [Simd128_impl< true, true, true, 8 >::Converter](#)
- struct [Simd128_impl< true, true, false, 8 >](#)
- union [Simd128_impl< true, true, false, 8 >::Converter](#)

Macros

- `#define __FFLASFFPACK_fflas_ffpack_utils_simd128_int64_INL`
- `#define vect_t Simd128_impl<true,true,true,8>::vect_t`

17.120.1 Macro Definition Documentation

17.120.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd128_int64_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd128_int64_INL
```

17.120.1.2 vect_t

```
#define vect_t Simd128_impl<true,true,true,8>::vect_t
```

17.121 simd256.inl File Reference

```
#include "simd256_float.inl"
#include "simd256_double.inl"
```

Data Structures

- struct [Simd256fp_base](#)
- struct [Simd256i_base](#)

Macros

- `#define __FFLASFFPACK_fflas_ffpack_utils_simd256_INL`

Typedefs

- `template<class T>`
`using Simd256 = Simd256_impl< std::is_arithmetic< T >::value, std::is_integral< T >::value, std::is_`
`signed< T >::value, sizeof(T)>`

17.121.1 Macro Definition Documentation

17.121.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_INL
```

17.121.2 Typedef Documentation

17.121.2.1 Simd256

```
using Simd256 = Simd256_impl<std::is_arithmetic<T>::value, std::is_integral<T>::value, std::is_
```

```
::is_signed<T>::value, sizeof(T)>
```

17.122 simd256_double.inl File Reference

Data Structures

- struct `Simd256_impl< true, false, true, 8 >`

Macros

- `#define __FFLASFFPACK_fflas_ffpack_utils_simd256_double_INL`

17.122.1 Macro Definition Documentation

17.122.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_double_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_double_INL
```

17.123 simd256_float.inl File Reference

Data Structures

- struct `Simd256_impl< true, false, true, 4 >`

Macros

- `#define __FFLASFFPACK_fflas_ffpack_utils_simd256_float_INL`

17.123.1 Macro Definition Documentation

17.123.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_float_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_float_INL
```

17.124 simd256_int16.inl File Reference

Data Structures

- struct [Simd256_impl](#)< true, true, true, 2 >
- union [Simd256_impl](#)< true, true, true, 2 >::Converter
- struct [Simd256_impl](#)< true, true, false, 2 >
- union [Simd256_impl](#)< true, true, false, 2 >::Converter

Macros

- #define [__FFLASFFPACK_fflas_ffpack_utils_simd256_int16_INL](#)

17.124.1 Macro Definition Documentation

17.124.1.1 [__FFLASFFPACK_fflas_ffpack_utils_simd256_int16_INL](#)

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_int16_INL
```

17.125 simd256_int32.inl File Reference

Data Structures

- struct [Simd256_impl](#)< true, true, true, 4 >
- union [Simd256_impl](#)< true, true, true, 4 >::Converter
- struct [Simd256_impl](#)< true, true, false, 4 >
- union [Simd256_impl](#)< true, true, false, 4 >::Converter

Macros

- #define [__FFLASFFPACK_fflas_ffpack_utils_simd256_int32_INL](#)

17.125.1 Macro Definition Documentation

17.125.1.1 [__FFLASFFPACK_fflas_ffpack_utils_simd256_int32_INL](#)

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_int32_INL
```

17.126 simd256_int64.inl File Reference

Data Structures

- struct [Simd256_impl](#)< true, true, true, 8 >
- union [Simd256_impl](#)< true, true, true, 8 >::Converter
- struct [Simd256_impl](#)< true, true, false, 8 >
- union [Simd256_impl](#)< true, true, false, 8 >::Converter

Macros

- #define [__FFLASFFPACK_fflas_ffpack_utils_simd256_int64_INL](#)
- #define [vect_t](#) [Simd256_impl](#)<true, true, true, 8>::vect_t

17.126.1 Macro Definition Documentation

17.126.1.1 __FFLASFFPACK_fflas_ffpack_utils_simd256_int64_INL

```
#define __FFLASFFPACK_fflas_ffpack_utils_simd256_int64_INL
```

17.126.1.2 vect_t

```
#define vect_t Simd256_impl<true, true, true, 8>::vect_t
```

17.127 simd512.inl File Reference

```
#include "simd512_float.inl"
#include "simd512_double.inl"
#include "simd512_int64.inl"
```

Data Structures

- struct [Simd512fp_base](#)
- struct [Simd512i_base](#)

Macros

- #define [__FFLASFFPACK_simd512_INL](#)

Typedefs

- template<class T >
using [Simd512](#) = [Simd512_impl](#)< std::is_arithmetic< T >::value, std::is_integral< T >::value, std::is_↵
signed< T >::value, sizeof(T)>

17.127.1 Macro Definition Documentation

17.127.1.1 __FFLASFFPACK_simd512_INL

```
#define __FFLASFFPACK_simd512_INL
```

17.127.2 Typedef Documentation

17.127.2.1 Simd512

```
using Simd512 = Simd512\_impl<std::is_arithmetic<T>::value, std::is_integral<T>::value, std↵  
::is_signed<T>::value, sizeof(T)>
```

17.128 simd512_double.inl File Reference

Data Structures

- struct [Simd512_impl](#)< true, false, true, 8 >

Macros

- `#define __FFLASFFPACK_simd512_double_INL`

17.128.1 Macro Definition Documentation

17.128.1.1 __FFLASFFPACK_simd512_double_INL

```
#define __FFLASFFPACK_simd512_double_INL
```

17.129 simd512_float.inl File Reference

Data Structures

- struct [Simd512_impl](#)< true, false, true, 4 >

Macros

- `#define __FFLASFFPACK_simd512_float_INL`

17.129.1 Macro Definition Documentation

17.129.1.1 __FFLASFFPACK_simd512_float_INL

```
#define __FFLASFFPACK_simd512_float_INL
```

17.130 simd512_int32.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_simd/simd512_int64.inl"
```

Data Structures

- struct [Simd256_impl](#)< true, true, true, 4 >
- union [Simd256_impl](#)< true, true, true, 4 >::Converter
- struct [Simd256_impl](#)< true, true, false, 4 >
- union [Simd256_impl](#)< true, true, false, 4 >::Converter

Macros

- `#define __FFLASFFPACK_simd512_int32_INL`

17.130.1 Macro Definition Documentation

17.130.1.1 __FFLASFFPACK_simd512_int32_INL

```
#define __FFLASFFPACK_simd512_int32_INL
```

17.131 simd512_int64.inl File Reference

Data Structures

- struct [Simd512_impl](#)< true, true, true, 8 >
- union [Simd512_impl](#)< true, true, true, 8 >::Converter
- struct [Simd512_impl](#)< true, true, false, 8 >
- union [Simd512_impl](#)< true, true, false, 8 >::Converter

Macros

- `#define` [_simd512_int64_INL](#)
- `#define` [vect_t](#) [Simd512_impl](#)<true, true, true, 8>::vect_t

17.131.1 Macro Definition Documentation

17.131.1.1 _simd512_int64_INL

```
#define _simd512_int64_INL
```

17.131.1.2 vect_t

```
#define vect_t Simd512_impl<true, true, true, 8>::vect_t
```

17.132 simd_modular.inl File Reference

Data Structures

- class [FieldSimd](#)< [_Field](#) >

17.133 fflas_sparse.h File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/config.h"
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/paladin/parallel.h"
#include <recint/recint.h>
#include <givaro/udl.h>
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/field/field-traits.h"
#include "fflas-ffpack/fflas/fflas_bounds.inl"
#include "fflas-ffpack/utils/fflas_memory.h"
#include <type_traits>
#include <vector>
#include <iostream>
#include "fflas-ffpack/fflas/fflas_sparse/sparse_matrix_traits.h"
#include "fflas-ffpack/fflas/fflas_sparse/utils.h"
#include "fflas-ffpack/fflas/fflas_sparse/csr.h"
#include "fflas-ffpack/fflas/fflas_sparse/coo.h"
#include "fflas-ffpack/fflas/fflas_sparse/ell.h"
#include "fflas-ffpack/fflas/fflas_sparse/sell.h"
#include "fflas-ffpack/fflas/fflas_sparse/csr_hyb.h"
#include "fflas-ffpack/fflas/fflas_sparse/ell_simd.h"
#include "fflas-ffpack/fflas/fflas_sparse/hyb_zo.h"
```



```
#include "fflas-ffpack/fflas/fflas_sparse.inl"
#include "fflas-ffpack/fflas/fflas_sparse/read_sparse.h"
```

Data Structures

- struct [HelperFlag](#)
- struct [CsrMat< Field >](#)
- struct [CooMat< Field >](#)
- struct [EllMat< Field >](#)
- struct [SpMat< Field, flag >](#)

Namespaces

- namespace [MKL_CONFIG](#)
- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details](#)

Macros

- [#define index_t uint32_t](#)
- [#define ROUND_DOWN\(x, s\) \(\(x\) & ~\(\(s\)-1\)\)](#)
- [#define __FFLASFFPACK_CACHE_LINE_SIZE 64](#)
- [#define assume_aligned\(pout, pin, v\) decltype\(pin\) pout = pin;](#)
- [#define DENSE_THRESHOLD 0.5](#)

Enumerations

- enum class [SparseMatrix_t](#) {
[CSR](#) , [CSR_ZO](#) , [CSC](#) , [CSC_ZO](#) ,
[COO](#) , [COO_ZO](#) , [ELL](#) , [ELL_ZO](#) ,
[SELL](#) , [SELL_ZO](#) , [ELL_simd](#) , [ELL_simd_ZO](#) ,
[CSR_HYB](#) , [HYB_ZO](#) }

Functions

- [template<class Field >](#)
[void init_y](#) (const [Field](#) &F, const size_t m, const typename [Field::Element](#) b, typename [Field::Element_ptr](#) y)
- [template<class Field >](#)
[void init_y](#) (const [Field](#) &F, const size_t m, const size_t n, const typename [Field::Element](#) b, typename [Field::Element_ptr](#) y, const int ldy)
- [template<class Field , class SM , class FC , class MZO >](#)
[std::enable_if<!std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloatTag >::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value>::type fspmv_dispatch](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FC fc, MZO mzo)
- [template<class Field , class SM , class FC , class MZO >](#)
[std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloatTag >::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value >::type fspmv_dispatch](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FC fc, MZO mzo)
- [template<class Field , class SM >](#)
[void fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FieldCategories::GenericTag, NotZOSparseMatrix)
- [template<class Field , class SM >](#)
[std::enable_if< !isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FieldCategories::UnparametricTag, NotZOSparseMatrix)

- `template<class Field, class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM`
`&A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::Unparametric←`
`Tag, NotZOSparseMatrix)`
- `template<class Field, class SM >`
`std::enable_if< !isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM`
`&A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag,`
`NotZOSparseMatrix)`
- `template<class Field, class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM &A,`
`typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, Not←`
`ZOSparseMatrix)`
- `template<class Field, class SM >`
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr`
`y, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field, class SM >`
`std::enable_if< !isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM`
`&A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::Unparametric←`
`Tag, ZOSparseMatrix)`
- `template<class Field, class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value >::type fspmv (const Field &F, const SM`
`&A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::Unparametric←`
`Tag, ZOSparseMatrix)`
- `template<class Field, class SM >`
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr`
`y, FieldCategories::ModularTag, std::true_type)`
- `template<class Field, class SM, class FCat, class MZO >`
`std::enable_if< !(std::is_same< typenameElementTraits< typenameField::Element >::value, Element←`
`Categories::MachineFloatTag >::value || std::is_same< typenameElementTraits< typenameField::Element`
`>::value, ElementCategories::MachineIntTag >::value) >::type fspmm_dispatch (const Field &F, const SM`
`&A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy,`
`FCat, MZO)`
- `template<class Field, class SM, class FCat, class MZO >`
`std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, Element←`
`Categories::MachineFloatTag >::value || std::is_same< typenameElementTraits< typenameField::Element`
`>::value, ElementCategories::MachineIntTag >::value >::type fspmm_dispatch (const Field &F, const SM`
`&A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy,`
`FCat, MZO)`
- `template<class Field, class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx,`
`typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field, class SM >`
`std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM`
`&A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy,`
`FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field, class SM >`
`std::enable_if< !support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM`
`&A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy,`
`FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field, class SM >`
`std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM`
`&A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy,`
`FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field, class SM >`
`std::enable_if< !support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM`
`&A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy,`
`FieldCategories::ModularTag, NotZOSparseMatrix)`

- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int Idx, typename Field::Element_ptr y, int Idy, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int Idx, typename Field::Element_ptr y, int Idy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if<!support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int Idx, typename Field::Element_ptr y, int Idy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int Idx, typename Field::Element_ptr y, int Idy, FieldCategories::ModularTag, ZOSparseMatrix)`
- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if<!(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloatTag >::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value)>::type pfspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int Idx, typename Field::Element_ptr y, int Idy, FCat, MZO)`
- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloatTag >::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value >::type pfspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int Idx, typename Field::Element_ptr y, int Idy, FCat, MZO)`
- `template<class Field , class SM >`
`void pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int Idx, typename Field::Element_ptr y, int Idy, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int Idx, typename Field::Element_ptr y, int Idy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if<!support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int Idx, typename Field::Element_ptr y, int Idy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int Idx, typename Field::Element_ptr y, int Idy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if<!support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int Idx, typename Field::Element_ptr y, int Idy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`void pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int Idx, typename Field::Element_ptr y, int Idy, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int Idx, typename Field::Element_ptr y, int Idy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if<!support_simd< typenameField::Element >::value >::type pfspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int Idx, typename Field::Element_ptr y, int Idy, FieldCategories::UnparametricTag, ZOSparseMatrix)`

- `template<class Field, class SM >`
`void pfsppmv (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, ZOSparseMatrix)`
- `template<class Field, class SM >`
`void pfsppmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, std::false_type)`
- `template<class Field, class SM >`
`void pfsppmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, std::false_type)`
- `template<class Field, class SM >`
`void pfsppmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, std::false_type)`
- `template<class Field, class SM >`
`void pfsppmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag, std::true_type)`
- `template<class Field, class SM >`
`void pfsppmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, std::true_type)`
- `template<class Field, class SM >`
`void pfsppmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, std::true_type)`
- `template<class Field, class SM >`
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, const typename Field::Element &beta, typename Field::Element_ptr y)`
- `template<class Field, class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, const typename Field::Element &beta, typename Field::Element_ptr y, int ldy)`

17.133.1 Macro Definition Documentation

17.133.1.1 index_t

```
#define index_t uint32_t
```

17.133.1.2 ROUND_DOWN

```
#define ROUND_DOWN(  
    x,  
    s ) ((x) & ~((s)-1))
```

17.133.1.3 __FFLASFFPACK_CACHE_LINE_SIZE

```
#define __FFLASFFPACK_CACHE_LINE_SIZE 64
```

17.133.1.4 assume_aligned

```
#define assume_aligned(  
    pout,  
    pin,  
    v ) decltype(pin) pout = pin;
```

17.133.1.5 DENSE_THRESHOLD

```
#define DENSE_THRESHOLD 0.5
```

17.134 fflas_sparse.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details](#)

Macros

- #define [__FFLASFFPACK_fflas_fflas_sparse_INL](#)

Functions

- template<class [Field](#) >
void [init_y](#) (const [Field](#) &F, const size_t m, const typename [Field::Element](#) b, typename [Field::Element_ptr](#) y)
- template<class [Field](#) >
void [init_y](#) (const [Field](#) &F, const size_t m, const size_t n, const typename [Field::Element](#) b, typename [Field::Element_ptr](#) y, const int ldy)
- template<class [Field](#) , class SM , class FC , class MZO >
std::enable_if<!(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloatTag >::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value)>::type [fspmv_dispatch](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FC fc, MZO mzo)
- template<class [Field](#) , class SM , class FC , class MZO >
std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloatTag >::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value >::type [fspmv_dispatch](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FC fc, MZO mzo)
- template<class [Field](#) , class SM >
void [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FieldCategories::GenericTag, NotZOSparseMatrix)
- template<class [Field](#) , class SM >
std::enable_if<lisSparseMatrixSimdFormat< [Field](#), SM >::value >::type [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FieldCategories::UnparametricTag, NotZOSparseMatrix)
- template<class [Field](#) , class SM >
std::enable_if< isSparseMatrixSimdFormat< [Field](#), SM >::value &&support_simd< typenameField::Element >::value >::type [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FieldCategories::UnparametricTag, NotZOSparseMatrix)
- template<class [Field](#) , class SM >
std::enable_if<lisSparseMatrixSimdFormat< [Field](#), SM >::value >::type [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FieldCategories::ModularTag, NotZOSparseMatrix)
- template<class [Field](#) , class SM >
std::enable_if< isSparseMatrixSimdFormat< [Field](#), SM >::value &&support_simd< typenameField::Element >::value >::type [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FieldCategories::ModularTag, NotZOSparseMatrix)
- template<class [Field](#) , class SM >
void [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FieldCategories::GenericTag, ZOSparseMatrix)
- template<class [Field](#) , class SM >
std::enable_if<lisSparseMatrixSimdFormat< [Field](#), SM >::value >::type [fspmv](#) (const [Field](#) &F, const SM &A, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, FieldCategories::UnparametricTag, ZOSparseMatrix)

- `template<class Field , class SM >`
`std::enable_if< isSparseMatrixSimdFormat< Field, SM >::value &&support_simd< typenameField::Element >::value >::type fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag, std::true_type)`
- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if<!(std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloatTag >::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value)>::type fspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field , class SM , class FCat , class MZO >`
`std::enable_if< std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineFloatTag >::value||std::is_same< typenameElementTraits< typenameField::Element >::value, ElementCategories::MachineIntTag >::value >::type fspmm_dispatch (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FCat, MZO)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if<!support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if<!support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, NotZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if< support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`std::enable_if<!support_simd< typenameField::Element >::value >::type fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::ModularTag, ZOSparseMatrix)`
- `template<class Field , class SM >`
`void fspmv (const Field &F, const SM &A, typename Field::ConstElement_ptr x, const typename Field::Element &beta, typename Field::Element_ptr y)`
- `template<class Field , class SM >`
`void fspmm (const Field &F, const SM &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, const typename Field::Element &beta, typename Field::Element_ptr y, int ldy)`

17.134.1 Macro Definition Documentation

17.134.1.1 __FFLASFFPACK_fflas_fflas_sparse_INL

```
#define __FFLASFFPACK_fflas_fflas_sparse_INL
```

17.135 coo.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/coo/coo_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/coo/coo_spmv.inl"
#include "fflas-ffpack/fflas/fflas_sparse/coo/coo_spm্ম.inl"
```

Data Structures

- struct [Sparse< _Field, SparseMatrix_t::COO >](#)
- struct [Sparse< _Field, SparseMatrix_t::COO_ZO >](#)

Namespaces

- namespace [FFLAS](#)

Functions

- template<class [Field](#) , class IndexT >
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::COO > &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class [Field](#) , class IndexT >
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::COO_ZO > &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class [Field](#) >
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::COO > &A)
- template<class [Field](#) >
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::COO_ZO > &A)

17.136 coo_spmmm.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details_impl](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_coo_spmmm_INL](#)

Functions

- template<class [Field](#) >
void [fspmm](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::COO > &A, size_t blockSize, typename [Field::ConstElement_ptr](#) x_, int ldx, typename [Field::Element_ptr](#) y_, int ldy, FieldCategories::GenericTag)
- template<class [Field](#) >
void [fspmm](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::COO > &A, size_t blockSize, typename [Field::ConstElement_ptr](#) x_, int ldx, typename [Field::Element_ptr](#) y_, int ldy, FieldCategories::UnparametricTag)

- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`
`void fspmm_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`
`void fspmm_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm_one_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_one_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::COO_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`

17.136.1 Macro Definition Documentation

17.136.1.1 __FFLASFFPACK_fflas_sparse_coo_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_coo_spmv_INL
```

17.137 coo_spmv.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details_impl](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_coo_spmv_INL](#)

Functions

- template<class [Field](#) >
void [fspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::COO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::GenericTag)
- template<class [Field](#) >
void [fspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::COO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::UnparametricTag)
- template<class [Field](#) >
void [fspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::COO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, const [uint64_t](#) kmax)
- template<class [Field](#) >
void [fspmv_one](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::COO_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::GenericTag)
- template<class [Field](#) >
void [fspmv_mone](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::COO_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::GenericTag)
- template<class [Field](#) >
void [fspmv_one](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::COO_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::UnparametricTag)
- template<class [Field](#) >
void [fspmv_mone](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::COO_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::UnparametricTag)

17.137.1 Macro Definition Documentation

17.137.1.1 __FFLASFFPACK_fflas_sparse_coo_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_coo_spmv_INL
```

17.138 coo_utils.inl File Reference

Namespaces

- namespace [FFLAS](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_coo_utils_INL](#)

Functions

- template<class [Field](#) >
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::COO > &A)
- template<class [Field](#) >
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::COO_ZO > &A)
- template<class [Field](#) , class IndexT >
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::COO > &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class [Field](#) , class IndexT >
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::COO_ZO > &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)

17.138.1 Macro Definition Documentation

17.138.1.1 __FFLASFFPACK_fflas_sparse_coo_utils_INL

```
#define __FFLASFFPACK_fflas_sparse_coo_utils_INL
```

17.139 csr.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/csr/csr_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/csr/csr_spmv.inl"
#include "fflas-ffpack/fflas/fflas_sparse/csr/csr_spmv.inl"
```

Data Structures

- struct [Sparse<_Field, SparseMatrix_t::CSR>](#)
- struct [Sparse<_Field, SparseMatrix_t::CSR_ZO>](#)

Namespaces

- namespace [FFLAS](#)

Functions

- template<class [Field](#), class IndexT>
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class [Field](#), class IndexT>
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class [Field](#)>
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::CSR > &A)
- template<class [Field](#)>
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::CSR_ZO > &A)

17.140 csr_pspmm.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details_impl](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_CSR_pspmm_INL](#)

Functions

- template<class [Field](#)>
void [pfspmm](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::CSR > &A, size_t blockSize, typename [Field::ConstElement_ptr](#) x_, int ldx, typename [Field::Element_ptr](#) y_, int ldy, FieldCategories::GenericTag)
- template<class [Field](#)>
void [pfspmm](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::CSR > &A, size_t blockSize, typename [Field::ConstElement_ptr](#) x_, int ldx, typename [Field::Element_ptr](#) y_, int ldy, FieldCategories::UnparametricTag)
- template<class [Field](#)>
void [pfspmm](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::CSR > &A, size_t blockSize, typename [Field::ConstElement_ptr](#) x_, int ldx, typename [Field::Element_ptr](#) y_, int ldy, const [int64_t](#) kmax)

- `template<class Field >`
`void pfpsmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize,`
`typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::↵`
`GenericTag)`
- `template<class Field >`
`void pfpsmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize,`
`typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::↵`
`GenericTag)`
- `template<class Field >`
`void pfpsmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize,`
`typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::↵`
`UnparametricTag)`
- `template<class Field >`
`void pfpsmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize,`
`typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::↵`
`UnparametricTag)`

17.140.1 Macro Definition Documentation

17.140.1.1 __FflasFFPACK_fflas_sparse_CSR_pspmm_INL

```
#define __FflasFFPACK_fflas_sparse_CSR_pspmm_INL
```

17.141 csr_pspmv.inl File Reference

```
#include <thread>
```

Namespaces

- namespace [Fflas](#)
- namespace [Fflas::sparse_details_impl](#)

Macros

- `#define __FflasFFPACK_fflas_sparse_CSR_pspmv_INL`

Functions

- `template<class Field >`
`void pfpsmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr`
`x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfpsmv_task (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const index_t iStart, const index_t iStop,`
`FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfpsmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr`
`x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfpsmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr`
`x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field >`
`void pfpsmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`

- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

17.141.1 Macro Definition Documentation

17.141.1.1 __FFLASFFPACK_fflas_sparse_CSR_pspmv_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_pspmv_INL
```

17.142 csr_spm.inl File Reference

Namespaces

- namespace `FFLAS`
- namespace `FFLAS::sparse_details_impl`

Macros

- `#define __FFLASFFPACK_fflas_sparse_CSR_spm_INL`

Functions

- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, index_t blockSize, typename Field::ConstElement_ptr x_, index_t ldx, typename Field::Element_ptr y_, index_t ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmm_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`

- `template<class Field >`
`void fspmm_one_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_one_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`

17.142.1 Macro Definition Documentation

17.142.1.1 __FFLASFFPACK_fflas_sparse_CSR_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_spmv_INL
```

17.143 csr_spmv.inl File Reference

Namespaces

- namespace `FFLAS`
- namespace `FFLAS::sparse_details_impl`

Macros

- `#define __FFLASFFPACK_fflas_sparse_CSR_spmv_INL`

Functions

- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

17.143.1 Macro Definition Documentation

17.143.1.1 __FFLASFFPACK_fflas_sparse_CSR_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_spmv_INL
```

17.144 csr_utils.inl File Reference

Namespaces

- namespace [FFLAS](#)

Functions

- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::CSR > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::CSR_ZO > &A)`
- `template<class Field >`
`std::ostream & sparse_print (std::ostream &os, const Sparse< Field, SparseMatrix_t::CSR > &A)`
- `template<class IndexT >`
`void sparse_init (const Givaro::Modular< Givaro::Integer > &F, Sparse< Givaro::Modular< Givaro::Integer >, SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT *col, Givaro::Integer *dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class IndexT >`
`void sparse_init (const Givaro::ZRing< Givaro::Integer > &F, Sparse< Givaro::ZRing< Givaro::Integer >, SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col, Givaro::Integer *dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class IndexT, size_t RECINT_SIZE>`
`void sparse_init (const Givaro::ZRing< RecInt::rmint< RECINT_SIZE > > &F, Sparse< Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >, SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col, typename Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >::Element_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class IndexT, size_t RECINT_SIZE>`
`void sparse_init (const Givaro::ZRing< RecInt::rmint< RECINT_SIZE > > &F, Sparse< Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >, SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT *col, typename Givaro::ZRing< RecInt::rmint< RECINT_SIZE > >::Element_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::CSR > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::CSR_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`

17.145 csr_hyb.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/csr_hyb/csr_hyb_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/csr_hyb/csr_hyb_spmv.inl"
#include "fflas-ffpack/fflas/fflas_sparse/csr_hyb/csr_hyb_spmmm.inl"
```

Data Structures

- struct [Sparse<_Field, SparseMatrix_t::CSR_HYB>](#)

Namespaces

- namespace [FFLAS](#)

Functions

- template<class [Field](#)>
void [sparse_delete](#) (const [Sparse<Field, SparseMatrix_t::CSR_HYB>](#) &A)
- template<class [Field](#), class [IndexT](#)>
void [sparse_init](#) (const [Field](#) &F, [Sparse<Field, SparseMatrix_t::CSR_HYB>](#) &A, const [IndexT](#) *row, const [IndexT](#) *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)

17.146 csr_hyb_pspmm.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details_impl](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_CSR_HYB_pspmm_INL](#)

Functions

- template<class [Field](#)>
void [pfpsmm](#) (const [Field](#) &F, const [Sparse<Field, SparseMatrix_t::CSR_HYB>](#) &A, [size_t](#) blockSize, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, [FieldCategories::GenericTag](#))
- template<class [Field](#)>
void [pfpsmm](#) (const [Field](#) &F, const [Sparse<Field, SparseMatrix_t::CSR_HYB>](#) &A, [size_t](#) blockSize, typename [Field::ConstElement_ptr](#) x, [int](#) ldx, typename [Field::Element_ptr](#) y, [int](#) ldy, [FieldCategories::GenericTag](#))
- template<class [Field](#)>
void [pfpsmm](#) (const [Field](#) &F, const [Sparse<Field, SparseMatrix_t::CSR_HYB>](#) &A, [size_t](#) blockSize, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, [FieldCategories::UnparametricTag](#))
- template<class [Field](#)>
void [pfpsmm](#) (const [Field](#) &F, const [Sparse<Field, SparseMatrix_t::CSR_HYB>](#) &A, [size_t](#) blockSize, typename [Field::ConstElement_ptr](#) x, [int](#) ldx, typename [Field::Element_ptr](#) y, [int](#) ldy, [FieldCategories::UnparametricTag](#))
- template<class [Field](#)>
void [pfpsmm](#) (const [Field](#) &F, const [Sparse<Field, SparseMatrix_t::CSR_HYB>](#) &A, [size_t](#) blockSize, typename [Field::ConstElement_ptr](#) x, typename [Field::Element_ptr](#) y, const [int64_t](#) kmax)
- template<class [Field](#)>
void [pfpsmm](#) (const [Field](#) &F, const [Sparse<Field, SparseMatrix_t::CSR_HYB>](#) &A, [size_t](#) blockSize, typename [Field::ConstElement_ptr](#) x, [int](#) ldx, typename [Field::Element_ptr](#) y, [int](#) ldy, const [int64_t](#) kmax)

17.146.1 Macro Definition Documentation

17.146.1.1 __FFLASFFPACK_fflas_sparse_CSR_HYB_pspmm_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_HYB_pspmm_INL
```

17.147 csr_hyb_pspmv.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_CSR_HYB_pspmv_INL`

Functions

- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`

17.147.1 Macro Definition Documentation

17.147.1.1 __FFLASFFPACK_fflas_sparse_CSR_HYB_pspmv_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_HYB_pspmv_INL
```

17.148 csr_hyb_spmv.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_CSR_HYB_spmv_INL`

Functions

- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::CSR_HYB > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`

17.148.1 Macro Definition Documentation

17.148.1.1 __FFLASFFPACK_fflas_sparse_CSR_HYB_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_HYB_spmv_INL
```

17.149 csr_hyb_spmv.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details_impl](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_CSR_HYB_spmv_INL](#)

Functions

- template<class [Field](#) >
void [fspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::CSR_HYB > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::GenericTag)
- template<class [Field](#) >
void [fspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::CSR_HYB > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::UnparametricTag)
- template<class [Field](#) >
void [fspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::CSR_HYB > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, const [uint64_t](#) kmax)

17.149.1 Macro Definition Documentation

17.149.1.1 __FFLASFFPACK_fflas_sparse_CSR_HYB_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_HYB_spmv_INL
```

17.150 csr_hyb_utils.inl File Reference

Data Structures

- struct [Info](#)
- struct [Coo](#)< [ValT](#), [IdxT](#) >

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::csr_hyb_details](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_CSR_HYB_utils_INL](#)

Functions

- template<class [Field](#) >
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::CSR_HYB > &A)
- template<class [Field](#) , class IndexT >
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::CSR_HYB > &A, const IndexT *row, const IndexT *col, typename [Field](#)::ConstElement_ptr dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)

17.150.1 Macro Definition Documentation

17.150.1.1 __FFLASFFPACK_fflas_sparse_CSR_HYB_utils_INL

```
#define __FFLASFFPACK_fflas_sparse_CSR_HYB_utils_INL
```

17.151 ell.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/ell/ell_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/ell/ell_spmv.inl"
#include "fflas-ffpack/fflas/fflas_sparse/ell/ell_spmv.inl"
```

Data Structures

- struct [Sparse< _Field, SparseMatrix_t::ELL >](#)
- struct [Sparse< _Field, SparseMatrix_t::ELL_ZO >](#)

Namespaces

- namespace [FFLAS](#)

Functions

- template<class [Field](#) , class IndexT >
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::ELL > &A, const IndexT *row, const IndexT *col, typename [Field](#)::ConstElement_ptr dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class [Field](#) , class IndexT >
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::ELL_ZO > &A, const IndexT *row, const IndexT *col, typename [Field](#)::ConstElement_ptr dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class [Field](#) >
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::ELL > &A)
- template<class [Field](#) >
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::ELL_ZO > &A)

17.152 ell_pspmm.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details_impl](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_ELL_pspmm_INL](#)

Functions

- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, const int64_t kmax)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, const int64_t kmax)`
- `template<class Field, class Func >`
`void pfspmm_zo (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, Func &&func)`
- `template<class Field, class Func >`
`void pfspmm_zo (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, Func &&func)`

17.152.1 Macro Definition Documentation

17.152.1.1 __FFLASFFPACK_fflas_sparse_ELL_pspmm_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_pspmm_INL
```

17.153 ell_pspmv.inl File Reference

Namespaces

- namespace `FFLAS`
- namespace `FFLAS::sparse_details_impl`

Macros

- `#define __FFLASFFPACK_fflas_sparse_ELL_pspmv_INL`

Functions

- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const int64_t kmax)`

- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

17.153.1 Macro Definition Documentation

17.153.1.1 __FFLASFFPACK_fflas_sparse_ELL_pspmv_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_pspmv_INL
```

17.154 ell_spmv.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_ELL_spmv_INL`

Functions

- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, const int64_t kmax)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::UnparametricTag)`

- `template<class Field >`
`void fspmm_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t blockSize,`
`typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, FieldCategories::↵`
`UnparametricTag)`
- `template<class Field >`
`void fspmm_one_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, size_t`
`blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy, Field↵`
`Categories::UnparametricTag)`
- `template<class Field >`
`void fspmm_one_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A,`
`size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_aligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A,`
`size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmm_mone_simd_unaligned (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A,`
`size_t blockSize, typename Field::ConstElement_ptr x_, int ldx, typename Field::Element_ptr y_, int ldy,`
`FieldCategories::UnparametricTag)`

17.154.1 Macro Definition Documentation

17.154.1.1 __FFLASFFPACK_fflas_sparse_ELL_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_spmv_INL
```

17.155 ell_spmv.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_ELL_spmv_INL`

Functions

- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr`
`x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr`
`x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::ELL > &A, typename Field::ConstElement_ptr`
`x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename`
`Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`

- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::ELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

17.155.1 Macro Definition Documentation

17.155.1.1 __FFLASFFPACK_fflas_sparse_ELL_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_spmv_INL
```

17.156 ell_utils.inl File Reference

```
#include <vector>
```

Namespaces

- namespace [FFLAS](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_ELL_utils_INL](#)

Functions

- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::ELL_ZO > &A)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::ELL_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`

17.156.1 Macro Definition Documentation

17.156.1.1 __FFLASFFPACK_fflas_sparse_ELL_utils_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_utils_INL
```

17.157 ell_simd.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/ell_simd/ell_simd_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/ell_simd/ell_simd_spmv.inl"
```

Data Structures

- struct [Sparse<_Field, SparseMatrix_t::ELL_simd>](#)
- struct [Sparse<_Field, SparseMatrix_t::ELL_simd_ZO>](#)

Namespaces

- namespace [FFLAS](#)

Functions

- template<class [Field](#), class IndexT>
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::ELL_simd > &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class [Field](#), class IndexT>
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::ELL_simd_ZO > &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class [Field](#)>
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::ELL_simd > &A)
- template<class [Field](#)>
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::ELL_simd_ZO > &A)

17.158 ell_simd_pspmv.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details_impl](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_ELL_simd_pspmv_INL](#)

Functions

- template<class [Field](#)>
void [pfspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::GenericTag)
- template<class [Field](#)>
void [pfspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::UnparametricTag)
- template<class [Field](#)>
void [pfspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, const [uint64_t](#) kmax)
- template<class [Field](#)>
void [pfspmv_one](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::GenericTag)
- template<class [Field](#)>
void [pfspmv_mone](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::GenericTag)
- template<class [Field](#)>
void [pfspmv_one](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::UnparametricTag)
- template<class [Field](#)>
void [pfspmv_mone](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::UnparametricTag)

17.158.1 Macro Definition Documentation

17.158.1.1 __FFLASFFPACK_fflas_sparse_ELL_simd_pspmv_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_simd_pspmv_INL
```

17.159 ell_simd_spmv.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details_impl](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_ELL_simd_spmv_INL](#)

Functions

- template<class [Field](#) >
void [fspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::GenericTag)
- template<class [Field](#) >
void [fspmv_simd](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::UnparametricTag)
- template<class [Field](#) >
void [fspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::UnparametricTag)
- template<class [Field](#) >
void [fspmv_simd](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, const [uint64_t](#) kmax)
- template<class [Field](#) >
void [fspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, const [uint64_t](#) kmax)
- template<class [Field](#) >
void [fspmv_one](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::GenericTag)
- template<class [Field](#) >
void [fspmv_mone](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::GenericTag)
- template<class [Field](#) >
void [fspmv_one](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::UnparametricTag)
- template<class [Field](#) >
void [fspmv_mone](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::UnparametricTag)
- template<class [Field](#) >
void [fspmv_one_simd](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::UnparametricTag)
- template<class [Field](#) >
void [fspmv_mone_simd](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::ELL_simd_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::UnparametricTag)

17.159.1 Macro Definition Documentation

17.159.1.1 __FFLASFFPACK_fflas_sparse_ELL_simd_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_ELL_simd_spmv_INL
```

17.160 ell_simd_utils.inl File Reference**Namespaces**

- namespace [FFLAS](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_ELL_simd_utils_INL](#)

Functions

- template<class [Field](#) >
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::ELL_simd > &A)
- template<class [Field](#) >
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::ELL_simd_ZO > &A)
- template<class [Field](#) >
void [sparse_print](#) (const Sparse< [Field](#), SparseMatrix_t::ELL_simd > &A)
- template<class [Field](#) , class IndexT >
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::ELL_simd > &A, const IndexT *row, const IndexT *col, typename [Field](#)::ConstElement_ptr dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<class [Field](#) , class IndexT >
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::ELL_simd_ZO > &A, const IndexT *row, const IndexT *col, typename [Field](#)::ConstElement_ptr dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)

17.160.1 Macro Definition Documentation**17.160.1.1 __FFLASFFPACK_fflas_sparse_ELL_simd_utils_INL**

```
#define __FFLASFFPACK_fflas_sparse_ELL_simd_utils_INL
```

17.161 hyb_zo.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/hyb_zo/hyb_zo_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/hyb_zo/hyb_zo_spmv.inl"
#include "fflas-ffpack/fflas/fflas_sparse/hyb_zo/hyb_zo_spmv.inl"
```

Data Structures

- struct [Sparse< _Field, SparseMatrix_t::HYB_ZO >](#)

Namespaces

- namespace [FFLAS](#)

17.162 hyb_zo_pspmm.inl File Reference**Namespaces**

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details_impl](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmm_INL`

Functions

- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize, type-`
`name Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize,`
`typename Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, FieldCategories::↵`
`UnparametricTag)`
- `template<class Field >`
`void pfspmm (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, size_t blockSize, type-`
`name Field::ConstElement_ptr x, int ldx, typename Field::Element_ptr y, int ldy, uint64_t kmax)`

17.162.1 Macro Definition Documentation

17.162.1.1 __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmm_INL

```
#define __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmm_INL
```

17.163 hyb_zo_pspmv.inl File Reference

Namespaces

- namespace `FFLAS`
- namespace `FFLAS::sparse_details_impl`

Macros

- `#define __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmv_INL`

Functions

- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename`
`Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::GenericTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename`
`Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void pfspmv (const Field &F, const Sparse< Field, SparseMatrix_t::HYB_ZO > &A, typename`
`Field::ConstElement_ptr x, typename Field::Element_ptr y, uint64_t kmax)`

17.163.1 Macro Definition Documentation

17.163.1.1 __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmv_INL

```
#define __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmv_INL
```

17.164 hyb_zo_spm্ম.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details_impl](#)

Macros

- `#define` [__FFLASFFPACK_fflas_sparse_HYB_ZO_spm্ম_INL](#)

Functions

- `template<class Field >`
void [fspmm](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::HYB_ZO > &A, size_t blockSize, typename [Field](#)::ConstElement_ptr x, int ldx, typename [Field](#)::Element_ptr y, int ldy, FieldCategories::GenericTag)
- `template<class Field >`
void [fspmm](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::HYB_ZO > &A, size_t blockSize, typename [Field](#)::ConstElement_ptr x, int ldx, typename [Field](#)::Element_ptr y, int ldy, FieldCategories::UnparametricTag)
- `template<class Field >`
void [fspmm](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::HYB_ZO > &A, size_t blockSize, typename [Field](#)::ConstElement_ptr x, int ldx, typename [Field](#)::Element_ptr y, int ldy, [uint64_t](#) kmax)

17.164.1 Macro Definition Documentation

17.164.1.1 [__FFLASFFPACK_fflas_sparse_HYB_ZO_spm্ম_INL](#)

```
#define __FFLASFFPACK_fflas_sparse_HYB_ZO_spm্ম_INL
```

17.165 hyb_zo_spmmv.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details_impl](#)

Macros

- `#define` [__FFLASFFPACK_fflas_sparse_HYB_ZO_spmmv_INL](#)

Functions

- `template<class Field >`
void [fspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::HYB_ZO > &A, typename [Field](#)::ConstElement_ptr x, typename [Field](#)::Element_ptr y, FieldCategories::GenericTag)
- `template<class Field >`
void [fspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::HYB_ZO > &A, typename [Field](#)::ConstElement_ptr x, typename [Field](#)::Element_ptr y, FieldCategories::UnparametricTag)
- `template<class Field >`
void [fspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::HYB_ZO > &A, typename [Field](#)::ConstElement_ptr x, typename [Field](#)::Element_ptr y, [uint64_t](#) kmax)

17.165.1 Macro Definition Documentation

17.165.1.1 __FFLASFFPACK_fflas_sparse_HYB_ZO_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_HYB_ZO_spmv_INL
```

17.166 hyb_zo_utils.inl File Reference

Namespaces

- namespace [FFLAS](#)

Macros

- #define [__FFLASFFPACK_fflas_sparse_HYB_ZO_utils_INL](#)

Functions

- template<class [Field](#) >
void [sparse_delete](#) (const Sparse< [Field](#), SparseMatrix_t::HYB_ZO > &A)
- template<class [Field](#) , class IndexT >
void [sparse_init](#) (const [Field](#) &F, Sparse< [Field](#), SparseMatrix_t::HYB_ZO > &A, const IndexT *row, const IndexT *col, typename [Field::ConstElement_ptr](#) dat, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)
- template<typename [_Field](#) >
std::ostream & [operator<<](#) (std::ostream &os, const Sparse< [_Field](#), SparseMatrix_t::HYB_ZO > &A)

17.166.1 Macro Definition Documentation

17.166.1.1 __FFLASFFPACK_fflas_sparse_HYB_ZO_utils_INL

```
#define __FFLASFFPACK_fflas_sparse_HYB_ZO_utils_INL
```

17.167 read_sparse.h File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <fstream>
#include <string>
#include <cstdlib>
#include <iterator>
```

Data Structures

- struct [Coo< Field >](#)
- struct [readMyMachineType< Field, T >](#)
- struct [readMyMachineType< Field, mpz_t >](#)

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::details_spmv](#)

Macros

- #define [DNS_BIN_VER](#) 0
- #define [mask_t](#) [uint64_t](#)

Functions

- `template<class Field, bool sorted = true, bool read_integer = false>`
`void readSmsFormat (const std::string &path, const Field &f, index_t *&row, index_t *&col, typename Field::Element_ptr &val, index_t &rowdim, index_t &coldim, uint64_t &nnz)`
- `template<class Field >`
`void readSprFormat (const std::string &path, const Field &f, index_t *&row, index_t *&col, typename Field::Element_ptr &val, index_t &rowdim, index_t &coldim, uint64_t &nnz)`
- `template<class T >`
`std::enable_if< std::is_integral< T >::value, int > getDataType ()`
- `template<class T >`
`std::enable_if< std::is_floating_point< T >::value, int > getDataType ()`
- `template<class T >`
`std::enable_if< std::is_same< T, mpz_t >::value, int > getDataType ()`
- `template<class T >`
`int getDataType ()`
- `template<class Field >`
`void readMachineType (const Field &F, typename Field::Element &modulo, typename Field::Element_ptr val, std::ifstream &file, const uint64_t dims, const mask_t data_type, const mask_t field_desc)`
- `template<class Field >`
`void readDnsFormat (const std::string &path, const Field &F, index_t &rowdim, index_t &coldim, typename Field::Element_ptr &val)`
- `template<class Field >`
`void writeDnsFormat (const std::string &path, const Field &F, const index_t &rowdim, const index_t &coldim, typename Field::Element_ptr A, index_t ldA)`

17.167.1 Macro Definition Documentation

17.167.1.1 DNS_BIN_VER

```
#define DNS_BIN_VER 0
```

17.167.1.2 mask_t

```
#define mask_t uint64_t
```

17.168 sell.h File Reference

```
#include "fflas-ffpack/fflas/fflas_sparse/sell/sell_utils.inl"
#include "fflas-ffpack/fflas/fflas_sparse/sell/sell_spmv.inl"
```

Data Structures

- struct `Sparse<_Field, SparseMatrix_t::SELL >`
- struct `Sparse<_Field, SparseMatrix_t::SELL_ZO >`

Namespaces

- namespace `FFLAS`

17.169 sell_pspmv.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details_impl](#)

Macros

- `#define` [__FFLASFFPACK_fflas_sparse_sell_pspmv_INL](#)

Functions

- `template<class Field >`
void [pfpspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::SELL > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::GenericTag)
- `template<class Field >`
void [pfpspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::SELL > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::UnparametricTag)
- `template<class Field >`
void [pfpspmv](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::SELL > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, const [int64_t](#) kmax)
- `template<class Field >`
void [pfpspmv_one](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::SELL_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::GenericTag)
- `template<class Field >`
void [pfpspmv_mone](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::SELL_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::GenericTag)
- `template<class Field >`
void [pfpspmv_one](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::SELL_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::UnparametricTag)
- `template<class Field >`
void [pfpspmv_mone](#) (const [Field](#) &F, const Sparse< [Field](#), SparseMatrix_t::SELL_ZO > &A, typename [Field::ConstElement_ptr](#) x_, typename [Field::Element_ptr](#) y_, FieldCategories::UnparametricTag)

17.169.1 Macro Definition Documentation

17.169.1.1 __FFLASFFPACK_fflas_sparse_sell_pspmv_INL

```
#define __FFLASFFPACK_fflas_sparse_sell_pspmv_INL
```

17.170 sell_spmv.inl File Reference

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sparse_details_impl](#)

Macros

- `#define` [__FFLASFFPACK_fflas_sparse_sell_spmv_INL](#)

Functions

- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, const uint64_t kmax)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::GenericTag)`
- `template<class Field >`
`void fspmv_one_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_mone_simd (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_one (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`
- `template<class Field >`
`void fspmv_mone (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x_, typename Field::Element_ptr y_, FieldCategories::UnparametricTag)`

17.170.1 Macro Definition Documentation

17.170.1.1 __FFLASFFPACK_fflas_sparse_sell_spmv_INL

```
#define __FFLASFFPACK_fflas_sparse_sell_spmv_INL
```

17.171 sell_utils.inl File Reference

Data Structures

- struct [Info](#)
- struct [Coo< ValT, IdxT >](#)

Namespaces

- namespace [FFLAS](#)
- namespace [FFLAS::sell_details](#)

Macros

- `#define __FFLASFFPACK_fflas_sparse_sell_utils_INL`

Functions

- `template<class Field >`
`void fspmv (const Field &F, const Sparse< Field, SparseMatrix_t::SELL_ZO > &A, typename Field::ConstElement_ptr x, typename Field::Element_ptr y, FieldCategories::ModularTag)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::SELL > &A)`
- `template<class Field >`
`void sparse_delete (const Sparse< Field, SparseMatrix_t::SELL_ZO > &A)`
- `template<class Field >`
`void sparse_print (const Sparse< Field, SparseMatrix_t::SELL > &A)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::SELL > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz, uint64_t sigma=0)`
- `template<class Field, class IndexT >`
`void sparse_init (const Field &F, Sparse< Field, SparseMatrix_t::SELL_ZO > &A, const IndexT *row, const IndexT *col, typename Field::ConstElement_ptr dat, uint64_t rowdim, uint64_t coldim, uint64_t nnz)`

17.171.1 Macro Definition Documentation

17.171.1.1 __FFLASFFPACK_fflas_sparse_sell_utils_INL

```
#define __FFLASFFPACK_fflas_sparse_sell_utils_INL
```

17.172 sparse_matrix_traits.h File Reference

```
#include <type_traits>
```

Data Structures

- `struct isSparseMatrix< Field, M >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_HYB > >`
- `struct isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::HYB_ZO > >`
- `struct isZOSparseMatrix< F, M >`
- `struct isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >`
- `struct isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >`
- `struct isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >`
- `struct isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >`

- struct [isZOSparseMatrix](#)< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >
- struct [isSparseMatrixSimdFormat](#)< F, M >
- struct [isSparseMatrixMKLFormat](#)< F, M >
- struct [tfn_plus](#)
- struct [tfn_mul](#)
- struct [tfn_mul_eq](#)
- struct [tfn_minus](#)
- struct [tfn_plus_eq](#)
- struct [tfn_minus_eq](#)
- struct [has_plus_impl](#)< C >
- struct [has_mul_impl](#)< C >
- struct [has_mul_eq_impl](#)< C >
- struct [has_plus_eq_impl](#)< C >
- struct [has_minus_eq_impl](#)< C >
- struct [has_minus_impl](#)< C >
- struct [has_operation](#)< T >

Namespaces

- namespace [FFLAS](#)

Typedefs

- using [ZOSparseMatrix](#) = std::true_type
- using [NotZOSparseMatrix](#) = std::false_type
- using [SimdSparseMatrix](#) = std::true_type
- using [NoSimdSparseMatrix](#) = std::false_type
- using [MKLSparseMatrixFormat](#) = std::true_type
- using [NotMKLSparseMatrixFormat](#) = std::false_type
- template<class T >
using [has_plus](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, has_plus_impl< T > >::type
- template<class T >
using [has_minus](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, has_minus_↵_impl< T > >::type
- template<class T >
using [has_equal](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, std::is_copy_↵_assignable< T > >::type
- template<class T >
using [has_plus_eq](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, has_plus_↵_eq_impl< T > >::type
- template<class T >
using [has_minus_eq](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, has_↵_minus_eq_impl< T > >::type
- template<class T >
using [has_mul](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, has_mul_impl< T > >::type
- template<class T >
using [has_mul_eq](#) = typename std::conditional< std::is_arithmetic< T >::value, std::true_type, has_mul_↵_eq_impl< T > >::type

17.173 utils.h File Reference

```
#include <algorithm>
#include <numeric>
#include <vector>
```

Data Structures

- struct [StatsMatrix](#)

Namespaces

- namespace [FFLAS](#)

Functions

- template<class It >
double [computeDeviation](#) (It begin, It end)
- template<class Field >
StatsMatrix [getStat](#) (const Field &F, const [index_t](#) *row, const [index_t](#) *col, typename [Field::ConstElement_ptr](#) val, [uint64_t](#) rowdim, [uint64_t](#) coldim, [uint64_t](#) nnz)

17.174 ffpack.doxy File Reference

17.175 ffpack.h File Reference

Set of elimination based routines for dense linear algebra.

```
#include "givaro/givpoly1.h"
#include <fflas-ffpack/fflas-ffpack-config.h>
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include <list>
#include <vector>
#include <iostream>
#include <algorithm>
#include "fflas-ffpack/checkers/checkers_ffpack.h"
#include "ffpack_fgesv.inl"
#include "ffpack_fgetrs.inl"
#include "fflas-ffpack/checkers/checkers_ffpack.inl"
#include "ffpack_pluq.inl"
#include "ffpack_pluq_mp.inl"
#include "ffpack_ppluq.inl"
#include "ffpack_ludivine.inl"
#include "ffpack_ludivine_mp.inl"
#include "ffpack_echelonforms.inl"
#include "ffpack_fsytrf.inl"
#include "ffpack_invert.inl"
#include "ffpack_ftrtr.inl"
#include "ffpack_ftrstr.inl"
#include "ffpack_ftrssyr2k.inl"
#include "ffpack_charpoly_kglu.inl"
#include "ffpack_charpoly_kgfast.inl"
#include "ffpack_charpoly_kgfastgeneralized.inl"
#include "ffpack_charpoly_danilevski.inl"
#include "ffpack_charpoly.inl"
#include "ffpack_frobenius.inl"
#include "ffpack_minpoly.inl"
#include "ffpack_krylovelim.inl"
#include "ffpack_permutation.inl"
#include "ffpack_rankprofiles.inl"
#include "ffpack_det_mp.inl"
#include "ffpack.inl"
```

Data Structures

- class [CharpolyFailed](#)

Namespaces

- namespace [FFPACK](#)
Finite Field PACK Set of elimination based routines for dense linear algebra.
- namespace [FFPACK::Protected](#)

Macros

- `#define __FFLASFFPACK_FTRSTR_THRESHOLD 64`
- `#define __FFLASFFPACK_FTRSSYR2K_THRESHOLD 64`

Functions

- void [LAPACKPerm2MathPerm](#) (size_t *MathP, const size_t *LapackP, const size_t N)
Conversion of a permutation from LAPACK format to Math format.
- void [MathPerm2LAPACKPerm](#) (size_t *LapackP, const size_t *MathP, const size_t N)
Conversion of a permutation from Maths format to LAPACK format.
- template<class [Field](#) >
void [applyP](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const [FFLAS::FFLAS_TRANSPOSE](#) Trans, const size_t M, const size_t ibeg, const size_t iend, typename [Field::Element_ptr](#) A, const size_t lda, const size_t *P)
Computes $P1 \times \text{Diag}(I_R, P2)$ where $P1$ is a LAPACK and $P2$ a LAPACK permutation and store the result in $P1$ as a LAPACK permutation.
- template<class [Field](#) >
void [applyP](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const [FFLAS::FFLAS_TRANSPOSE](#) Trans, const size_t m, const size_t ibeg, const size_t iend, typename [Field::Element_ptr](#) A, const size_t lda, const size_t *P, const [FFLAS::ParSeqHelper::Sequential](#) seq)
- template<class [Field](#) , class [Cut](#) , class [Param](#) >
void [applyP](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const [FFLAS::FFLAS_TRANSPOSE](#) Trans, const size_t m, const size_t ibeg, const size_t iend, typename [Field::Element_ptr](#) A, const size_t lda, const size_t *P, const [FFLAS::ParSeqHelper::Parallel](#)< [Cut](#) , [Param](#) > par)
- template<class [Field](#) >
void [MonotonicApplyP](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const [FFLAS::FFLAS_TRANSPOSE](#) Trans, const size_t M, const size_t ibeg, const size_t iend, typename [Field::Element_ptr](#) A, const size_t lda, const size_t *P, const size_t R)
Apply a R-monotonically increasing permutation P, to the matrix A.
- template<class [Field](#) >
void [fgetrs](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, const size_t R, typename [Field::Element_ptr](#) A, const size_t lda, const size_t *P, const size_t *Q, typename [Field::Element_ptr](#) B, const size_t ldb, int *info)
Solve the system $AX = B$ or $XA = B$.
- template<class [Field](#) >
[Field::Element_ptr](#) [fgetrs](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, const size_t NRHS, const size_t R, typename [Field::Element_ptr](#) A, const size_t lda, const size_t *P, const size_t *Q, typename [Field::Element_ptr](#) X, const size_t ldx, typename [Field::ConstElement_ptr](#) B, const size_t ldb, int *info)
Solve the system $AX = B$ or $XA = B$.
- template<class [Field](#) >
size_t [fgesv](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb, int *info)
Square system solver.

- `template<class Field >`
`size_t fgesv (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t NRHS, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx, typename Field::ConstElement_ptr B, const size_t ldb, int *info)`
Rectangular system solver.
- `template<class Field >`
`void ftrtri (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG Diag, const size_t N, typename Field::Element_ptr A, const size_t lda, const size_t threshold=__FFLASFFPACK_FTRTRI_THRESHOLD)`
Compute the inverse of a triangular matrix.
- `template<class Field >`
`void trinv_left (const Field &F, const size_t N, typename Field::ConstElement_ptr L, const size_t ldL, typename Field::Element_ptr X, const size_t ldx)`
- `template<class Field >`
`void ftrrm (const Field &F, const FFLAS::FFLAS_SIDE side, const FFLAS::FFLAS_DIAG diag, const size_t N, typename Field::Element_ptr A, const size_t lda)`
Compute the product of two triangular matrices of opposite shape.
- `template<class Field >`
`void ftrstr (const Field &F, const FFLAS::FFLAS_SIDE side, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diagA, const FFLAS::FFLAS_DIAG diagB, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const size_t threshold=__FFLASFFPACK_FTRSTR_THRESHOLD)`
Solve a triangular system with a triangular right hand side of the same shape.
- `template<class Field >`
`void ftrssyr2k (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diagA, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldx, const size_t ldb, const size_t threshold=__FFLASFFPACK_FTRSSYR2K_THRESHOLD)`
Solve a triangular system in a symmetric sum: find B upper/lower triangular such that $A^T B + B^T A = C$ where C is symmetric.
- `template<class Field >`
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
Triangular factorization of symmetric matrices.
- `template<class Field >`
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const FFLAS::ParSeqHelper::Sequential seq, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
- `template<class Field, class Cut, class Param >`
`bool fsytrf (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
- `template<class Field >`
`bool fsytrf_nonunit (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr D, const size_t incD, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)`
Triangular factorization of symmetric matrices.
- `template<class Field >`
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q)`
Compute a PLUQ factorization of the given matrix.
- `template<class Field >`
`size_t pPLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q)`
- `template<class Field >`
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFLAS::ParSeqHelper::Sequential &PSeqHelper, const size_t BCTHreshold=__FFLASFFPACK_PLUQ_THRESHOLD)`

- `template<class Field , class Cut , class Param >`
`size_t PLUQ (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Q, const FFLAS::ParSeqHelper::Parallel< Cut, Param > &PSHelper)`
- `template<class Field >`
`size_t LUdivine (const Field &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const FFPACK_LU_TAG LuTag=FpackSlabRecursive, const size_t cutoff=__FFLASFFPACK_LUDIVINE<←_THRESHOLD)`
Compute the CUP or PLE factorization of the given matrix.
- `template<class Field >`
`size_t LUdivine_construct (const Field &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t ldx, typename Field::Element_ptr u, const size_t incu, size_t *P, bool computeX, const FFPACK_MINPOLY_TAG MinTag=FpackDense, const size_t kg_mc=0, const size_t kg_mb=0, const size_t kg_j=0)`
- `template<class Field >`
`size_t ColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, bool transform=false, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`
Compute the Column Echelon form of the input matrix in-place.
- `template<class Field >`
`size_t pColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, bool transform=false, size_t numthreads=0, const FFPACK_LU_TAG LuTag=FpackTileRecursive)`
- `template<class Field , class PSHelper >`
`size_t ColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag, const PSHelper &psH)`
- `template<class Field >`
`size_t RowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`
Compute the Row Echelon form of the input matrix in-place.
- `template<class Field >`
`size_t pRowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, size_t numthreads=0, const FFPACK_LU_TAG LuTag=FpackTileRecursive)`
- `template<class Field , class PSHelper >`
`size_t RowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag, const PSHelper &psH)`
- `template<class Field >`
`size_t ReducedColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, const FFPACK_LU_TAG LuTag=FpackSlabRecursive)`
Compute the Reduced Column Echelon form of the input matrix in-place.
- `template<class Field >`
`size_t pReducedColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform=false, size_t numthreads=0, const FFPACK_LU_TAG LuTag=FpackTileRecursive)`
- `template<class Field , class PSHelper >`
`size_t ReducedColumnEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag, const PSHelper &psH)`
- `template<class Field >`
`size_t ReducedRowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr`

A, const size_t Ida, size_t *P, size_t *Qt, const bool transform=false, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)

Compute the Reduced Row Echelon form of the input matrix in-place.

- template<class Field >
size_t pReducedRowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t Ida, size_t *P, size_t *Qt, const bool transform=false, size_t numthreads=0, const FFPACK_LU_TAG LuTag=FfpackTileRecursive)
- template<class Field , class PSHelper >
size_t ReducedRowEchelonForm (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t Ida, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag, const PSHelper &psH)
- template<class Field >
size_t GaussJordan (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t Ida, const size_t colbeg, const size_t rowbeg, const size_t colsize, size_t *P, size_t *Q, const FFPACK::FFPACK_LU_TAG LuTag)
- Gauss-Jordan algorithm computing the Reduced Row echelon form and its transform matrix.*
- template<class Field >
Field::Element_ptr Invert (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t Ida, int &>nullity)
- Invert the given matrix in place or computes its nullity if it is singular.*
- template<class Field >
Field::Element_ptr Invert (const Field &F, const size_t M, typename Field::ConstElement_ptr A, const size_t Ida, typename Field::Element_ptr X, const size_t Idx, int &>nullity)
- Invert the given matrix or computes its nullity if it is singular.*
- template<class Field >
Field::Element_ptr Invert2 (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t Ida, typename Field::Element_ptr X, const size_t Idx, int &>nullity)
- Invert the given matrix or computes its nullity if it is singular.*
- template<class PolRing >
std::list< typename PolRing::Element > & CharPoly (const PolRing &R, std::list< typename PolRing::Element > &charp, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t Ida, typename PolRing::Domain_t::Randlter &G, const FFPACK_CHARPOLY_TAG CharpTag=FfpackAuto, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)
- Compute the characteristic polynomial of the matrix A.*
- template<class PolRing >
PolRing::Element & CharPoly (const PolRing &R, typename PolRing::Element &charp, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t Ida, typename PolRing::Domain_t::Randlter &G, const FFPACK_CHARPOLY_TAG CharpTag=FfpackAuto, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)
- Compute the characteristic polynomial of the matrix A.*
- template<class PolRing >
PolRing::Element & CharPoly (const PolRing &R, typename PolRing::Element &charp, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t Ida, const FFPACK_CHARPOLY_TAG CharpTag=FfpackAuto, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)
- Compute the characteristic polynomial of the matrix A.*
- template<class Field , class Polynomial >
std::list< Polynomial > & KellerGehrig (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::ConstElement_ptr A, const size_t Ida)
- template<class Field , class Polynomial >
int KGFast (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t Ida, size_t *kg_mc, size_t *kg_mb, size_t *kg_j)
- template<class Field , class Polynomial >
std::list< Polynomial > & KGFast_generalized (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t Ida)
- template<class Field >
void fgemv_kgf (const Field &F, const size_t N, typename Field::ConstElement_ptr A, const size_t Ida, typename Field::ConstElement_ptr X, const size_t incX, typename Field::Element_ptr Y, const size_t incY, const size_t kg_mc, const size_t kg_mb, const size_t kg_j)

- template<class [Field](#) , class Polynomial , class Randlter >
std::list< Polynomial > & [LUKrylov](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) U, const size_t ldu, Randlter &G)
- template<class [Field](#) , class Polynomial >
std::list< Polynomial > & [Danilevski](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda)
- template<class PolRing >
void [RandomKrylovPrecond](#) (const PolRing &PR, std::list< typename PolRing::Element > &completed, Factors, const size_t N, typename [PolRing::Domain_t::Element_ptr](#) A, const size_t lda, size_t &Nb, typename [PolRing::Domain_t::Element_ptr](#) &B, size_t &ldb, typename PolRing::Domain_t::Randlter &g, const size_t degree=[_FFLASFFPACK_ARITHPROG_THRESHOLD](#))
- template<class PolRing >
std::list< typename PolRing::Element > & [ArithProg](#) (const PolRing &PR, std::list< typename PolRing::Element > &frobeniusForm, const size_t N, typename [PolRing::Domain_t::Element_ptr](#) A, const size_t lda, const size_t degree)
- template<class [Field](#) , class Polynomial >
std::list< Polynomial > & [LUKrylov_KGFast](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) X, const size_t ldx)
- template<class [Field](#) , class Polynomial >
Polynomial & [MinPoly](#) (const [Field](#) &F, Polynomial &minP, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda)
Compute the minimal polynomial of the matrix A.
- template<class [Field](#) , class Polynomial , class Randlter >
Polynomial & [MinPoly](#) (const [Field](#) &F, Polynomial &minP, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, Randlter &G)
Compute the minimal polynomial of the matrix A.
- template<class [Field](#) , class Polynomial >
Polynomial & [MatVecMinPoly](#) (const [Field](#) &F, Polynomial &minP, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) v, const size_t incv)
Compute the minimal polynomial of the matrix A and a vector v, namely the first linear dependency relation in the Krylov basis $(v, Av, \dots, A^N v)$.
- template<class [Field](#) , class Polynomial >
Polynomial & [MatVecMinPoly](#) (const [Field](#) &F, Polynomial &minP, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) v, const size_t incv, typename [Field::Element_ptr](#) K, const size_t ldk, size_t *P)
- template<class [Field](#) , class Polynomial >
Polynomial & [Hybrid_KGF_LUK_MinPoly](#) (const [Field](#) &F, Polynomial &minP, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) X, const size_t ldx, size_t *P, const [FFPACK_MINPOLY_TAG](#) MinTag=[FFPACK::FfpackDense](#), const size_t kg_mc=0, const size_t kg_mb=0, const size_t kg_j=0)
- template<class [Field](#) >
size_t [Rank](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda)
Computes the rank of the given matrix using a PLUQ factorization.
- template<class [Field](#) >
size_t [pRank](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t numthreads=0)
- template<class [Field](#) , class PSHelper >
size_t [Rank](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, const PSHelper &psH)
- template<class [Field](#) >
bool [IsSingular](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda)
Returns true if the given matrix is singular.
- template<class [Field](#) >
[Field::Element](#) & [Det](#) (const [Field](#) &F, typename [Field::Element](#) &det, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *P=NULL, size_t *Q=NULL)

Returns the determinant of the given square matrix.

- `template<class Field >`
`Field::Element & pDet (const Field &F, typename Field::Element &det, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t numthreads=0, size_t *P=NULL, size_t *Q=NULL)`
- `template<class Field , class PSHelper >`
`Field::Element & Det (const Field &F, typename Field::Element &det, const size_t N, typename Field::Element_ptr A, const size_t lda, const PSHelper &psH, size_t *P=NULL, size_t *Q=NULL)`
- `template<class Field >`
`Field::Element_ptr Solve (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr x, const int incx, typename Field::ConstElement_ptr b, const int incb)`

Solves a linear system $AX = b$ using PLUQ factorization.

- `template<class Field , class PSHelper >`
`Field::Element_ptr Solve (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr x, const int incx, typename Field::ConstElement_ptr b, const int incb, PSHelper &psH)`
- `template<class Field >`
`Field::Element_ptr pSolve (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr x, const int incx, typename Field::ConstElement_ptr b, const int incb, size_t numthreads=0)`
- `template<class Field >`
`*void RandomNullSpaceVector (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t incX)`

Solve $LX = B$ or $XL = B$ in place.

- `template<class Field >`
`size_t NullSpaceBasis (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr &NS, size_t &ldn, size_t &NSdim)`

Computes a basis of the Left/Right nullspace of the matrix A.

- `template<class Field >`
`size_t RowRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *&rkprofile, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`

Computes the row rank profile of A.

- `template<class Field >`
`size_t pRowRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *&rkprofile, size_t numthreads=0, const FFPACK_LU_TAG LuTag=FfpackTileRecursive)`
- `template<class Field , class PSHelper >`
`size_t RowRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *&rkprofile, const FFPACK_LU_TAG LuTag, PSHelper &psH)`
- `template<class Field >`
`size_t ColumnRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *&rkprofile, const FFPACK_LU_TAG LuTag=FfpackSlabRecursive)`

Computes the column rank profile of A.

- `template<class Field >`
`size_t pColumnRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *&rkprofile, size_t numthreads=0, const FFPACK_LU_TAG LuTag=FfpackTileRecursive)`
- `template<class Field , class PSHelper >`
`size_t ColumnRankProfile (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *&rkprofile, const FFPACK_LU_TAG LuTag, PSHelper &psH)`
- `void RankProfileFromLU (const size_t *P, const size_t N, const size_t R, size_t *&rkprofile, const FFPACK_LU_TAG LuTag)`

Recovers the column/row rank profile from the permutation of an LU decomposition.

- `size_t LeadingSubmatrixRankProfiles (const size_t M, const size_t N, const size_t R, const size_t LSm, const size_t LSs, const size_t *P, const size_t *Q, size_t *RRP, size_t *CRP)`

Recovers the row and column rank profiles of any leading submatrix from the PLUQ decomposition.

- template<class [Field](#) >
size_t [RowRankProfileSubmatrixIndices](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *&rowindices, size_t *&colindices, size_t &R)
RowRankProfileSubmatrixIndices.
- template<class [Field](#) >
size_t [ColRankProfileSubmatrixIndices](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *&rowindices, size_t *&colindices, size_t &R)
Computes the indices of the submatrix $r \times r$ X of A whose columns correspond to the column rank profile of A.
- template<class [Field](#) >
size_t [RowRankProfileSubmatrix](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) &X, size_t &R)
Computes the $r \times r$ submatrix X of A, by picking the row rank profile rows of A.
- template<class [Field](#) >
size_t [ColRankProfileSubmatrix](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) &X, size_t &R)
Compute the $r \times r$ submatrix X of A, by picking the row rank profile rows of A.
- template<class [Field](#) >
void [getTriangular](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) diag, const size_t M, const size_t N, const size_t R, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) T, const size_t ldt, const bool OnlyNonZeroVectors=false)
Extracts a triangular matrix from a compact storage $A=L\backslash U$ of rank R.
- template<class [Field](#) >
void [getTriangular](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) diag, const size_t M, const size_t N, const size_t R, typename [Field::Element_ptr](#) A, const size_t lda)
Cleans up a compact storage $A=L\backslash U$ to reveal a triangular matrix of rank R.
- template<class [Field](#) >
void [getEchelonForm](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) diag, const size_t M, const size_t N, const size_t R, const size_t *P, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) T, const size_t ldt, const bool OnlyNonZeroVectors=false, const [FFPACK_LU_TAG](#) LuTag=[FfpackSlabRecursive](#))
Extracts a matrix in echelon form from a compact storage $A=L\backslash U$ of rank R obtained by RowEchelonForm or ColumnEchelonForm.
- template<class [Field](#) >
void [getEchelonForm](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) diag, const size_t M, const size_t N, const size_t R, const size_t *P, typename [Field::Element_ptr](#) A, const size_t lda, const [FFPACK_LU_TAG](#) LuTag=[FfpackSlabRecursive](#))
Cleans up a compact storage $A=L\backslash U$ obtained by RowEchelonForm or ColumnEchelonForm to reveal an echelon form of rank R.
- template<class [Field](#) >
void [getEchelonTransform](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) diag, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) T, const size_t ldt, const [FFPACK_LU_TAG](#) LuTag=[FfpackSlabRecursive](#))
Extracts a transformation matrix to echelon form from a compact storage $A=L\backslash U$ of rank R obtained by RowEchelonForm or ColumnEchelonForm.
- template<class [Field](#) >
void [getReducedEchelonForm](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) T, const size_t ldt, const bool OnlyNonZeroVectors=false, const [FFPACK_LU_TAG](#) LuTag=[FfpackSlabRecursive](#))
Extracts a matrix in echelon form from a compact storage $A=L\backslash U$ of rank R obtained by ReducedRowEchelonForm or ReducedColumnEchelonForm with transform = true.
- template<class [Field](#) >
void [getReducedEchelonForm](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, typename [Field::Element_ptr](#) A, const size_t lda, const [FFPACK_LU_TAG](#) LuTag=[FfpackSlabRecursive](#))

Cleans up a compact storage $A=L\backslash U$ of rank R obtained by `ReducedRowEchelonForm` or `ReducedColumnEchelonForm` with `transform = true`.

- template<class [Field](#) >
void [getReducedEchelonTransform](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) T, const size_t ldt, const [FFPACK_LU_TAG](#) LuTag=[FpackSlabRecursive](#))
Extracts a transformation matrix to echelon form from a compact storage $A=L\backslash U$ of rank R obtained by `RowEchelonForm` or `ColumnEchelonForm`.
- void [PLUQtoEchelonPermutation](#) (const size_t N, const size_t R, const size_t *P, size_t *outPerm)
Auxiliary routine: determines the permutation that changes a PLUQ decomposition into a echelon form revealing PLUQ decomposition.
- template<class [Field](#) >
[Field::Element_ptr](#) [LQUPtoInverseOfFullRankMinor](#) (const [Field](#) &F, const size_t rank, typename [Field::Element_ptr](#) A_factors, const size_t lda, const size_t *QtPointer, typename [Field::Element_ptr](#) X, const size_t ldx)
LQUPtoInverseOfFullRankMinor.

17.175.1 Detailed Description

Set of elimination based routines for dense linear algebra.

Matrices are supposed over finite prime field of characteristic less than 2^{26} .

17.175.2 Macro Definition Documentation

17.175.2.1 __FFLASFFPACK_FTRSTR_THRESHOLD

```
#define __FFLASFFPACK_FTRSTR_THRESHOLD 64
```

17.175.2.2 __FFLASFFPACK_FTRSSYR2K_THRESHOLD

```
#define __FFLASFFPACK_FTRSSYR2K_THRESHOLD 64
```

17.176 fpack.inl File Reference

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_fpack_INL](#)

Functions

- template<class [Field](#) >
size_t [Rank](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda)
Computes the rank of the given matrix using a PLUQ factorization.
- template<class [Field](#) >
size_t [pRank](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t numthreads=0)
- template<class [Field](#) , class PSHelper >
size_t [Rank](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, const PSHelper &psH)

- `template<class Field >`
`bool IsSingular (const Field &F, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda)`
Returns true if the given matrix is singular.
- `template<class Field >`
`Field::Element & Det (const Field &F, typename Field::Element &det, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P=NULL, size_t *Q=NULL)`
Returns the determinant of the given square matrix.
- `template<class Field >`
`Field::Element & pDet (const Field &F, typename Field::Element &det, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t numthreads=0, size_t *P=NULL, size_t *Q=NULL)`
- `template<class Field, class PSHelper >`
`Field::Element & Det (const Field &F, typename Field::Element &det, const size_t N, typename Field::Element_ptr A, const size_t lda, const PSHelper &psH, size_t *P=NULL, size_t *Q=NULL)`
- `template<class Field >`
`Field::Element_ptr Solve (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr x, const int incx, typename Field::ConstElement_ptr b, const int incb)`
Solves a linear system $AX = b$ using PLUQ factorization.
- `template<class Field, class PSHelper >`
`Field::Element_ptr Solve (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr x, const int incx, typename Field::ConstElement_ptr b, const int incb, PSHelper &psH)`
- `template<class Field >`
`Field::Element_ptr pSolve (const Field &F, const size_t M, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr x, const int incx, typename Field::ConstElement_ptr b, const int incb, size_t numthreads=0)`
- `template<class Field >`
`void RandomNullSpaceVector (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr X, const size_t incX)`
Solve $LX = B$ or $XL = B$ in place.
- `template<class Field >`
`size_t NullSpaceBasis (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr &NS, size_t &ldn, size_t &NSdim)`
Computes a basis of the Left/Right nullspace of the matrix A.
- `template<class Field >`
`void solveLB (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr L, const size_t ldl, const size_t *Q, typename Field::Element_ptr B, const size_t ldb)`
- `template<class Field >`
`void solveLB2 (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, typename Field::Element_ptr L, const size_t ldl, const size_t *Q, typename Field::Element_ptr B, const size_t ldb)`

17.176.1 Macro Definition Documentation

17.176.1.1 __FFLASFFPACK_ffpack_INL

```
#define __FFLASFFPACK_ffpack_INL
```

17.177 ffpack_charpoly.inl File Reference

```
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "ffpack_charpoly_mp.inl"
```

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- namespace [FFPACK::Protected](#)

Macros

- `#define __FFLASFFPACK_charpoly_INL`

Functions

- `template<class PolRing >`
`std::list< typename PolRing::Element > & CharPoly (const PolRing &R, std::list< typename PolRing::Element > &charp, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t Ida, typename PolRing::Domain_t::RandIter &G, const FFPACK_CHARPOLY_TAG CharpTag=FfpackAuto, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`
Compute the characteristic polynomial of the matrix A.
- `template<class PolRing >`
`PolRing::Element & CharPoly (const PolRing &R, typename PolRing::Element &charp, const size_t N, typename PolRing::Domain_t::Element_ptr A, const size_t Ida, typename PolRing::Domain_t::RandIter &G, const FFPACK_CHARPOLY_TAG CharpTag=FfpackAuto, const size_t degree=__FFLASFFPACK_ARITHPROG_THRESHOLD)`
Compute the characteristic polynomial of the matrix A.
- `template<class Field , class Polynomial , class RandIter >`
`std::list< Polynomial > & LUKrylov (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t Ida, typename Field::Element_ptr U, const size_t ldu, RandIter &G)`
- `template<class Field , class Polynomial >`
`std::list< Polynomial > & LUKrylov_KGFast (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t Ida, typename Field::Element_ptr X, const size_t ldx)`

17.177.1 Macro Definition Documentation

17.177.1.1 __FFLASFFPACK_charpoly_INL

```
#define __FFLASFFPACK_charpoly_INL
```

17.178 ffpack_charpoly_danilevski.inl File Reference

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define __FFLASFFPACK_ffpack_charpoly_danilveski_INL`

Functions

- `template<class Field , class Polynomial >`
`std::list< Polynomial > & Danilevski (const Field &F, std::list< Polynomial > &charp, const size_t N, typename Field::Element_ptr A, const size_t Ida)`

17.178.1 Macro Definition Documentation

17.178.1.1 __FFLASFFPACK_ffpack_charpoly_danilveski_INL

```
#define __FFLASFFPACK_ffpack_charpoly_danilveski_INL
```

17.179 ffpack_charpoly_kgfast.inl File Reference

Namespaces

- namespace [FFPACK](#)
Finite Field PACK Set of elimination based routines for dense linear algebra.
- namespace [FFPACK::Protected](#)

Macros

- #define [__FFLASFFPACK_ffpack_charpoly_kgfast_INL](#)

Functions

- template<class [Field](#) , class Polynomial >
int [KGFast](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *kg_mc, size_t *kg_mb, size_t *kg_j)
- template<class [Field](#) >
void [fgemv_kgf](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) X, const size_t incX, typename [Field::Element_ptr](#) Y, const size_t incY, const size_t kg_mc, const size_t kg_mb, const size_t kg_j)

17.179.1 Macro Definition Documentation

17.179.1.1 __FFLASFFPACK_ffpack_charpoly_kgfast_INL

```
#define __FFLASFFPACK_ffpack_charpoly_kgfast_INL
```

17.180 ffpack_charpoly_kgfastgeneralized.inl File Reference

```
#include <iostream>
#include "fflas-ffpack/utils/fflas_io.h"
```

Namespaces

- namespace [FFPACK](#)
Finite Field PACK Set of elimination based routines for dense linear algebra.
- namespace [FFPACK::Protected](#)

Macros

- #define [__FFLASFFPACK_ffpack_charpoly_kgfastgeneralized_INL](#)

Functions

- template<class [Field](#) >
[Field::Element_ptr buildMatrix](#) (const [Field](#) &F, typename [Field::ConstElement_ptr](#) E, typename [Field::ConstElement_ptr](#) C, const size_t lda, const size_t *B, const size_t *T, const size_t me, const size_t mc, const size_t lambda, const size_t mu)

- template<class [Field](#) , class Polynomial >
std::list< Polynomial > & [KGFast_generalized](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda)

17.180.1 Macro Definition Documentation

17.180.1.1 __FFLASFFPACK_ffpack_charpoly_kgfastgeneralized_INL

```
#define __FFLASFFPACK_ffpack_charpoly_kgfastgeneralized_INL
```

17.181 ffpack_charpoly_kglu.inl File Reference

Namespaces

- namespace [FFPACK](#)
*Finite **Field** **PACK** Set of elimination based routines for dense linear algebra.*
- namespace [FFPACK::Protected](#)

Macros

- #define [__FFLASFFPACK_ffpack_charpoly_kglu_INL](#)

Functions

- template<class [Field](#) >
size_t [updated](#) (const [Field](#) &F, size_t *d, size_t k, std::vector< std::vector< typename [Field::Element](#) > > &minpt)
- template<class [Field](#) >
size_t [newD](#) (const [Field](#) &F, size_t *d, bool &KeepOn, const size_t l, const size_t N, typename [Field::Element_ptr](#) X, const size_t *Q, std::vector< std::vector< typename [Field::Element](#) > > &minpt)
- template<class [Field](#) , class Polynomial >
std::list< Polynomial > & [KellerGehrig](#) (const [Field](#) &F, std::list< Polynomial > &charp, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda)

17.181.1 Macro Definition Documentation

17.181.1.1 __FFLASFFPACK_ffpack_charpoly_kglu_INL

```
#define __FFLASFFPACK_ffpack_charpoly_kglu_INL
```

17.182 ffpack_charpoly_mp.inl File Reference

```
#include <givaro/zring.h>
#include "givaro/givinteger.h"
#include "givaro/givpoly1.h"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/fflas-ffpack.h"
```

Namespaces

- namespace [FFPACK](#)
*Finite **Field** **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- `#define __FFPACK_charpoly_mp_INL`

Functions

- `FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr CharPoly` (const `FFPACK::RNSInteger< FFPACK::rns_double > &F`, typename `FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr` charp, const `size_t N`, typename `FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr` A, const `size_t Ida`, `Givaro::ZRing< Givaro::Integer >::RandIter &G`, const `FFPACK_CHARPOLY_TAG` CharpTag, `size_t degree`)
- `template<> Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > >::Element & CharPoly` (const `Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > > &R`, `Givaro::Poly1Dom< Givaro::ZRing< Givaro::Integer > >::Element &charp`, const `size_t N`, `Givaro::Integer *A`, const `size_t Ida`, `Givaro::ZRing< Givaro::Integer >::RandIter &G`, const `FFPACK_CHARPOLY_TAG` CharpTag, `size_t degree`)

17.182.1 Macro Definition Documentation

17.182.1.1 __FFPACK_charpoly_mp_INL

```
#define __FFPACK_charpoly_mp_INL
```

17.183 ffpack_det_mp.inl File Reference

```
#include <givaro/zring.h>
#include "givaro/givinteger.h"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/fflas-ffpack.h"
```

Namespaces

- namespace `FFPACK`
Finite Field PACK Set of elimination based routines for dense linear algebra.

Macros

- `#define __FFPACK_det_mp_INL`

Functions

- `template<class PSHelper > FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr & Det` (const `FFPACK::RNSInteger< FFPACK::rns_double > &F`, typename `FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr` &det, const `size_t N`, typename `FFPACK::RNSInteger< FFPACK::rns_double >::Element_ptr` A, const `size_t Ida`, const `PSHelper &psH`)
- `template<class PSHelper > Givaro::Integer & Det` (const `Givaro::ZRing< Givaro::Integer > &F`, `Givaro::Integer &det`, const `size_t N`, `Givaro::Integer *A`, const `size_t Ida`, const `PSHelper &psH`, `size_t *P`, `size_t *Q`)

17.183.1 Macro Definition Documentation

17.183.1.1 __FFPACK_det_mp_INL

```
#define __FFPACK_det_mp_INL
```

17.184 ffpack_echelonforms.inl File Reference

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_ffpack_echelon_forms_INL](#)
- #define [__FFLASFFPACK_GAUSSJORDAN_BASECASE](#) 256

Functions

- template<class [Field](#) >
void [getTriangular](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) diag, const size_t M, const size_t N, const size_t R, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) T, const size_t ldt, const bool OnlyNonZeroVectors=false)
Extracts a triangular matrix from a compact storage $A=L\backslash U$ of rank R .
- template<class [Field](#) >
void [getTriangular](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) diag, const size_t M, const size_t N, const size_t R, typename [Field::Element_ptr](#) A, const size_t lda)
Cleans up a compact storage $A=L\backslash U$ to reveal a triangular matrix of rank R .
- void [PLUQtoEchelonPermutation](#) (const size_t N, const size_t R, const size_t *P, size_t *outPerm)
Auxiliary routine: determines the permutation that changes a PLUQ decomposition into a echelon form revealing PLUQ decomposition.
- template<class [Field](#) >
void [getEchelonForm](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) diag, const size_t M, const size_t N, const size_t R, const size_t *P, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) T, const size_t ldt, const bool OnlyNonZeroVectors=false, const [FFPACK_LU_TAG](#) LuTag=[FfpackSlabRecursive](#))
Extracts a matrix in echelon form from a compact storage $A=L\backslash U$ of rank R obtained by RowEchelonForm or Column↔EchelonForm.
- template<class [Field](#) >
void [getEchelonForm](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) diag, const size_t M, const size_t N, const size_t R, const size_t *P, typename [Field::Element_ptr](#) A, const size_t lda, const [FFPACK_LU_TAG](#) LuTag=[FfpackSlabRecursive](#))
Cleans up a compact storage $A=L\backslash U$ obtained by RowEchelonForm or ColumnEchelonForm to reveal an echelon form of rank R .
- template<class [Field](#) >
void [getEchelonTransform](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) diag, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) T, const size_t ldt, const [FFPACK_LU_TAG](#) LuTag=[FfpackSlabRecursive](#))
Extracts a transformation matrix to echelon form from a compact storage $A=L\backslash U$ of rank R obtained by RowEchelon↔Form or ColumnEchelonForm.
- template<class [Field](#) >
void [getReducedEchelonForm](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) T, const size_t ldt, const bool OnlyNonZeroVectors=false, const [FFPACK_LU_TAG](#) LuTag=[FfpackSlabRecursive](#))
Extracts a matrix in echelon form from a compact storage $A=L\backslash U$ of rank R obtained by ReducedRowEchelonForm or ReducedColumnEchelonForm with transform = true.
- template<class [Field](#) >
void [getReducedEchelonForm](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, typename [Field::Element_ptr](#) A, const size_t lda, const [FFPACK_LU_TAG](#) LuTag=[FfpackSlabRecursive](#))

Cleans up a compact storage $A=LU$ of rank R obtained by `ReducedRowEchelonForm` or `ReducedColumnEchelonForm` with `transform = true`.

- template<class [Field](#) >
void [getReducedEchelonTransform](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) T, const size_t ldt, const [FFPACK_LU_TAG](#) LuTag=[FfpackSlabRecursive](#))

Extracts a transformation matrix to echelon form from a compact storage $A=LU$ of rank R obtained by `RowEchelonForm` or `ColumnEchelonForm`.

17.184.1 Macro Definition Documentation

17.184.1.1 __FFLASFFPACK_ffpack_echelon_forms_INL

```
#define __FFLASFFPACK_ffpack_echelon_forms_INL
```

17.184.1.2 __FFLASFFPACK_GAUSSJORDAN_BASECASE

```
#define __FFLASFFPACK_GAUSSJORDAN_BASECASE 256
```

17.185 ffpack_fgesv.inl File Reference

Namespaces

- namespace [FFPACK](#)
*Finite **Field** **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_ffpack_fgesv_INL](#)

Functions

- template<class [Field](#) >
size_t [fgesv](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb, int *info)
Square system solver.
- template<class [Field](#) >
size_t [fgesv](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, const size_t NRHS, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) X, const size_t ldx, typename [Field::ConstElement_ptr](#) B, const size_t ldb, int *info)
Rectangular system solver.

17.185.1 Macro Definition Documentation

17.185.1.1 __FFLASFFPACK_ffpack_fgesv_INL

```
#define __FFLASFFPACK_ffpack_fgesv_INL
```

17.186 ffpack_fgetrs.inl File Reference

Namespaces

- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_ffpack_fgetrs_INL](#)

Functions

- template<class [Field](#) >
void [fgetrs](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, const size_t R, typename [Field::Element_ptr](#) A, const size_t lda, const size_t *P, const size_t *Q, typename [Field::Element_ptr](#) B, const size_t ldb, int *info)
Solve the system $AX = B$ or $XA = B$.
- template<class [Field](#) >
[Field::Element_ptr](#) [fgetrs](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, const size_t NRHS, const size_t R, typename [Field::Element_ptr](#) A, const size_t lda, const size_t *P, const size_t *Q, typename [Field::Element_ptr](#) X, const size_t idx, typename [Field::ConstElement_ptr](#) B, const size_t ldb, int *info)
Solve the system $A X = B$ or $X A = B$.

17.186.1 Macro Definition Documentation

17.186.1.1 __FFLASFFPACK_ffpack_fgetrs_INL

```
#define __FFLASFFPACK_ffpack_fgetrs_INL
```

17.187 ffpack_frobenius.inl File Reference

```
#include <givaro/givranditer.h>
```

Namespaces

- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

- namespace [FFPACK::Protected](#)

Functions

- template<class [Field](#) >
void [CompressRows](#) ([Field](#) &F, const size_t M, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)
- template<class [Field](#) >
void [CompressRowsQK](#) ([Field](#) &F, const size_t M, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) tmp, const size_t ldtmp, const size_t *d, const size_t deg, const size_t nb_blocs)
- template<class [Field](#) >
void [DeCompressRows](#) ([Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)

- template<class [Field](#) >
void [DeCompressRowsQK](#) ([Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) tmp, const size_t ldtmp, const size_t *d, const size_t deg, const size_t nb_blocs)
- template<class [Field](#) >
void [CompressRowsQA](#) ([Field](#) &F, const size_t M, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)
- template<class [Field](#) >
void [DeCompressRowsQA](#) ([Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) tmp, const size_t ldtmp, const size_t *d, const size_t nb_blocs)
- template<class [PolRing](#) >
void [RandomKrylovPrecond](#) (const [PolRing](#) &PR, std::list< typename [PolRing::Element](#) > &completedFactors, const size_t N, typename [PolRing::Domain_t::Element_ptr](#) A, const size_t lda, size_t &Nb, typename [PolRing::Domain_t::Element_ptr](#) &B, size_t &ldb, typename [PolRing::Domain_t::RandIter](#) &g, const size_t degree=[__FFLASFFPACK_ARITHPROG_THRESHOLD](#))
- template<class [PolRing](#) >
std::list< typename [PolRing::Element](#) > & [ArithProg](#) (const [PolRing](#) &PR, std::list< typename [PolRing::Element](#) > &frobeniusForm, const size_t N, typename [PolRing::Domain_t::Element_ptr](#) A, const size_t lda, const size_t degree)

17.188 ffpack_fsytrf.inl File Reference

```
#include "fflas-ffpack/utils/fflas_io.h"
```

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_ffpack_fsytrf_INL](#)

Functions

- template<class [Field](#) >
bool [fsytrf_BC_Crout](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) UpLo, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) Dinv, const size_t incDinv)
- template<class [Field](#) >
size_t [fsytrf_BC_RL](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) UpLo, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) Dinv, const size_t incDinv)
- template<class [Field](#) >
size_t [fsytrf_UP_RPM_BC_RL](#) (const [Field](#) &F, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) Dinv, const size_t incDinv, size_t *P)
- template<class [Field](#) >
size_t [fsytrf_LOW_RPM_BC_Crout](#) (const [Field](#) &F, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) Dinv, const size_t incDinv, size_t *P)
- template<class [Field](#) >
size_t [fsytrf_UP_RPM_BC_Crout](#) (const [Field](#) &F, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) Dinv, const size_t incDinv, size_t *P)
- template<class [Field](#) >
size_t [fsytrf_UP_RPM](#) (const [Field](#) &Fi, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) Dinv, const size_t incDinv, size_t *P, size_t BCThreshold)
- template<class [Field](#) >
bool [fsytrf_nonunit](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) UpLo, const size_t N, typename

```
Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv,
FFLAS::ParSeqHelper::Sequential seq, size_t threshold)
```

- template<class Field, class Cut, class Param >
bool **fsytrf_nonunit** (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr Dinv, const size_t incDinv, FFLAS::ParSeqHelper::Parallel< Cut, Param > par, size_t threshold)
- template<class Field >
bool **fsytrf** (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)
Triangular factorization of symmetric matrices.
- template<class Field >
bool **fsytrf** (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const FFLAS::ParSeqHelper::Sequential seq, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)
- template<class Field, class Cut, class Param >
bool **fsytrf** (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par, const size_t threshold=__FFLASFFPACK_FSYTRF_THRESHOLD)
- template<class Field >
size_t **fsytrf_RPM** (const Field &F, const FFLAS::FFLAS_UPLO UpLo, const size_t N, typename Field::Element_ptr A, const size_t lda, size_t *P, size_t threshold)
- template<class Field >
void **getTridiagonal** (const Field &F, const size_t N, const size_t R, typename Field::ConstElement_ptr A, const size_t lda, size_t *P, typename Field::Element_ptr T, const size_t ldt)

17.188.1 Macro Definition Documentation

17.188.1.1 __FFLASFFPACK_ffpack_fsytrf_INL

```
#define __FFLASFFPACK_ffpack_fsytrf_INL
```

17.189 ffpack_ftrssyr2k.inl File Reference

```
#include "fflas-ffpack/utils/fflas_io.h"
```

Namespaces

- namespace **FFPACK**
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define **__FFLASFFPACK_ffpack_ftrssyr2k_INL**

Functions

- template<class Field >
void **ftrssyr2k** (const Field &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG diagA, const size_t N, typename Field::ConstElement_ptr A, const size_t lda, typename Field::Element_ptr B, const size_t ldb, const size_t threshold=__FFLASFFPACK_FTRSSYR2K_THRESHOLD)
Solve a triangular system in a symmetric sum: find B upper/lower triangular such that $A^T B + B^T A = C$ where C is symmetric.

17.189.1 Macro Definition Documentation

17.189.1.1 __FFLASFFPACK_ffpack_ftrssyr2k_INL

```
#define __FFLASFFPACK_ffpack_ftrssyr2k_INL
```

17.190 ffpack_ftrstr.inl File Reference

```
#include "fflas-ffpack/utils/fflas_io.h"
```

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_ffpack_ftrstr_INL](#)

Functions

- template<class [Field](#) >
void [ftrstr](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) side, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) diagA, const [FFLAS::FFLAS_DIAG](#) diagB, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) B, const size_t ldb, const size_t threshold=[__FFLASFFPACK_FTRSTR_THRESHOLD](#))
Solve a triangular system with a triangular right hand side of the same shape.

17.190.1 Macro Definition Documentation

17.190.1.1 __FFLASFFPACK_ffpack_ftrstr_INL

```
#define __FFLASFFPACK_ffpack_ftrstr_INL
```

17.191 ffpack_ftrtr.inl File Reference

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [ENABLE_ALL_CHECKINGS](#) 1
- #define [__FFLASFFPACK_ffpack_ftrtr_INL](#)

Functions

- template<class [Field](#) >
void [ftrtri](#) (const [Field](#) &F, const [FFLAS::FFLAS_UPLO](#) Uplo, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, const size_t threshold=[__FFLASFFPACK_FTRTRI_THRESHOLD](#))
Compute the inverse of a triangular matrix.
- template<class [Field](#) >
void [ftrtrm](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) side, const [FFLAS::FFLAS_DIAG](#) diag, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda)

Compute the product of two triangular matrices of opposite shape.

- template<class [Field](#) >
void [trinv_left](#) (const [Field](#) &F, const size_t N, typename [Field::ConstElement_ptr](#) L, const size_t ldl, typename [Field::Element_ptr](#) X, const size_t ldx)

17.191.1 Macro Definition Documentation

17.191.1.1 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.191.1.2 __FFLASFFPACK_ffpack_ftrtr_INL

```
#define __FFLASFFPACK_ffpack_ftrtr_INL
```

17.192 ffpack_invert.inl File Reference

Namespaces

- namespace [FFPACK](#)
*Finite **Field** **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_ffpack_invert_INL](#)

Functions

- template<class [Field](#) >
[Field::Element_ptr Invert](#) (const [Field](#) &F, const size_t M, typename [Field::Element_ptr](#) A, const size_t lda, int &nullity)
Invert the given matrix in place or computes its nullity if it is singular.
- template<class [Field](#) >
[Field::Element_ptr Invert](#) (const [Field](#) &F, const size_t M, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) X, const size_t ldx, int &nullity)
Invert the given matrix or computes its nullity if it is singular.
- template<class [Field](#) >
[Field::Element_ptr Invert2](#) (const [Field](#) &F, const size_t M, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) X, const size_t ldx, int &nullity)
Invert the given matrix or computes its nullity if it is singular.

17.192.1 Macro Definition Documentation

17.192.1.1 __FFLASFFPACK_ffpack_invert_INL

```
#define __FFLASFFPACK_ffpack_invert_INL
```

17.193 ffpack_krylovelim.inl File Reference

Macros

- #define [__FFLASFFPACK_ffpack_krylovelim_INL](#)

17.193.1 Macro Definition Documentation

17.193.1.1 __FFLASFFPACK_ffpack_krylovelim_INL

```
#define __FFLASFFPACK_ffpack_krylovelim_INL
```

17.194 ffpack_ludivine.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_bounds.inl"
```

Data Structures

- class [callLUdivine_small< Element >](#)
- class [callLUdivine_small< double >](#)
- class [callLUdivine_small< float >](#)

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- namespace [FFPACK::Protected](#)

Macros

- #define [__FFLASFFPACK_ffpack_ludivine_INL](#)

Functions

- template<class [Field](#) >
size_t [LUdivine_gauss](#) (const [Field](#) &F, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *P, size_t *Q, const [FFPACK::FFPACK_LU_TAG](#) LuTag)
- template<class [Field](#) >
size_t [LUdivine_small](#) (const [Field](#) &F, const [FFLAS::FFLAS_DIAG](#) Diag, const [FFLAS::FFLAS_TRANSPOSE](#) trans, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *P, size_t *Q, const [FFPACK::FFPACK_LU_TAG](#) LuTag)
- template<class [Field](#) >
size_t [LUdivine](#) (const [Field](#) &F, const [FFLAS::FFLAS_DIAG](#) Diag, const [FFLAS::FFLAS_TRANSPOSE](#) trans, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *P, size_t *Q, const [FFPACK::FFPACK_LU_TAG](#) LuTag, const size_t cutoff)
- template<class [Field](#) >
size_t [LUdivine_construct](#) (const [Field](#) &F, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t M, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) X, const size_t ldx, typename [Field::Element_ptr](#) u, const size_t incu, size_t *P, bool computeX, const [FFPACK::FFPACK_MINPOLY_TAG](#) MinTag, const size_t kg_mc, const size_t kg_mb, const size_t kg_j)

17.194.1 Macro Definition Documentation

17.194.1.1 __FFLASFFPACK_ffpack_ludivine_INL

```
#define __FFLASFFPACK_ffpack_ludivine_INL
```

17.195 ffpack_ludivine_mp.inl File Reference

```
#include <givaro/modular-integer.h>
#include <givaro/givinteger.h>
#include "fflas-ffpack/field/rns-integer-mod.h"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/ffpack/ffpack_ludivine.inl"
```

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFPACK_ludivine_mp_INL](#)

Functions

- template<> size_t [LUdivine](#) (const Givaro::Modular< Givaro::Integer > &F, const [FFLAS::FFLAS_DIAG](#) Diag, const [FFLAS::FFLAS_TRANSPOSE](#) trans, const size_t M, const size_t N, typename Givaro::Integer *A, const size_t lda, size_t *P, size_t *Q, const FFPACK::FFPACK_LU_TAG LuTag, const size_t cutoff)

17.195.1 Macro Definition Documentation

17.195.1.1 __FFPACK_ludivine_mp_INL

```
#define __FFPACK_ludivine_mp_INL
```

17.196 ffpack_minpoly.inl File Reference

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- namespace [FFPACK::Protected](#)

Macros

- #define [__FFLASFFPACK_ffpack_minpoly_INL](#)

Functions

- template<class [Field](#) , class Polynomial >
Polynomial & [MinPoly](#) (const [Field](#) &F, Polynomial &minP, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda)
Compute the minimal polynomial of the matrix A.
- template<class [Field](#) , class Polynomial , class RandIter >
Polynomial & [MinPoly](#) (const [Field](#) &F, Polynomial &minP, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, RandIter &G)
Compute the minimal polynomial of the matrix A.

- template<class [Field](#) , class Polynomial >
Polynomial & [MatVecMinPoly](#) (const [Field](#) &F, Polynomial &minP, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::ConstElement_ptr](#) v, const size_t incv)
Compute the minimal polynomial of the matrix A and a vector v, namely the first linear dependency relation in the Krylov basis $(v, Av, \dots, A^N v)$.
- template<class [Field](#) , class Polynomial >
Polynomial & [MatVecMinPoly](#) (const [Field](#) &F, Polynomial &minP, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) v, const size_t incv, typename [Field::Element_ptr](#) K, const size_t ldk, size_t *P)
- template<class [Field](#) , class Polynomial >
Polynomial & [Hybrid_KGF_LUK_MinPoly](#) (const [Field](#) &F, Polynomial &minP, const size_t N, typename [Field::ConstElement_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) X, const size_t ldx, size_t *P, const FFPACK_MINPOLY_TAG MinTag=[FFPACK::FfpackDense](#), const size_t kg_mc=0, const size_t kg_↵ mb=0, const size_t kg_j=0)

17.196.1 Macro Definition Documentation

17.196.1.1 __FFLASFFPACK_ffpack_minpoly_INL

```
#define __FFLASFFPACK_ffpack_minpoly_INL
```

17.197 ffpack_permutation.inl File Reference

```
#include <givaro/zring.h>
#include "fflas-ffpack/fflas/fflas_fassign.h"
```

Namespaces

- namespace [FFPACK](#)
Finite Field PACK Set of elimination based routines for dense linear algebra.

Macros

- #define [__FFLASFFPACK_ffpack_permutation_INL](#)
- #define [FFLASFFPACK_PERM_BKSIZE](#) 32

Functions

- template<class [Field](#) >
void [MonotonicApplyP](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const [FFLAS::FFLAS_TRANSPOSE](#) Trans, const size_t M, const size_t ibeg, const size_t iend, typename [Field::Element_ptr](#) A, const size_t lda, const size_t *P, const size_t R)
Apply a R-monotonically increasing permutation P, to the matrix A.
- template<class [Field](#) >
void [MonotonicCompress](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const size_t M, typename [Field::Element_ptr](#) A, const size_t lda, const size_t incA, const size_t *MathP, const size_t R, const size_t maxpiv, const size_t rowstomove, const std::vector< bool > &ispiv)
- template<class [Field](#) >
void [MonotonicCompressMorePivots](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const size_t M, type-name [Field::Element_ptr](#) A, const size_t lda, const size_t incA, const size_t *MathP, const size_t R, const size_t rowstomove, const size_t lenP)
- template<class [Field](#) >
void [MonotonicCompressCycles](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const size_t M, typename [Field::Element_ptr](#) A, const size_t lda, const size_t incA, const size_t *MathP, const size_t lenP)

- `template<class Field >`
`void MonotonicExpand (const Field &F, const FFLAS::FFLAS_SIDE Side, const size_t M, typename Field::Element_ptr A, const size_t lda, const size_t incA, const size_t *MathP, const size_t R, const size_t maxpiv, const size_t rowstomove, const std::vector< bool > &ispiv)`
- `template<class Field >`
`void applyP_block (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t M, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const size_t *P)`
- `template<class Field >`
`void applyP (const Field &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t m, const size_t ibeg, const size_t iend, typename Field::Element_ptr A, const size_t lda, const size_t *P, const FFLAS::ParSeqHelper::Sequential seq)`
- `template<class Field >`
`void doApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field >`
`void MatrixApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field >`
`void MatrixApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const FFLAS::ParSeqHelper::Sequential seq)`
- `template<class Field, class Cut, class Param >`
`void MatrixApplyS (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par)`
- `template<class T >`
`void PermApplyS (T *A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field >`
`void doApplyT (const Field &F, typename Field::Element_ptr A, const size_t lda, typename Field::Element_ptr tmp, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field >`
`void MatrixApplyT (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `template<class Field >`
`void MatrixApplyT (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const FFLAS::ParSeqHelper::Sequential seq)`
- `template<class Field, class Cut, class Param >`
`void MatrixApplyT (const Field &F, typename Field::Element_ptr A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, const FFLAS::ParSeqHelper::Parallel< Cut, Param > par)`
- `template<class T >`
`void PermApplyT (T *A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)`
- `void LAPACKPerm2MathPerm (size_t *MathP, const size_t *LapackP, const size_t N)`
Conversion of a permutation from LAPACK format to Math format.
- `void MathPerm2LAPACKPerm (size_t *LapackP, const size_t *MathP, const size_t N)`
Conversion of a permutation from Maths format to LAPACK format.
- `void composePermutationsLLL (size_t *P1, const size_t *P2, const size_t R, const size_t N)`
Computes $P1 \times \text{Diag}(I_R, P2)$ where $P1$ is a LAPACK and $P2$ a LAPACK permutation and store the result in $P1$ as a LAPACK permutation.
- `void composePermutationsLLM (size_t *MathP, const size_t *P1, const size_t *P2, const size_t R, const size_t N)`
Computes $P1 \times \text{Diag}(I_R, P2)$ where $P1$ is a LAPACK and $P2$ a LAPACK permutation and store the result in $MathP$ as a MathPermutation format.

- void [composePermutationsMLM](#) (size_t *MathP1, const size_t *P2, const size_t R, const size_t N)
Computes MathP1 x Diag (I_R, P2) where MathP1 is a MathPermutation and P2 a LAPACK permutation and store the result in MathP1 as a MathPermutation format.
- void [cyclic_shift_mathPerm](#) (size_t *P, const size_t s)
- template<class [Field](#) >
void [cyclic_shift_row_col](#) (const [Field](#) &F, typename [Field::Element_ptr](#) A, size_t m, size_t n, size_t lda)
- template<class [Field](#) >
void [cyclic_shift_row](#) (const [Field](#) &F, typename [Field::Element_ptr](#) A, size_t m, size_t n, size_t lda)
- template<typename T >
void [cyclic_shift_row](#) (const RNSIntegerMod< T > &F, typename [T::Element_ptr](#) A, size_t m, size_t n, size_t lda)
- template<class [Field](#) >
void [cyclic_shift_col](#) (const [Field](#) &F, typename [Field::Element_ptr](#) A, size_t m, size_t n, size_t lda)
- template<typename T >
void [cyclic_shift_col](#) (const RNSIntegerMod< T > &F, typename [T::Element_ptr](#) A, size_t m, size_t n, size_t lda)
- template<class [Field](#) >
void [applyP](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const [FFLAS::FFLAS_TRANSPOSE](#) Trans, const size_t M, const size_t ibeg, const size_t iend, typename [Field::Element_ptr](#) A, const size_t lda, const size_t *P)
Computes P1 x Diag (I_R, P2) where P1 is a LAPACK and P2 a LAPACK permutation and store the result in P1 as a LAPACK permutation.
- template<class [Field](#) , class Cut , class Param >
void [applyP](#) (const [Field](#) &F, const [FFLAS::FFLAS_SIDE](#) Side, const [FFLAS::FFLAS_TRANSPOSE](#) Trans, const size_t m, const size_t ibeg, const size_t iend, typename [Field::Element_ptr](#) A, const size_t lda, const size_t *P, const [FFLAS::ParSeqHelper::Parallel](#)< Cut, Param > par)

17.197.1 Macro Definition Documentation

17.197.1.1 __FFLASFFPACK_ffpack_permutation_INL

```
#define __FFLASFFPACK_ffpack_permutation_INL
```

17.197.1.2 FFLASFFPACK_PERM_BKSIZE

```
#define FFLASFFPACK_PERM_BKSIZE 32
```

17.198 ffpack_pluq.inl File Reference

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_ffpack_pluq_INL](#)
- #define [CROUT](#)

Functions

- template<class [Field](#) >
size_t [PLUQ_basecaseV3](#) (const [Field](#) &Fi, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t M, const size_t N, typename [Field::Element](#) *A, const size_t lda, size_t *P, size_t *Q)

- template<class [Field](#) >
size_t [PLUQ_basecaseV2](#) (const [Field](#) &Fi, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t M, const size_t N, typename [Field::Element](#) *A, const size_t lda, size_t *P, size_t *Q)
- template<class [Field](#) >
size_t [PLUQ_basecaseCrout](#) (const [Field](#) &Fi, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *P, size_t *Q)
- template<class [Field](#) >
size_t [_PLUQ](#) (const [Field](#) &Fi, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *P, size_t *Q, size_t BCThreshold)
- template<class [Field](#) >
size_t [PLUQ](#) (const [Field](#) &F, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *P, size_t *Q, const [FFLAS::ParSeqHelper::Sequential](#) &PSHelper, size_t BCThreshold=[__FFLASFFPACK_PLUQ_THRESHOLD](#))
- template<class [Field](#) >
size_t [PLUQ](#) (const [Field](#) &F, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *P, size_t *Q)

Compute a PLUQ factorization of the given matrix.

17.198.1 Macro Definition Documentation

17.198.1.1 [__FFLASFFPACK_ffpack_pluq_INL](#)

```
#define \_\_FFLASFFPACK\_ffpack\_pluq\_INL
```

17.198.1.2 CROUT

```
#define CROUT
```

17.199 [ffpack_pluq_mp.inl](#) File Reference

```
#include "fflas-ffpack/field/rns-integer-mod.h"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/fflas-ffpack.h"
#include "givaro/givinteger.h"
#include "givaro/modular-integer.h"
```

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFPACK_pluq_mp_INL](#)

Functions

- template<class Cut, class Param >
size_t [PLUQ](#) (const Givaro::Modular< Givaro::Integer > &F, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t M, const size_t N, typename Givaro::Integer *A, const size_t lda, size_t *P, size_t *Q, size_t BCThreshold, [FFLAS::ParSeqHelper::Parallel](#)< Cut, Param > &PSHelper)

17.199.1 Macro Definition Documentation

17.199.1.1 __FFPACK_pluq_mp_INL

```
#define __FFPACK_pluq_mp_INL
```

17.200 ffpack_ppluq.inl File Reference

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_ffpack_ppluq_INL](#)
- #define [__FFLAS__TRSM_READONLY](#)
- #define [PBASECASE_K](#) 256

Functions

- template<class [Field](#) >
void [threads_fgemm](#) (const size_t m, const size_t n, const size_t r, int nbthreads, size_t *W1, size_t *W2, size_t *W3, size_t gamma)
- template<class [Field](#) >
void [threads_frsm](#) (const size_t m, const size_t n, int nbthreads, size_t *t1, size_t *t2)
- template<class [Field](#) >
size_t [PLUQ](#) (const [Field](#) &Fi, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *P, size_t *Q, const [FFLAS::ParSeqHelper::Parallel](#)<[FFLAS::CuttingStrategy::Recursive](#), [FFLAS::StrategyParameter::Threads](#) > &PHelper)
- template<class [Field](#) >
size_t [pPLUQ](#) (const [Field](#) &F, const [FFLAS::FFLAS_DIAG](#) Diag, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *P, size_t *Q)

17.200.1 Macro Definition Documentation

17.200.1.1 __FFLASFFPACK_ffpack_ppluq_INL

```
#define __FFLASFFPACK_ffpack_ppluq_INL
```

17.200.1.2 __FFLAS__TRSM_READONLY

```
#define __FFLAS__TRSM_READONLY
```

17.200.1.3 PBASECASE_K

```
#define PBASECASE_K 256
```

17.201 ffpack_rankprofiles.inl File Reference

Namespaces

- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_ffpack_rank_profiles_INL](#)

Functions

- template<class [Field](#) >
size_t [RowRankProfile](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *rkprofile, const FFPACK_LU_TAG LuTag=[FfpackSlabRecursive](#))
Computes the row rank profile of A.
- template<class [Field](#) >
size_t [pRowRankProfile](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *rkprofile, size_t numthreads=0, const FFPACK_LU_TAG LuTag=[FfpackTileRecursive](#))
- template<class [Field](#), class PSHelper >
size_t [RowRankProfile](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *rkprofile, const FFPACK_LU_TAG LuTag, PSHelper &psH)
- template<class [Field](#) >
size_t [ColumnRankProfile](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *rkprofile, const FFPACK_LU_TAG LuTag=[FfpackSlabRecursive](#))
Computes the column rank profile of A.
- template<class [Field](#) >
size_t [pColumnRankProfile](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *rkprofile, size_t numthreads=0, const FFPACK_LU_TAG LuTag=[FfpackTileRecursive](#))
- template<class [Field](#), class PSHelper >
size_t [ColumnRankProfile](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *rkprofile, const FFPACK_LU_TAG LuTag, PSHelper &psH)
- void [RankProfileFromLU](#) (const size_t *P, const size_t N, const size_t R, size_t *rkprofile, const FFPACK_LU_TAG LuTag)
Recovers the column/row rank profile from the permutation of an LU decomposition.
- size_t [LeadingSubmatrixRankProfiles](#) (const size_t M, const size_t N, const size_t R, const size_t LSm, const size_t LSn, const size_t *P, const size_t *Q, size_t *RRP, size_t *CRP)
Recovers the row and column rank profiles of any leading submatrix from the PLUQ decomposition.
- template<class [Field](#) >
size_t [RowRankProfileSubmatrixIndices](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *&rowindices, size_t *&colindices, size_t &R)
RowRankProfileSubmatrixIndices.
- template<class [Field](#) >
size_t [ColRankProfileSubmatrixIndices](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, size_t *&rowindices, size_t *&colindices, size_t &R)
Computes the indices of the submatrix $r \times r$ X of A whose columns correspond to the column rank profile of A.
- template<class [Field](#) >
size_t [RowRankProfileSubmatrix](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) &X, size_t &R)
Computes the $r \times r$ submatrix X of A, by picking the row rank profile rows of A.
- template<class [Field](#) >
size_t [ColRankProfileSubmatrix](#) (const [Field](#) &F, const size_t M, const size_t N, typename [Field::Element_ptr](#) A, const size_t lda, typename [Field::Element_ptr](#) &X, size_t &R)
Compute the $r \times r$ submatrix X of A, by picking the row rank profile rows of A.

- template<class [Field](#) >
[Field::Element_ptr](#) [LQUPtoInverseOfFullRankMinor](#) (const [Field](#) &F, const size_t rank, typename [Field::Element_ptr](#) A_factors, const size_t lda, const size_t *QtPointer, typename [Field::Element_ptr](#) X, const size_t ldx)
LQUPtoInverseOfFullRankMinor.

17.201.1 Macro Definition Documentation

17.201.1.1 __FFLASFFPACK_ffpack_rank_profiles_INL

```
#define __FFLASFFPACK_ffpack_rank_profiles_INL
```

17.202 field-traits.h File Reference

Field Traits.

```
#include <type_traits>
#include "fflas-ffpack/field/rns-double-elt.h"
#include "recint/rmint.h"
#include "givaro/modular-general.h"
#include "givaro/zring.h"
```

Data Structures

- struct [GenericTag](#)
generic ring.
- struct [ModularTag](#)
This is a modular field like e.g. [Modular<T>](#) or [ModularBalanced<T>](#)
- struct [UnparametricTag](#)
If the field uses a representation with infix operators.
- struct [DefaultTag](#)
No specific mode of action: use standard field operations.
- struct [DefaultBoundedTag](#)
Use standard field operations, but keeps track of bounds on input and output.
- struct [ConvertTo< T >](#)
Force conversion to appropriate element type of [ElementCategory](#) T.
- struct [DelayedTag](#)
Performs field operations with delayed mod reductions. Ensures result is reduced.
- struct [LazyTag](#)
Performs field operations with delayed mod only when necessary. Result may not be reduced.
- struct [GenericTag](#)
default is generic
- struct [MachineFloatTag](#)
float or double
- struct [MachineIntTag](#)
short, int, long, long long, and unsigned variants
- struct [FixedPrecIntTag](#)
Fixed precision integers above machine precision: [Givaro::reclnt](#).
- struct [ArbitraryPrecIntTag](#)
Arbitrary precision integers: GMP.
- struct [RNSElementTag](#)

Representation in a Residue Number System.

- struct [ElementTraits](#)< [Element](#) >

ElementTraits.

- struct [ElementTraits](#)< float >
- struct [ElementTraits](#)< double >
- struct [ElementTraits](#)< int8_t >
- struct [ElementTraits](#)< int16_t >
- struct [ElementTraits](#)< int32_t >
- struct [ElementTraits](#)< int64_t >
- struct [ElementTraits](#)< uint8_t >
- struct [ElementTraits](#)< uint16_t >
- struct [ElementTraits](#)< uint32_t >
- struct [ElementTraits](#)< uint64_t >
- struct [ElementTraits](#)< Givaro::Integer >
- struct [ElementTraits](#)< Reclnt::rint< K > >
- struct [ElementTraits](#)< Reclnt::ruint< K > >
- struct [ElementTraits](#)< Reclnt::rmint< K, MG > >
- struct [ElementTraits](#)< FFPACK::rns_double_elt >
- struct [ModeTraits](#)< [Field](#) >

ModeTraits.

- struct [ModeTraits](#)< Givaro::Modular< [Element](#), [Compute](#) > >
- struct [ModeTraits](#)< Givaro::Modular< int8_t, [Compute](#) > >
- struct [ModeTraits](#)< Givaro::Modular< int16_t, [Compute](#) > >
- struct [ModeTraits](#)< Givaro::Modular< int32_t, [Compute](#) > >
- struct [ModeTraits](#)< Givaro::Modular< uint8_t, [Compute](#) > >
- struct [ModeTraits](#)< Givaro::Modular< uint16_t, [Compute](#) > >
- struct [ModeTraits](#)< Givaro::Modular< uint32_t, [Compute](#) > >
- struct [ModeTraits](#)< Givaro::Modular< Givaro::Integer, [Compute](#) > >
- struct [ModeTraits](#)< Givaro::Modular< Reclnt::ruint< K >, [Compute](#) > >
- struct [ModeTraits](#)< Givaro::ModularBalanced< [Element](#) > >
- struct [ModeTraits](#)< Givaro::ModularBalanced< int8_t > >
- struct [ModeTraits](#)< Givaro::ModularBalanced< int16_t > >
- struct [ModeTraits](#)< Givaro::ModularBalanced< int32_t > >
- struct [ModeTraits](#)< Givaro::ModularBalanced< Givaro::Integer > >
- struct [ModeTraits](#)< Givaro::ZRing< Givaro::Integer > >
- struct [ModeTraits](#)< Givaro::ZRing< float > >
- struct [ModeTraits](#)< Givaro::ZRing< double > >
- struct [ModeTraits](#)< Givaro::Montgomery< T > >
- struct [FieldTraits](#)< [Field](#) >

FieldTrait.

- struct [FieldTraits](#)< Givaro::ZRing< Reclnt::ruint< K > > >
- struct [FieldTraits](#)< Givaro::Modular< [Element](#) > >
- struct [FieldTraits](#)< Givaro::ModularBalanced< [Element](#) > >
- struct [FieldTraits](#)< Givaro::ZRing< double > >
- struct [FieldTraits](#)< Givaro::ZRing< float > >
- struct [FieldTraits](#)< Givaro::ZRing< int16_t > >
- struct [FieldTraits](#)< Givaro::ZRing< uint16_t > >
- struct [FieldTraits](#)< Givaro::ZRing< int32_t > >
- struct [FieldTraits](#)< Givaro::ZRing< uint32_t > >
- struct [FieldTraits](#)< Givaro::ZRing< int64_t > >
- struct [FieldTraits](#)< Givaro::ZRing< uint64_t > >
- struct [FieldTraits](#)< Givaro::ZRing< Givaro::Integer > >
- struct [FieldTraits](#)< FFPACK::RNSInteger< T > >
- struct [FieldTraits](#)< FFPACK::RNSIntegerMod< T > >

- struct [associatedDelayedField< Field >](#)
- struct [associatedDelayedField< const Givaro::Modular< T, X > >](#)
- struct [associatedDelayedField< const Givaro::ModularBalanced< T > >](#)
- struct [associatedDelayedField< const Givaro::ZRing< T > >](#)
- struct [associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > >](#)

Namespaces

- namespace [Reclnt](#)
- namespace [Givaro](#)
- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- namespace [FFLAS](#)
- namespace [FFLAS::FieldCategories](#)
Traits and categories will need to be placed in a proper file later.
- namespace [FFLAS::ModeCategories](#)
Specifies the mode of action for an algorithm w.r.t.
- namespace [FFLAS::ElementCategories](#)

17.202.1 Detailed Description

Field Traits.

17.203 field.doxy File Reference

17.204 rns-double-elt.h File Reference

rns elt structure with double support

```
#include "fflas-ffpack/utils/fflas_memory.h"
#include "fflas-ffpack/utils/cast.h"
```

Data Structures

- struct [rns_double_elt](#)
- struct [rns_double_elt_ptr](#)
- struct [rns_double_elt_cstptr](#)

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Functions

- template<> [rns_double_elt_ptr fflas_const_cast](#) (rns_double_elt_cstptr x)
- template<> [rns_double_elt_cstptr fflas_const_cast](#) (rns_double_elt_ptr x)

17.204.1 Detailed Description

rns elt structure with double support

17.205 rns-double-recint.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_freduce.h"
```

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [__FFLASFFPACK_field_rns_double_recint_INL](#)

17.205.1 Macro Definition Documentation

17.205.1.1 __FFLASFFPACK_field_rns_double_recint_INL

```
#define __FFLASFFPACK_field_rns_double_recint_INL
```

17.206 rns-double.h File Reference

rns structure with double support

```
#include <iterator>
#include <vector>
#include <givaro/modular-floating.h>
#include <givaro/givinteger.h>
#include <givaro/givintprime.h>
#include "givaro/modular-extended.h"
#include <recint/ruint.h>
#include "fflas-ffpack/config-blas.h"
#include "fflas-ffpack/utils/fflas_memory.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include "fflas-ffpack/field/rns-double-elt.h"
#include "rns-double.inl"
#include "rns-double-recint.inl"
```

Data Structures

- struct [rns_double](#)
- struct [rns_double_extended](#)
- class [rnsRandIter](#)< [RNS](#) >

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*
- namespace [FFLAS](#)

Macros

- #define [ROUND_DOWN](#)(x, s) ((x) & ~((s)-1))

Functions

- `template<> void fflas_delete (FFPACK::rns_double_elt_ptr A)`
- `template<> void fflas_delete (FFPACK::rns_double_elt_cstptr A)`

17.206.1 Detailed Description

rns structure with double support

17.206.2 Macro Definition Documentation

17.206.2.1 ROUND_DOWN

```
#define ROUND_DOWN(
    x,
    s ) ((x) & ~((s)-1))
```

17.207 rns-double.inl File Reference

```
#include "fflas-ffpack/fflas/fflas_freduce.h"
```

Namespaces

- namespace [FFPACK](#)
Finite Field PACK Set of elimination based routines for dense linear algebra.

Macros

- `#define __FFLASFFPACK_field_rns_double_INL`

17.207.1 Macro Definition Documentation

17.207.1.1 __FFLASFFPACK_field_rns_double_INL

```
#define __FFLASFFPACK_field_rns_double_INL
```

17.208 rns-integer-mod.h File Reference

representation of $\mathbb{Z}/p\mathbb{Z}$ using RNS representation (note: fixed precision)

```
#include <vector>
#include <cmath>
#include <recint/recint.h>
#include <givaro/modular-integer.h>
#include <givaro/givinteger.h>
#include <givaro/udl.h>
#include "givaro/modular-extended.h"
#include "fflas-ffpack/field/rns-double.h"
#include "fflas-ffpack/field/rns-integer.h"
#include "fflas-ffpack/fflas/fflas_level1.inl"
#include "fflas-ffpack/fflas/fflas_level2.inl"
#include "fflas-ffpack/fflas/fflas_level3.inl"
#include "fflas-ffpack/fflas/fflas_enum.h"
```

```
#include "fflas-ffpack/fflas/fflas_fscal_mp.inl"
```

Data Structures

- class [RNSIntegerMod< RNS >](#)
- class [RNSIntegerMod< RNS >::RandIter](#)

Namespaces

- namespace [FFPACK](#)
Finite Field PACK Set of elimination based routines for dense linear algebra.
- namespace [FFLAS](#)

Functions

- template<> [FFPACK::rns_double_elt_ptr fflas_new](#) (const [FFPACK::RNSIntegerMod< FFPACK::rns_double >](#) &F, const size_t m, const Alignment align)
- template<> [FFPACK::rns_double_elt_ptr fflas_new](#) (const [FFPACK::RNSIntegerMod< FFPACK::rns_double >](#) &F, const size_t m, const size_t n, const Alignment align)
- template<typename [RNS](#) >
void [finit_rns](#) (const [FFPACK::RNSIntegerMod< RNS >](#) &F, const size_t m, const size_t n, size_t k, const Givaro::Integer *B, const size_t ldb, typename [RNS::Element_ptr](#) A)
- template<typename [RNS](#) >
void [finit_trans_rns](#) (const [FFPACK::RNSIntegerMod< RNS >](#) &F, const size_t m, const size_t n, size_t k, const Givaro::Integer *B, const size_t ldb, typename [RNS::Element_ptr](#) A)
- template<typename [RNS](#) >
void [fconvert_rns](#) (const [FFPACK::RNSIntegerMod< RNS >](#) &F, const size_t m, const size_t n, Givaro::Integer alpha, Givaro::Integer *B, const size_t ldb, typename [RNS::ConstElement_ptr](#) A)
- template<typename [RNS](#) >
void [fconvert_trans_rns](#) (const [FFPACK::RNSIntegerMod< RNS >](#) &F, const size_t m, const size_t n, Givaro::Integer alpha, Givaro::Integer *B, const size_t ldb, typename [RNS::ConstElement_ptr](#) A)

17.208.1 Detailed Description

representation of $\mathbb{Z}/p\mathbb{Z}$ using RNS representation (note: fixed precision)

17.209 rns-integer.h File Reference

representation of \mathbb{Z} using RNS representation (note: fixed precision)

```
#include <givaro/givinteger.h>
#include "fflas-ffpack/field/rns-double.h"
```

Data Structures

- class [RNSInteger< RNS >](#)
- class [RNSInteger< RNS >::RandIter](#)

Namespaces

- namespace [FFPACK](#)
Finite Field PACK Set of elimination based routines for dense linear algebra.
- namespace [FFLAS](#)

Functions

- `template<> FFPACK::rns_double_elt_ptr fflas_new` (const `FFPACK::RNSInteger< FFPACK::rns_double >` &F, const `size_t` m, const `Alignment` align)
- `template<> FFPACK::rns_double_elt_ptr fflas_new` (const `FFPACK::RNSInteger< FFPACK::rns_double >` &F, const `size_t` m, const `size_t` n, const `Alignment` align)
- `template<typename RNS >`
void `finit_rns` (const `FFPACK::RNSInteger< RNS >` &F, const `size_t` m, const `size_t` n, `size_t` k, const `Givaro::Integer *B`, const `size_t` ldb, `typename FFPACK::RNSInteger< RNS >::Element_ptr` A)
- `template<typename RNS >`
void `fconvert_rns` (const `FFPACK::RNSInteger< RNS >` &F, const `size_t` m, const `size_t` n, `Givaro::Integer` alpha, `Givaro::Integer *B`, const `size_t` ldb, `typename FFPACK::RNSInteger< RNS >::ConstElement_ptr` A)

17.209.1 Detailed Description

representation of \mathbb{Z} using RNS representation (note: fixed precision)

17.210 rns.h File Reference

Namespaces

- namespace `FFPACK`
Finite Field PACK Set of elimination based routines for dense linear algebra.

17.211 rns.inl File Reference

```
#include "rns-double.h"
#include "rns-integer.h"
#include "rns-integer-mod.h"
```

Macros

- `#define __FFLASFFPACK_field_rns_INL`

17.211.1 Macro Definition Documentation

17.211.1.1 __FFLASFFPACK_field_rns_INL

```
#define __FFLASFFPACK_field_rns_INL
```

17.212 interfaces.doxy File Reference

17.213 fflas_c.h File Reference

```
#include <stdbool.h>
#include <stdlib.h>
#include <inttypes.h>
```

Macros

- `#define FFLAS_COMPILED`

Enumerations

- enum `FFLAS_C_ORDER` { `FflasRowMajor` = 101 , `FflasColMajor` = 102 , `FflasRowMajor` = 101 , `FflasColMajor` = 102 }
- Storage by row or col ?*
- enum `FFLAS_C_TRANSPOSE` { `FflasNoTrans` = 111 , `FflasTrans` = 112 , `FflasNoTrans` = 111 , `FflasTrans` = 112 }
- Is matrix transposed ?*
- enum `FFLAS_C_UPLO` { `FflasUpper` = 121 , `FflasLower` = 122 , `FflasUpper` = 121 , `FflasLower` = 122 }
- Is triangular matrix's shape upper ?*
- enum `FFLAS_C_DIAG` { `FflasNonUnit` = 131 , `FflasUnit` = 132 , `FflasNonUnit` = 131 , `FflasUnit` = 132 }
- Is the triangular matrix implicitly unit diagonal ?*
- enum `FFLAS_C_SIDE` { `FflasLeft` = 141 , `FflasRight` = 142 , `FflasLeft` = 141 , `FflasRight` = 142 }
- On what side ?*
- enum `FFLAS_C_BASE` { `FflasDouble` = 151 , `FflasFloat` = 152 , `FflasGeneric` = 153 }
- FFLAS_C_BASE determines the type of the element representation for Matrix Mult kernel.*

Functions

- void `freducein_1_modular_double` (const double p, const size_t n, double *X, const size_t incX, bool positive)
- void `freduce_1_modular_double` (const double F, const size_t n, const double *Y, const size_t incY, double *X, const size_t incX, bool positive)
- void `fnegin_1_modular_double` (const double F, const size_t n, double *X, const size_t incX, bool positive)
- void `fneg_1_modular_double` (const double p, const size_t n, const double *Y, const size_t incY, double *X, const size_t incX, bool positive)
- void `fzero_1_modular_double` (const double p, const size_t n, double *X, const size_t incX, bool positive)
- bool `fiszero_1_modular_double` (const double p, const size_t n, const double *X, const size_t incX, bool positive)
- bool `fequal_1_modular_double` (const double p, const size_t n, const double *X, const size_t incX, const double *Y, const size_t incY, bool positive)
- void `fassign_1_modular_double` (const double p, const size_t n, const double *Y, const size_t incY, double *X, const size_t incX, bool positive)
- void `fscal_1_modular_double` (const double p, const size_t n, const double alpha, double *X, const size_t incX, bool positive)
- void `fsca_1_modular_double` (const double p, const size_t n, const double alpha, const double *X, const size_t incX, double *Y, const size_t incY, bool positive)
- void `faxpy_1_modular_double` (const double p, const size_t n, const double alpha, const double *X, const size_t incX, double *Y, const size_t incY, bool positive)
- double `fdot_1_modular_double` (const double p, const size_t n, const double *X, const size_t incX, const double *Y, const size_t incY, bool positive)
- void `fswap_1_modular_double` (const double p, const size_t n, double *X, const size_t incX, double *Y, const size_t incY, bool positive)
- void `fadd_1_modular_double` (const double p, const size_t n, const double *A, const size_t incA, const double *B, const size_t incB, double *C, const size_t incC, bool positive)
- void `fsub_1_modular_double` (const double p, const size_t n, const double *A, const size_t incA, const double *B, const size_t incB, double *C, const size_t incC, bool positive)
- void `faddin_1_modular_double` (const double p, const size_t n, const double *B, const size_t incB, double *C, const size_t incC, bool positive)
- void `fsubin_1_modular_double` (const double p, const size_t n, const double *B, const size_t incB, double *C, const size_t incC, bool positive)
- void `fassign_2_modular_double` (const double p, const size_t m, const size_t n, const double *B, const size_t incB, const double *A, const size_t incA, bool positive)
- void `fzero_2_modular_double` (const double p, const size_t m, const size_t n, double *A, const size_t incA, bool positive)
- bool `fequal_2_modular_double` (const double p, const size_t m, const size_t n, const double *A, const size_t incA, const double *B, const size_t incB, bool positive)

- `bool fiszero_2_modular_double` (const double p, const size_t m, const size_t n, const double *A, const size_t lda, bool positive)
- `void fidentity_2_modular_double` (const double p, const size_t m, const size_t n, double *A, const size_t lda, const double d, bool positive)
- `void freducein_2_modular_double` (const double p, const size_t m, const size_t n, double *A, const size_t lda, bool positive)
- `void freduce_2_modular_double` (const double p, const size_t m, const size_t n, const double *B, const size_t ldb, double *A, const size_t lda, bool positive)
- `void fnegin_2_modular_double` (const double p, const size_t m, const size_t n, double *A, const size_t lda, bool positive)
- `void fneg_2_modular_double` (const double p, const size_t m, const size_t n, const double *B, const size_t ldb, double *A, const size_t lda, bool positive)
- `void fscal_2_modular_double` (const double p, const size_t m, const size_t n, const double alpha, double *A, const size_t lda, bool positive)
- `void fscale_2_modular_double` (const double p, const size_t m, const size_t n, const double alpha, const double *A, const size_t lda, double *B, const size_t ldb, bool positive)
- `void faxpy_2_modular_double` (const double p, const size_t m, const size_t n, const double alpha, const double *X, const size_t ldX, double *Y, const size_t ldY, bool positive)
- `void fmove_2_modular_double` (const double p, const size_t m, const size_t n, double *A, const size_t lda, double *B, const size_t ldb, bool positive)
- `void fadd_2_modular_double` (const double p, const size_t m, const size_t n, const double *A, const size_t lda, const double *B, const size_t ldb, double *C, const size_t ldc, bool positive)
- `void fsub_2_modular_double` (const double p, const size_t m, const size_t n, const double *A, const size_t lda, const double *B, const size_t ldb, double *C, const size_t ldc, bool positive)
- `void fsubin_2_modular_double` (const double p, const size_t m, const size_t n, const double *B, const size_t ldb, double *C, const size_t ldc, bool positive)
- `void faddin_2_modular_double` (const double p, const size_t m, const size_t n, const double *B, const size_t ldb, double *C, const size_t ldc, bool positive)
- `double * fgemv_2_modular_double` (const double p, const enum FFLAS_C_TRANSPOSE TransA, const size_t m, const size_t n, const double alpha, const double *A, const size_t lda, const double *X, const size_t incX, const double beta, double *Y, const size_t incY, bool positive)
- `void fger_2_modular_double` (const double p, const size_t m, const size_t n, const double alpha, const double *x, const size_t incX, const double *y, const size_t incY, double *A, const size_t lda, bool positive)
- `void ftrsv_2_modular_double` (const double p, const enum FFLAS_C_UPLO Uplo, const enum FFLAS_C_TRANSPOSE TransA, const enum FFLAS_C_DIAG Diag, const size_t n, const double *A, const size_t lda, double *X, int incX, bool positive)
- `void ftrsm_3_modular_double` (const double p, const enum FFLAS_C_SIDE Side, const enum FFLAS_C_UPLO Uplo, const enum FFLAS_C_TRANSPOSE TransA, const enum FFLAS_C_DIAG Diag, const size_t m, const size_t n, const double alpha, const double *A, const size_t lda, double *B, const size_t ldb, bool positive)
- `void ftrmm_3_modular_double` (const double p, const enum FFLAS_C_SIDE Side, const enum FFLAS_C_UPLO Uplo, const enum FFLAS_C_TRANSPOSE TransA, const enum FFLAS_C_DIAG Diag, const size_t m, const size_t n, const double alpha, double *A, const size_t lda, double *B, const size_t ldb, bool positive)
- `double * fgemm_3_modular_double` (const double p, const enum FFLAS_C_TRANSPOSE tA, const enum FFLAS_C_TRANSPOSE tB, const size_t m, const size_t n, const size_t k, const double alpha, const double *A, const size_t lda, const double *B, const size_t ldb, const double beta, double *C, const size_t ldc, bool positive)
- `double * fsquare_3_modular_double` (const double p, const enum FFLAS_C_TRANSPOSE tA, const size_t n, const double alpha, const double *A, const size_t lda, const double beta, double *C, const size_t ldc, bool positive)

17.213.1 Macro Definition Documentation

17.213.1.1 FFLAS_COMPILED

```
#define FFLAS_COMPILED
```

17.213.2 Enumeration Type Documentation

17.213.2.1 FFLAS_C_ORDER

```
enum FFLAS_C_ORDER
```

Storage by row or col ?

Enumerator

FflasRowMajor	row major
FflasColMajor	col major
FflasRowMajor	
FflasColMajor	

17.213.2.2 FFLAS_C_TRANSPOSE

```
enum FFLAS_C_TRANSPOSE
```

Is matrix transposed ?

Enumerator

FflasNoTrans	Matrix is not transposed.
FflasTrans	Matrix is transposed.
FflasNoTrans	
FflasTrans	

17.213.2.3 FFLAS_C_UPLO

```
enum FFLAS_C_UPLO
```

Is triangular matrix's shape upper ?

Enumerator

FflasUpper	Triangular matrix is Upper triangular (if $i > j$ then $T_{i,j} = 0$)
FflasLower	Triangular matrix is Lower triangular (if $i < j$ then $T_{i,j} = 0$)
FflasUpper	
FflasLower	

17.213.2.4 FFLAS_C_DIAG

```
enum FFLAS_C_DIAG
```

Is the triangular matrix implicitly unit diagonal ?

Enumerator

FflasNonUnit	Triangular matrix has an explicit arbitrary diagonal.
FflasUnit	Triangular matrix has an implicit unit diagonal ($T_{i,i} = 1$)
FflasNonUnit	
FflasUnit	

17.213.2.5 FFLAS_C_SIDE

enum [FFLAS_C_SIDE](#)

On what side ?

Enumerator

FflasLeft	Operator applied on the left.
FflasRight	Operator applied on the righth.
FflasLeft	
FflasRight	

17.213.2.6 FFLAS_C_BASE

enum [FFLAS_C_BASE](#)

FFLAS_C_BASE determines the type of the element representation for Matrix Mult kernel.
(deprecated, should not be used)

Enumerator

FflasDouble	to use the double precision BLAS
FflasFloat	to use the single precision BLAS
FflasGeneric	for any other domain, that can not be converted to floating point integers

17.213.3 Function Documentation

17.213.3.1 `freducein_1_modular_double()`

```
void freducein_1_modular_double (
    const double p,
    const size_t n,
    double * X,
    const size_t incX,
    bool positive )
```

17.213.3.2 `freduce_1_modular_double()`

```
void freduce_1_modular_double (
    const double F,
    const size_t n,
    const double * Y,
```

```
    const size_t incY,  
    double * X,  
    const size_t incX,  
    bool positive )
```

17.213.3.3 fnegin_1_modular_double()

```
void fnegin_1_modular_double (  
    const double F,  
    const size_t n,  
    double * X,  
    const size_t incX,  
    bool positive )
```

17.213.3.4 fneg_1_modular_double()

```
void fneg_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * Y,  
    const size_t incY,  
    double * X,  
    const size_t incX,  
    bool positive )
```

17.213.3.5 fzero_1_modular_double()

```
void fzero_1_modular_double (  
    const double p,  
    const size_t n,  
    double * X,  
    const size_t incX,  
    bool positive )
```

17.213.3.6 fiszero_1_modular_double()

```
bool fiszero_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * X,  
    const size_t incX,  
    bool positive )
```

17.213.3.7 fequal_1_modular_double()

```
bool fequal_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * X,  
    const size_t incX,  
    const double * Y,  
    const size_t incY,  
    bool positive )
```

17.213.3.8 fassign_1_modular_double()

```
void fassign_1_modular_double (
    const double p,
    const size_t n,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX,
    bool positive )
```

17.213.3.9 fscaln_1_modular_double()

```
void fscaln_1_modular_double (
    const double p,
    const size_t n,
    const double alpha,
    double * X,
    const size_t incX,
    bool positive )
```

17.213.3.10 fscale_1_modular_double()

```
void fscale_1_modular_double (
    const double p,
    const size_t n,
    const double alpha,
    const double * X,
    const size_t incX,
    double * Y,
    const size_t incY,
    bool positive )
```

17.213.3.11 faxpy_1_modular_double()

```
void faxpy_1_modular_double (
    const double p,
    const size_t n,
    const double alpha,
    const double * X,
    const size_t incX,
    double * Y,
    const size_t incY,
    bool positive )
```

17.213.3.12 fdot_1_modular_double()

```
double fdot_1_modular_double (
    const double p,
    const size_t n,
    const double * X,
    const size_t incX,
    const double * Y,
    const size_t incY,
    bool positive )
```

17.213.3.13 fswap_1_modular_double()

```
void fswap_1_modular_double (
    const double p,
    const size_t n,
    double * X,
    const size_t incX,
    double * Y,
    const size_t incY,
    bool positive )
```

17.213.3.14 fadd_1_modular_double()

```
void fadd_1_modular_double (
    const double p,
    const size_t n,
    const double * A,
    const size_t incA,
    const double * B,
    const size_t incB,
    double * C,
    const size_t incC,
    bool positive )
```

17.213.3.15 fsub_1_modular_double()

```
void fsub_1_modular_double (
    const double p,
    const size_t n,
    const double * A,
    const size_t incA,
    const double * B,
    const size_t incB,
    double * C,
    const size_t incC,
    bool positive )
```

17.213.3.16 faddin_1_modular_double()

```
void faddin_1_modular_double (
    const double p,
    const size_t n,
    const double * B,
    const size_t incB,
    double * C,
    const size_t incC,
    bool positive )
```

17.213.3.17 fsubin_1_modular_double()

```
void fsubin_1_modular_double (
    const double p,
    const size_t n,
    const double * B,
    const size_t incB,
```

```
double * C,  
const size_t incC,  
bool positive )
```

17.213.3.18 fassign_2_modular_double()

```
void fassign_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * B,  
    const size_t ldB,  
    double * A,  
    const size_t ldA,  
    bool positive )
```

17.213.3.19 fzero_2_modular_double()

```
void fzero_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    double * A,  
    const size_t ldA,  
    bool positive )
```

17.213.3.20 fequal_2_modular_double()

```
bool fequal_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * A,  
    const size_t ldA,  
    const double * B,  
    const size_t ldB,  
    bool positive )
```

17.213.3.21 fiszero_2_modular_double()

```
bool fiszero_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * A,  
    const size_t ldA,  
    bool positive )
```

17.213.3.22 fidentity_2_modular_double()

```
void fidentity_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,
```

```
double * A,  
const size_t ldA,  
const double d,  
bool positive )
```

17.213.3.23 **freducein_2_modular_double()**

```
void freducein_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    double * A,  
    const size_t ldA,  
    bool positive )
```

17.213.3.24 **freduce_2_modular_double()**

```
void freduce_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * B,  
    const size_t ldB,  
    double * A,  
    const size_t ldA,  
    bool positive )
```

17.213.3.25 **fnegin_2_modular_double()**

```
void fnegin_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    double * A,  
    const size_t ldA,  
    bool positive )
```

17.213.3.26 **fneg_2_modular_double()**

```
void fneg_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * B,  
    const size_t ldB,  
    double * A,  
    const size_t ldA,  
    bool positive )
```

17.213.3.27 **fscaln_2_modular_double()**

```
void fscaln_2_modular_double (  
    const double p,  
    const size_t m,
```

```
    const size_t n,  
    const double alpha,  
    double * A,  
    const size_t ldA,  
    bool positive )
```

17.213.3.28 fscal_2_modular_double()

```
void fscal_2_modular_double (   
    const double p,  
    const size_t m,  
    const size_t n,  
    const double alpha,  
    const double * A,  
    const size_t ldA,  
    double * B,  
    const size_t ldB,  
    bool positive )
```

17.213.3.29 faxpy_2_modular_double()

```
void faxpy_2_modular_double (   
    const double p,  
    const size_t m,  
    const size_t n,  
    const double alpha,  
    const double * X,  
    const size_t ldX,  
    double * Y,  
    const size_t ldY,  
    bool positive )
```

17.213.3.30 fmove_2_modular_double()

```
void fmove_2_modular_double (   
    const double p,  
    const size_t m,  
    const size_t n,  
    double * A,  
    const size_t ldA,  
    double * B,  
    const size_t ldB,  
    bool positive )
```

17.213.3.31 fadd_2_modular_double()

```
void fadd_2_modular_double (   
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * A,  
    const size_t ldA,  
    const double * B,  
    const size_t ldB,  
    double * C,
```

```
    const size_t ldC,
    bool positive )
```

17.213.3.32 fsub_2_modular_double()

```
void fsub_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t ldA,
    const double * B,
    const size_t ldB,
    double * C,
    const size_t ldC,
    bool positive )
```

17.213.3.33 fsubin_2_modular_double()

```
void fsubin_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * B,
    const size_t ldB,
    double * C,
    const size_t ldC,
    bool positive )
```

17.213.3.34 faddin_2_modular_double()

```
void faddin_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * B,
    const size_t ldB,
    double * C,
    const size_t ldC,
    bool positive )
```

17.213.3.35 fgemv_2_modular_double()

```
double * fgemv_2_modular_double (
    const double p,
    const enum FFLAS_C_TRANSPOSE TransA,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t ldA,
    const double * X,
    const size_t incX,
    const double betA,
    double * Y,
```



```
    const size_t incY,  
    bool positive )
```

17.213.3.36 fger_2_modular_double()

```
void fger_2_modular_double (  
    const double p,  
    const size_t m,  
    const size_t n,  
    const double alpha,  
    const double * x,  
    const size_t incX,  
    const double * y,  
    const size_t incY,  
    double * A,  
    const size_t ldA,  
    bool positive )
```

17.213.3.37 ftrsv_2_modular_double()

```
void ftrsv_2_modular_double (  
    const double p,  
    const enum FFLAS_C_UPLO Uplo,  
    const enum FFLAS_C_TRANSPOSE TransA,  
    const enum FFLAS_C_DIAG Diag,  
    const size_t n,  
    const double * A,  
    const size_t ldA,  
    double * X,  
    int incX,  
    bool positive )
```

17.213.3.38 ftrsm_3_modular_double()

```
void ftrsm_3_modular_double (  
    const double p,  
    const enum FFLAS_C_SIDE Side,  
    const enum FFLAS_C_UPLO Uplo,  
    const enum FFLAS_C_TRANSPOSE TransA,  
    const enum FFLAS_C_DIAG Diag,  
    const size_t m,  
    const size_t n,  
    const double alpha,  
    const double * A,  
    const size_t ldA,  
    double * B,  
    const size_t ldB,  
    bool positive )
```

17.213.3.39 ftrmm_3_modular_double()

```
void ftrmm_3_modular_double (  
    const double p,  
    const enum FFLAS_C_SIDE Side,  
    const enum FFLAS_C_UPLO Uplo,
```

```

const enum FFLAS_C_TRANSPOSE TransA,
const enum FFLAS_C_DIAG Diag,
const size_t m,
const size_t n,
const double alpha,
double * A,
const size_t ldA,
double * B,
const size_t ldB,
bool positive )

```

17.213.3.40 fgemm_3_modular_double()

```

double * fgemm_3_modular_double (
    const double p,
    const enum FFLAS_C_TRANSPOSE tA,
    const enum FFLAS_C_TRANSPOSE tB,
    const size_t m,
    const size_t n,
    const size_t k,
    const double alpha,
    const double * A,
    const size_t ldA,
    const double * B,
    const size_t ldB,
    const double betA,
    double * C,
    const size_t ldC,
    bool positive )

```

17.213.3.41 fsquare_3_modular_double()

```

double * fsquare_3_modular_double (
    const double p,
    const enum FFLAS_C_TRANSPOSE tA,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t ldA,
    const double betA,
    double * C,
    const size_t ldC,
    bool positive )

```

17.214 fflas_L1_inst.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas_L1_inst_implem.inl"

```

Macros

- `#define __FFLAS_L1_INST_C`
- `#define INST_OR_DECL`
- `#define FFLAS_FIELD Givaro::ModularBalanced`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`
- `#define FFLAS_FIELD Givaro::Modular`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`

17.214.1 Macro Definition Documentation

17.214.1.1 __FFLAS_L1_INST_C

```
#define __FFLAS_L1_INST_C
```

17.214.1.2 INST_OR_DECL

```
#define INST_OR_DECL
```

17.214.1.3 FFLAS_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

17.214.1.4 FFLAS_ELT [1/6]

```
#define FFLAS_ELT double
```

17.214.1.5 FFLAS_ELT [2/6]

```
#define FFLAS_ELT float
```

17.214.1.6 FFLAS_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

17.214.1.7 FFLAS_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

17.214.1.8 FFLAS_ELT [4/6]

```
#define FFLAS_ELT double
```

17.214.1.9 FFLAS_ELT [5/6]

```
#define FFLAS_ELT float
```

17.214.1.10 FFLAS_ELT [6/6]

```
#define FFLAS_ELT int64_t
```

17.215 fflas_L1_inst.h File Reference

```
#include "givaro/modular.h"  
#include "givaro/modular-balanced.h"  
#include "fflas-ffpack/fflas/fflas.h"  
#include "fflas-ffpack/fflas/fflas_helpers.inl"  
#include "fflas_L1_inst_implem.inl"
```

Macros

- #define [INST_OR_DECL](#) <>
- #define [FFLAS_FIELD](#) Givaro::ModularBalanced
- #define [FFLAS_ELT](#) double
- #define [FFLAS_ELT](#) float
- #define [FFLAS_ELT](#) int64_t
- #define [FFLAS_FIELD](#) Givaro::Modular
- #define [FFLAS_ELT](#) double
- #define [FFLAS_ELT](#) float
- #define [FFLAS_ELT](#) int64_t

17.215.1 Macro Definition Documentation

17.215.1.1 INST_OR_DECL

```
#define INST_OR_DECL <>
```

17.215.1.2 FFLAS_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

17.215.1.3 FFLAS_ELT [1/6]

```
#define FFLAS_ELT double
```

17.215.1.4 FFLAS_ELT [2/6]

```
#define FFLAS_ELT float
```

17.215.1.5 FFLAS_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

17.215.1.6 FFLAS_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

17.215.1.7 FFLAS_ELT [4/6]

```
#define FFLAS_ELT double
```

17.215.1.8 FFLAS_ELT [5/6]

```
#define FFLAS_ELT float
```

17.215.1.9 FFLAS_ELT [6/6]

```
#define FFLAS_ELT int64_t
```

17.216 fflas_L1_inst_implem.inl File Reference**Namespaces**

- namespace [FFLAS](#)

Functions

- template [INST_OR_DECL](#) void [freduce](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t n, [FFLAS_ELT](#) *X, const size_t incX)

$$freduce\ x \leftarrow x mod F.$$
- template [INST_OR_DECL](#) void [freduce](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t n, const [FFLAS_ELT](#) *Y, const size_t incY, [FFLAS_ELT](#) *X, const size_t incX)

$$freduce\ x \leftarrow y mod F.$$
- template [INST_OR_DECL](#) void [finit](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t n, const [FFLAS_ELT](#) *Y, const size_t incY, [FFLAS_ELT](#) *X, const size_t incX)

$$finit\ x \leftarrow y mod F.$$
- template [INST_OR_DECL](#) void [fconvert](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t n, [FFLAS_ELT](#) *X, const size_t incX, const [FFLAS_ELT](#) *Y, const size_t incY)

$$fconvert\ x \leftarrow y mod F.$$
- template [INST_OR_DECL](#) void [fnegin](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t n, [FFLAS_ELT](#) *X, const size_t incX)

$$fnegin\ x \leftarrow -x.$$
- template [INST_OR_DECL](#) void [fneg](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t n, const [FFLAS_ELT](#) *Y, const size_t incY, [FFLAS_ELT](#) *X, const size_t incX)

$$fneg\ x \leftarrow -y.$$
- template [INST_OR_DECL](#) void [fzero](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t n, [FFLAS_ELT](#) *X, const size_t incX)

$$fzero : A \leftarrow 0.$$
- template [INST_OR_DECL](#) bool [fiszero](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t n, const [FFLAS_ELT](#) *X, const size_t incX)

$$fiszero : test\ X = 0.$$
- template [INST_OR_DECL](#) bool [fequal](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t n, const [FFLAS_ELT](#) *X, const size_t incX, const [FFLAS_ELT](#) *Y, const size_t incY)

$$fequal : test\ X = Y.$$
- template [INST_OR_DECL](#) void [fassign](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t N, const [FFLAS_ELT](#) *Y, const size_t incY, [FFLAS_ELT](#) *X, const size_t incX)

- fassign* : $x \leftarrow y$.
- template `INST_OR_DECL` void `fscal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t n, const `FFLAS_ELT` alpha, `FFLAS_ELT` *X, const size_t incX)
 - fscal* $x \leftarrow \alpha \cdot x$.
- template `INST_OR_DECL` void `fscal` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t n, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *X, const size_t incX, `FFLAS_ELT` *Y, const size_t incY)
 - fscal* $y \leftarrow \alpha \cdot x$.
- template `INST_OR_DECL` void `faxpy` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *X, const size_t incX, `FFLAS_ELT` *Y, const size_t incY)
 - faxpy* : $y \leftarrow \alpha \cdot x + y$.
- template `INST_OR_DECL` `FFLAS_ELT` `fdot` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t N, const `FFLAS_ELT` *X, const size_t incX, const `FFLAS_ELT` *Y, const size_t incY)
 - fdot* : $y \leftarrow \alpha \cdot x + \beta \cdot y$.
- template `INST_OR_DECL` void `fswap` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t N, `FFLAS_ELT` *X, const size_t incX, `FFLAS_ELT` *Y, const size_t incY)
 - fswap* : $X \leftrightarrow Y$.
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t N, const `FFLAS_ELT` *A, const size_t inca, const `FFLAS_ELT` *B, const size_t incb, `FFLAS_ELT` *C, const size_t incc)
- template `INST_OR_DECL` void `fsub` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t N, const `FFLAS_ELT` *A, const size_t inca, const `FFLAS_ELT` *B, const size_t incb, `FFLAS_ELT` *C, const size_t incc)
- template `INST_OR_DECL` void `faddin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t N, const `FFLAS_ELT` *B, const size_t incb, `FFLAS_ELT` *C, const size_t incc)
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t N, const `FFLAS_ELT` *A, const size_t inca, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *B, const size_t incb, `FFLAS_ELT` *C, const size_t incc)

17.217 fflas_L2_inst.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas_L2_inst_implem.inl"
```

Macros

- #define `__FFLAS_L2_INST_C`
- #define `INST_OR_DECL`
- #define `FFLAS_FIELD` Givaro::ModularBalanced
- #define `FFLAS_ELT` double
- #define `FFLAS_ELT` float
- #define `FFLAS_ELT` int64_t
- #define `FFLAS_FIELD` Givaro::Modular
- #define `FFLAS_ELT` double
- #define `FFLAS_ELT` float
- #define `FFLAS_ELT` int64_t

17.217.1 Macro Definition Documentation

17.217.1.1 __FFLAS_L2_INST_C

```
#define __FFLAS_L2_INST_C
```

17.217.1.2 INST_OR_DECL

```
#define INST_OR_DECL
```

17.217.1.3 FFLAS_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

17.217.1.4 FFLAS_ELT [1/6]

```
#define FFLAS_ELT double
```

17.217.1.5 FFLAS_ELT [2/6]

```
#define FFLAS_ELT float
```

17.217.1.6 FFLAS_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

17.217.1.7 FFLAS_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

17.217.1.8 FFLAS_ELT [4/6]

```
#define FFLAS_ELT double
```

17.217.1.9 FFLAS_ELT [5/6]

```
#define FFLAS_ELT float
```

17.217.1.10 FFLAS_ELT [6/6]

```
#define FFLAS_ELT int64_t
```

17.218 fflas_L2_inst.h File Reference

```
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas_L2_inst_implem.inl"
```

Macros

- `#define INST_OR_DECL <>`
- `#define FFLAS_FIELD Givaro::ModularBalanced`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`
- `#define FFLAS_FIELD Givaro::Modular`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`

17.218.1 Macro Definition Documentation

17.218.1.1 INST_OR_DECL

```
#define INST_OR_DECL <>
```

17.218.1.2 FFLAS_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

17.218.1.3 FFLAS_ELT [1/6]

```
#define FFLAS_ELT double
```

17.218.1.4 FFLAS_ELT [2/6]

```
#define FFLAS_ELT float
```

17.218.1.5 FFLAS_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

17.218.1.6 FFLAS_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

17.218.1.7 FFLAS_ELT [4/6]

```
#define FFLAS_ELT double
```

17.218.1.8 FFLAS_ELT [5/6]

```
#define FFLAS_ELT float
```

17.218.1.9 FFLAS_ELT [6/6]

```
#define FFLAS_ELT int64_t
```


17.219 fflas_L2_inst_implem.inl File Reference

Namespaces

- namespace [FFLAS](#)

Functions

- template [INST_OR_DECL](#) void [fassign](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, const [FFLAS_ELT](#) *B, const size_t ldb, [FFLAS_ELT](#) *A, const size_t lda)
 $fassign : A \leftarrow B.$
- template [INST_OR_DECL](#) void [fzero](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, [FFLAS_ELT](#) *A, const size_t lda)
 $fzero : A \leftarrow 0.$
- template [INST_OR_DECL](#) bool [fequal](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, const [FFLAS_ELT](#) *A, const size_t lda, const [FFLAS_ELT](#) *B, const size_t ldb)
 $fequal : test A = B.$
- template [INST_OR_DECL](#) bool [fiszero](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, const [FFLAS_ELT](#) *A, const size_t lda)
 $fiszero : test A = 0.$
- template [INST_OR_DECL](#) void [fidentity](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, [FFLAS_ELT](#) *A, const size_t lda, const [FFLAS_ELT](#) &d)
 $creates a diagonal matrix$
- template [INST_OR_DECL](#) void [fidentity](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, [FFLAS_ELT](#) *A, const size_t lda)
 $creates a diagonal matrix$
- template [INST_OR_DECL](#) void [freduce](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, [FFLAS_ELT](#) *A, const size_t lda)
 $freduce A \leftarrow A mod F.$
- template [INST_OR_DECL](#) void [freduce](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, const [FFLAS_ELT](#) *B, const size_t ldb, [FFLAS_ELT](#) *A, const size_t lda)
 $freduce A \leftarrow B mod F.$
- template [INST_OR_DECL](#) void [finit](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, const [FFLAS_ELT](#) *B, const size_t ldb, [FFLAS_ELT](#) *A, const size_t lda)
 $finit A \leftarrow B mod F.$
- template [INST_OR_DECL](#) void [fnegin](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, [FFLAS_ELT](#) *A, const size_t lda)
 $fnegin A \leftarrow -A.$
- template [INST_OR_DECL](#) void [fneg](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, const [FFLAS_ELT](#) *B, const size_t ldb, [FFLAS_ELT](#) *A, const size_t lda)
 $fneg A \leftarrow -B.$
- template [INST_OR_DECL](#) void [fscaln](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, const [FFLAS_ELT](#) alpha, [FFLAS_ELT](#) *A, const size_t lda)
 $fscaln A \leftarrow a \cdot A.$
- template [INST_OR_DECL](#) void [fscal](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, const [FFLAS_ELT](#) alpha, const [FFLAS_ELT](#) *A, const size_t lda, [FFLAS_ELT](#) *B, const size_t ldb)
 $fscal B \leftarrow a \cdot A.$
- template [INST_OR_DECL](#) void [faxpy](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, const [FFLAS_ELT](#) alpha, const [FFLAS_ELT](#) *X, const size_t ldx, [FFLAS_ELT](#) *Y, const size_t ldy)
 $faxpy : y \leftarrow \alpha \cdot x + y.$
- template [INST_OR_DECL](#) void [fmove](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const size_t m, const size_t n, [FFLAS_ELT](#) *A, const size_t lda, [FFLAS_ELT](#) *B, const size_t ldb)
 $fmove : y \leftarrow \alpha \cdot x + \beta \cdot y.$

- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)
fadd : matrix addition.
- template `INST_OR_DECL` void `fsub` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)
fsub : matrix subtraction.
- template `INST_OR_DECL` void `fsubin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)
fsubin $C = C - B$
- template `INST_OR_DECL` void `fadd` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)
fadd : matrix addition with scaling.
- template `INST_OR_DECL` void `faddin` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` *B, const size_t ldb, `FFLAS_ELT` *C, const size_t ldc)
faddin
- template `INST_OR_DECL` `FFLAS_ELT` * `fgemv` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS_TRANSPOSE` TransA, const size_t M, const size_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *A, const size_t lda, const `FFLAS_ELT` *X, const size_t incX, const `FFLAS_ELT` beta, `FFLAS_ELT` *Y, const size_t incY)
finite prime `FFLAS_FIELD`<`FFLAS_ELT`> GEneral Matrix Vector multiplication.
- template `INST_OR_DECL` void `fger` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const size_t M, const size_t N, const `FFLAS_ELT` alpha, const `FFLAS_ELT` *x, const size_t incx, const `FFLAS_ELT` *y, const size_t incy, `FFLAS_ELT` *A, const size_t lda)
fger: rank one update of a general matrix
- template `INST_OR_DECL` void `ftsv` (const `FFLAS_FIELD`< `FFLAS_ELT` > &F, const `FFLAS_UPLO` Uplo, const `FFLAS_TRANSPOSE` TransA, const `FFLAS_DIAG` Diag, const size_t N, const `FFLAS_ELT` *A, const size_t lda, `FFLAS_ELT` *X, int incX)
ftsv: TRIangular System solve with Vector Computes $X \leftarrow \text{op}(A^{-1})X$

17.220 fflas_L3_inst.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
#include "fflas_L3_inst_implem.inl"
```

Macros

- #define `__FFLAS_L3_INST_C`
- #define `INST_OR_DECL`
- #define `FFLAS_FIELD` Givaro::ModularBalanced
- #define `FFLAS_ELT` double
- #define `FFLAS_ELT` float
- #define `FFLAS_ELT` int64_t
- #define `FFLAS_FIELD` Givaro::Modular
- #define `FFLAS_ELT` double
- #define `FFLAS_ELT` float
- #define `FFLAS_ELT` int64_t

17.220.1 Macro Definition Documentation

17.220.1.1 __FFLAS_L3_INST_C

```
#define __FFLAS_L3_INST_C
```

17.220.1.2 INST_OR_DECL

```
#define INST_OR_DECL
```

17.220.1.3 FFLAS_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

17.220.1.4 FFLAS_ELT [1/6]

```
#define FFLAS_ELT double
```

17.220.1.5 FFLAS_ELT [2/6]

```
#define FFLAS_ELT float
```

17.220.1.6 FFLAS_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

17.220.1.7 FFLAS_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

17.220.1.8 FFLAS_ELT [4/6]

```
#define FFLAS_ELT double
```

17.220.1.9 FFLAS_ELT [5/6]

```
#define FFLAS_ELT float
```

17.220.1.10 FFLAS_ELT [6/6]

```
#define FFLAS_ELT int64_t
```

17.221 fflas_L3_inst.h File Reference

```
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/fflas/fflas_helpers.inl"
```

```
#include "fflas_L3_inst_implem.inl"
```

Macros

- `#define INST_OR_DECL <>`
- `#define FFLAS_FIELD Givaro::ModularBalanced`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`
- `#define FFLAS_FIELD Givaro::Modular`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`

17.221.1 Macro Definition Documentation

17.221.1.1 INST_OR_DECL

```
#define INST_OR_DECL <>
```

17.221.1.2 FFLAS_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

17.221.1.3 FFLAS_ELT [1/6]

```
#define FFLAS_ELT double
```

17.221.1.4 FFLAS_ELT [2/6]

```
#define FFLAS_ELT float
```

17.221.1.5 FFLAS_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

17.221.1.6 FFLAS_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

17.221.1.7 FFLAS_ELT [4/6]

```
#define FFLAS_ELT double
```

17.221.1.8 FFLAS_ELT [5/6]

```
#define FFLAS_ELT float
```

17.221.1.9 FFLAS_ELT [6/6]

```
#define FFLAS_ELT int64_t
```

17.222 fflas_L3_inst_implem.inl File Reference

Namespaces

- namespace [FFLAS](#)

Macros

- #define [__FFLAS__TRSM_READONLY](#)

Functions

- template [INST_OR_DECL](#) void [ftrsm](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const [FFLAS_ELT](#) alpha, const [FFLAS_ELT](#) *A, const size_t lda, [FFLAS_ELT](#) *B, const size_t ldb)

*ftrsm: **TR**iangular **S**ystem solve with **M**atrix.*

- template [INST_OR_DECL](#) void [ftrmm](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const FFLAS_SIDE Side, const FFLAS_UPLO Uplo, const FFLAS_TRANSPOSE TransA, const FFLAS_DIAG Diag, const size_t M, const size_t N, const [FFLAS_ELT](#) alpha, const [FFLAS_ELT](#) *A, const size_t lda, [FFLAS_ELT](#) *B, const size_t ldb)

*ftrmm: **TR**iangular **M**atrix **M**ultiply.*

- template [INST_OR_DECL](#) [FFLAS_ELT](#) * [fgemm](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const [FFLAS_ELT](#) alpha, const [FFLAS_ELT](#) *A, const size_t lda, const [FFLAS_ELT](#) *B, const size_t ldb, const [FFLAS_ELT](#) beta, [FFLAS_ELT](#) *C, const size_t ldc)

*fgemm: **F**ield **GE**neral **M**atrix **M**ultiply.*

- template [INST_OR_DECL](#) [FFLAS_ELT](#) * [fgemm](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const [FFLAS_ELT](#) alpha, const [FFLAS_ELT](#) *A, const size_t lda, const [FFLAS_ELT](#) *B, const size_t ldb, const [FFLAS_ELT](#) beta, [FFLAS_ELT](#) *C, const size_t ldc, const ParSeqHelper::Sequential seq)
- template [INST_OR_DECL](#) [FFLAS_ELT](#) * [fgemm](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const [FFLAS_ELT](#) alpha, const [FFLAS_ELT](#) *A, const size_t lda, const [FFLAS_ELT](#) *B, const size_t ldb, const [FFLAS_ELT](#) beta, [FFLAS_ELT](#) *C, const size_t ldc, const ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoDAdaptive > par)
- template [INST_OR_DECL](#) [FFLAS_ELT](#) * [fgemm](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const [FFLAS_ELT](#) alpha, const [FFLAS_ELT](#) *A, const size_t lda, const [FFLAS_ELT](#) *B, const size_t ldb, const [FFLAS_ELT](#) beta, [FFLAS_ELT](#) *C, const size_t ldc, const ParSeqHelper::Parallel< CuttingStrategy::Block, StrategyParameter::Threads > par)
- template [INST_OR_DECL](#) [FFLAS_ELT](#) * [fsquare](#) (const [FFLAS_FIELD](#)< [FFLAS_ELT](#) > &F, const FFLAS_TRANSPOSE ta, const size_t n, const [FFLAS_ELT](#) alpha, const [FFLAS_ELT](#) *A, const size_t lda, const [FFLAS_ELT](#) beta, [FFLAS_ELT](#) *C, const size_t ldc)

fsquare: Squares a matrix.

17.222.1 Macro Definition Documentation

17.222.1.1 __FFLAS__TRSM_READONLY

```
#define __FFLAS__TRSM_READONLY
```

17.223 fflas_lvl1.C File Reference

C functions calls for level 1 [FFLAS](#) in fflas-c.h.

```
#include "fflas-ffpack/interfaces/libs/fflas_c.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "givaro//modular-balanced.h"
#include "givaro//modular.h"
```

Functions

- void [freducein_1_modular_double](#) (const double p, const size_t n, double *X, const size_t incX, bool positive)
- void [freduce_1_modular_double](#) (const double p, const size_t n, const double *Y, const size_t incY, double *X, const size_t incX, bool positive)
- void [fnegin_1_modular_double](#) (const double p, const size_t n, double *X, const size_t incX, bool positive)
- void [fneg_1_modular_double](#) (const double p, const size_t n, const double *Y, const size_t incY, double *X, const size_t incX, bool positive)
- void [fzero_1_modular_double](#) (const double p, const size_t n, double *X, const size_t incX, bool positive)
- bool [fiszero_1_modular_double](#) (const double p, const size_t n, const double *X, const size_t incX, bool positive)
- bool [fequal_1_modular_double](#) (const double p, const size_t n, const double *X, const size_t incX, const double *Y, const size_t incY, bool positive)
- void [fassign_1_modular_double](#) (const double p, const size_t n, const double *Y, const size_t incY, double *X, const size_t incX, bool positive)
- void [fscal_1_modular_double](#) (const double p, const size_t n, const double alpha, double *X, const size_t incX, bool positive)
- void [fscal_1_modular_double](#) (const double p, const size_t n, const double alpha, const double *X, const size_t incX, double *Y, const size_t incY, bool positive)
- void [faxpy_1_modular_double](#) (const double p, const size_t n, const double alpha, const double *X, const size_t incX, double *Y, const size_t incY, bool positive)
- double [fdot_1_modular_double](#) (const double p, const size_t n, const double *X, const size_t incX, const double *Y, const size_t incY, bool positive)
- void [fswap_1_modular_double](#) (const double p, const size_t n, double *X, const size_t incX, double *Y, const size_t incY, bool positive)
- void [fadd_1_modular_double](#) (const double p, const size_t n, const double *A, const size_t incA, const double *B, const size_t incB, double *C, const size_t incC, bool positive)
- void [fsub_1_modular_double](#) (const double p, const size_t n, const double *A, const size_t incA, const double *B, const size_t incB, double *C, const size_t incC, bool positive)
- void [faddin_1_modular_double](#) (const double p, const size_t n, const double *B, const size_t incB, double *C, const size_t incC, bool positive)
- void [fsubin_1_modular_double](#) (const double p, const size_t n, const double *B, const size_t incB, double *C, const size_t incC, bool positive)

17.223.1 Detailed Description

C functions calls for level 1 [FFLAS](#) in fflas-c.h.

Author

Brice Boyer

See also

[fflas/fflas_level1.inl](#)

17.223.2 Function Documentation

17.223.2.1 freducein_1_modular_double()

```
void freducein_1_modular_double (
    const double p,
    const size_t n,
    double * X,
    const size_t incX,
    bool positive )
```

17.223.2.2 freduce_1_modular_double()

```
void freduce_1_modular_double (
    const double p,
    const size_t n,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX,
    bool positive )
```

17.223.2.3 fnegin_1_modular_double()

```
void fnegin_1_modular_double (
    const double p,
    const size_t n,
    double * X,
    const size_t incX,
    bool positive )
```

17.223.2.4 fneg_1_modular_double()

```
void fneg_1_modular_double (
    const double p,
    const size_t n,
    const double * Y,
    const size_t incY,
    double * X,
    const size_t incX,
    bool positive )
```

17.223.2.5 fzero_1_modular_double()

```
void fzero_1_modular_double (
    const double p,
    const size_t n,
    double * X,
    const size_t incX,
    bool positive )
```

17.223.2.6 fiszero_1_modular_double()

```
bool fiszero_1_modular_double (
    const double p,
    const size_t n,
```

```
    const double * X,  
    const size_t incX,  
    bool positive )
```

17.223.2.7 fequal_1_modular_double()

```
bool fequal_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * X,  
    const size_t incX,  
    const double * Y,  
    const size_t incY,  
    bool positive )
```

17.223.2.8 fassign_1_modular_double()

```
void fassign_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * Y,  
    const size_t incY,  
    double * X,  
    const size_t incX,  
    bool positive )
```

17.223.2.9 fscaln_1_modular_double()

```
void fscaln_1_modular_double (  
    const double p,  
    const size_t n,  
    const double alpha,  
    double * X,  
    const size_t incX,  
    bool positive )
```

17.223.2.10 fscal_1_modular_double()

```
void fscal_1_modular_double (  
    const double p,  
    const size_t n,  
    const double alpha,  
    const double * X,  
    const size_t incX,  
    double * Y,  
    const size_t incY,  
    bool positive )
```

17.223.2.11 faxpy_1_modular_double()

```
void faxpy_1_modular_double (  
    const double p,  
    const size_t n,  
    const double alpha,
```



```
const double * X,  
const size_t incX,  
double * Y,  
const size_t incY,  
bool positive )
```

17.223.2.12 fdot_1_modular_double()

```
double fdot_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * X,  
    const size_t incX,  
    const double * Y,  
    const size_t incY,  
    bool positive )
```

17.223.2.13 fswap_1_modular_double()

```
void fswap_1_modular_double (  
    const double p,  
    const size_t n,  
    double * X,  
    const size_t incX,  
    double * Y,  
    const size_t incY,  
    bool positive )
```

17.223.2.14 fadd_1_modular_double()

```
void fadd_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * A,  
    const size_t incA,  
    const double * B,  
    const size_t incB,  
    double * C,  
    const size_t incC,  
    bool positive )
```

17.223.2.15 fsub_1_modular_double()

```
void fsub_1_modular_double (  
    const double p,  
    const size_t n,  
    const double * A,  
    const size_t incA,  
    const double * B,  
    const size_t incB,  
    double * C,  
    const size_t incC,  
    bool positive )
```

17.223.2.16 faddin_1_modular_double()

```
void faddin_1_modular_double (
    const double p,
    const size_t n,
    const double * B,
    const size_t incB,
    double * C,
    const size_t incC,
    bool positive )
```

17.223.2.17 fsubin_1_modular_double()

```
void fsubin_1_modular_double (
    const double p,
    const size_t n,
    const double * B,
    const size_t incB,
    double * C,
    const size_t incC,
    bool positive )
```

17.224 fflas_lvl2.C File Reference

C functions calls for level 2 [FFLAS](#) in `fflas-c.h`.

```
#include "fflas-ffpack/interfaces/libs/fflas_c.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "givaro/modular-balanced.h"
#include "givaro/modular.h"
```

Functions

- void [fassign_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t lda, double *B, const size_t ldb, bool positive)
- void [fzero_2_modular_double](#) (const double p, const size_t m, const size_t n, double *A, const size_t lda, bool positive)
- bool [fequal_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t lda, const double *B, const size_t ldb, bool positive)
- bool [fiszero_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t lda, bool positive)
- void [fidentity_2_modular_double](#) (const double p, const size_t m, const size_t n, double *A, const size_t lda, const double d, bool positive)
- void [freducein_2_modular_double](#) (const double p, const size_t m, const size_t n, double *A, const size_t lda, bool positive)
- void [freduce_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t lda, double *B, const size_t ldb, bool positive)
- void [fnegin_2_modular_double](#) (const double p, const size_t m, const size_t n, double *A, const size_t lda, bool positive)
- void [fneg_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t lda, double *B, const size_t ldb, bool positive)
- void [fscalin_2_modular_double](#) (const double p, const size_t m, const size_t n, const double alpha, double *A, const size_t lda, bool positive)
- void [fscale_2_modular_double](#) (const double p, const size_t m, const size_t n, const double alpha, const double *A, const size_t lda, double *B, const size_t ldb, bool positive)
- void [faxpy_2_modular_double](#) (const double p, const size_t m, const size_t n, const double alpha, const double *A, const size_t lda, double *B, const size_t ldb, bool positive)

- void [fmove_2_modular_double](#) (const double p, const size_t m, const size_t n, double *A, const size_t lda, double *B, const size_t ldb, bool positive)
- void [fadd_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t lda, const double *B, const size_t ldb, double *C, const size_t ldc, bool positive)
- void [fsub_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *A, const size_t lda, const double *B, const size_t ldb, double *C, const size_t ldc, bool positive)
- void [fsubin_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *B, const size_t ldb, double *C, const size_t ldc, bool positive)
- void [faddin_2_modular_double](#) (const double p, const size_t m, const size_t n, const double *B, const size_t ldb, double *C, const size_t ldc, bool positive)
- double * [fgemv_2_modular_double](#) (const double p, const enum [FFLAS_C_TRANSPOSE](#) TransA, const size_t m, const size_t n, const double alpha, const double *A, const size_t lda, const double *X, const size_t incX, const double beta, double *Y, const size_t incY, bool positive)
- void [fger_2_modular_double](#) (const double p, const size_t m, const size_t n, const double alpha, const double *X, const size_t incX, const double *Y, const size_t incY, double *A, const size_t lda, bool positive)
- void [ftrsv_2_modular_double](#) (const double p, const enum [FFLAS_C_UPLO](#) Uplo, const enum [FFLAS_C_TRANSPOSE](#) TransA, const enum [FFLAS_C_DIAG](#) Diag, const size_t n, const double *A, const size_t lda, double *X, int incX, bool positive)

17.224.1 Detailed Description

C functions calls for level 2 [FFLAS](#) in fflas-c.h.

Author

Brice Boyer

See also

[fflas/fflas_level2.inl](#)

17.224.2 Function Documentation

17.224.2.1 fassign_2_modular_double()

```
void fassign_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t lda,
    double * B,
    const size_t ldb,
    bool positive )
```

17.224.2.2 fzero_2_modular_double()

```
void fzero_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    double * A,
    const size_t lda,
    bool positive )
```

17.224.2.3 fequal_2_modular_double()

```
bool fequal_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t lda,
    const double * B,
    const size_t ldb,
    bool positive )
```

17.224.2.4 fiszero_2_modular_double()

```
bool fiszero_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t lda,
    bool positive )
```

17.224.2.5 fidentity_2_modular_double()

```
void fidentity_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    double * A,
    const size_t lda,
    const double d,
    bool positive )
```

17.224.2.6 freducein_2_modular_double()

```
void freducein_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    double * A,
    const size_t lda,
    bool positive )
```

17.224.2.7 freduce_2_modular_double()

```
void freduce_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t lda,
    double * B,
    const size_t ldb,
    bool positive )
```

17.224.2.8 fnegin_2_modular_double()

```
void fnegin_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    double * A,
    const size_t lda,
    bool positive )
```

17.224.2.9 fneg_2_modular_double()

```
void fneg_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * A,
    const size_t lda,
    double * B,
    const size_t ldb,
    bool positive )
```

17.224.2.10 fscaln_2_modular_double()

```
void fscaln_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double alpha,
    double * A,
    const size_t lda,
    bool positive )
```

17.224.2.11 fscale_2_modular_double()

```
void fscale_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t lda,
    double * B,
    const size_t ldb,
    bool positive )
```

17.224.2.12 faxpy_2_modular_double()

```
void faxpy_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t lda,
```

```
double * B,  
const size_t ldb,  
bool positive )
```

17.224.2.13 fmove_2_modular_double()

```
void fmove_2_modular_double (   
    const double p,  
    const size_t m,  
    const size_t n,  
    double * A,  
    const size_t lda,  
    double * B,  
    const size_t ldb,  
    bool positive )
```

17.224.2.14 fadd_2_modular_double()

```
void fadd_2_modular_double (   
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * A,  
    const size_t lda,  
    const double * B,  
    const size_t ldb,  
    double * C,  
    const size_t ldc,  
    bool positive )
```

17.224.2.15 fsub_2_modular_double()

```
void fsub_2_modular_double (   
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * A,  
    const size_t lda,  
    const double * B,  
    const size_t ldb,  
    double * C,  
    const size_t ldc,  
    bool positive )
```

17.224.2.16 fsubin_2_modular_double()

```
void fsubin_2_modular_double (   
    const double p,  
    const size_t m,  
    const size_t n,  
    const double * B,  
    const size_t ldb,  
    double * C,  
    const size_t ldc,  
    bool positive )
```

17.224.2.17 faddin_2_modular_double()

```
void faddin_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double * B,
    const size_t ldb,
    double * C,
    const size_t ldc,
    bool positive )
```

17.224.2.18 fgemv_2_modular_double()

```
double * fgemv_2_modular_double (
    const double p,
    const enum FFLAS_C_TRANSPOSE TransA,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * A,
    const size_t lda,
    const double * X,
    const size_t incX,
    const double beta,
    double * Y,
    const size_t incY,
    bool positive )
```

17.224.2.19 fger_2_modular_double()

```
void fger_2_modular_double (
    const double p,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * X,
    const size_t incX,
    const double * Y,
    const size_t incY,
    double * A,
    const size_t lda,
    bool positive )
```

17.224.2.20 ftrsv_2_modular_double()

```
void ftrsv_2_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_TRANSPOSE TransA,
    const enum FFLAS_C_DIAG Diag,
    const size_t n,
    const double * A,
    const size_t lda,
```

```
double * X,
int incX,
bool positive )
```

17.225 fflas_lvl3.C File Reference

C functions calls for level 3 [FFLAS](#) in fflas-c.h.

```
#include "fflas-ffpack/interfaces/libs/fflas_c.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "givaro/modular-balanced.h"
#include "givaro/modular.h"
```

Functions

- void [ftrsm_3_modular_double](#) (const double p, const enum [FFLAS_C_SIDE](#) Side, const enum [FFLAS_C_UPLO](#) Uplo, const enum [FFLAS_C_TRANSPOSE](#) tA, const enum [FFLAS_C_DIAG](#) Diag, const size_t m, const size_t n, const double alpha, const double *A, const size_t ldA, double *B, const size_t ldB, bool positive)
- void [ftrmm_3_modular_double](#) (const double p, const enum [FFLAS_C_SIDE](#) Side, const enum [FFLAS_C_UPLO](#) Uplo, const enum [FFLAS_C_TRANSPOSE](#) tA, const enum [FFLAS_C_DIAG](#) Diag, const size_t m, const size_t n, const double alpha, double *A, const size_t ldA, double *B, const size_t ldB, bool positive)
- double * [fgemm_3_modular_double](#) (const double p, const enum [FFLAS_C_TRANSPOSE](#) tA, const enum [FFLAS_C_TRANSPOSE](#) tB, const size_t m, const size_t n, const size_t k, const double alpha, const double *A, const size_t ldA, const double *B, const size_t ldB, const double betA, double *C, const size_t ldC, bool positive)
- double * [fsquare_3_modular_double](#) (const double p, const enum [FFLAS_C_TRANSPOSE](#) tA, const size_t n, const double alpha, const double *A, const size_t ldA, const double betA, double *C, const size_t ldC, bool positive)

17.225.1 Detailed Description

C functions calls for level 3 [FFLAS](#) in fflas-c.h.

Author

Brice Boyer

See also

[fflas/fflas_level3.inl](#)

17.225.2 Function Documentation

17.225.2.1 ftrsm_3_modular_double()

```
void ftrsm_3_modular_double (
    const double p,
    const enum FFLAS\_C\_SIDE Side,
    const enum FFLAS\_C\_UPLO Uplo,
    const enum FFLAS\_C\_TRANSPOSE tA,
    const enum FFLAS\_C\_DIAG Diag,
    const size_t m,
    const size_t n,
    const double alpha,
    const double * A,
```



```
    const size_t ldA,  
    double * B,  
    const size_t ldB,  
    bool positive )
```

17.225.2.2 ftrmm_3_modular_double()

```
void ftrmm_3_modular_double (   
    const double p,  
    const enum FFLAS_C_SIDE Side,  
    const enum FFLAS_C_UPLO Uplo,  
    const enum FFLAS_C_TRANSPOSE tA,  
    const enum FFLAS_C_DIAG Diag,  
    const size_t m,  
    const size_t n,  
    const double alpha,  
    double * A,  
    const size_t ldA,  
    double * B,  
    const size_t ldB,  
    bool positive )
```

17.225.2.3 fgemv_3_modular_double()

```
double * fgemv_3_modular_double (   
    const double p,  
    const enum FFLAS_C_TRANSPOSE tA,  
    const enum FFLAS_C_TRANSPOSE tB,  
    const size_t m,  
    const size_t n,  
    const size_t k,  
    const double alpha,  
    const double * A,  
    const size_t ldA,  
    const double * B,  
    const size_t ldB,  
    const double betaA,  
    double * C,  
    const size_t ldC,  
    bool positive )
```

17.225.2.4 fsquare_3_modular_double()

```
double * fsquare_3_modular_double (   
    const double p,  
    const enum FFLAS_C_TRANSPOSE tA,  
    const size_t n,  
    const double alpha,  
    const double * A,  
    const size_t ldA,  
    const double betaA,  
    double * C,  
    const size_t ldC,  
    bool positive )
```

17.226 fflas_sparse.C File Reference

C functions calls for level 1.5 and 2.5 [FFLAS](#) in fflas-c.h.

17.226.1 Detailed Description

C functions calls for level 1.5 and 2.5 [FFLAS](#) in fflas-c.h.

Author

Brice Boyer

See also

[fflas/fflas_sparse.h](#)

17.227 ffpack.C File Reference

C functions calls for [FFPACK](#) in ffpack-c.h.

```
#include "fflas-ffpack/interfaces/libs/ffpack_c.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "givaro/modular-balanced.h"
#include "givaro/modular.h"
```

Functions

- void [LAPACKPerm2MathPerm](#) (size_t *MathP, const size_t *LapackP, const size_t N)
- void [MathPerm2LAPACKPerm](#) (size_t *LapackP, const size_t *MathP, const size_t N)
- void [MatrixApplyS_modular_double](#) (const double p, double *A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, bool positive)
- void [PermApplyS_double](#) (double *A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)
- void [MatrixApplyT_modular_double](#) (const double p, double *A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, bool positive)
- void [PermApplyT_double](#) (double *A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)
- void [composePermutationsLLM](#) (size_t *MathP, const size_t *P1, const size_t *P2, const size_t R, const size_t N)
- void [composePermutationsLLL](#) (size_t *P1, const size_t *P2, const size_t R, const size_t N)
- void [composePermutationsMLM](#) (size_t *MathP1, const size_t *P2, const size_t R, const size_t N)
- void [cyclic_shift_mathPerm](#) (size_t *P, const size_t s)
- void [cyclic_shift_row_modular_double](#) (const double p, double *A, size_t m, size_t n, size_t lda, bool positive)
- void [cyclic_shift_col_modular_double](#) (const double p, double *A, size_t m, size_t n, size_t lda, bool positive)
- void [applyP_modular_double](#) (const double p, const enum [FFLAS::FFLAS_SIDE](#) Side, const enum [FFLAS::FFLAS_TRANSPOSE](#) Trans, const size_t M, const size_t ibeg, const size_t iend, double *A, const size_t lda, const size_t *P, bool positive)
- void [fgetrsin_modular_double](#) (const double p, const enum [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, const size_t R, double *A, const size_t lda, const size_t *P, const size_t *Q, double *B, const size_t ldb, int *info, bool positive)
- double * [fgetrsv_modular_double](#) (const double p, const enum [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, const size_t NRHS, const size_t R, double *A, const size_t lda, const size_t *P, const size_t *Q, double *X, const size_t idx, const double *B, const size_t ldb, int *info, bool positive)
- size_t [fgesvin_modular_double](#) (const double p, const enum [FFLAS::FFLAS_SIDE](#) Side, const size_t M, const size_t N, double *A, const size_t lda, double *B, const size_t ldb, int *info, bool positive)

- `size_t fgesv_modular_double` (const double p, const enum [FFLAS::FFLAS_SIDE](#) Side, const `size_t` M, const `size_t` N, const `size_t` NRHS, double *A, const `size_t` lda, double *X, const `size_t` ldx, const double *B, const `size_t` ldb, int *info, bool positive)
- `void ftrtri_modular_double` (const double p, const enum [FFLAS::FFLAS_UPLO](#) Uplo, const enum [FFLAS::FFLAS_DIAG](#) Diag, const `size_t` N, double *A, const `size_t` lda, bool positive)
- `void trinv_left_modular_double` (const double p, const `size_t` N, const double *L, const `size_t` ldl, double *X, const `size_t` ldx, bool positive)
- `void ftrrm_modular_double` (const double p, const [FFLAS::FFLAS_SIDE](#) side, const enum [FFLAS::FFLAS_DIAG](#) Diag, const `size_t` N, double *A, const `size_t` lda, bool positive)
- `size_t PLUQ_modular_double` (const double p, const enum [FFLAS::FFLAS_DIAG](#) Diag, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` *P, `size_t` *Q, bool positive)
- `size_t LUdivine_modular_double` (const double p, const enum [FFLAS::FFLAS_DIAG](#) Diag, const enum [FFLAS::FFLAS_TRANSPOSE](#) Trans, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const enum [FFPACK_C_LU_TAG](#) LuTag, const `size_t` cutoff, bool positive)
- `size_t ColumnEchelonForm_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- `size_t RowEchelonForm_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- `size_t ReducedColumnEchelonForm_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- `size_t ReducedRowEchelonForm_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- `size_t ColumnEchelonForm_modular_float` (const float p, const `size_t` M, const `size_t` N, float *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- `size_t RowEchelonForm_modular_float` (const float p, const `size_t` M, const `size_t` N, float *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- `size_t ReducedColumnEchelonForm_modular_float` (const float p, const `size_t` M, const `size_t` N, float *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- `size_t ReducedRowEchelonForm_modular_float` (const float p, const `size_t` M, const `size_t` N, float *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- `size_t ColumnEchelonForm_modular_int32_t` (const [int32_t](#) p, const `size_t` M, const `size_t` N, [int32_t](#) *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- `size_t RowEchelonForm_modular_int32_t` (const [int32_t](#) p, const `size_t` M, const `size_t` N, [int32_t](#) *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- `size_t ReducedColumnEchelonForm_modular_int32_t` (const [int32_t](#) p, const `size_t` M, const `size_t` N, [int32_t](#) *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- `size_t ReducedRowEchelonForm_modular_int32_t` (const [int32_t](#) p, const `size_t` M, const `size_t` N, [int32_t](#) *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- `size_t pColumnEchelonForm_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- `size_t pRowEchelonForm_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- `size_t pReducedColumnEchelonForm_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- `size_t pReducedRowEchelonForm_modular_double` (const double p, const `size_t` M, const `size_t` N, double *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- `size_t pColumnEchelonForm_modular_float` (const float p, const `size_t` M, const `size_t` N, float *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- `size_t pRowEchelonForm_modular_float` (const float p, const `size_t` M, const `size_t` N, float *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)

- `size_t pReducedColumnEchelonForm_modular_float` (const float p, const size_t M, const size_t N, float *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t pReducedRowEchelonForm_modular_float` (const float p, const size_t M, const size_t N, float *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t pColumnEchelonForm_modular_int32_t` (const int32_t p, const size_t M, const size_t N, int32_t *A, const size_t lda, size_t *P, size_t *Qt, bool transform, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t pRowEchelonForm_modular_int32_t` (const int32_t p, const size_t M, const size_t N, int32_t *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t pReducedColumnEchelonForm_modular_int32_t` (const int32_t p, const size_t M, const size_t N, int32_t *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t pReducedRowEchelonForm_modular_int32_t` (const int32_t p, const size_t M, const size_t N, int32_t *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `double * Invertin_modular_double` (const double p, const size_t M, double *A, const size_t lda, int *nullity, bool positive)
- `double * Invert_modular_double` (const double p, const size_t M, const double *A, const size_t lda, double *X, const size_t idx, int *nullity, bool positive)
- `double * Invert2_modular_double` (const double p, const size_t M, double *A, const size_t lda, double *X, const size_t idx, int *nullity, bool positive)
- `size_t KrylovElim_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Q, const size_t deg, size_t *iterates, size_t *inviterates, const size_t maxit, size_t virt, bool positive)
- `size_t SpecRankProfile_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, const size_t deg, size_t *rankProfile, bool positive)
- `size_t Rank_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, bool positive)
- `bool IsSingular_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, bool positive)
- `double Det_modular_double` (const double p, const size_t N, double *A, const size_t lda, bool positive)
- `double * Solve_modular_double` (const double p, const size_t M, double *A, const size_t lda, double *x, const int incx, const double *b, const int incb, bool positive)
- `void solveLB_modular_double` (const double p, const enum `FFLAS::FFLAS_SIDE` Side, const size_t M, const size_t N, const size_t R, double *L, const size_t ldl, const size_t *Q, double *B, const size_t ldb, bool positive)
- `void solveLB2_modular_double` (const double p, const enum `FFLAS::FFLAS_SIDE` Side, const size_t M, const size_t N, const size_t R, double *L, const size_t ldl, const size_t *Q, double *B, const size_t ldb, bool positive)
- `void RandomNullSpaceVector_modular_double` (const double p, const enum `FFLAS::FFLAS_SIDE` Side, const size_t M, const size_t N, double *A, const size_t lda, double *X, const size_t incX, bool positive)
- `size_t NullSpaceBasis_modular_double` (const double p, const enum `FFLAS::FFLAS_SIDE` Side, const size_t M, const size_t N, double *A, const size_t lda, double **NS, size_t *ldn, size_t *NSdim, bool positive)
- `size_t RowRankProfile_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t **rkprofile, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `size_t ColumnRankProfile_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t **rkprofile, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- `void RankProfileFromLU` (const size_t *P, const size_t N, const size_t R, size_t *rkprofile, const enum `FFPACK_C_LU_TAG` LuTag)
- `size_t LeadingSubmatrixRankProfiles` (const size_t M, const size_t N, const size_t R, const size_t LSm, const size_t LSn, const size_t *P, const size_t *Q, size_t *RRP, size_t *CRP)
- `size_t RowRankProfileSubmatrixIndices_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t **rowindices, size_t **colindices, size_t *R, bool positive)
- `size_t ColRankProfileSubmatrixIndices_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t **rowindices, size_t **colindices, size_t *R, bool positive)
- `size_t RowRankProfileSubmatrix_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, double **X, size_t *R, bool positive)

- `size_t ColRankProfileSubmatrix_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, double **X, size_t *R, bool positive)
- void `getTriangular_modular_double` (const double p, const enum `FFLAS::FFLAS_UPLO` Uplo, const enum `FFLAS::FFLAS_DIAG` Diag, const size_t M, const size_t N, const size_t R, const double *A, const size_t lda, double *T, const size_t ldt, const bool OnlyNonZeroVectors, bool positive)
- void `getTriangularin_modular_double` (const double p, const enum `FFLAS::FFLAS_UPLO` Uplo, const enum `FFLAS::FFLAS_DIAG` Diag, const size_t M, const size_t N, const size_t R, double *A, const size_t lda, bool positive)
- void `getEchelonForm_modular_double` (const double p, const enum `FFLAS::FFLAS_UPLO` Uplo, const enum `FFLAS::FFLAS_DIAG` Diag, const size_t M, const size_t N, const size_t R, const size_t *P, const double *A, const size_t lda, double *T, const size_t ldt, const bool OnlyNonZeroVectors, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- void `getEchelonFormin_modular_double` (const double p, const enum `FFLAS::FFLAS_UPLO` Uplo, const enum `FFLAS::FFLAS_DIAG` Diag, const size_t M, const size_t N, const size_t R, const size_t *P, double *A, const size_t lda, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- void `getEchelonTransform_modular_double` (const double p, const enum `FFLAS::FFLAS_UPLO` Uplo, const enum `FFLAS::FFLAS_DIAG` Diag, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, const double *A, const size_t lda, double *T, const size_t ldt, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- void `getReducedEchelonForm_modular_double` (const double p, const enum `FFLAS::FFLAS_UPLO` Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const double *A, const size_t lda, double *T, const size_t ldt, const bool OnlyNonZeroVectors, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- void `getReducedEchelonFormin_modular_double` (const double p, const enum `FFLAS::FFLAS_UPLO` Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, double *A, const size_t lda, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- void `getReducedEchelonTransform_modular_double` (const double p, const enum `FFLAS::FFLAS_UPLO` Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, const double *A, const size_t lda, double *T, const size_t ldt, const enum `FFPACK_C_LU_TAG` LuTag, bool positive)
- void `PLUQtoEchelonPermutation` (const size_t N, const size_t R, const size_t *P, size_t *outPerm)

17.227.1 Detailed Description

C functions calls for `FFPACK` in `ffpack-c.h`.

Author

Brice Boyer

See also

[ffpack/ffpack.h](#)

17.227.2 Function Documentation

17.227.2.1 LAPACKPerm2MathPerm()

```
void LAPACKPerm2MathPerm (
    size_t * MathP,
    const size_t * LapackP,
    const size_t N )
```

17.227.2.2 MathPerm2LAPACKPerm()

```
void MathPerm2LAPACKPerm (
    size_t * LapackP,
    const size_t * MathP,
    const size_t N )
```

17.227.2.3 MatrixApplyS_modular_double()

```
void MatrixApplyS_modular_double (
    const double p,
    double * A,
    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4,
    bool positive )
```

17.227.2.4 PermApplyS_double()

```
void PermApplyS_double (
    double * A,
    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4 )
```

17.227.2.5 MatrixApplyT_modular_double()

```
void MatrixApplyT_modular_double (
    const double p,
    double * A,
    const size_t lda,
    const size_t width,
    const size_t N2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4,
    bool positive )
```

17.227.2.6 PermApplyT_double()

```
void PermApplyT_double (
    double * A,
    const size_t lda,
    const size_t width,
    const size_t N2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4 )
```

17.227.2.7 composePermutationsLLM()

```
void composePermutationsLLM (
    size_t * MathP,
```

```
const size_t * P1,  
const size_t * P2,  
const size_t R,  
const size_t N )
```

17.227.2.8 composePermutationsLLL()

```
void composePermutationsLLL (  
    size_t * P1,  
    const size_t * P2,  
    const size_t R,  
    const size_t N )
```

17.227.2.9 composePermutationsMLM()

```
void composePermutationsMLM (  
    size_t * MathP1,  
    const size_t * P2,  
    const size_t R,  
    const size_t N )
```

17.227.2.10 cyclic_shift_mathPerm()

```
void cyclic_shift_mathPerm (  
    size_t * P,  
    const size_t s )
```

17.227.2.11 cyclic_shift_row_modular_double()

```
void cyclic_shift_row_modular_double (  
    const double p,  
    double * A,  
    size_t m,  
    size_t n,  
    size_t lda,  
    bool positive )
```

17.227.2.12 cyclic_shift_col_modular_double()

```
void cyclic_shift_col_modular_double (  
    const double p,  
    double * A,  
    size_t m,  
    size_t n,  
    size_t lda,  
    bool positive )
```

17.227.2.13 applyP_modular_double()

```
void applyP_modular_double (  
    const double p,  
    const enum FFLAS::FFLAS_SIDE Side,  
    const enum FFLAS::FFLAS_TRANSPOSE Trans,
```

```

    const size_t M,
    const size_t ibeg,
    const size_t iend,
    double * A,
    const size_t lda,
    const size_t * P,
    bool positive )

```

17.227.2.14 fgetrsin_modular_double()

```

void fgetrsin_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    double * A,
    const size_t lda,
    const size_t * P,
    const size_t * Q,
    double * B,
    const size_t ldb,
    int * info,
    bool positive )

```

17.227.2.15 fgetrsv_modular_double()

```

double * fgetrsv_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t NRHS,
    const size_t R,
    double * A,
    const size_t lda,
    const size_t * P,
    const size_t * Q,
    double * X,
    const size_t ldx,
    const double * B,
    const size_t ldb,
    int * info,
    bool positive )

```

17.227.2.16 fgesvin_modular_double()

```

size_t fgesvin_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double * B,
    const size_t ldb,

```



```
int * info,  
bool positive )
```

17.227.2.17 fgesv_modular_double()

```
size_t fgesv_modular_double (  
    const double p,  
    const enum FFLAS::FFLAS_SIDE Side,  
    const size_t M,  
    const size_t N,  
    const size_t NRHS,  
    double * A,  
    const size_t lda,  
    double * X,  
    const size_t ldx,  
    const double * B,  
    const size_t ldb,  
    int * info,  
    bool positive )
```

17.227.2.18 ftrtri_modular_double()

```
void ftrtri_modular_double (  
    const double p,  
    const enum FFLAS::FFLAS_UPLO Uplo,  
    const enum FFLAS::FFLAS_DIAG Diag,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    bool positive )
```

17.227.2.19 trinv_left_modular_double()

```
void trinv_left_modular_double (  
    const double p,  
    const size_t N,  
    const double * L,  
    const size_t ldl,  
    double * X,  
    const size_t ldx,  
    bool positive )
```

17.227.2.20 ftrtrm_modular_double()

```
void ftrtrm_modular_double (  
    const double p,  
    const FFLAS::FFLAS_SIDE side,  
    const enum FFLAS::FFLAS_DIAG Diag,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    bool positive )
```

17.227.2.21 PLUQ_modular_double()

```
size_t PLUQ_modular_double (
    const double p,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    bool positive )
```

17.227.2.22 LUdivine_modular_double()

```
size_t LUdivine_modular_double (
    const double p,
    const enum FFLAS::FFLAS_DIAG Diag,
    const enum FFLAS::FFLAS_TRANSPOSE Trans,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const enum FFPACK_C_LU_TAG LuTag,
    const size_t cutoff,
    bool positive )
```

17.227.2.23 ColumnEchelonForm_modular_double()

```
size_t ColumnEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.227.2.24 RowEchelonForm_modular_double()

```
size_t RowEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.227.2.25 ReducedColumnEchelonForm_modular_double()

```
size_t ReducedColumnEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.227.2.26 ReducedRowEchelonForm_modular_double()

```
size_t ReducedRowEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.227.2.27 ColumnEchelonForm_modular_float()

```
size_t ColumnEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.227.2.28 RowEchelonForm_modular_float()

```
size_t RowEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
```

```
const enum FFPACK_C_LU_TAG LuTag,
bool positive )
```

17.227.2.29 ReducedColumnEchelonForm_modular_float()

```
size_t ReducedColumnEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.227.2.30 ReducedRowEchelonForm_modular_float()

```
size_t ReducedRowEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.227.2.31 ColumnEchelonForm_modular_int32_t()

```
size_t ColumnEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.227.2.32 RowEchelonForm_modular_int32_t()

```
size_t RowEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
```

```
const bool transform,  
const enum FFPACK_C_LU_TAG LuTag,  
bool positive )
```

17.227.2.33 ReducedColumnEchelonForm_modular_int32_t()

```
size_t ReducedColumnEchelonForm_modular_int32_t (  
    const int32_t p,  
    const size_t M,  
    const size_t N,  
    int32_t * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive )
```

17.227.2.34 ReducedRowEchelonForm_modular_int32_t()

```
size_t ReducedRowEchelonForm_modular_int32_t (  
    const int32_t p,  
    const size_t M,  
    const size_t N,  
    int32_t * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive )
```

17.227.2.35 pColumnEchelonForm_modular_double()

```
size_t pColumnEchelonForm_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive )
```

17.227.2.36 pRowEchelonForm_modular_double()

```
size_t pRowEchelonForm_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    size_t * P,
```

```

size_t * Qt,
const bool transform,
const enum FFPACK_C_LU_TAG LuTag,
bool positive )

```

17.227.2.37 pReducedColumnEchelonForm_modular_double()

```

size_t pReducedColumnEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.227.2.38 pReducedRowEchelonForm_modular_double()

```

size_t pReducedRowEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.227.2.39 pColumnEchelonForm_modular_float()

```

size_t pColumnEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.227.2.40 pRowEchelonForm_modular_float()

```

size_t pRowEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,

```

```

size_t * P,
size_t * Qt,
const bool transform,
const enum FFPACK_C_LU_TAG LuTag,
bool positive )

```

17.227.2.41 pReducedColumnEchelonForm_modular_float()

```

size_t pReducedColumnEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.227.2.42 pReducedRowEchelonForm_modular_float()

```

size_t pReducedRowEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.227.2.43 pColumnEchelonForm_modular_int32_t()

```

size_t pColumnEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.227.2.44 pRowEchelonForm_modular_int32_t()

```

size_t pRowEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,

```

```

    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.227.2.45 pReducedColumnEchelonForm_modular_int32_t()

```

size_t pReducedColumnEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.227.2.46 pReducedRowEchelonForm_modular_int32_t()

```

size_t pReducedRowEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.227.2.47 Invertin_modular_double()

```

double * Invertin_modular_double (
    const double p,
    const size_t M,
    double * A,
    const size_t lda,
    int * nullity,
    bool positive )

```

17.227.2.48 Invert_modular_double()

```

double * Invert_modular_double (
    const double p,
    const size_t M,
    const double * A,
    const size_t lda,
    double * X,
    const size_t ldx,

```



```
int * nullity,  
bool positive )
```

17.227.2.49 Invert2_modular_double()

```
double * Invert2_modular_double (  
    const double p,  
    const size_t M,  
    double * A,  
    const size_t lda,  
    double * X,  
    const size_t ldx,  
    int * nullity,  
    bool positive )
```

17.227.2.50 KrylovElim_modular_double()

```
size_t KrylovElim_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Q,  
    const size_t deg,  
    size_t * iterates,  
    size_t * inviterates,  
    const size_t maxit,  
    size_t virt,  
    bool positive )
```

17.227.2.51 SpecRankProfile_modular_double()

```
size_t SpecRankProfile_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    const size_t deg,  
    size_t * rankProfile,  
    bool positive )
```

17.227.2.52 Rank_modular_double()

```
size_t Rank_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    bool positive )
```

17.227.2.53 IsSingular_modular_double()

```
bool IsSingular_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    bool positive )
```

17.227.2.54 Det_modular_double()

```
double Det_modular_double (
    const double p,
    const size_t N,
    double * A,
    const size_t lda,
    bool positive )
```

17.227.2.55 Solve_modular_double()

```
double * Solve_modular_double (
    const double p,
    const size_t M,
    double * A,
    const size_t lda,
    double * x,
    const int incx,
    const double * b,
    const int incb,
    bool positive )
```

17.227.2.56 solveLB_modular_double()

```
void solveLB_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    double * L,
    const size_t ldl,
    const size_t * Q,
    double * B,
    const size_t ldb,
    bool positive )
```

17.227.2.57 solveLB2_modular_double()

```
void solveLB2_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
```

```
double * L,
const size_t ldl,
const size_t * Q,
double * B,
const size_t ldb,
bool positive )
```

17.227.2.58 RandomNullSpaceVector_modular_double()

```
void RandomNullSpaceVector_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double * X,
    const size_t incX,
    bool positive )
```

17.227.2.59 NullSpaceBasis_modular_double()

```
size_t NullSpaceBasis_modular_double (
    const double p,
    const enum FFLAS::FFLAS_SIDE Side,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double ** NS,
    size_t * ldn,
    size_t * NSdim,
    bool positive )
```

17.227.2.60 RowRankProfile_modular_double()

```
size_t RowRankProfile_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rkprofile,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.227.2.61 ColumnRankProfile_modular_double()

```
size_t ColumnRankProfile_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rkprofile,
```

```

    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.227.2.62 RankProfileFromLU()

```

void RankProfileFromLU (
    const size_t * P,
    const size_t N,
    const size_t R,
    size_t * rkprofile,
    const enum FFPACK_C_LU_TAG LuTag )

```

17.227.2.63 LeadingSubmatrixRankProfiles()

```

size_t LeadingSubmatrixRankProfiles (
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t LSm,
    const size_t LSn,
    const size_t * P,
    const size_t * Q,
    size_t * RRP,
    size_t * CRP )

```

17.227.2.64 RowRankProfileSubmatrixIndices_modular_double()

```

size_t RowRankProfileSubmatrixIndices_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rowindices,
    size_t ** colindices,
    size_t * R,
    bool positive )

```

17.227.2.65 ColRankProfileSubmatrixIndices_modular_double()

```

size_t ColRankProfileSubmatrixIndices_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rowindices,
    size_t ** colindices,
    size_t * R,
    bool positive )

```

17.227.2.66 RowRankProfileSubmatrix_modular_double()

```

size_t RowRankProfileSubmatrix_modular_double (

```

```
const double p,  
const size_t M,  
const size_t N,  
double * A,  
const size_t lda,  
double ** X,  
size_t * R,  
bool positive )
```

17.227.2.67 ColRankProfileSubmatrix_modular_double()

```
size_t ColRankProfileSubmatrix_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    double ** X,  
    size_t * R,  
    bool positive )
```

17.227.2.68 getTriangular_modular_double()

```
void getTriangular_modular_double (  
    const double p,  
    const enum FFLAS::FFLAS_UPLO Uplo,  
    const enum FFLAS::FFLAS_DIAG Diag,  
    const size_t M,  
    const size_t N,  
    const size_t R,  
    const double * A,  
    const size_t lda,  
    double * T,  
    const size_t ldt,  
    const bool OnlyNonZeroVectors,  
    bool positive )
```

17.227.2.69 getTriangularin_modular_double()

```
void getTriangularin_modular_double (  
    const double p,  
    const enum FFLAS::FFLAS_UPLO Uplo,  
    const enum FFLAS::FFLAS_DIAG Diag,  
    const size_t M,  
    const size_t N,  
    const size_t R,  
    double * A,  
    const size_t lda,  
    bool positive )
```

17.227.2.70 getEchelonForm_modular_double()

```
void getEchelonForm_modular_double (  
    const double p,  
    const enum FFLAS::FFLAS_UPLO Uplo,
```

```

const enum FFLAS::FFLAS_DIAG Diag,
const size_t M,
const size_t N,
const size_t R,
const size_t * P,
const double * A,
const size_t lda,
double * T,
const size_t ldt,
const bool OnlyNonZeroVectors,
const enum FFPACK_C_LU_TAG LuTag,
bool positive )

```

17.227.2.71 getEchelonFormin_modular_double()

```

void getEchelonFormin_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    double * A,
    const size_t lda,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.227.2.72 getEchelonTransform_modular_double()

```

void getEchelonTransform_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const enum FFLAS::FFLAS_DIAG Diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.227.2.73 getReducedEchelonForm_modular_double()

```

void getReducedEchelonForm_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const double * A,

```

```

    const size_t lda,
    double * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.227.2.74 getReducedEchelonFormin_modular_double()

```

void getReducedEchelonFormin_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    double * A,
    const size_t lda,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.227.2.75 getReducedEchelonTransform_modular_double()

```

void getReducedEchelonTransform_modular_double (
    const double p,
    const enum FFLAS::FFLAS_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.227.2.76 PLUQtoEchelonPermutation()

```

void PLUQtoEchelonPermutation (
    const size_t N,
    const size_t R,
    const size_t * P,
    size_t * outPerm )

```

17.228 ffpack_c.h File Reference

```

#include <stdbool.h>
#include <stdlib.h>
#include <inttypes.h>

```

Macros

- `#define FFPACK_COMPILED`

Enumerations

- enum `FFLAS_C_ORDER` { `FflasRowMajor` =101 , `FflasColMajor` =102 , `FflasRowMajor` =101 , `FflasColMajor` =102 }
- enum `FFLAS_C_TRANSPOSE` { `FflasNoTrans` = 111 , `FflasTrans` = 112 , `FflasNoTrans` = 111 , `FflasTrans` = 112 }
- enum `FFLAS_C_UPLO` { `FflasUpper` = 121 , `FflasLower` = 122 , `FflasUpper` = 121 , `FflasLower` = 122 }
- enum `FFLAS_C_DIAG` { `FflasNonUnit` = 131 , `FflasUnit` = 132 , `FflasNonUnit` = 131 , `FflasUnit` = 132 }
- enum `FFLAS_C_SIDE` { `FflasLeft` = 141 , `FflasRight` = 142 , `FflasLeft` = 141 , `FflasRight` = 142 }
- enum `FFPACK_C_LU_TAG` { `FfpackSlabRecursive` = 1 , `FfpackTileRecursive` = 2 , `FfpackSingular` = 3 }
- enum `FFPACK_C_CHARPOLY_TAG` {
`FfpackLUK` =1 , `FfpackKG` =2 , `FfpackHybrid` =3 , `FfpackKGFast` =4 ,
`FfpackDanilevski` =5 , `FfpackArithProg` =6 , `FfpackKGFastG` =7 }
- enum `FFPACK_C_MINPOLY_TAG` { `FfpackDense` =1 , `FfpackKGF` =2 }

Functions

- void `LAPACKPerm2MathPerm` (size_t *MathP, const size_t *LapackP, const size_t N)
- void `MathPerm2LAPACKPerm` (size_t *LapackP, const size_t *MathP, const size_t N)
- void `MatrixApplyS_modular_double` (const double p, double *A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, bool positive)
- void `PermApplyS_double` (double *A, const size_t lda, const size_t width, const size_t M2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)
- void `MatrixApplyT_modular_double` (const double p, double *A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4, bool positive)
- void `PermApplyT_double` (double *A, const size_t lda, const size_t width, const size_t N2, const size_t R1, const size_t R2, const size_t R3, const size_t R4)
- void `composePermutationsLLM` (size_t *MathP, const size_t *P1, const size_t *P2, const size_t R, const size_t N)
- void `composePermutationsLLL` (size_t *P1, const size_t *P2, const size_t R, const size_t N)
- void `composePermutationsMLM` (size_t *MathP1, const size_t *P2, const size_t R, const size_t N)
- void `cyclic_shift_mathPerm` (size_t *P, const size_t s)
- void `cyclic_shift_row_modular_double` (const double p, double *A, size_t m, size_t n, size_t lda, bool positive)
- void `cyclic_shift_col_modular_double` (const double p, double *A, size_t m, size_t n, size_t lda, bool positive)
- void `applyP_modular_double` (const double p, const enum `FFLAS_C_SIDE` Side, const enum `FFLAS_C_TRANSPOSE` Trans, const size_t M, const size_t ibeg, const size_t iend, double *A, const size_t lda, const size_t *P, bool positive)
- void `fgetrsin_modular_double` (const double p, const enum `FFLAS_C_SIDE` Side, const size_t M, const size_t N, const size_t R, double *A, const size_t lda, const size_t *P, const size_t *Q, double *B, const size_t ldb, int *info, bool positive)
- double * `fgetrs_modular_double` (const double p, const enum `FFLAS_C_SIDE` Side, const size_t M, const size_t N, const size_t NRHS, const size_t R, double *A, const size_t lda, const size_t *P, const size_t *Q, double *X, const size_t ldx, const double *B, const size_t ldb, int *info, bool positive)
- size_t `fgesvin_modular_double` (const double p, const enum `FFLAS_C_SIDE` Side, const size_t M, const size_t N, double *A, const size_t lda, double *B, const size_t ldb, int *info, bool positive)
- size_t `fgesv_modular_double` (const double p, const enum `FFLAS_C_SIDE` Side, const size_t M, const size_t N, const size_t NRHS, double *A, const size_t lda, double *X, const size_t ldx, const double *B, const size_t ldb, int *info)
- void `frtri_modular_double` (const double p, const enum `FFLAS_C_UPLO` Uplo, const enum `FFLAS_C_DIAG` Diag, const size_t N, double *A, const size_t lda, bool positive)
- void `trinv_left_modular_double` (const double p, const size_t N, const double *L, const size_t ldl, double *X, const size_t ldx, bool positive)

- void [ftrrm_modular_double](#) (const double p, const enum [FFLAS_C_DIAG](#) diag, const size_t N, double *A, const size_t lda, bool positive)
- size_t [PLUQ_modular_double](#) (const double p, const enum [FFLAS_C_DIAG](#) Diag, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Q, bool positive)
- size_t [LUdivine_modular_double](#) (const double p, const enum [FFLAS_C_DIAG](#) Diag, const enum [FFLAS_C_TRANSPOSE](#) trans, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Qt, const enum [FFPACK_C_LU_TAG](#) LuTag, const size_t cutoff, bool positive)
- size_t [LUdivine_small_modular_double](#) (const double p, const enum [FFLAS_C_DIAG](#) Diag, const enum [FFLAS_C_TRANSPOSE](#) trans, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Q, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [LUdivine_gauss_modular_double](#) (const double p, const enum [FFLAS_C_DIAG](#) Diag, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Q, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [ColumnEchelonForm_modular_double](#) (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Qt, bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [RowEchelonForm_modular_double](#) (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [ColumnEchelonForm_modular_float](#) (const float p, const size_t M, const size_t N, float *A, const size_t lda, size_t *P, size_t *Qt, bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [RowEchelonForm_modular_float](#) (const float p, const size_t M, const size_t N, float *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [ColumnEchelonForm_modular_int32_t](#) (const int32_t p, const size_t M, const size_t N, int32_t *A, const size_t lda, size_t *P, size_t *Qt, bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [RowEchelonForm_modular_int32_t](#) (const int32_t p, const size_t M, const size_t N, int32_t *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [ReducedColumnEchelonForm_modular_double](#) (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [ReducedRowEchelonForm_modular_double](#) (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [ReducedColumnEchelonForm_modular_float](#) (const float p, const size_t M, const size_t N, float *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [ReducedRowEchelonForm_modular_float](#) (const float p, const size_t M, const size_t N, float *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [ReducedColumnEchelonForm_modular_int32_t](#) (const int32_t p, const size_t M, const size_t N, int32_t *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [ReducedRowEchelonForm_modular_int32_t](#) (const int32_t p, const size_t M, const size_t N, int32_t *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const enum [FFPACK_C_LU_TAG](#) LuTag, bool positive)
- size_t [ReducedRowEchelonForm2_modular_double](#) (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, bool positive)
- size_t [REF_modular_double](#) (const double p, const size_t M, const size_t N, double *A, const size_t lda, const size_t colbeg, const size_t rowbeg, const size_t colsize, size_t *Qt, size_t *P, bool positive)
- double * [Invertin_modular_double](#) (const double p, const size_t M, double *A, const size_t lda, int *nullity, bool positive)
- double * [Invert_modular_double](#) (const double p, const size_t M, const double *A, const size_t lda, double *X, const size_t idx, int *nullity, bool positive)
- double * [Invert2_modular_double](#) (const double p, const size_t M, double *A, const size_t lda, double *X, const size_t idx, int *nullity, bool positive)
- size_t [KrylovElim_modular_double](#) (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t *P, size_t *Q, const size_t deg, size_t *iterates, size_t *inviterates, const size_t maxit, size_t virt, bool positive)
- size_t [SpecRankProfile_modular_double](#) (const double p, const size_t M, const size_t N, double *A, const size_t lda, const size_t deg, size_t *rankProfile, bool positive)

- `size_t Rank_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, bool positive)
- `bool IsSingular_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, bool positive)
- `double Det_modular_double` (const double p, const size_t N, double *A, const size_t lda, bool positive)
- `double * Solve_modular_double` (const double p, const size_t M, double *A, const size_t lda, double *x, const int incx, const double *b, const int incb, bool positive)
- `void solveLB_modular_double` (const double p, const enum FFLAS_C_SIDE Side, const size_t M, const size_t N, const size_t R, double *L, const size_t ldl, const size_t *Q, double *B, const size_t ldb)
- `void solveLB2_modular_double` (const double p, const enum FFLAS_C_SIDE Side, const size_t M, const size_t N, const size_t R, double *L, const size_t ldl, const size_t *Q, double *B, const size_t ldb, bool positive)
- `void RandomNullSpaceVector_modular_double` (const double p, const enum FFLAS_C_SIDE Side, const size_t M, const size_t N, double *A, const size_t lda, double *X, const size_t incX, bool positive)
- `size_t NullSpaceBasis_modular_double` (const double p, const enum FFLAS_C_SIDE Side, const size_t M, const size_t N, double *A, const size_t lda, double **NS, size_t *ldn, size_t *NSdim, bool positive)
- `size_t RowRankProfile_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t **rkprofile, const enum FFPACK_C_LU_TAG LuTag, bool positive)
- `size_t ColumnRankProfile_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t **rkprofile, const enum FFPACK_C_LU_TAG LuTag, bool positive)
- `void RankProfileFromLU` (const size_t *P, const size_t N, const size_t R, size_t *rkprofile, const enum FFPACK_C_LU_TAG LuTag)
- `size_t LeadingSubmatrixRankProfiles` (const size_t M, const size_t N, const size_t R, const size_t LSm, const size_t LSn, const size_t *P, const size_t *Q, size_t *RRP, size_t *CRP)
- `size_t RowRankProfileSubmatrixIndices_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t **rowindices, size_t **colindices, size_t *R, bool positive)
- `size_t ColRankProfileSubmatrixIndices_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, size_t **rowindices, size_t **colindices, size_t *R, bool positive)
- `size_t RowRankProfileSubmatrix_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, double **X, size_t *R, bool positive)
- `size_t ColRankProfileSubmatrix_modular_double` (const double p, const size_t M, const size_t N, double *A, const size_t lda, double **X, size_t *R, bool positive)
- `void getTriangular_modular_double` (const double p, const enum FFLAS_C_UPLO Uplo, const enum FFLAS_C_DIAG diag, const size_t M, const size_t N, const size_t R, const double *A, const size_t lda, double *T, const size_t ldt, const bool OnlyNonZeroVectors, bool positive)
- `void getTriangularin_modular_double` (const double p, const enum FFLAS_C_UPLO Uplo, const enum FFLAS_C_DIAG diag, const size_t M, const size_t N, const size_t R, double *A, const size_t lda, bool positive)
- `void getEchelonForm_modular_double` (const double p, const enum FFLAS_C_UPLO Uplo, const enum FFLAS_C_DIAG diag, const size_t M, const size_t N, const size_t R, const size_t *P, const double *A, const size_t lda, double *T, const size_t ldt, const bool OnlyNonZeroVectors, const enum FFPACK_C_LU_TAG LuTag, bool positive)
- `void getEchelonFormin_modular_double` (const double p, const enum FFLAS_C_UPLO Uplo, const enum FFLAS_C_DIAG diag, const size_t M, const size_t N, const size_t R, const size_t *P, double *A, const size_t lda, const enum FFPACK_C_LU_TAG LuTag, bool positive)
- `void getEchelonTransform_modular_double` (const double p, const enum FFLAS_C_UPLO Uplo, const enum FFLAS_C_DIAG diag, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, const double *A, const size_t lda, double *T, const size_t ldt, const enum FFPACK_C_LU_TAG LuTag, bool positive)
- `void getReducedEchelonForm_modular_double` (const double p, const enum FFLAS_C_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const double *A, const size_t lda, double *T, const size_t ldt, const bool OnlyNonZeroVectors, const enum FFPACK_C_LU_TAG LuTag, bool positive)
- `void getReducedEchelonFormin_modular_double` (const double p, const enum FFLAS_C_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, double *A, const size_t lda, const enum FFPACK_C_LU_TAG LuTag, bool positive)
- `void getReducedEchelonTransform_modular_double` (const double p, const enum FFLAS_C_UPLO Uplo, const size_t M, const size_t N, const size_t R, const size_t *P, const size_t *Q, const double *A, const size_t lda, double *T, const size_t ldt, const enum FFPACK_C_LU_TAG LuTag, bool positive)
- `void PLUQtoEchelonPermutation` (const size_t N, const size_t R, const size_t *P, size_t *outPerm)

17.228.1 Macro Definition Documentation

17.228.1.1 FFPACK_COMPILED

```
#define FFPACK_COMPILED
```

17.228.2 Enumeration Type Documentation

17.228.2.1 FFLAS_C_ORDER

```
enum FFLAS_C_ORDER
```

Enumerator

FflasRowMajor	row major
FflasColMajor	col major
FflasRowMajor	
FflasColMajor	

17.228.2.2 FFLAS_C_TRANSPOSE

```
enum FFLAS_C_TRANSPOSE
```

Enumerator

FflasNoTrans	Matrix is not transposed.
FflasTrans	Matrix is transposed.
FflasNoTrans	
FflasTrans	

17.228.2.3 FFLAS_C_UPLO

```
enum FFLAS_C_UPLO
```

Enumerator

FflasUpper	Triangular matrix is Upper triangular (if $i > j$ then $T_{i,j} = 0$)
FflasLower	Triangular matrix is Lower triangular (if $i < j$ then $T_{i,j} = 0$)
FflasUpper	
FflasLower	

17.228.2.4 FFLAS_C_DIAG

```
enum FFLAS_C_DIAG
```

Enumerator

Enumerator

FflasNonUnit	Triangular matrix has an explicit arbitrary diagonal.
FflasUnit	Triangular matrix has an implicit unit diagonal ($T_{i,i} = 1$)
FflasNonUnit	
FflasUnit	

17.228.2.5 FFLAS_C_SIDE

enum [FFLAS_C_SIDE](#)

Enumerator

FflasLeft	Operator applied on the left.
FflasRight	Operator applied on the righth.
FflasLeft	
FflasRight	

17.228.2.6 FFPACK_C_LU_TAG

enum [FFPACK_C_LU_TAG](#)

Enumerator

FfpackSlabRecursive	
FfpackTileRecursive	
FfpackSingular	

17.228.2.7 FFPACK_C_CHARPOLY_TAG

enum [FFPACK_C_CHARPOLY_TAG](#)

Enumerator

FfpackLUK	
FfpackKG	
FfpackHybrid	
FfpackKGFast	
FfpackDanilevski	
FfpackArithProg	
FfpackKGFastG	

17.228.2.8 FFPACK_C_MINPOLY_TAG

enum [FFPACK_C_MINPOLY_TAG](#)

Enumerator

FfpackDense	
FfpackKGF	

17.228.3 Function Documentation

17.228.3.1 LAPACKPerm2MathPerm()

```
void LAPACKPerm2MathPerm (
    size_t * MathP,
    const size_t * LapackP,
    const size_t N )
```

17.228.3.2 MathPerm2LAPACKPerm()

```
void MathPerm2LAPACKPerm (
    size_t * LapackP,
    const size_t * MathP,
    const size_t N )
```

17.228.3.3 MatrixApplyS_modular_double()

```
void MatrixApplyS_modular_double (
    const double p,
    double * A,
    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4,
    bool positive )
```

17.228.3.4 PermApplyS_double()

```
void PermApplyS_double (
    double * A,
    const size_t lda,
    const size_t width,
    const size_t M2,
    const size_t R1,
    const size_t R2,
    const size_t R3,
    const size_t R4 )
```

17.228.3.5 MatrixApplyT_modular_double()

```
void MatrixApplyT_modular_double (
    const double p,
    double * A,
```

```
const size_t lda,  
const size_t width,  
const size_t N2,  
const size_t R1,  
const size_t R2,  
const size_t R3,  
const size_t R4,  
bool positive )
```

17.228.3.6 PermApplyT_double()

```
void PermApplyT_double (   
    double * A,  
    const size_t lda,  
    const size_t width,  
    const size_t N2,  
    const size_t R1,  
    const size_t R2,  
    const size_t R3,  
    const size_t R4 )
```

17.228.3.7 composePermutationsLLM()

```
void composePermutationsLLM (   
    size_t * MathP,  
    const size_t * P1,  
    const size_t * P2,  
    const size_t R,  
    const size_t N )
```

17.228.3.8 composePermutationsLLL()

```
void composePermutationsLLL (   
    size_t * P1,  
    const size_t * P2,  
    const size_t R,  
    const size_t N )
```

17.228.3.9 composePermutationsMLM()

```
void composePermutationsMLM (   
    size_t * MathP1,  
    const size_t * P2,  
    const size_t R,  
    const size_t N )
```

17.228.3.10 cyclic_shift_mathPerm()

```
void cyclic_shift_mathPerm (   
    size_t * P,  
    const size_t s )
```

17.228.3.11 cyclic_shift_row_modular_double()

```
void cyclic_shift_row_modular_double (
    const double p,
    double * A,
    size_t m,
    size_t n,
    size_t lda,
    bool positive )
```

17.228.3.12 cyclic_shift_col_modular_double()

```
void cyclic_shift_col_modular_double (
    const double p,
    double * A,
    size_t m,
    size_t n,
    size_t lda,
    bool positive )
```

17.228.3.13 applyP_modular_double()

```
void applyP_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const enum FFLAS_C_TRANSPOSE Trans,
    const size_t M,
    const size_t ibeg,
    const size_t iend,
    double * A,
    const size_t lda,
    const size_t * P,
    bool positive )
```

17.228.3.14 fgetrsin_modular_double()

```
void fgetrsin_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    double * A,
    const size_t lda,
    const size_t * P,
    const size_t * Q,
    double * B,
    const size_t ldb,
    int * info,
    bool positive )
```

17.228.3.15 fgetrs_modular_double()

```
double * fgetrs_modular_double (
    const double p,
```

```

const enum FFLAS_C_SIDE Side,
const size_t M,
const size_t N,
const size_t NRHS,
const size_t R,
double * A,
const size_t lda,
const size_t * P,
const size_t * Q,
double * X,
const size_t ldX,
const double * B,
const size_t ldb,
int * info,
bool positive )

```

17.228.3.16 fgesvin_modular_double()

```

size_t fgesvin_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double * B,
    const size_t ldb,
    int * info,
    bool positive )

```

17.228.3.17 fgesv_modular_double()

```

size_t fgesv_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t NRHS,
    double * A,
    const size_t lda,
    double * X,
    const size_t ldX,
    const double * B,
    const size_t ldb,
    int * info )

```

17.228.3.18 ftrtri_modular_double()

```

void ftrtri_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG Diag,
    const size_t N,
    double * A,
    const size_t lda,
    bool positive )

```


17.228.3.19 trinv_left_modular_double()

```
void trinv_left_modular_double (
    const double p,
    const size_t N,
    const double * L,
    const size_t ldl,
    double * X,
    const size_t ldx,
    bool positive )
```

17.228.3.20 ftrtrm_modular_double()

```
void ftrtrm_modular_double (
    const double p,
    const enum FFLAS_C_DIAG diag,
    const size_t N,
    double * A,
    const size_t lda,
    bool positive )
```

17.228.3.21 PLUQ_modular_double()

```
size_t PLUQ_modular_double (
    const double p,
    const enum FFLAS_C_DIAG Diag,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    bool positive )
```

17.228.3.22 LUdivine_modular_double()

```
size_t LUdivine_modular_double (
    const double p,
    const enum FFLAS_C_DIAG Diag,
    const enum FFLAS_C_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const enum FFPACK_C_LU_TAG LuTag,
    const size_t cutoff,
    bool positive )
```

17.228.3.23 LUdivine_small_modular_double()

```
size_t LUdivine_small_modular_double (
```

```

    const double p,
    const enum FFLAS_C_DIAG Diag,
    const enum FFLAS_C_TRANSPOSE trans,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.228.3.24 LUdivine_gauss_modular_double()

```

size_t LUdivine_gauss_modular_double (
    const double p,
    const enum FFLAS_C_DIAG Diag,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.228.3.25 ColumnEchelonForm_modular_double()

```

size_t ColumnEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.228.3.26 RowEchelonForm_modular_double()

```

size_t RowEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.228.3.27 ColumnEchelonForm_modular_float()

```
size_t ColumnEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.228.3.28 RowEchelonForm_modular_float()

```
size_t RowEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.228.3.29 ColumnEchelonForm_modular_int32_t()

```
size_t ColumnEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.228.3.30 RowEchelonForm_modular_int32_t()

```
size_t RowEchelonForm_modular_int32_t (
    const int32_t p,
    const size_t M,
    const size_t N,
    int32_t * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.228.3.31 ReducedColumnEchelonForm_modular_double()

```

size_t ReducedColumnEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.228.3.32 ReducedRowEchelonForm_modular_double()

```

size_t ReducedRowEchelonForm_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.228.3.33 ReducedColumnEchelonForm_modular_float()

```

size_t ReducedColumnEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.228.3.34 ReducedRowEchelonForm_modular_float()

```

size_t ReducedRowEchelonForm_modular_float (
    const float p,
    const size_t M,
    const size_t N,
    float * A,
    const size_t lda,
    size_t * P,
    size_t * Qt,
    const bool transform,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.228.3.35 ReducedColumnEchelonForm_modular_int32_t()

```
size_t ReducedColumnEchelonForm_modular_int32_t (  
    const int32_t p,  
    const size_t M,  
    const size_t N,  
    int32_t * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive )
```

17.228.3.36 ReducedRowEchelonForm_modular_int32_t()

```
size_t ReducedRowEchelonForm_modular_int32_t (  
    const int32_t p,  
    const size_t M,  
    const size_t N,  
    int32_t * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    const enum FFPACK_C_LU_TAG LuTag,  
    bool positive )
```

17.228.3.37 ReducedRowEchelonForm2_modular_double()

```
size_t ReducedRowEchelonForm2_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    size_t * P,  
    size_t * Qt,  
    const bool transform,  
    bool positive )
```

17.228.3.38 REF_modular_double()

```
size_t REF_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    const size_t colbeg,  
    const size_t rowbeg,  
    const size_t colsize,  
    size_t * Qt,  
    size_t * P,  
    bool positive )
```

17.228.3.39 Invertin_modular_double()

```
double * Invertin_modular_double (
    const double p,
    const size_t M,
    double * A,
    const size_t lda,
    int * nullity,
    bool positive )
```

17.228.3.40 Invert_modular_double()

```
double * Invert_modular_double (
    const double p,
    const size_t M,
    const double * A,
    const size_t lda,
    double * X,
    const size_t ldx,
    int * nullity,
    bool positive )
```

17.228.3.41 Invert2_modular_double()

```
double * Invert2_modular_double (
    const double p,
    const size_t M,
    double * A,
    const size_t lda,
    double * X,
    const size_t ldx,
    int * nullity,
    bool positive )
```

17.228.3.42 KrylovElim_modular_double()

```
size_t KrylovElim_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t * P,
    size_t * Q,
    const size_t deg,
    size_t * iterates,
    size_t * inviterates,
    const size_t maxit,
    size_t virt,
    bool positive )
```

17.228.3.43 SpecRankProfile_modular_double()

```
size_t SpecRankProfile_modular_double (
    const double p,
```

```
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    const size_t deg,  
    size_t * rankProfile,  
    bool positive )
```

17.228.3.44 Rank_modular_double()

```
size_t Rank_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    bool positive )
```

17.228.3.45 IsSingular_modular_double()

```
bool IsSingular_modular_double (  
    const double p,  
    const size_t M,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    bool positive )
```

17.228.3.46 Det_modular_double()

```
double Det_modular_double (  
    const double p,  
    const size_t N,  
    double * A,  
    const size_t lda,  
    bool positive )
```

17.228.3.47 Solve_modular_double()

```
double * Solve_modular_double (  
    const double p,  
    const size_t M,  
    double * A,  
    const size_t lda,  
    double * x,  
    const int incx,  
    const double * b,  
    const int incb,  
    bool positive )
```

17.228.3.48 solveLB_modular_double()

```
void solveLB_modular_double (  
    const double p,
```

```

    const enum FFLAS_C_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    double * L,
    const size_t ldl,
    const size_t * Q,
    double * B,
    const size_t ldb )

```

17.228.3.49 solveLB2_modular_double()

```

void solveLB2_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const size_t M,
    const size_t N,
    const size_t R,
    double * L,
    const size_t ldl,
    const size_t * Q,
    double * B,
    const size_t ldb,
    bool positive )

```

17.228.3.50 RandomNullSpaceVector_modular_double()

```

void RandomNullSpaceVector_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double * X,
    const size_t incX,
    bool positive )

```

17.228.3.51 NullSpaceBasis_modular_double()

```

size_t NullSpaceBasis_modular_double (
    const double p,
    const enum FFLAS_C_SIDE Side,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double ** NS,
    size_t * ldn,
    size_t * NSdim,
    bool positive )

```

17.228.3.52 RowRankProfile_modular_double()

```

size_t RowRankProfile_modular_double (

```



```

    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rkprofile,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.228.3.53 ColumnRankProfile_modular_double()

```

size_t ColumnRankProfile_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rkprofile,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.228.3.54 RankProfileFromLU()

```

void RankProfileFromLU (
    const size_t * P,
    const size_t N,
    const size_t R,
    size_t * rkprofile,
    const enum FFPACK_C_LU_TAG LuTag )

```

17.228.3.55 LeadingSubmatrixRankProfiles()

```

size_t LeadingSubmatrixRankProfiles (
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t LSm,
    const size_t LSn,
    const size_t * P,
    const size_t * Q,
    size_t * RRP,
    size_t * CRP )

```

17.228.3.56 RowRankProfileSubmatrixIndices_modular_double()

```

size_t RowRankProfileSubmatrixIndices_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rowindices,
    size_t ** colindices,
    size_t * R,
    bool positive )

```

17.228.3.57 ColRankProfileSubmatrixIndices_modular_double()

```
size_t ColRankProfileSubmatrixIndices_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    size_t ** rowindices,
    size_t ** colindices,
    size_t * R,
    bool positive )
```

17.228.3.58 RowRankProfileSubmatrix_modular_double()

```
size_t RowRankProfileSubmatrix_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double ** X,
    size_t * R,
    bool positive )
```

17.228.3.59 ColRankProfileSubmatrix_modular_double()

```
size_t ColRankProfileSubmatrix_modular_double (
    const double p,
    const size_t M,
    const size_t N,
    double * A,
    const size_t lda,
    double ** X,
    size_t * R,
    bool positive )
```

17.228.3.60 getTriangular_modular_double()

```
void getTriangular_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    bool positive )
```

17.228.3.61 getTriangularin_modular_double()

```
void getTriangularin_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    double * A,
    const size_t lda,
    bool positive )
```

17.228.3.62 getEchelonForm_modular_double()

```
void getEchelonForm_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.228.3.63 getEchelonFormin_modular_double()

```
void getEchelonFormin_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    double * A,
    const size_t lda,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )
```

17.228.3.64 getEchelonTransform_modular_double()

```
void getEchelonTransform_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const enum FFLAS_C_DIAG diag,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
```

```

    const size_t * Q,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.228.3.65 getReducedEchelonForm_modular_double()

```

void getReducedEchelonForm_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const bool OnlyNonZeroVectors,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.228.3.66 getReducedEchelonFormin_modular_double()

```

void getReducedEchelonFormin_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    double * A,
    const size_t lda,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.228.3.67 getReducedEchelonTransform_modular_double()

```

void getReducedEchelonTransform_modular_double (
    const double p,
    const enum FFLAS_C_UPLO Uplo,
    const size_t M,
    const size_t N,
    const size_t R,
    const size_t * P,
    const size_t * Q,
    const double * A,
    const size_t lda,
    double * T,
    const size_t ldt,
    const enum FFPACK_C_LU_TAG LuTag,
    bool positive )

```

17.228.3.68 PLUQtoEchelonPermutation()

```
void PLUQtoEchelonPermutation (
    const size_t N,
    const size_t R,
    const size_t * P,
    size_t * outPerm )
```

17.229 ffpack_inst.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "ffpack_inst_implem.inl"
```

Macros

- `#define __FFPACK_INST_C`
- `#define FFLAS_COMPILED`
- `#define INST_OR_DECL`
- `#define FFLAS_FIELD Givaro::ModularBalanced`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`
- `#define FFLAS_FIELD Givaro::Modular`
- `#define FFLAS_ELT double`
- `#define FFLAS_ELT float`
- `#define FFLAS_ELT int64_t`

17.229.1 Macro Definition Documentation**17.229.1.1 __FFPACK_INST_C**

```
#define __FFPACK_INST_C
```

17.229.1.2 FFLAS_COMPILED

```
#define FFLAS_COMPILED
```

17.229.1.3 INST_OR_DECL

```
#define INST_OR_DECL
```

17.229.1.4 FFLAS_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

17.229.1.5 FFLAS_ELT [1/6]

```
#define FFLAS_ELT double
```

17.229.1.6 FFLAS_ELT [2/6]

```
#define FFLAS_ELT float
```

17.229.1.7 FFLAS_ELT [3/6]

```
#define FFLAS_ELT int64\_t
```

17.229.1.8 FFLAS_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

17.229.1.9 FFLAS_ELT [4/6]

```
#define FFLAS_ELT double
```

17.229.1.10 FFLAS_ELT [5/6]

```
#define FFLAS_ELT float
```

17.229.1.11 FFLAS_ELT [6/6]

```
#define FFLAS_ELT int64\_t
```

17.230 ffpack_inst.h File Reference

```
#include "givaro/modular.h"
#include "givaro/modular-balanced.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "ffpack_inst_implem.inl"
```

Macros

- [#define FFLAS_COMPILED](#)
- [#define INST_OR_DECL <>](#)
- [#define FFLAS_FIELD Givaro::ModularBalanced](#)
- [#define FFLAS_ELT double](#)
- [#define FFLAS_ELT float](#)
- [#define FFLAS_ELT \[int64_t\]\(#\)](#)
- [#define FFLAS_FIELD Givaro::Modular](#)
- [#define FFLAS_ELT double](#)
- [#define FFLAS_ELT float](#)
- [#define FFLAS_ELT \[int64_t\]\(#\)](#)

17.230.1 Macro Definition Documentation**17.230.1.1 FFLAS_COMPILED**

```
#define FFLAS_COMPILED
```

17.230.1.2 INST_OR_DECL

```
#define INST_OR_DECL <>
```

17.230.1.3 FFLAS_FIELD [1/2]

```
#define FFLAS_FIELD Givaro::ModularBalanced
```

17.230.1.4 FFLAS_ELT [1/6]

```
#define FFLAS_ELT double
```

17.230.1.5 FFLAS_ELT [2/6]

```
#define FFLAS_ELT float
```

17.230.1.6 FFLAS_ELT [3/6]

```
#define FFLAS_ELT int64_t
```

17.230.1.7 FFLAS_FIELD [2/2]

```
#define FFLAS_FIELD Givaro::Modular
```

17.230.1.8 FFLAS_ELT [4/6]

```
#define FFLAS_ELT double
```

17.230.1.9 FFLAS_ELT [5/6]

```
#define FFLAS_ELT float
```

17.230.1.10 FFLAS_ELT [6/6]

```
#define FFLAS_ELT int64_t
```

17.231 ffpack_inst_implem.inl File Reference**Namespaces**

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Functions

- void [composePermutationsLLM](#) (size_t *MathP, const size_t *P1, const size_t *P2, const size_t R, const size_t N)
Computes $P1 \times \text{Diag}(I_R, P2)$ where $P1$ is a LAPACK and $P2$ a LAPACK permutation and store the result in MathP as a MathPermutation format.
- void [composePermutationsLLL](#) (size_t *P1, const size_t *P2, const size_t R, const size_t N)

Computes $P1 \times \text{Diag}(I_R, P2)$ where $P1$ is a LAPACK and $P2$ a LAPACK permutation and store the result in $P1$ as a LAPACK permutation.

- void `composePermutationsMLM` (size_t *MathP1, const size_t *P2, const size_t R, const size_t N)

Computes $\text{MathP1} \times \text{Diag}(I_R, P2)$ where MathP1 is a MathPermutation and $P2$ a LAPACK permutation and store the result in MathP1 as a MathPermutation format.

- void `cyclic_shift_mathPerm` (size_t *P, const size_t s)
- template<typename Base_t >
void `cyclic_shift_row_col` (Base_t *A, size_t m, size_t n, size_t lda)
- template `INST_OR_DECL` void `cyclic_shift_row` (const FFLAS_FIELD< FFLAS_ELT > &F, FFLAS_ELT *A, size_t m, size_t n, size_t lda)
- template `INST_OR_DECL` void `cyclic_shift_col` (const FFLAS_FIELD< FFLAS_ELT > &F, FFLAS_ELT *A, size_t m, size_t n, size_t lda)
- template `INST_OR_DECL` void `applyP` (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_SIDE Side, const FFLAS::FFLAS_TRANSPOSE Trans, const size_t M, const size_t ibeg, const size_t iend, FFLAS_ELT *A, const size_t lda, const size_t *P)
- template `INST_OR_DECL` void `fgetrs` (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t R, FFLAS_ELT *A, const size_t lda, const size_t *P, const size_t *Q, FFLAS_ELT *B, const size_t ldb, int *info)
- template `INST_OR_DECL` FFLAS_ELT * `fgetrs` (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t NRHS, const size_t R, FFLAS_ELT *A, const size_t lda, const size_t *P, const size_t *Q, FFLAS_ELT *X, const size_t ldx, const FFLAS_ELT *B, const size_t ldb, int *info)
- template `INST_OR_DECL` size_t `fgesv` (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, FFLAS_ELT *A, const size_t lda, FFLAS_ELT *B, const size_t ldb, int *info)
- template `INST_OR_DECL` size_t `fgesv` (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_SIDE Side, const size_t M, const size_t N, const size_t NRHS, FFLAS_ELT *A, const size_t lda, FFLAS_ELT *X, const size_t ldx, const FFLAS_ELT *B, const size_t ldb, int *info)
- template `INST_OR_DECL` void `fttrtri` (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_UPLO Uplo, const FFLAS::FFLAS_DIAG Diag, const size_t N, FFLAS_ELT *A, const size_t lda, const size_t threshold)
- template `INST_OR_DECL` void `trinv_left` (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t N, const FFLAS_ELT *L, const size_t ldl, FFLAS_ELT *X, const size_t ldx)
- template `INST_OR_DECL` void `fttrtm` (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_SIDE side, const FFLAS::FFLAS_DIAG diag, const size_t N, FFLAS_ELT *A, const size_t lda)
- template `INST_OR_DECL` size_t `PLUQ` (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, FFLAS_ELT *A, const size_t lda, size_t *P, size_t *Q)
- template `INST_OR_DECL` size_t `LUdivine` (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans, const size_t M, const size_t N, FFLAS_ELT *A, const size_t lda, size_t *P, size_t *Qt, const FFPACK_LU_TAG LuTag, const size_t cutoff)
- template `INST_OR_DECL` size_t `LUdivine_small` (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_DIAG Diag, const FFLAS::FFLAS_TRANSPOSE trans, const size_t M, const size_t N, FFLAS_ELT *A, const size_t lda, size_t *P, size_t *Q, const FFPACK_LU_TAG LuTag)
- template `INST_OR_DECL` size_t `LUdivine_gauss` (const FFLAS_FIELD< FFLAS_ELT > &F, const FFLAS::FFLAS_DIAG Diag, const size_t M, const size_t N, FFLAS_ELT *A, const size_t lda, size_t *P, size_t *Q, const FFPACK_LU_TAG LuTag)
- template `INST_OR_DECL` size_t `RowEchelonForm` (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t M, const size_t N, FFLAS_ELT *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag)
- template `INST_OR_DECL` size_t `ReducedRowEchelonForm` (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t M, const size_t N, FFLAS_ELT *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag)
- template `INST_OR_DECL` size_t `ColumnEchelonForm` (const FFLAS_FIELD< FFLAS_ELT > &F, const size_t M, const size_t N, FFLAS_ELT *A, const size_t lda, size_t *P, size_t *Qt, const bool transform, const FFPACK_LU_TAG LuTag)

- template `INST_OR_DECL` `size_t ReducedColumnEchelonForm` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *P, `size_t` *Qt, const bool transform, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` `FFLAS_ELT` * `Invert` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, `FFLAS_ELT` *A, const `size_t` lda, int &nullity)
- template `INST_OR_DECL` `FFLAS_ELT` * `Invert` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *X, const `size_t` ldx, int &nullity)
- template `INST_OR_DECL` `FFLAS_ELT` * `Invert2` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *X, const `size_t` ldx, int &nullity)
- template `INST_OR_DECL` `std::list< Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element > & CharPoly` (const `Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > > &R`, `std::list< Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element > &charp`, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_FIELD< FFLAS_ELT >::RandIter &G`, const `FFPACK_CHARPOLY_TAG` CharpTag, const `size_t` degree)
- template `INST_OR_DECL` `Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element & CharPoly` (const `Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > > &R`, `Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element &charp`, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_FIELD< FFLAS_ELT >::RandIter &G`, const `FFPACK_CHARPOLY_TAG` CharpTag, const `size_t` degree)
- template `INST_OR_DECL` `Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element & CharPoly` (const `Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > > &R`, `Givaro::Poly1Dom< FFLAS_FIELD< FFLAS_ELT > >::Element &charp`, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, const `FFPACK_CHARPOLY_TAG` CharpTag, const `size_t` degree)
- template `INST_OR_DECL` `std::vector< FFLAS_ELT > & MinPoly` (const `FFLAS_FIELD< FFLAS_ELT >` &F, `std::vector< FFLAS_ELT > &minP`, const `size_t` N, const `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_FIELD< FFLAS_ELT >::RandIter &G`)
- template `INST_OR_DECL` `std::vector< FFLAS_ELT > & MinPoly` (const `FFLAS_FIELD< FFLAS_ELT >` &F, `std::vector< FFLAS_ELT > &minP`, const `size_t` N, const `FFLAS_ELT` *A, const `size_t` lda)
- template `INST_OR_DECL` `std::vector< FFLAS_ELT > & MatVecMinPoly` (const `FFLAS_FIELD< FFLAS_ELT >` &F, `std::vector< FFLAS_ELT > &minP`, const `size_t` N, const `FFLAS_ELT` *A, const `size_t` lda, const `FFLAS_ELT` *V, const `size_t` incv)
- template `INST_OR_DECL` `size_t KrylovElim` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *P, `size_t` *Q, const `size_t` deg, `size_t` *iterates, `size_t` *inviterates, const `size_t` maxit, `size_t` virt)
- template `INST_OR_DECL` `size_t SpecRankProfile` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, const `size_t` deg, `size_t` *rankProfile)
- template `INST_OR_DECL` `size_t Rank` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda)
- template `INST_OR_DECL` bool `IsSingular` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda)
- template `INST_OR_DECL` `FFLAS_ELT` & `Det` (const `FFLAS_FIELD< FFLAS_ELT >` &F, `FFLAS_ELT` &det, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *P, `size_t` *Q)
- template `INST_OR_DECL` `FFLAS_ELT` & `Det` (const `FFLAS_FIELD< FFLAS_ELT >` &F, `FFLAS_ELT` &det, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, const `FFLAS::ParSeqHelper::Parallel< FFLAS::CuttingStrategy::Recursive, FFLAS::StrategyParameter::Threads >` &parH, `size_t` *P, `size_t` *Q)
- template `INST_OR_DECL` `FFLAS_ELT` * `Solve` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *x, const int incx, const `FFLAS_ELT` *b, const int incb)
- template `INST_OR_DECL` void `solveLB` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, const `size_t` R, `FFLAS_ELT` *L, const `size_t` ldl, const `size_t` *Q, `FFLAS_ELT` *B, const `size_t` ldb)
- template `INST_OR_DECL` void `solveLB2` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, const `size_t` R, `FFLAS_ELT` *L, const `size_t` ldl, const `size_t` *Q, `FFLAS_ELT` *B, const `size_t` ldb)
- template `INST_OR_DECL` void `RandomNullSpaceVector` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *X, const `size_t` incX)
- template `INST_OR_DECL` `size_t NullSpaceBasis` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_SIDE` Side, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *NS, `size_t` &ldn, `size_t` &NSdim)

- template `INST_OR_DECL` `size_t` `RowRankProfile` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *&rkprofile, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` `size_t` `ColumnRankProfile` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *&rkprofile, const `FFPACK_LU_TAG` LuTag)
- void `RankProfileFromLU` (const `size_t` *P, const `size_t` N, const `size_t` R, `size_t` *&rkprofile, const `FFPACK_LU_TAG` LuTag)
Recovers the column/row rank profile from the permutation of an LU decomposition.
- `size_t` `LeadingSubmatrixRankProfiles` (const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` LSm, const `size_t` LSn, const `size_t` *P, const `size_t` *Q, `size_t` *RRP, `size_t` *CRP)
Recovers the row and column rank profiles of any leading submatrix from the PLUQ decomposition.
- template `INST_OR_DECL` `size_t` `RowRankProfileSubmatrixIndices` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *&rowindices, `size_t` *&colindices, `size_t` &R)
- template `INST_OR_DECL` `size_t` `ColRankProfileSubmatrixIndices` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `size_t` *&rowindices, `size_t` *&colindices, `size_t` &R)
- template `INST_OR_DECL` `size_t` `RowRankProfileSubmatrix` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *X, `size_t` &R)
- template `INST_OR_DECL` `size_t` `ColRankProfileSubmatrix` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` M, const `size_t` N, `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *X, `size_t` &R)
- template `INST_OR_DECL` void `getTriangular< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const `size_t` M, const `size_t` N, const `size_t` R, const `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *T, const `size_t` ldt, const bool OnlyNonZeroVectors)
- template `INST_OR_DECL` void `getTriangular< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const `size_t` M, const `size_t` N, const `size_t` R, `FFLAS_ELT` *A, const `size_t` lda)
- template `INST_OR_DECL` void `getEchelonForm< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` *P, const `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *T, const `size_t` ldt, const bool OnlyNonZeroVectors, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` void `getEchelonForm< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` *P, `FFLAS_ELT` *A, const `size_t` lda, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` void `getEchelonTransform< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `FFLAS::FFLAS_DIAG` diag, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` *P, const `size_t` *Q, const `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *T, const `size_t` ldt, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` void `getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` *P, const `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *T, const `size_t` ldt, const bool OnlyNonZeroVectors, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` void `getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` *P, `FFLAS_ELT` *A, const `size_t` lda, const `FFPACK_LU_TAG` LuTag)
- template `INST_OR_DECL` void `getReducedEchelonTransform< FFLAS_FIELD< FFLAS_ELT > >` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `FFLAS::FFLAS_UPLO` Uplo, const `size_t` M, const `size_t` N, const `size_t` R, const `size_t` *P, const `size_t` *Q, const `FFLAS_ELT` *A, const `size_t` lda, `FFLAS_ELT` *T, const `size_t` ldt, const `FFPACK_LU_TAG` LuTag)
- void `PLUQtoEchelonPermutation` (const `size_t` N, const `size_t` R, const `size_t` *P, `size_t` *outPerm)
Auxiliary routine: determines the permutation that changes a PLUQ decomposition into a echelon form revealing PLUQ decomposition.
- template `INST_OR_DECL` `FFLAS_ELT` * `LQUPtoInverseOfFullRankMinor` (const `FFLAS_FIELD< FFLAS_ELT >` &F, const `size_t` rank, `FFLAS_ELT` *A_factors, const `size_t` lda, const `size_t` *QtPointer, `FFLAS_ELT` *X, const `size_t` ldx)

17.232 blockcuts.inl File Reference

```
#include <fflas-ffpack/fflas/fflas_enum.h>
#include <math.h>
#include <cassert>
```

Data Structures

- struct [Single](#)
- struct [Row](#)
- struct [Column](#)
- struct [Block](#)
- struct [Recursive](#)
- struct [Fixed](#)
- struct [Threads](#)
- struct [Grain](#)
- struct [TwoD](#)
- struct [TwoDAdaptive](#)
- struct [ThreeD](#)
- struct [ThreeDInPlace](#)
- struct [ThreeDAdaptive](#)
- struct [Parallel< C, P >](#)
- struct [Sequential](#)
- struct [Compose< H1, H2 >](#)
- struct [ForStrategy1D< blocksize_t, Cut, Param >](#)
- struct [ForStrategy2D< blocksize_t, Cut, Param >](#)

Namespaces

- namespace [FFLAS](#)
 - namespace [FFLAS::CuttingStrategy](#)
 - namespace [FFLAS::StrategyParameter](#)
 - namespace [FFLAS::ParSeqHelper](#)
- [ParSeqHelper](#) for both *fgemm* and *ftrsm*.*

Macros

- #define [__FFLASFFPACK_fflas_blockcuts_INL](#)
- #define [__FFLASFFPACK_MINBLOCKCUTS](#) ((size_t)256)

Typedefs

- typedef Row [RNSModulus](#)

Functions

- template<class Cut = CuttingStrategy::Block, class Strat = StrategyParameter::Threads>
void [BlockCuts](#) (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)
- template<> void [BlockCuts< CuttingStrategy::Single, StrategyParameter::Threads >](#) (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)
- template<> void [BlockCuts< CuttingStrategy::Row, StrategyParameter::Fixed >](#) (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)
- template<> void [BlockCuts< CuttingStrategy::Row, StrategyParameter::Grain >](#) (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t grainsize)

- `template<> void BlockCuts< CuttingStrategy::Block, StrategyParameter::Grain > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t grainsize)`
- `template<> void BlockCuts< CuttingStrategy::Column, StrategyParameter::Fixed > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Column, StrategyParameter::Grain > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t grainsize)`
- `template<> void BlockCuts< CuttingStrategy::Block, StrategyParameter::Fixed > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Row, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Column, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<> void BlockCuts< CuttingStrategy::Block, StrategyParameter::Threads > (size_t &RBLOCKSIZE, size_t &CBLOCKSIZE, const size_t m, const size_t n, const size_t numthreads)`
- `template<class Cut = CuttingStrategy::Block, class Param = StrategyParameter::Threads>
void BlockCuts (size_t &rowBlockSize, size_t &colBlockSize, size_t &lastRBS, size_t &lastCBS, size_t &changeRBS, size_t &changeCBS, size_t &numRowBlock, size_t &numColBlock, size_t m, size_t n, const size_t numthreads)`

17.232.1 Macro Definition Documentation

17.232.1.1 __FFLASFFPACK_fflas_blockcuts_INL

```
#define __FFLASFFPACK_fflas_blockcuts_INL
```

17.232.1.2 __FFLASFFPACK_MINBLOCKCUTS

```
#define __FFLASFFPACK_MINBLOCKCUTS ((size_t)256)
```

17.233 fflas_plevel1.h File Reference

```
#include "fflas-ffpack/paladin/parallel.h"
```

Namespaces

- namespace [FFLAS](#)

Functions

- `template<class Field >
void pfzero (const Field &F, size_t m, size_t n, typename Field::Element_ptr C, size_t BS=0)`
- `template<class Field, class RandIter >
void pfrand (const Field &F, RandIter &G, size_t m, size_t n, typename Field::Element_ptr C, size_t BS=0)`
- `template<class Field, class Cut, class Param >
Field::Element & fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr x, const size_t incx, typename Field::ConstElement_ptr y, const size_t incy, typename Field::Element &d, const ParSeqHelper::Parallel< Cut, Param > par)`
- `template<typename Field, class Cut, class Param >
Field::Element fdot (const Field &F, const size_t N, typename Field::ConstElement_ptr X, const size_t incX, typename Field::ConstElement_ptr Y, const size_t incY, const ParSeqHelper::Parallel< Cut, Param > par)`

17.234 kaapi_routines.inl File Reference

Macros

- [#define __FFLASFFPACK_KAAPI_ROUTINES_INL](#)

17.234.1 Macro Definition Documentation

17.234.1.1 __FFLASFFPACK_KAAPI_ROUTINES_INL

```
#define __FFLASFFPACK_KAAPI_ROUTINES_INL
```

17.235 parallel.h File Reference

```
#include "fflas-ffpack/config.h"
#include "fflas-ffpack/paladin/blockcuts.inl"
```

Macros

- [#define __FFLASFFPACK_SEQUENTIAL](#)
- [#define index_t](#) size_t
- [#define TASK\(M, l\)](#) {l;}
- [#define WAIT](#)
- [#define CHECK_DEPENDENCIES](#)
- [#define BARRIER](#)
- [#define PAR_BLOCK](#)
- [#define SYNCH_GROUP](#)(Args...) {{Args};}
- [#define NUM_THREADS](#) 1
- [#define MAX_THREADS](#) 1
- [#define READ](#)(Args...)
- [#define WRITE](#)(Args...)
- [#define READWRITE](#)(Args...)
- [#define CONSTREFERENCE](#)(...)
- [#define VALUE](#)(...)
- [#define BEGIN_PARALLEL_MAIN](#)(Args...) int main(Args) {
- [#define END_PARALLEL_MAIN](#)(void) return 0; }
- [#define FORBLOCK1D](#)(iter, m, Helper, Args...)
- [#define FOR1D](#)(i, m, Helper, Args...)
- [#define PARFORBLOCK1D](#)(iter, m, Helper, Args...)
- [#define PARFOR1D](#)(iter, m, Helper, Args...)
- [#define FORBLOCK2D](#)(iter, m, n, Helper, Args...)
- [#define FOR2D](#)(i, j, m, n, Helper, Args...)
- [#define PARFORBLOCK2D](#)(iter, m, n, Helper, Args...) [FORBLOCK2D](#)(iter, m, n, Helper, Args)
- [#define PARFOR2D](#)(i, j, m, n, Helper, Args...) [FOR2D](#)(i, j, m, n, Helper, Args)
- [#define COMMA](#) ,
- [#define MODE](#)(...) __VA_ARGS__
- [#define RETURNPARAM](#)(f, P1, Args...) P1=f(Args)
- [#define NUMARGS](#)(...) [PP_NARG](#)(__VA_ARGS__,[PP_RSEQ_N](#)())
- [#define PP_NARG](#)(...) [PP_ARG_N](#)(__VA_ARGS__)
- [#define PP_ARG_N](#)(_1, _2, _3, _4, _5, _6, _7, _8, _9, _10, _11, _12, _13, _14, _15, _16, _17, _18, _19, _20, _21, _22, _23, _24, _25, _26, _27, _28, _29, _30, _31, _32, _33, _34, _35, _36, _37, _38, _39, _40, _41, _42, _43, _44, _45, _46, _47, _48, _49, _50, _51, _52, _53, _54, _55, _56, _57, _58, _59, _60, _61, _62, _63, N, ...) N

- `#define PP_RSEQ_N()`
- `#define NOSPLIT() FFLAS::ParSeqHelper::Sequential()`
- `#define splitting_0() FFLAS::ParSeqHelper::Parallel<FFLAS::CuttingStrategy::Block,FFLAS::StrategyParameter::Threads>()`
- `#define splitting_1(a) FFLAS::ParSeqHelper::Parallel<FFLAS::CuttingStrategy::Block,FFLAS::StrategyParameter::Threads>(a)`
- `#define splitting_2(a, c) FFLAS::ParSeqHelper::Parallel<FFLAS::CuttingStrategy::Block,c>(a)`
- `#define splitting_3(a, b, c) FFLAS::ParSeqHelper::Parallel<b,c>(a)`
- `#define splitt(_1, _2, _3, NAME, ...) NAME`
- `#define SPLITTER(...) splitt(__VA_ARGS__, splitting_3, splitting_2, splitting_1, splitting_0)(__VA_ARGS__)`

17.235.1 Macro Definition Documentation

17.235.1.1 __FFLASFFPACK_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

17.235.1.2 index_t

```
#define index_t size_t
```

17.235.1.3 TASK

```
#define TASK(
    M,
    I ) {I;}
```

17.235.1.4 WAIT

```
#define WAIT
```

17.235.1.5 CHECK_DEPENDENCIES

```
#define CHECK_DEPENDENCIES
```

17.235.1.6 BARRIER

```
#define BARRIER
```

17.235.1.7 PAR_BLOCK

```
#define PAR_BLOCK
```

17.235.1.8 SYNCH_GROUP

```
#define SYNCH_GROUP(
    Args... ) {{Args}};
```

17.235.1.9 NUM_THREADS

```
#define NUM_THREADS 1
```

17.235.1.10 MAX_THREADS

```
#define MAX_THREADS 1
```

17.235.1.11 READ

```
#define READ(  
    Args... )
```

17.235.1.12 WRITE

```
#define WRITE(  
    Args... )
```

17.235.1.13 READWRITE

```
#define READWRITE(  
    Args... )
```

17.235.1.14 CONSTREFERENCE

```
#define CONSTREFERENCE(  
    ... )
```

17.235.1.15 VALUE

```
#define VALUE(  
    ... )
```

17.235.1.16 BEGIN_PARALLEL_MAIN

```
#define BEGIN_PARALLEL_MAIN(  
    Args... ) int main(Args) {
```

17.235.1.17 END_PARALLEL_MAIN

```
#define END_PARALLEL_MAIN(  
    void ) return 0; }
```

17.235.1.18 FORBLOCK1D

```
#define FORBLOCK1D(  
    iter,  
    m,  
    Helper,  
    Args... )
```

Value:

```
{ FFLAS::ForStrategy1D<std::remove_const<decltype(m)>::type, typename decltype(Helper)::Cut, typename  
    decltype(Helper)::Param> iter(m, Helper); \  
    for(iter.initialize(); !iter.isTerminated(); ++iter) \  
    {Args;} }
```

17.235.1.19 FOR1D

```
#define FOR1D(
    i,
    m,
    Helper,
    Args... )
```

Value:

```
FORBLOCK1D(_internal_iterator, m, Helper,
    for(auto i=_internal_iterator.begin(); i!=_internal_iterator.end(); ++i) \
    { Args; })
```

17.235.1.20 PARFORBLOCK1D

```
#define PARFORBLOCK1D(
    iter,
    m,
    Helper,
    Args... )
```

Value:

```
for(std::remove_const<decltype(m)>::type iter=0; iter<m; ++iter) \
{ Args; }
```

17.235.1.21 PARFOR1D

```
#define PARFOR1D(
    iter,
    m,
    Helper,
    Args... )
```

Value:

```
for(std::remove_const<decltype(m)>::type iter=0; iter<m; ++iter) \
{ Args; }
```

17.235.1.22 FORBLOCK2D

```
#define FORBLOCK2D(
    iter,
    m,
    n,
    Helper,
    Args... )
```

Value:

```
{ FFLAS::ForStrategy2D<std::remove_const<decltype(m)>::type, typename decltype(Helper)::Cut, typename
    decltype(Helper)::Param> iter(m,n,Helper); \
    for(iter.initialize(); !iter.isTerminated(); ++iter) \
    { Args; } }
```

17.235.1.23 FOR2D

```
#define FOR2D(
    i,
    j,
    m,
    n,
    Helper,
    Args... )
```

Value:

```
FORBLOCK2D(_internal_iterator, m, n, Helper,
    for(auto i=_internal_iterator.ibegin(); i!=_internal_iterator.iend(); ++i) \
```



```
for(auto j=_internal_iterator.jbegin(); j!=_internal_iterator.jend(); ++j) \
{ Args; }
```

17.235.1.24 PARFORBLOCK2D

```
#define PARFORBLOCK2D(  
    iter,  
    m,  
    n,  
    Helper,  
    Args... ) FORBLOCK2D(iter, m, n, Helper, Args)
```

17.235.1.25 PARFOR2D

```
#define PARFOR2D(  
    i,  
    j,  
    m,  
    n,  
    Helper,  
    Args... ) FOR2D(i, j, m, n, Helper, Args)
```

17.235.1.26 COMMA

```
#define COMMA ,
```

17.235.1.27 MODE

```
#define MODE(  
    ... ) __VA_ARGS__
```

17.235.1.28 RETURNPARAM

```
#define RETURNPARAM(  
    f,  
    Pl,  
    Args... ) Pl=f(Args)
```

17.235.1.29 NUMARGS

```
#define NUMARGS(  
    ... ) PP_NARG__(__VA_ARGS__, PP_RSEQ_N())
```

17.235.1.30 PP_NARG__

```
#define PP_NARG_(  
    ... ) PP_ARG_N(__VA_ARGS__)
```

17.235.1.31 PP_ARG_N

```
#define PP_ARG_N(  
    _1,
```

_2,
_3,
_4,
_5,
_6,
_7,
_8,
_9,
_10,
_11,
_12,
_13,
_14,
_15,
_16,
_17,
_18,
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_42,
_43,
_44,
_45,
_46,
_47,
_48,
_49,
_50,
_51,
_52,
_53,
_54,
_55,
_56,
_57,
_58,
_59,

```

    _60,
    _61,
    _62,
    _63,
    N,
    ... ) N

```

17.235.1.32 PP_RSEQ_N

```
#define PP_RSEQ_N( )
```

Value:

```

63, 62, 61, 60, \
59, 58, 57, 56, 55, 54, 53, 52, 51, 50, \
49, 48, 47, 46, 45, 44, 43, 42, 41, 40, \
39, 38, 37, 36, 35, 34, 33, 32, 31, 30, \
29, 28, 27, 26, 25, 24, 23, 22, 21, 20, \
19, 18, 17, 16, 15, 14, 13, 12, 11, 10, \
9, 8, 7, 6, 5, 4, 3, 2, 1, 0

```

17.235.1.33 NOSPLIT

```
#define NOSPLIT( ) FFLAS::ParSeqHelper::Sequential()
```

17.235.1.34 splitting_0

```
#define splitting_0( ) FFLAS::ParSeqHelper::Parallel<FFLAS::CuttingStrategy::Block, FFLAS::StrategyParameter::Threading>(a)
```

17.235.1.35 splitting_1

```
#define splitting_1(
    a ) FFLAS::ParSeqHelper::Parallel<FFLAS::CuttingStrategy::Block, FFLAS::StrategyParameter::Threading>(a)
```

17.235.1.36 splitting_2

```
#define splitting_2(
    a,
    c ) FFLAS::ParSeqHelper::Parallel<FFLAS::CuttingStrategy::Block, c>(a)
```

17.235.1.37 splitting_3

```
#define splitting_3(
    a,
    b,
    c ) FFLAS::ParSeqHelper::Parallel<b, c>(a)
```

17.235.1.38 splitt

```
#define splitt(
    _1,
    _2,
    _3,
    NAME,
    ... ) NAME
```

17.235.1.39 SPLITTER

```
#define SPLITTER(
    ... ) splitt(__VA_ARGS__, splitting_3, splitting_2, splitting_1, splitting_0) (↔
__VA_ARGS__)
```

17.236 pfgemm_variants.inl File Reference

Namespaces

- namespace [FFLAS](#)

Functions

- template<class [Field](#) , class AlgoT , class FieldTrait >
[Field::Element](#) * [pfgemm](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, const typename [Field::ConstElement_ptr](#) A, const size_t lda, const typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element](#) *C, const size_t ldc, MMHelper< [Field](#), AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Block, StrategyParameter::Threads > > &H)
- template<class [Field](#) , class AlgoT , class FieldTrait >
[Field::Element](#) * [pfgemm](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, const typename [Field::ConstElement_ptr](#) AA, const size_t lda, const typename [Field::ConstElement_ptr](#) BB, const size_t ← t ldb, const typename [Field::Element](#) beta, typename [Field::Element](#) *C, const size_t ldc, MMHelper< [Field](#), AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::ThreeDAdaptive > > &H)
- template<class [Field](#) , class AlgoT , class FieldTrait >
[Field::Element](#) * [pfgemm](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, const typename [Field::ConstElement_ptr](#) AA, const size_t lda, const typename [Field::ConstElement_ptr](#) BB, const size_t ← t ldb, const typename [Field::Element](#) beta, typename [Field::Element](#) *C, const size_t ldc, MMHelper< [Field](#), AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoDAdaptive > > &H)
- template<class [Field](#) , class AlgoT , class FieldTrait >
[Field::Element](#) * [pfgemm](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, const typename [Field::ConstElement_ptr](#) AA, const size_t lda, const typename [Field::ConstElement_ptr](#) BB, const size_t ← t ldb, const typename [Field::Element](#) beta, typename [Field::Element](#) *C, const size_t ldc, MMHelper< [Field](#), AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::TwoD > > &H)
- template<class [Field](#) , class AlgoT , class FieldTrait >
[Field::Element_ptr](#) [pfgemm](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, const typename [Field::ConstElement_ptr](#) A, const size_t lda, const typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::ThreeD > > &H)
- template<class [Field](#) , class AlgoT , class FieldTrait >
[Field::Element](#) * [pfgemm](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const FFLAS_TRANSPOSE tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, const typename [Field::ConstElement_ptr](#) A, const size_t lda, const typename [Field::ConstElement_ptr](#) B, const size_t ldb, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) C, const size_t ldc, MMHelper< [Field](#), AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::ThreeDInPlace > > &H)

17.237 pfgemv.inl File Reference

Namespaces

- namespace [FFLAS](#)

Functions

- template<class [Field](#) , class AlgoT , class FieldTrait >
[Field::Element_ptr](#) [fgemv](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const size_t m, const size_t n, const typename [Field::Element](#) alpha, const typename [Field::ConstElement_ptr](#) A, const size_t lda, const typename [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t incY, MMHelper< [Field](#), AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Recursive, StrategyParameter::Threads > > &H)
- template<class [Field](#) , class AlgoT , class FieldTrait , class Cut >
[Field::Element_ptr](#) [fgemv](#) (const [Field](#) &F, const FFLAS_TRANSPOSE ta, const size_t m, const size_t n, const typename [Field::Element](#) alpha, const typename [Field::ConstElement_ptr](#) A, const size_t lda, const typename [Field::ConstElement_ptr](#) X, const size_t incX, const typename [Field::Element](#) beta, typename [Field::Element_ptr](#) Y, const size_t incY, MMHelper< [Field](#), AlgoT, FieldTrait, ParSeqHelper::Parallel< CuttingStrategy::Row, Cut > > &H)

17.238 align-allocator.h File Reference

```
#include "fflas-ffpack/config.h"
```

17.239 args-parser.h File Reference

```
#include <fflas-ffpack/fflas-ffpack-config.h>
#include <givaro/givinteger.h>
#include <givaro/givprint.h>
#include <iostream>
#include <fstream>
#include <vector>
#include <string>
#include <cstring>
#include <list>
#include <stdlib.h>
```

Data Structures

- struct [Argument](#)

Namespaces

- namespace [FFLAS](#)

Macros

- #define [TYPE_BOOL](#) [TYPE_NONE](#)
- #define [END_OF_ARGUMENTS](#) { '\0', '\0', '\0', [TYPE_NONE](#), NULL }
- #define [type_integer](#) long int

Enumerations

- enum [ArgumentType](#) {
[TYPE_NONE](#) , [TYPE_INT](#) , [TYPE_UINT64](#) , [TYPE_LONGLONG](#) ,
[TYPE_INTEGER](#) , [TYPE_DOUBLE](#) , [TYPE_INTLIST](#) , [TYPE_STR](#) }

Functions

- void [parseArguments](#) (int argc, char **argv, [Argument](#) *args, bool printDefaults=true)
- void [printHelpMessage](#) (const char *program, [Argument](#) *args, bool printDefaults=false)
- [Argument](#) * [findArgument](#) ([Argument](#) *args, char c)
- int [getListArgs](#) (std::list< int > &outlist, std::string &instring)
transforms a string list of ints to a list of int string "12,13,15" is turned into list of ints {12,13,15}
- std::ostream & [writeCommandString](#) (std::ostream &os, [Argument](#) *args, const char *programName=nullptr)
writes the values of all arguments, preceded by the programName

17.239.1 Macro Definition Documentation

17.239.1.1 TYPE_BOOL

```
#define TYPE_BOOL TYPE\_NONE
```

17.239.1.2 END_OF_ARGUMENTS

```
#define END_OF_ARGUMENTS { '\0', "\0", "\0", TYPE\_NONE, NULL }
```

17.239.1.3 type_integer

```
#define type_integer long int
```

17.239.2 Enumeration Type Documentation

17.239.2.1 ArgumentType

```
enum ArgumentType
```

Enumerator

TYPE_NONE	
TYPE_INT	
TYPE_UINT64	
TYPE_LONGLONG	
TYPE_INTEGER	
TYPE_DOUBLE	
TYPE_INTLIST	
TYPE_STR	

17.239.3 Function Documentation

17.239.3.1 printHelpMessage()

```
void printHelpMessage (
    const char * program,
    Argument * args,
    bool printDefaults = false )
```

17.239.3.2 findArgument()

```
Argument * findArgument (
    Argument * args,
    char c )
```

17.239.3.3 getListArgs()

```
int getListArgs (
    std::list< int > & outlist,
    std::string & instring )
```

transforms a string list of ints to a list of int string "12,13,15" is turned into list of ints {12,13,15}

Parameters

<i>outlist</i>	list once converted
<i>instring</i>	list to be converted

Returns

status message.

17.240 bit_manipulation.h File Reference

```
#include <givaro/udl.h>
#include "fflas-ffpack/fflas-ffpack-config.h"
```

Macros

- #define `__has_builtin(x)` 0

Functions

- `int32_t clz (uint64_t val)`
- `int32_t clz (uint32_t val)`
- `int32_t ctz (uint32_t val)`
- `int32_t ctz (uint64_t val)`

17.240.1 Macro Definition Documentation**17.240.1.1 __has_builtin**

```
#define __has_builtin(
    x ) 0
```

17.240.2 Function Documentation

17.240.2.1 clz() [1/2]

```
int32_t clz (
    uint64_t val ) [inline]
```

17.240.2.2 clz() [2/2]

```
int32_t clz (
    uint32_t val ) [inline]
```

17.240.2.3 ctz() [1/2]

```
int32_t ctz (
    uint32_t val ) [inline]
```

17.240.2.4 ctz() [2/2]

```
int32_t ctz (
    uint64_t val ) [inline]
```

17.241 cast.h File Reference

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Functions

- template<class T, class CT = const T>
T [fflas_const_cast](#) (CT x)

17.242 debug.h File Reference

Various utilities for debugging.

```
#include <fflas-ffpack/fflas-ffpack-config.h>
#include <iostream>
#include <sstream>
#include <cmath>
#include <stdexcept>
```

Data Structures

- class [Failure](#)
A precondition failed.

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Macros

- #define [FFLASFFPACK_check](#)(check)
- #define [FFLASFFPACK_abort](#)(msg)

Functions

- Failure & [failure](#) ()
- template<class T >
bool [isOdd](#) (const T &a)
- bool [isOdd](#) (const float &a)
- bool [isOdd](#) (const double &a)

17.242.1 Detailed Description

Various utilities for debugging.

Todo we should put vector printing elsewhere.

17.242.2 Macro Definition Documentation

17.242.2.1 FFLASFFPACK_check

```
#define FFLASFFPACK_check(  
    check )
```

Value:

```
if (!(check)) {\n    FFPACK::failure() (__func__, __FILE__, __LINE__, #check); \n    throw std::runtime_error(#check); \n}
```

17.242.2.2 FFLASFFPACK_abort

```
#define FFLASFFPACK_abort(  
    msg )
```

Value:

```
{\n    FFPACK::failure() (__func__, __FILE__, __LINE__, msg); \n    throw std::runtime_error(msg); \n}
```

17.243 fflas_intrinsic.h File Reference

17.244 fflas_io.h File Reference

```
#include <cstring>\n#include <stdio.h>\n#include <stdlib.h>\n#include <fstream>\n#include "fflas-ffpack/fflas/fflas.h"\n#include "fflas_memory.h"
```

Namespaces

- namespace [FFLAS](#)

Enumerations

- enum `FFLAS_FORMAT` {
`FflasAuto` = 0 , `FflasDense` = 1 , `FflasSMS` = 2 , `FflasBinary` = 3 ,
`FflasMath` = 4 , `FflasMaple` = 5 , `FflasSageMath` = 6 }

Functions

- template<class `Field` >
`std::ostream & WriteMatrix` (`std::ostream &c`, const `Field &F`, `size_t m`, `size_t n`, typename `Field::ConstElement_ptr` `A`, `size_t lda`, `FFLAS_FORMAT` `format`, bool `column_major`)
WriteMatrix: write a matrix to an output stream.
- void `preamble` (`std::ifstream &ifs`, `FFLAS_FORMAT` &`format`)
- template<class `Field` >
`Field::Element_ptr ReadMatrix` (`std::ifstream &ifs`, `Field &F`, `size_t &m`, `size_t &n`, typename `Field::Element_ptr` &`A`, `FFLAS_FORMAT` `format=FflasAuto`)
ReadMatrix: read a matrix from an input stream.
- template<class `Field` >
`Field::Element_ptr ReadMatrix` (const `std::string &matrix_file`, `Field &F`, `size_t &m`, `size_t &n`, typename `Field::Element_ptr` &`A`, `FFLAS_FORMAT` `format=FflasAuto`)
ReadMatrix: read a matrix from a file.
- template<class `Field` >
void `WriteMatrix` (`std::string &matrix_file`, const `Field &F`, int `m`, int `n`, typename `Field::ConstElement_ptr` `A`, `size_t lda`, `FFLAS_FORMAT` `format=FflasDense`, bool `column_major=false`)
WriteMatrix: write a matrix to a file.
- `std::ostream & WritePermutation` (`std::ostream &c`, const `size_t *P`, `size_t N`)
WritePermutation: write a permutation matrix to an output stream.

17.245 fflas_memory.h File Reference

```
#include "fflas-ffpack/utils/align-allocator.h"
#include <givaro/givinteger.h>
```

Namespaces

- namespace `FFLAS`

Functions

- template<class `Element` >
bool `alignable` ()
- template<> bool `alignable`< `Givaro::Integer *` > ()
- template<class `Field` >
`Field::Element_ptr fflas_new` (const `Field &F`, const `size_t m`, const `Alignment` `align=Alignment::DEFAULT`)
- template<class `Field` >
`Field::Element_ptr fflas_new` (const `Field &F`, const `size_t m`, const `size_t n`, const `Alignment` `align=Alignment::DEFAULT`)
- template<class `Element` >
`Element * fflas_new` (const `size_t m`, const `Alignment` `align=Alignment::DEFAULT`)
- template<class `Element_ptr` >
void `fflas_delete` (`Element_ptr` `A`)
- template<class `Ptr` , class ... `Args`>
void `fflas_delete` (`Ptr p`, `Args ... args`)
- void `prefetch` (const `int64_t *`)
- void `getTLBSize` (int &`tlb`)

- void [queryCacheSizes](#) (int &l1, int &l2, int &l3)
- int [queryL1CacheSize](#) ()
- int [queryTopLevelCacheSize](#) ()

17.246 fflas_randommatrix.h File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/debug.h"
#include "fflas-ffpack/fflas/fflas.h"
#include <givaro/givinteger.h>
#include <givaro/givintprime.h>
#include <givaro/givranditer.h>
#include "fflas-ffpack/ffpack/ffpack.h"
```

Namespaces

- namespace [FFPACK](#)
*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Functions

- template<class [Field](#) , class RandIter >
[Field::Element_ptr NonZeroRandomMatrix](#) (const [Field](#) &F, size_t m, size_t n, typename [Field::Element_ptr](#) A, size_t lda, RandIter &G)
Random non-zero Matrix.
- template<class [Field](#) , class RandIter >
[Field::Element_ptr NonZeroRandomMatrix](#) (const [Field](#) &F, size_t m, size_t n, typename [Field::Element_ptr](#) A, size_t lda)
Random non-zero Matrix.
- template<class [Field](#) , class RandIter >
[Field::Element_ptr RandomMatrix](#) (const [Field](#) &F, size_t m, size_t n, typename [Field::Element_ptr](#) A, size_t lda, RandIter &G)
Random Matrix.
- template<class [Field](#) >
[Field::Element_ptr RandomMatrix](#) (const [Field](#) &F, size_t m, size_t n, typename [Field::Element_ptr](#) A, size_t lda)
Random Matrix.
- template<class [Field](#) , class RandIter >
[Field::Element_ptr RandomTriangularMatrix](#) (const [Field](#) &F, size_t m, size_t n, const [FFLAS::FFLAS_UPLO](#) UpLo, const [FFLAS::FFLAS_DIAG](#) Diag, bool nonsingular, typename [Field::Element_ptr](#) A, size_t lda, RandIter &G)
Random Triangular Matrix.
- template<class [Field](#) >
[Field::Element_ptr RandomTriangularMatrix](#) (const [Field](#) &F, size_t m, size_t n, const [FFLAS::FFLAS_UPLO](#) UpLo, const [FFLAS::FFLAS_DIAG](#) Diag, bool nonsingular, typename [Field::Element_ptr](#) A, size_t lda)
Random Triangular Matrix.
- size_t [RandInt](#) (size_t a, size_t b)
- template<class [Field](#) , class RandIter >
[Field::Element_ptr RandomSymmetricMatrix](#) (const [Field](#) &F, size_t n, bool nonsingular, typename [Field::Element_ptr](#) A, size_t lda, RandIter &G)
Random Symmetric Matrix.
- template<class [Field](#) , class RandIter >
[Field::Element_ptr RandomMatrixWithRank](#) (const [Field](#) &F, size_t m, size_t n, size_t r, typename [Field::Element_ptr](#) A, size_t lda, RandIter &G)

Random Matrix with prescribed rank.

- template<class [Field](#) >
[Field::Element_ptr](#) [RandomMatrixWithRank](#) (const [Field](#) &F, size_t m, size_t n, size_t r, typename [Field::Element_ptr](#) A, size_t lda)

Random Matrix with prescribed rank.

- size_t * [RandomIndexSubset](#) (size_t N, size_t R, size_t *P)
Pick uniformly at random a sequence of R distinct elements from the set $\{0, \dots, N - 1\}$ using Knuth's shuffle.
- size_t * [RandomPermutation](#) (size_t N, size_t *P)
Pick uniformly at random a permutation of size N stored in LAPACK format using Knuth's shuffle.
- void [RandomRankProfileMatrix](#) (size_t M, size_t N, size_t R, size_t *rows, size_t *cols)
Pick uniformly at random an R -subpermutation of dimension $M \times N$: a matrix with only R non-zeros equal to one, in a random rook placement.
- void [swapval](#) (size_t k, size_t N, size_t *P, size_t val)
- void [RandomSymmetricRankProfileMatrix](#) (size_t N, size_t R, size_t *rows, size_t *cols)
Pick uniformly at random a symmetric R -subpermutation of dimension $N \times N$: a symmetric matrix with only R non-zeros, all equal to one, in a random rook placement.
- template<class [Field](#) , class RandIter >
[Field::Element_ptr](#) [RandomMatrixWithRankandRPM](#) (const [Field](#) &F, size_t M, size_t N, size_t R, typename [Field::Element_ptr](#) A, size_t lda, const size_t *RRP, const size_t *CRP, RandIter &G)
Random Matrix with prescribed rank and rank profile matrix Creates an $m \times n$ matrix with random entries and rank r .
- template<class [Field](#) >
[Field::Element_ptr](#) [RandomMatrixWithRankandRPM](#) (const [Field](#) &F, size_t M, size_t N, size_t R, typename [Field::Element_ptr](#) A, size_t lda, const size_t *RRP, const size_t *CRP)
Random Matrix with prescribed rank and rank profile matrix Creates an $m \times n$ matrix with random entries and rank r .
- template<class [Field](#) , class RandIter >
[Field::Element_ptr](#) [RandomSymmetricMatrixWithRankandRPM](#) (const [Field](#) &F, size_t N, size_t R, typename [Field::Element_ptr](#) A, size_t lda, const size_t *RRP, const size_t *CRP, RandIter &G)
Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an $n \times n$ symmetric matrix with random entries and rank r .
- template<class [Field](#) >
[Field::Element_ptr](#) [RandomSymmetricMatrixWithRankandRPM](#) (const [Field](#) &F, size_t M, size_t N, size_t R, typename [Field::Element_ptr](#) A, size_t lda, const size_t *RRP, const size_t *CRP)
Random Symmetric Matrix with prescribed rank and rank profile matrix Creates an $n \times n$ symmetric matrix with random entries and rank r .
- template<class [Field](#) , class RandIter >
[Field::Element_ptr](#) [RandomMatrixWithRankandRandomRPM](#) (const [Field](#) &F, size_t M, size_t N, size_t R, typename [Field::Element_ptr](#) A, size_t lda, RandIter &G)
Random Matrix with prescribed rank, with random rank profile matrix Creates an $m \times n$ matrix with random entries, rank r and with a rank profile matrix chosen uniformly at random.
- template<class [Field](#) >
[Field::Element_ptr](#) [RandomMatrixWithRankandRandomRPM](#) (const [Field](#) &F, size_t M, size_t N, size_t R, typename [Field::Element_ptr](#) A, size_t lda)
Random Matrix with prescribed rank, with random rank profile matrix Creates an $m \times n$ matrix with random entries, rank r and with a rank profile matrix chosen uniformly at random.
- template<class [Field](#) , class RandIter >
[Field::Element_ptr](#) [RandomSymmetricMatrixWithRankandRandomRPM](#) (const [Field](#) &F, size_t N, size_t R, typename [Field::Element_ptr](#) A, size_t lda, RandIter &G)
Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an $n \times n$ matrix with random entries, rank r and with a rank profile matrix chosen uniformly at random.
- template<class [Field](#) >
[Field::Element_ptr](#) [RandomSymmetricMatrixWithRankandRandomRPM](#) (const [Field](#) &F, size_t N, size_t R, typename [Field::Element_ptr](#) A, size_t lda)
Random Symmetric Matrix with prescribed rank, with random rank profile matrix Creates an $n \times n$ matrix with random entries, rank r and with a rank profile matrix chosen uniformly at random.

- `template<class Field >`
`Field::Element_ptr RandomMatrixWithDet` (const `Field` &F, `size_t` n, const typename `Field::Element` d, type-name `Field::Element_ptr` A, `size_t` lda)
Random Matrix with prescribed det.
- `template<class Field , class RandIter >`
`Field::Element_ptr RandomMatrixWithDet` (const `Field` &F, `size_t` n, const typename `Field::Element` d, type-name `Field::Element_ptr` A, `size_t` lda, `RandIter` &G)
Random Matrix with prescribed det.

17.247 flimits.h File Reference

```
#include <climits>
#include <limits>
#include <type_traits>
#include <givaro/givinteger.h>
```

Data Structures

- `struct limits< unsigned char >`
- `struct limits< signed char >`
- `struct limits< char >`
- `struct limits< unsigned short int >`
- `struct limits< short int >`
- `struct limits< unsigned int >`
- `struct limits< int >`
- `struct limits< unsigned long >`
- `struct limits< long >`
- `struct limits< unsigned long long >`
- `struct limits< long long >`
- `struct limits< float >`
- `struct limits< double >`
- `struct limits< Givaro::Integer >`
- `struct limits< Reclnt::ruint< K > >`
- `struct limits< Reclnt::rint< K > >`

Functions

- `template<class T , class E >`
`std::enable_if< std::is_signed< T >::value==std::is_signed< E >::value, bool >::type in_range` (E e)
- `template<class T , class E >`
`std::enable_if<(std::is_signed< T >::value)&&!std::is_signed< E >::value, bool >::type in_range` (E e)
- `template<class T , class E >`
`std::enable_if<!std::is_signed< T >::value)&&std::is_signed< E >::value, bool >::type in_range` (E e)

17.247.1 Function Documentation

17.247.1.1 in_range() [1/3]

```
std::enable_if< std::is_signed< T >::value==std::is_signed< E >::value, bool >::type in_↔
range (
    E e )
```

17.247.1.2 in_range() [2/3]

```
std::enable_if<(std::is_signed< T >::value)&&!(std::is_signed< E >::value), bool >::type
in_range (
    E e )
```

17.247.1.3 in_range() [3/3]

```
std::enable_if<!(std::is_signed< T >::value)&&(std::is_signed< E >::value), bool >::type
in_range (
    E e )
```

17.248 Matio.h File Reference

```
#include <cstring>
#include <stdio.h>
#include <stdlib.h>
#include "fflas_memory.h"
```

Functions

- template<class [Field](#) >
[Field::Element_ptr read_field](#) (const [Field](#) &F, const char *mat_file, size_t *tni, size_t *tnj)
- template<class [Field](#) >
std::ostream & [write_field](#) (const [Field](#) &F, std::ostream &c, typename [Field::ConstElement_ptr](#) E, int n, int m, int id, bool mapleFormat=false, bool column_major=false)

17.248.1 Function Documentation**17.248.1.1 read_field()**

```
Field::Element\_ptr read_field (
    const Field & F,
    const char * mat_file,
    size_t * tni,
    size_t * tnj )
```

17.248.1.2 write_field()

```
std::ostream & write_field (
    const Field & F,
    std::ostream & c,
    typename Field::ConstElement\_ptr E,
    int n,
    int m,
    int id,
    bool mapleFormat = false,
    bool column_major = false )
```

17.249 test-utils.h File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/debug.h"
```

```
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <givaro/givinteger.h>
#include <givaro/givintprime.h>
#include <givaro/givranditer.h>
#include <random>
#include <functional>
```

Namespaces

- namespace [FFLAS](#)
- namespace [FFPACK](#)

*Finite Field **PACK** Set of elimination based routines for dense linear algebra.*

Functions

- [uint64_t](#) [getSeed](#) ()
- template<typename [Field](#) >
Givaro::Integer [maxFieldElt](#) ()
- template<> Givaro::Integer [maxFieldElt](#)< Givaro::ZRing< [Givaro::Integer](#) > > ()
- template<typename [Field](#) >
[Field](#) * [chooseField](#) (Givaro::Integer q, [uint64_t](#) b, [uint64_t](#) seed)
- template<> Givaro::ZRing< [int32_t](#) > * [chooseField](#)< Givaro::ZRing< [int32_t](#) > > (Givaro::Integer q, [uint64_t](#) b, [uint64_t](#) seed)
- template<> Givaro::ZRing< [int64_t](#) > * [chooseField](#)< Givaro::ZRing< [int64_t](#) > > (Givaro::Integer q, [uint64_t](#) b, [uint64_t](#) seed)
- template<> Givaro::ZRing< float > * [chooseField](#)< Givaro::ZRing< float > > (Givaro::Integer q, [uint64_t](#) b, [uint64_t](#) seed)
- template<> Givaro::ZRing< double > * [chooseField](#)< Givaro::ZRing< double > > (Givaro::Integer q, [uint64_t](#) b, [uint64_t](#) seed)

17.250 timer.h File Reference

```
#include <time.h>
#include <givaro/givtimer.h>
```

Namespaces

- namespace [FFLAS](#)

Typedefs

- typedef Givaro::Timer [Timer](#)
- typedef Givaro::BaseTimer [BaseTimer](#)
- typedef Givaro::UserTimer [UserTimer](#)
- typedef Givaro::SysTimer [SysTimer](#)

17.251 cblas.C File Reference

```
#include "fflas-ffpack/config-blas.h"
```

Macros

- `#define __FFLASFFPACK_CONFIGURATION`
- `#define __FFLASFFPACK_HAVE_CBLAS 1`

Functions

- `int main ()`

17.251.1 Macro Definition Documentation

17.251.1.1 __FFLASFFPACK_CONFIGURATION

```
#define __FFLASFFPACK_CONFIGURATION
```

17.251.1.2 __FFLASFFPACK_HAVE_CBLAS

```
#define __FFLASFFPACK_HAVE_CBLAS 1
```

17.251.2 Function Documentation

17.251.2.1 main()

```
int main (  
    void )
```

17.252 clapack.C File Reference

```
#include "fflas-ffpack/config-blas.h"
```

Macros

- `#define __FFLASFFPACK_CONFIGURATION`
- `#define __FFLASFFPACK_HAVE_LAPACK 1`
- `#define __FFLASFFPACK_HAVE_CLAPACK 1`

Functions

- `int main ()`

17.252.1 Macro Definition Documentation

17.252.1.1 __FFLASFFPACK_CONFIGURATION

```
#define __FFLASFFPACK_CONFIGURATION
```

17.252.1.2 __FFLASFFPACK_HAVE_LAPACK

```
#define __FFLASFFPACK_HAVE_LAPACK 1
```


17.252.1.3 __FFLASFFPACK_HAVE_CLAPACK

```
#define __FFLASFFPACK_HAVE_CLAPACK 1
```

17.252.2 Function Documentation

17.252.2.1 main()

```
int main (  
    void )
```

17.253 cuda.C File Reference

```
#include <stdio.h>  
#include <cuda_runtime.h>  
#include <cusparse.h>
```

Functions

- int [main](#) ()

17.253.1 Function Documentation

17.253.1.1 main()

```
int main (  
    void )
```

17.254 fblas.C File Reference

```
#include "fflas-ffpack/config-blas.h"
```

Macros

- #define [__FFLASFFPACK_CONFIGURATION](#)

Functions

- void [dgemm_](#) (const char *, const char *, const int *, const int *, const int *, const double *, const double *, const int *, const double *, const int *, const double *, double *, const int *)
- int [main](#) ()

17.254.1 Macro Definition Documentation

17.254.1.1 __FFLASFFPACK_CONFIGURATION

```
#define __FFLASFFPACK_CONFIGURATION
```

17.254.2 Function Documentation

17.254.2.1 dgemm_()

```
void dgemm_ (
    const char * ,
    const char * ,
    const int * ,
    const int * ,
    const int * ,
    const double * ,
    const double * ,
    const int * ,
    const double * ,
    const int * ,
    const double * ,
    double * ,
    const int * )
```

17.254.2.2 main()

```
int main (
    void )
```

17.255 gmp.C File Reference

```
#include <gmpxx.h>
```

Functions

- int [main](#) ()

17.255.1 Function Documentation

17.255.1.1 main()

```
int main (
    void )
```

17.256 instrset.h File Reference

```
#include <stdlib.h>
```

Data Structures

- class [Const_int_t< n >](#)
- class [Const_uint_t< n >](#)
- class [Static_error_check< bool >](#)
- class [Static_error_check< false >](#)

Macros

- #define `INSTRSET_H` 125
- #define `INSTRSET` 0
- #define `const_int(n)` (`Const_int_t <n>()`)
- #define `const_uint(n)` (`Const_uint_t <n>()`)

Typedefs

- typedef signed char `int8_t`
- typedef unsigned char `uint8_t`
- typedef signed short int `int16_t`
- typedef unsigned short int `uint16_t`
- typedef signed int `int32_t`
- typedef unsigned int `uint32_t`
- typedef long long `int64_t`
- typedef unsigned long long `uint64_t`
- typedef `int32_t` `intptr_t`

Functions

- int `instrset_detect` (void)
- bool `hasFMA3` (void)
- bool `hasFMA4` (void)
- bool `hasXOP` (void)
- bool `hasAVX512ER` (void)

17.256.1 Macro Definition Documentation

17.256.1.1 INSTRSET_H

```
#define INSTRSET_H 125
```

17.256.1.2 INSTRSET

```
#define INSTRSET 0
```

17.256.1.3 const_int

```
#define const_int(  
    n ) (Const_int_t <n>())
```

17.256.1.4 const_uint

```
#define const_uint(  
    n ) (Const_uint_t <n>())
```

17.256.2 Typedef Documentation

17.256.2.1 int8_t

```
typedef signed char int8_t
```

17.256.2.2 uint8_t

```
typedef unsigned char uint8_t
```

17.256.2.3 int16_t

```
typedef signed short int int16_t
```

17.256.2.4 uint16_t

```
typedef unsigned short int uint16_t
```

17.256.2.5 int32_t

```
typedef signed int int32_t
```

17.256.2.6 uint32_t

```
typedef unsigned int uint32_t
```

17.256.2.7 int64_t

```
typedef long long int64_t
```

17.256.2.8 uint64_t

```
typedef unsigned long long uint64_t
```

17.256.2.9 intptr_t

```
typedef int32_t intptr_t
```

17.256.3 Function Documentation**17.256.3.1 instrset_detect()**

```
int instrset_detect (  
    void )
```

17.256.3.2 hasFMA3()

```
bool hasFMA3 (  
    void )
```

17.256.3.3 hasFMA4()

```
bool hasFMA4 (  
    void )
```

17.256.3.4 hasXOP()

```
bool hasXOP (  
    void )
```

17.256.3.5 hasAVX512ER()

```
bool hasAVX512ER (  
    void )
```

17.257 instrset_detect.cpp File Reference

```
#include "instrset.h"
```

Functions

- int [instrset_detect](#) (void)
- bool [hasFMA3](#) (void)
- bool [hasFMA4](#) (void)
- bool [hasXOP](#) (void)
- bool [hasF16C](#) (void)
- bool [hasAVX512ER](#) (void)

17.257.1 Function Documentation

17.257.1.1 instrset_detect()

```
int instrset_detect (  
    void )
```

17.257.1.2 hasFMA3()

```
bool hasFMA3 (  
    void )
```

17.257.1.3 hasFMA4()

```
bool hasFMA4 (  
    void )
```

17.257.1.4 hasXOP()

```
bool hasXOP (  
    void )
```

17.257.1.5 hasF16C()

```
bool hasF16C (
    void )
```

17.257.1.6 hasAVX512ER()

```
bool hasAVX512ER (
    void )
```

17.258 lapack.C File Reference

```
#include "fflas-ffpack/config-blas.h"
```

Macros

- `#define __FFLASFFPACK_CONFIGURATION`
- `#define __FFLASFFPACK_HAVE_LAPACK 1`

Functions

- `int main ()`

17.258.1 Macro Definition Documentation

17.258.1.1 __FFLASFFPACK_CONFIGURATION

```
#define __FFLASFFPACK_CONFIGURATION
```

17.258.1.2 __FFLASFFPACK_HAVE_LAPACK

```
#define __FFLASFFPACK_HAVE_LAPACK 1
```

17.258.2 Function Documentation

17.258.2.1 main()

```
int main (
    void )
```

17.259 regression-check.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack.h"
```

Functions

- bool [check1](#) ()
- bool [check2](#) ()
- bool [check3](#) ()
- bool [check4](#) ()
- bool [checkZeroDimCharpoly](#) ()
- bool [checkZeroDimMinPoly](#) ()
- bool [gf2ModularBalanced](#) ()
- int [main](#) ()

17.259.1 Function Documentation

17.259.1.1 [check1\(\)](#)

```
bool check1 ( )
```

17.259.1.2 [check2\(\)](#)

```
bool check2 ( )
```

17.259.1.3 [check3\(\)](#)

```
bool check3 ( )
```

17.259.1.4 [check4\(\)](#)

```
bool check4 ( )
```

17.259.1.5 [checkZeroDimCharpoly\(\)](#)

```
bool checkZeroDimCharpoly ( )
```

17.259.1.6 [checkZeroDimMinPoly\(\)](#)

```
bool checkZeroDimMinPoly ( )
```

17.259.1.7 [gf2ModularBalanced\(\)](#)

```
bool gf2ModularBalanced ( )
```

17.259.1.8 [main\(\)](#)

```
int main (
    void )
```

17.260 test-charpoly-check.C File Reference

```
#include <iostream>
#include <stdlib.h>
#include <time.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"
```

Macros

- `#define` [ENABLE_CHECKER_charpoly](#) 1
- `#define` [TIME_CHECKER_CHARPOLY](#) 1

Functions

- `template<class Field, class Polynomial >`
`void printPolynomial (const Field &F, Polynomial &v)`
- `int main (int argc, char **argv)`

17.260.1 Macro Definition Documentation

17.260.1.1 [ENABLE_CHECKER_charpoly](#)

```
#define ENABLE_CHECKER_charpoly 1
```

17.260.1.2 [TIME_CHECKER_CHARPOLY](#)

```
#define TIME_CHECKER_CHARPOLY 1
```

17.260.2 Function Documentation

17.260.2.1 [printPolynomial\(\)](#)

```
void printPolynomial (
    const Field & F,
    Polynomial & v )
```

17.260.2.2 [main\(\)](#)

```
int main (
    int argc,
    char ** argv )
```

17.261 test-charpoly.C File Reference

```
#include <iostream>
#include <iomanip>
#include "givaro/modular.h"
#include "fflas-ffpack/utils/fflas_io.h"
```



```
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <random>
#include <chrono>
```

Functions

- template<class [Field](#), class RandIter >
bool [launch_test](#) (const [Field](#) &F, size_t n, typename [Field::Element](#) *A, size_t lda, size_t nbit, RandIter &G, FFPACK::FFPACK_CHARPOLY_TAG CT)
- template<class [Field](#) >
bool [run_with_field](#) (const Givaro::Integer p, [uint64_t](#) bits, size_t n, std::string file, int variant, size_t iter, [uint64_t](#) seed)
- int [main](#) (int argc, char **argv)

17.261.1 Function Documentation

17.261.1.1 [launch_test\(\)](#)

```
bool launch_test (
    const Field & F,
    size_t n,
    typename Field::Element * A,
    size_t lda,
    size_t nbit,
    RandIter & G,
    FFPACK::FFPACK_CHARPOLY_TAG CT )
```

17.261.1.2 [run_with_field\(\)](#)

```
bool run_with_field (
    const Givaro::Integer p,
    uint64\_t bits,
    size_t n,
    std::string file,
    int variant,
    size_t iter,
    uint64\_t seed )
```

17.261.1.3 [main\(\)](#)

```
int main (
    int argc,
    char ** argv )
```

17.262 test-compressQ.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <list>
#include <vector>
```

```
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Typedefs

- typedef Givaro::Modular< double > [Field](#)

Functions

- template<class T >
std::ostream & [printvect](#) (std::ostream &o, vector< T > &vect)
- int [main](#) (int argc, char **argv)

17.262.1 Typedef Documentation

17.262.1.1 Field

```
typedef Givaro::Modular<double> Field
```

17.262.2 Function Documentation

17.262.2.1 printvect()

```
std::ostream & printvect (
    std::ostream & o,
    vector< T > & vect )
```

[Bug](#) does not belong here

17.262.2.2 main()

```
int main (
    int argc,
    char ** argv )
```

17.263 test-det-check.C File Reference

```
#include <iostream>
#include <stdlib.h>
#include <time.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/checkers/checkers_ffpack.h"
#include "fflas-ffpack/checkers/checkers_ffpack.inl"
```

Macros

- #define [ENABLE_CHECKER_Det](#) 1
- #define [TIME_CHECKER_Det](#) 1

Functions

- int [main](#) (int argc, char **argv)

17.263.1 Macro Definition Documentation

17.263.1.1 [ENABLE_CHECKER_Det](#)

```
#define ENABLE_CHECKER_Det 1
```

17.263.1.2 [TIME_CHECKER_Det](#)

```
#define TIME_CHECKER_Det 1
```

17.263.2 Function Documentation

17.263.2.1 [main\(\)](#)

```
int main (  
    int argc,  
    char ** argv )
```

17.264 test-det.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"  
#include <iomanip>  
#include <iostream>  
#include <givaro/modular-balanced.h>  
#include "fflas-ffpack/utils/timer.h"  
#include "fflas-ffpack/ffpack/ffpack.h"  
#include "fflas-ffpack/utils/args-parser.h"  
#include "fflas-ffpack/utils/test-utils.h"
```

Functions

- template<class [Field](#) , class RandIter >
 bool [test_det](#) ([Field](#) &F, size_t n, int iter, RandIter &G)
- int [main](#) (int argc, char **argv)

17.264.1 Function Documentation

17.264.1.1 test_det()

```
bool test_det (
    Field & F,
    size_t n,
    int iter,
    RandIter & G )
```

Todo test with stride

17.264.1.2 main()

```
int main (
    int argc,
    char ** argv )
```

17.265 test-echelon.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <iomanip>
#include <givaro/modular-balanced.h>
#include <givaro/udl.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include <random>
#include <chrono>
```

Macros

- `#define __FFLASFFPACK_SEQUENTIAL`
- `#define __FFLASFFPACK_GAUSSJORDAN_BASECASE 25`
- `#define __FFLASFFPACK_PLUQ_THRESHOLD 25`

Functions

- `template<class Field , class RandIter >`
`bool test_colechelon (Field &F, size_t m, size_t n, size_t r, size_t iters, FFPACK::FFPACK_LU_TAG LuTag, RandIter &G, bool par)`
- `template<class Field , class RandIter >`
`bool test_rowechelon (Field &F, size_t m, size_t n, size_t r, size_t iters, FFPACK::FFPACK_LU_TAG LuTag, RandIter &G, bool par)`
- `template<class Field , class RandIter >`
`bool test_redcoechelon (Field &F, size_t m, size_t n, size_t r, size_t iters, FFPACK::FFPACK_LU_TAG LuTag, RandIter &G, bool par)`
- `template<class Field , class RandIter >`
`bool test_redrowechelon (Field &F, size_t m, size_t n, size_t r, size_t iters, FFPACK::FFPACK_LU_TAG LuTag, RandIter &G, bool par)`
- `template<class Field >`
`bool run_with_field (Givaro::Integer q, uint64_t b, size_t m, size_t n, size_t r, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

17.265.1 Macro Definition Documentation

17.265.1.1 __FFLASFFPACK_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

17.265.1.2 __FFLASFFPACK_GAUSSJORDAN_BASECASE

```
#define __FFLASFFPACK_GAUSSJORDAN_BASECASE 25
```

17.265.1.3 __FFLASFFPACK_PLUQ_THRESHOLD

```
#define __FFLASFFPACK_PLUQ_THRESHOLD 25
```

17.265.2 Function Documentation

17.265.2.1 test_colechelon()

```
bool test_colechelon (  
    Field & F,  
    size_t m,  
    size_t n,  
    size_t r,  
    size_t iters,  
    FFPACK::FFPACK_LU_TAG LuTag,  
    RandIter & G,  
    bool par )
```

Todo check Ida

17.265.2.2 test_rowechelon()

```
bool test_rowechelon (  
    Field & F,  
    size_t m,  
    size_t n,  
    size_t r,  
    size_t iters,  
    FFPACK::FFPACK_LU_TAG LuTag,  
    RandIter & G,  
    bool par )
```

Todo check Ida

17.265.2.3 test_redcolechelon()

```
bool test_redcolechelon (  
    Field & F,  
    size_t m,  
    size_t n,
```

```

    size_t r,
    size_t iters,
    FFPACK::FFPACK_LU_TAG LuTag,
    RandIter & G,
    bool par )

```

Todo check Ida

17.265.2.4 test_redrowechelon()

```

bool test_redrowechelon (
    Field & F,
    size_t m,
    size_t n,
    size_t r,
    size_t iters,
    FFPACK::FFPACK_LU_TAG LuTag,
    RandIter & G,
    bool par )

```

Todo check Ida

17.265.2.5 run_with_field()

```

bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t m,
    size_t n,
    size_t r,
    size_t iters,
    uint64_t seed )

```

17.265.2.6 main()

```

int main (
    int argc,
    char ** argv )

```

17.266 test-fadd.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <typeinfo>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "assert.h"

```

Functions

- template<class [Field](#) >
bool [test_fadd](#) (const [Field](#) &F, size_t m, size_t k, size_t n, bool timing, [uint64_t](#) seed)

- `template<class Field >`
`bool test_faddin (const Field &F, size_t m, size_t k, size_t n, bool timing, uint64_t seed)`
- `template<class Field >`
`bool test_fsub (const Field &F, size_t m, size_t k, size_t n, bool timing, uint64_t seed)`
- `template<class Field >`
`bool test_fsubin (const Field &F, size_t m, size_t k, size_t n, bool timing, uint64_t seed)`
- `int main (int ac, char **av)`

17.266.1 Function Documentation

17.266.1.1 test_fadd()

```
bool test_fadd (  
    const Field & F,  
    size_t m,  
    size_t k,  
    size_t n,  
    bool timing,  
    uint64_t seed )
```

17.266.1.2 test_faddin()

```
bool test_faddin (  
    const Field & F,  
    size_t m,  
    size_t k,  
    size_t n,  
    bool timing,  
    uint64_t seed )
```

17.266.1.3 test_fsub()

```
bool test_fsub (  
    const Field & F,  
    size_t m,  
    size_t k,  
    size_t n,  
    bool timing,  
    uint64_t seed )
```

17.266.1.4 test_fsubin()

```
bool test_fsubin (  
    const Field & F,  
    size_t m,  
    size_t k,  
    size_t n,  
    bool timing,  
    uint64_t seed )
```

17.266.1.5 main()

```
int main (
    int ac,
    char ** av )
```

17.267 test-fdot.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/paladin/parallel.h"
#include "fflas-ffpack/paladin/fflas_plevel1.h"
#include <givaro/zring.h>
#include <givaro/modular.h>
#include <random>
#include <chrono>
```

Macros

- #define [ENABLE_ALL_CHECKINGS](#) 1

Functions

- template<typename [Field](#) >
bool [check_fdot](#) (const [Field](#) &F, size_t n, typename [Field::ConstElement_ptr](#) a, size_t inca, typename [Field::ConstElement_ptr](#) b, size_t incb)
- template<class [Field](#) >
bool [run_with_field](#) (Givaro::Integer q, size_t BS, size_t n, size_t iters, [uint64_t](#) seed)
- bool [run_with_Integer](#) (size_t BS, size_t n, size_t iters, [uint64_t](#) seed)
- int [main](#) (int argc, char **argv)

17.267.1 Macro Definition Documentation**17.267.1.1 ENABLE_ALL_CHECKINGS**

```
#define ENABLE_ALL_CHECKINGS 1
```

17.267.2 Function Documentation**17.267.2.1 check_fdot()**

```
bool check_fdot (
    const Field & F,
    size_t n,
    typename Field::ConstElement\_ptr a,
    size_t inca,
    typename Field::ConstElement\_ptr b,
    size_t incb )
```


17.267.2.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t BS,
    size_t n,
    size_t iters,
    uint64_t seed )
```

17.267.2.3 run_with_Integer()

```
bool run_with_Integer (
    size_t BS,
    size_t n,
    size_t iters,
    uint64_t seed )
```

17.267.2.4 main()

```
int main (
    int argc,
    char ** argv )
```

17.268 test-fgemm-check.C File Reference

```
#include <iostream>
#include <stdlib.h>
#include <time.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utis/args-parser.h"
#include "fflas-ffpack/utis/test-utis.h"
```

Macros

- #define [ENABLE_ALL_CHECKINGS](#) 1

Functions

- template<class [Field](#) , class RandIter >
bool [launch_MM_dispatch](#) (const [Field](#) &F, const int mm, const int nn, const int kk, const typename [Field::Element](#) alpha, const typename [Field::Element](#) beta, const size_t iters, RandIter &G)
- template<class [Field](#) >
bool [run_with_field](#) (Givaro::Integer q, [uint64_t](#) b, int m, int n, int k, size_t iters, [uint64_t](#) seed)
- int [main](#) (int argc, char **argv)

17.268.1 Macro Definition Documentation

17.268.1.1 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.268.2 Function Documentation

17.268.2.1 launch_MM_dispatch()

```
bool launch_MM_dispatch (
    const Field & F,
    const int mm,
    const int nn,
    const int kk,
    const typename Field::Element alpha,
    const typename Field::Element beta,
    const size_t iters,
    RandIter & G )
```

Bug test for ldX equal

Bug

Bug test for transpo

Bug

Todo does nbw actually do nbw recursive calls and then call blas (check ?) ?

17.268.2.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    int m,
    int n,
    int k,
    size_t iters,
    uint64_t seed )
```

17.268.2.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.269 test-fgemm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <givaro/modular.h>
#include <recint/rint.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <random>
```

Macros

- #define `ENABLE_CHECKER_fgemm` 1

Functions

- template<class [Field](#) >
bool [check_MM](#) (const [Field](#) &F, const typename [Field::Element_ptr](#) Cd, enum [FFLAS_TRANSPOSE](#) &ta, enum [FFLAS_TRANSPOSE](#) &tb, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) &alpha, const typename [Field::Element_ptr](#) A, size_t lda, const typename [Field::Element_ptr](#) B, size_t ldb, const typename [Field::Element](#) &beta, const typename [Field::Element_ptr](#) C, size_t ldc)
- template<class [Field](#) , class RandIter >
bool [launch_MM](#) (const [Field](#) &F, const size_t m, const size_t n, const size_t k, const typename [Field::Element](#) alpha, const typename [Field::Element](#) beta, const size_t ldc, const size_t lda, enum [FFLAS_TRANSPOSE](#) ta, const size_t ldb, enum [FFLAS_TRANSPOSE](#) tb, size_t iters, int nbw, bool par, RandIter &G)
- template<class [Field](#) , class RandIter >
bool [launch_MM_dispatch](#) (const [Field](#) &F, const int mm, const int nn, const int kk, const typename [Field::Element](#) alpha, const typename [Field::Element](#) beta, const size_t iters, const int nbw, const bool par, RandIter &G)
- template<class [Field](#) >
bool [run_with_field](#) (Givaro::Integer q, [uint64_t](#) b, int m, int n, int k, int nbw, size_t iters, bool par, size_t seed)
- int [main](#) (int argc, char **argv)

17.269.1 Macro Definition Documentation

17.269.1.1 ENABLE_CHECKER_fgemm

```
#define ENABLE_CHECKER_fgemm 1
```

17.269.2 Function Documentation

17.269.2.1 check_MM()

```
bool check_MM (
    const Field & F,
    const typename Field::Element\_ptr Cd,
    enum FFLAS\_TRANSPOSE & ta,
    enum FFLAS\_TRANSPOSE & tb,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element & alpha,
    const typename Field::Element\_ptr A,
    size_t lda,
    const typename Field::Element\_ptr B,
    size_t ldb,
    const typename Field::Element & beta,
    const typename Field::Element\_ptr C,
    size_t ldc )
```

17.269.2.2 launch_MM()

```
bool launch_MM (
    const Field & F,
    const size_t m,
    const size_t n,
    const size_t k,
    const typename Field::Element alpha,
```

```

const typename Field::Element beta,
const size_t ldc,
const size_t lda,
enum FFLAS_TRANSPOSE ta,
const size_t ldb,
enum FFLAS_TRANSPOSE tb,
size_t iters,
int nbw,
bool par,
RandIter & G )

```

17.269.2.3 launch_MM_dispatch()

```

bool launch_MM_dispatch (
    const Field & F,
    const int mm,
    const int nn,
    const int kk,
    const typename Field::Element alpha,
    const typename Field::Element beta,
    const size_t iters,
    const int nbw,
    const bool par,
    RandIter & G )

```

Bug test for ldX equal

Bug

Bug test for transpo

Bug

Todo does nbw actually do nbw recursive calls and then call blas (check ?) ?

17.269.2.4 run_with_field()

```

bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    int m,
    int n,
    int k,
    int nbw,
    size_t iters,
    bool par,
    size_t seed )

```

17.269.2.5 main()

```

int main (
    int argc,
    char ** argv )

```

17.270 test-fgemv.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <givaro/modular.h>
#include <recint/rint.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
```

Functions

- template<class [Field](#) >
bool [check_MV](#) (const [Field](#) &F, const typename [Field::Element_ptr](#) Cd, enum [FFLAS_TRANSPOSE](#) &ta, const size_t m, const size_t k, const typename [Field::Element](#) &alpha, const typename [Field::Element_ptr](#) A, size_t lda, const typename [Field::Element_ptr](#) X, size_t incX, const typename [Field::Element](#) &beta, const typename [Field::Element_ptr](#) Y, size_t incY)
- template<class [Field](#) , class RandIter >
bool [launch_MV](#) (const [Field](#) &F, const size_t m, const size_t k, const typename [Field::Element](#) alpha, const typename [Field::Element](#) beta, const size_t lda, enum [FFLAS_TRANSPOSE](#) ta, const size_t incX, const size_t incY, size_t iters, bool par, RandIter &G)
- template<class [Field](#) , class RandIter >
bool [launch_MV_dispatch](#) (const [Field](#) &F, const int mm, const int kk, const typename [Field::Element](#) alpha, const typename [Field::Element](#) beta, const size_t iters, const bool par, RandIter &G)
- template<class [Field](#) >
bool [run_with_field](#) (Givaro::Integer q, [uint64_t](#) b, int m, int k, size_t iters, bool par, [uint64_t](#) seed)
- int [main](#) (int argc, char **argv)

17.270.1 Function Documentation

17.270.1.1 [check_MV\(\)](#)

```
bool check_MV (
    const Field & F,
    const typename Field::Element\_ptr Cd,
    enum FFLAS\_TRANSPOSE & ta,
    const size_t m,
    const size_t k,
    const typename Field::Element & alpha,
    const typename Field::Element\_ptr A,
    size_t lda,
    const typename Field::Element\_ptr X,
    size_t incX,
    const typename Field::Element & beta,
    const typename Field::Element\_ptr Y,
    size_t incY )
```

17.270.1.2 [launch_MV\(\)](#)

```
bool launch_MV (
    const Field & F,
    const size_t m,
```

```

    const size_t k,
    const typename Field::Element alpha,
    const typename Field::Element beta,
    const size_t lda,
    enum FFLAS_TRANSPOSE ta,
    const size_t incX,
    const size_t incY,
    size_t iters,
    bool par,
    RandIter & G )

```

17.270.1.3 launch_MV_dispatch()

```

bool launch_MV_dispatch (
    const Field & F,
    const int mm,
    const int kk,
    const typename Field::Element alpha,
    const typename Field::Element beta,
    const size_t iters,
    const bool par,
    RandIter & G )

```

17.270.1.4 run_with_field()

```

bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    int m,
    int k,
    size_t iters,
    bool par,
    uint64_t seed )

```

17.270.1.5 main()

```

int main (
    int argc,
    char ** argv )

```

17.271 test-fger.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <givaro/modular-integral.h>
#include <givaro/modular-balanced.h>
#include <givaro/givintprime.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"

```

Macros

- `#define TIME 1`

Functions

- `template<class Field >`
`bool check_fger (const Field &F, const typename Field::Element_ptr Cd, const size_t m, const size_t n, const`
`typename Field::Element &alpha, const typename Field::Element_ptr x, const size_t incx, const typename`
`Field::Element_ptr y, const size_t incy, const typename Field::Element_ptr C, const size_t ldc)`
- `template<class Field, class Randlter >`
`bool launch_fger (const Field &F, const size_t m, const size_t n, const typename Field::Element alpha, const`
`size_t ldc, const size_t inca, const size_t incb, size_t iters, Randlter &G)`
- `template<class Field, class Randlter >`
`bool launch_fger_dispatch (const Field &F, const size_t nn, const typename Field::Element alpha, const`
`size_t iters, Randlter &G)`
- `template<class Field >`
`bool run_with_field (int64_t q, uint64_t b, size_t n, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

17.271.1 Macro Definition Documentation

17.271.1.1 TIME

```
#define TIME 1
```

17.271.2 Function Documentation

17.271.2.1 check_fger()

```
bool check_fger (
    const Field & F,
    const typename Field::Element_ptr Cd,
    const size_t m,
    const size_t n,
    const typename Field::Element & alpha,
    const typename Field::Element_ptr x,
    const size_t incx,
    const typename Field::Element_ptr y,
    const size_t incy,
    const typename Field::Element_ptr C,
    const size_t ldc )
```

17.271.2.2 launch_fger()

```
bool launch_fger (
    const Field & F,
    const size_t m,
    const size_t n,
    const typename Field::Element alpha,
    const size_t ldc,
    const size_t inca,
    const size_t incb,
```

```
    size_t iters,
    RandIter & G )
```

17.271.2.3 launch_fger_dispatch()

```
bool launch_fger_dispatch (
    const Field & F,
    const size_t nn,
    const typename Field::Element alpha,
    const size_t iters,
    RandIter & G )
```

Bug test for incx equal

Bug

Bug test for transpo

Bug

Todo does nbw actually do nbw recursive calls and then call blas (check ?) ?

17.271.2.4 run_with_field()

```
bool run_with_field (
    int64_t q,
    uint64_t b,
    size_t n,
    size_t iters,
    uint64_t seed )
```

17.271.2.5 main()

```
int main (
    int argc,
    char ** argv )
```

17.272 test-fgesv.C File Reference

```
#include <iostream>
#include <iomanip>
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
```

Functions

- template<class Field, class RandIter >
bool **test_square_fgesv** (Field &F, FFLAS_SIDE side, string fileA, string fileB, size_t m, size_t k, size_t r, RandIter &G)
- template<class Field, class RandIter >
bool **test_rect_fgesv** (Field &F, FFLAS_SIDE side, string fileA, string fileB, size_t m, size_t n, size_t k, size_t r, RandIter &G)

- `template<class Field >`
 `bool run_with_field` (Givaro::Integer *q*, `uint64_t` *b*, `size_t` *m*, `size_t` *n*, `size_t` *k*, `size_t` *r*, `size_t` *iters*, `string` *fileA*, `string` *fileB*, `uint64_t` &*seed*)
- `int main` (`int` *argc*, `char **`*argv*)

17.272.1 Function Documentation

17.272.1.1 test_square_fgesv()

```
bool test_square_fgesv (  
    Field & F,  
    FFLAS_SIDE side,  
    string fileA,  
    string fileB,  
    size_t m,  
    size_t k,  
    size_t r,  
    RandIter & G )
```

17.272.1.2 test_rect_fgesv()

```
bool test_rect_fgesv (  
    Field & F,  
    FFLAS_SIDE side,  
    string fileA,  
    string fileB,  
    size_t m,  
    size_t n,  
    size_t k,  
    size_t r,  
    RandIter & G )
```

17.272.1.3 run_with_field()

```
bool run_with_field (  
    Givaro::Integer q,  
    uint64_t b,  
    size_t m,  
    size_t n,  
    size_t k,  
    size_t r,  
    size_t iters,  
    string fileA,  
    string fileB,  
    uint64_t & seed )
```

17.272.1.4 main()

```
int main (  
    int argc,  
    char ** argv )
```

17.273 test-finit.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <typeinfo>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "assert.h"
#include <random>
#include <chrono>
```

Functions

- template<class [Field](#) >
bool [test_freduce](#) (const [Field](#) &F, size_t m, size_t k, size_t n, bool timing, [uint64_t](#) seed)
- template<class [Field](#) >
bool [run_with_field](#) (Givaro::Integer q, size_t b, size_t m, size_t k, size_t n, size_t iters, bool timing, [uint64_t](#) seed)
- int [main](#) (int ac, char **av)

17.273.1 Function Documentation

17.273.1.1 test_freduce()

```
bool test_freduce (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    uint64\_t seed )
```

17.273.1.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t m,
    size_t k,
    size_t n,
    size_t iters,
    bool timing,
    uint64\_t seed )
```

17.273.1.3 main()

```
int main (
    int ac,
    char ** av )
```

17.274 test-fscal.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <typeinfo>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "assert.h"
```

Functions

- template<class [Field](#), class RandIter >
bool [test_fscal](#) (const [Field](#) &F, const typename [Field::Element](#) &alpha, size_t m, size_t k, size_t n, bool timing, RandIter &G)
- template<class [Field](#) >
bool [test_fscal](#) (const [Field](#) &F, size_t m, size_t k, size_t n, bool timing, [uint64_t](#) seed)
- template<class [Field](#), class RandIter >
bool [test_fscalin](#) (const [Field](#) &F, const typename [Field::Element](#) &alpha, size_t m, size_t k, size_t n, bool timing, RandIter &G)
- template<class [Field](#) >
bool [test_fscalin](#) (const [Field](#) &F, size_t m, size_t k, size_t n, bool timing, [uint64_t](#) seed)
- int [main](#) (int ac, char **av)

17.274.1 Function Documentation

17.274.1.1 test_fscal() [1/2]

```
bool test_fscal (
    const Field & F,
    const typename Field::Element & alpha,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    RandIter & G )
```

17.274.1.2 test_fscal() [2/2]

```
bool test_fscal (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    uint64\_t seed )
```

17.274.1.3 test_fscalin() [1/2]

```
bool test_fscalin (
    const Field & F,
    const typename Field::Element & alpha,
    size_t m,
```

```

    size_t k,
    size_t n,
    bool timing,
    RandIter & G )

```

17.274.1.4 test_fscalin() [2/2]

```

bool test_fscalin (
    const Field & F,
    size_t m,
    size_t k,
    size_t n,
    bool timing,
    uint64_t seed )

```

17.274.1.5 main()

```

int main (
    int ac,
    char ** av )

```

17.275 test-fsyr2k.C File Reference

```

#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <random>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>

```

Macros

- #define [ENABLE_ALL_CHECKINGS](#) 1

Functions

- template<typename [Field](#) , class RandIter >
bool [check_fsyr2k](#) (const [Field](#) &F, size_t n, size_t k, const typename [Field::Element](#) &alpha, const typename [Field::Element](#) &beta, [FFLAS::FFLAS_UPLO](#) uplo, [FFLAS::FFLAS_TRANSPOSE](#) trans, RandIter &Rand)
- template<class [Field](#) >
bool [run_with_field](#) (Givaro::Integer q, size_t b, size_t n, size_t k, int a, int c, size_t iters, [uint64_t](#) seed)
- int [main](#) (int argc, char **argv)

17.275.1 Macro Definition Documentation

17.275.1.1 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.275.2 Function Documentation

17.275.2.1 check_fsyrr2k()

```
bool check_fsyrr2k (
    const Field & F,
    size_t n,
    size_t k,
    const typename Field::Element & alpha,
    const typename Field::Element & beta,
    FFLAS::FFLAS_UPLO uplo,
    FFLAS::FFLAS_TRANSPOSE trans,
    RandIter & Rand )
```

17.275.2.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t k,
    int a,
    int c,
    size_t iters,
    uint64_t seed )
```

17.275.2.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.276 test-fsyrrk.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <random>
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
```

Macros

- #define [ENABLE_ALL_CHECKINGS](#) 1

Functions

- template<typename [Field](#) , class RandIter >
bool [check_fsyrrk](#) (const [Field](#) &F, size_t n, size_t k, const typename [Field::Element](#) &alpha, const typename [Field::Element](#) &beta, [FFLAS::FFLAS_UPLO](#) uplo, [FFLAS::FFLAS_TRANSPOSE](#) trans, RandIter &Rand)

- `template<typename Field, class RandIter >`
`bool check_fsyrk_diag (const Field &F, size_t n, size_t k, const typename Field::Element &alpha, const`
`typename Field::Element &beta, FFLAS::FFLAS_UPLO uplo, FFLAS::FFLAS_TRANSPOSE trans, RandIter`
`&Rand)`
- `template<typename Field, class RandIter >`
`bool check_fsyrk_bkdiag (const Field &F, size_t n, size_t k, const typename Field::Element &alpha, const`
`typename Field::Element &beta, FFLAS::FFLAS_UPLO uplo, FFLAS::FFLAS_TRANSPOSE trans, RandIter`
`&Rand)`
- `template<class Field >`
`bool run_with_field (Givaro::Integer q, size_t b, size_t n, size_t k, int a, int c, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

17.276.1 Macro Definition Documentation

17.276.1.1 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.276.2 Function Documentation

17.276.2.1 check_fsyrk()

```
bool check_fsyrk (
    const Field & F,
    size_t n,
    size_t k,
    const typename Field::Element & alpha,
    const typename Field::Element & beta,
    FFLAS::FFLAS_UPLO uplo,
    FFLAS::FFLAS_TRANSPOSE trans,
    RandIter & Rand )
```

17.276.2.2 check_fsyrk_diag()

```
bool check_fsyrk_diag (
    const Field & F,
    size_t n,
    size_t k,
    const typename Field::Element & alpha,
    const typename Field::Element & beta,
    FFLAS::FFLAS_UPLO uplo,
    FFLAS::FFLAS_TRANSPOSE trans,
    RandIter & Rand )
```

17.276.2.3 check_fsyrk_bkdiag()

```
bool check_fsyrk_bkdiag (
    const Field & F,
    size_t n,
    size_t k,
    const typename Field::Element & alpha,
    const typename Field::Element & beta,
    FFLAS::FFLAS_UPLO uplo,
```

```

    FFLAS::FFLAS_TRANSPOSE trans,
    RandIter & Rand )

```

17.276.2.4 run_with_field()

```

bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t k,
    int a,
    int c,
    size_t iters,
    uint64_t seed )

```

17.276.2.5 main()

```

int main (
    int argc,
    char ** argv )

```

17.277 test-fsytrf.C File Reference

```

#include <iostream>
#include <iterator>
#include <vector>
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include <iomanip>
#include <random>
#include <chrono>
#include <givaro/modular.h>
#include "fflas-ffpack/utils/test-utils.h"

```

Functions

- `template<typename T >`
`std::ostream & operator<< (std::ostream &os, const std::vector< T > &x)`
- `template<class Field , class RandIter >`
`bool test_RPM_fsytrf (Field &F, FFLAS_UPLO uplo, string file, size_t n, size_t r, RandIter &G, size_t threshold)`
- `template<class Field , class RandIter >`
`bool test_generic_fsytrf (Field &F, FFLAS_UPLO uplo, string file, size_t n, RandIter &G, size_t threshold)`
- `template<class Field >`
`bool run_with_field (Givaro::Integer q, uint64_t b, size_t n, size_t r, size_t iters, string file, size_t threshold, uint64_t &seed)`
- `int main (int argc, char **argv)`

17.277.1 Function Documentation

17.277.1.1 operator<<()

```
std::ostream & operator<< (
    std::ostream & os,
    const std::vector< T > & x )
```

17.277.1.2 test_RPM_fsytrf()

```
bool test_RPM_fsytrf (
    Field & F,
    FFLAS_UPLO uplo,
    string file,
    size_t n,
    size_t r,
    RandIter & G,
    size_t threshold )
```

17.277.1.3 test_generic_fsytrf()

```
bool test_generic_fsytrf (
    Field & F,
    FFLAS_UPLO uplo,
    string file,
    size_t n,
    RandIter & G,
    size_t threshold )
```

17.277.1.4 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t n,
    size_t r,
    size_t iters,
    string file,
    size_t threshold,
    uint64_t & seed )
```

17.277.1.5 main()

```
int main (
    int argc,
    char ** argv )
```

17.278 test-ffrmm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular-integer.h>
#include <iomanip>
#include <iostream>
#include <random>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
```



```
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
```

Macros

- `#define __FFLASFFPACK_SEQUENTIAL`

Functions

- `template<typename Field, class RandIter >`
`bool check_ftrmm (const Field &F, size_t m, size_t n, const typename Field::Element &alpha,`
`FFLAS::FFLAS_SIDE side, FFLAS::FFLAS_UPLO uplo, FFLAS::FFLAS_TRANSPOSE trans, FFLAS::FFLAS_DIAG`
`diag, RandIter &Rand)`
- `template<class Field >`
`bool run_with_field (Givaro::Integer q, size_t b, size_t m, size_t n, uint64_t a, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

17.278.1 Macro Definition Documentation

17.278.1.1 __FFLASFFPACK_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

17.278.2 Function Documentation

17.278.2.1 check_ftrmm()

```
bool check_ftrmm (
    const Field & F,
    size_t m,
    size_t n,
    const typename Field::Element & alpha,
    FFLAS::FFLAS_SIDE side,
    FFLAS::FFLAS_UPLO uplo,
    FFLAS::FFLAS_TRANSPOSE trans,
    FFLAS::FFLAS_DIAG diag,
    RandIter & Rand )
```

17.278.2.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t m,
    size_t n,
    uint64_t a,
    size_t iters,
    uint64_t seed )
```

17.278.2.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.279 test-ffrmv.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <chrono>
#include <random>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
```

Macros

- `#define __FFLASFFPACK_SEQUENTIAL`
- `#define ENABLE_ALL_CHECKINGS 1`

Functions

- `template<typename Field, class RandIter >`
`bool check_ffrmv (const Field &F, size_t n, FFLAS_UPLO uplo, FFLAS_TRANSPOSE trans, FFLAS_DIAG diag, RandIter &Rand)`
- `template<class Field >`
`bool run_with_field (Givaro::Integer q, size_t b, size_t n, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

17.279.1 Macro Definition Documentation

17.279.1.1 __FFLASFFPACK_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

17.279.1.2 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.279.2 Function Documentation

17.279.2.1 check_ffrmv()

```
bool check_ffrmv (
    const Field & F,
    size_t n,
    FFLAS_UPLO uplo,
    FFLAS_TRANSPOSE trans,
```

```

    FFLAS_DIAG diag,
    RandIter & Rand )

```

17.279.2.2 run_with_field()

```

bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t iters,
    uint64_t seed )

```

17.279.2.3 main()

```

int main (
    int argc,
    char ** argv )

```

17.280 test-ffrsm-check.C File Reference

```

#include <iostream>
#include <stdlib.h>
#include <time.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"

```

Macros

- #define [ENABLE_ALL_CHECKINGS](#) 1

Functions

- int [main](#) (int argc, char **argv)

17.280.1 Macro Definition Documentation

17.280.1.1 ENABLE_ALL_CHECKINGS

```

#define ENABLE_ALL_CHECKINGS 1

```

17.280.2 Function Documentation

17.280.2.1 main()

```

int main (
    int argc,
    char ** argv )

```

17.281 test-fftrsm.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular-integer.h>
#include <iomanip>
#include <iostream>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <random>
```

Macros

- `#define __FFLASFFPACK_SEQUENTIAL`
- `#define ENABLE_ALL_CHECKINGS 1`

Functions

- `template<typename Field, class RandIter >`
`bool check_fftrsm (const Field &F, size_t m, size_t n, const typename Field::Element &alpha,`
`FFLAS::FFLAS_SIDE side, FFLAS::FFLAS_UPLO uplo, FFLAS::FFLAS_TRANSPOSE trans, FFLAS::FFLAS_DIAG`
`diag, RandIter &Rand)`
- `template<class Field >`
`bool run_with_field (Givaro::Integer q, size_t b, size_t m, size_t n, uint64_t a, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

17.281.1 Macro Definition Documentation

17.281.1.1 __FFLASFFPACK_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

17.281.1.2 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.281.2 Function Documentation

17.281.2.1 check_fftrsm()

```
bool check_fftrsm (
    const Field & F,
    size_t m,
    size_t n,
    const typename Field::Element & alpha,
    FFLAS::FFLAS_SIDE side,
    FFLAS::FFLAS_UPLO uplo,
    FFLAS::FFLAS_TRANSPOSE trans,
    FFLAS::FFLAS_DIAG diag,
    RandIter & Rand )
```

17.281.2.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t m,
    size_t n,
    uint64_t a,
    size_t iters,
    uint64_t seed )
```

17.281.2.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.282 test-ffrssyr2k.C File Reference

```
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular-integer.h>
#include <iomanip>
#include <iostream>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <random>
```

Macros

- #define [ENABLE_ALL_CHECKINGS](#) 1

Functions

- template<typename [Field](#) , class RandIter >
bool [check_ffrssyr2k](#) (const [Field](#) &F, size_t n, [FFLAS::FFLAS_UPLO](#) uplo, [FFLAS::FFLAS_DIAG](#) diagA, RandIter &Rand)
- template<class [Field](#) >
bool [run_with_field](#) (Givaro::Integer q, size_t b, size_t n, size_t iters, [uint64_t](#) seed)
- int [main](#) (int argc, char **argv)

17.282.1 Macro Definition Documentation

17.282.1.1 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.282.2 Function Documentation

17.282.2.1 check_ftrssyr2k()

```
bool check_ftrssyr2k (
    const Field & F,
    size_t n,
    FFLAS::FFLAS_UPLO uplo,
    FFLAS::FFLAS_DIAG diagA,
    RandIter & Rand )
```

17.282.2.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t iters,
    uint64_t seed )
```

17.282.2.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.283 test-ftrstr.C File Reference

```
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular-integer.h>
#include <iomanip>
#include <iostream>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <random>
```

Macros

- #define `ENABLE_ALL_CHECKINGS` 1

Functions

- template<typename `Field` , class `RandIter` >
bool `check_ftrstr` (const `Field` &F, size_t n, `FFLAS::FFLAS_SIDE` side, `FFLAS::FFLAS_UPLO` uplo, `FFLAS::FFLAS_DIAG` diagA, `FFLAS::FFLAS_DIAG` diagB, `RandIter` &Rand)
- template<class `Field` >
bool `run_with_field` (`Givaro::Integer` q, size_t b, size_t n, size_t iters, `uint64_t` seed)
- int `main` (int argc, char **argv)

17.283.1 Macro Definition Documentation

17.283.1.1 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.283.2 Function Documentation

17.283.2.1 check_ftrstr()

```
bool check_ftrstr (
    const Field & F,
    size_t n,
    FFLAS::FFLAS_SIDE side,
    FFLAS::FFLAS_UPLO uplo,
    FFLAS::FFLAS_DIAG diagA,
    FFLAS::FFLAS_DIAG diagB,
    RandIter & Rand )
```

17.283.2.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t iters,
    uint64_t seed )
```

17.283.2.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.284 test-ffrsv.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <random>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
```

Macros

- #define [__FFLASFFPACK_SEQUENTIAL](#)
- #define [ENABLE_ALL_CHECKINGS](#) 1

Functions

- template<typename [Field](#) , class RandIter >
bool [check_ftsrv](#) (const [Field](#) &F, size_t n, [FFLAS_UPLO](#) uplo, [FFLAS_TRANSPOSE](#) trans, [FFLAS_DIAG](#) diag, RandIter &Rand)
- template<class [Field](#) >
bool [run_with_field](#) (Givaro::Integer q, size_t b, size_t n, size_t iters, [uint64_t](#) seed)
- int [main](#) (int argc, char **argv)

17.284.1 Macro Definition Documentation

17.284.1.1 [__FFLASFFPACK_SEQUENTIAL](#)

```
#define __FFLASFFPACK_SEQUENTIAL
```

17.284.1.2 [ENABLE_ALL_CHECKINGS](#)

```
#define ENABLE_ALL_CHECKINGS 1
```

17.284.2 Function Documentation

17.284.2.1 [check_ftsrv\(\)](#)

```
bool check_ftsrv (
    const Field & F,
    size_t n,
    FFLAS\_UPLO uplo,
    FFLAS\_TRANSPOSE trans,
    FFLAS\_DIAG diag,
    RandIter & Rand )
```

17.284.2.2 [run_with_field\(\)](#)

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t iters,
    uint64\_t seed )
```

17.284.2.3 [main\(\)](#)

```
int main (
    int argc,
    char ** argv )
```

17.285 test-fftrtri.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iomanip>
#include <iostream>
#include <random>
```



```
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/ffpack/ffpack.h"
```

Macros

- `#define __FFLASFFPACK_SEQUENTIAL`
- `#define ENABLE_ALL_CHECKINGS 1`

Functions

- `template<typename Field, class RandIter >`
`bool check_ftrtri (const Field &F, size_t n, FFLAS_UPLO uplo, FFLAS_DIAG diag, RandIter &Rand)`
- `template<class Field >`
`bool run_with_field (Givaro::Integer q, size_t b, size_t n, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

17.285.1 Macro Definition Documentation

17.285.1.1 __FFLASFFPACK_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

17.285.1.2 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.285.2 Function Documentation

17.285.2.1 check_ftrtri()

```
bool check_ftrtri (
    const Field & F,
    size_t n,
    FFLAS_UPLO uplo,
    FFLAS_DIAG diag,
    RandIter & Rand )
```

17.285.2.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t iters,
    uint64_t seed )
```

17.285.2.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.286 test-interfaces-c.c File Reference

```
#include <fflas-ffpack/interfaces/libs/fflas_c.h>
#include <fflas-ffpack/interfaces/libs/ffpack_c.h>
#include <stdlib.h>
#include <stdio.h>
```

Functions

- int [main](#) ()

17.286.1 Function Documentation

17.286.1.1 main()

```
int main (
    void )
```

17.287 test-invert-check.C File Reference

```
#include <iostream>
#include <stdlib.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
```

Macros

- #define [ENABLE_ALL_CHECKINGS](#) 1

Functions

- int [main](#) (int argc, char **argv)

17.287.1 Macro Definition Documentation

17.287.1.1 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.287.2 Function Documentation

17.287.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.288 test-io.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <random>
#include <givaro/modular.h>
#include <givaro/zring.h>
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/args-parser.h"
```

Data Structures

- struct [CompactElement< Element >](#)
- struct [CompactElement< double >](#)
- struct [CompactElement< float >](#)
- struct [CompactElement< int64_t >](#)
- struct [CompactElement< int32_t >](#)
- struct [CompactElement< int16_t >](#)

Functions

- template<class [Field](#) >
bool [run_with_field](#) (Givaro::Integer q, [uint64_t](#) b, size_t m, size_t n, size_t iters, [uint64_t](#) seed)
- int [main](#) (int argc, char **argv)

17.288.1 Function Documentation

17.288.1.1 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t m,
    size_t n,
    size_t iters,
    uint64_t seed )
```

17.288.1.2 main()

```
int main (
    int argc,
    char ** argv )
```

17.289 test-lu.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <givaro/modular-balanced.h>
#include <iostream>
#include <iomanip>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/args-parser.h"
#include <random>
```

Macros

- #define [BASECASE_K](#) 37
- #define [__FFLASFFPACK_SEQUENTIAL](#)
- #define [__LUDIVINE_CUTOFF](#) 1

Functions

- template<class [Field](#) , [FFLAS_DIAG](#) diag, [FFLAS_TRANSPOSE](#) trans>
bool [test_LUdivine](#) (const [Field](#) &F, typename [Field::ConstElement_ptr](#) A, size_t lda, size_t r, size_t m, size_t n)
Tests the LUdivine routine.
- template<class [Field](#) , [FFLAS_DIAG](#) diag>
bool [verifPLUQ](#) (const [Field](#) &F, typename [Field::ConstElement_ptr](#) A, size_t lda, typename [Field::Element_ptr](#) PLUQ, size_t ldpluq, size_t *P, size_t *Q, size_t m, size_t n, size_t R)
Verifies that $B = PLUQ$ where A stores $[L|U]$.
- template<class [Field](#) , [FFLAS_DIAG](#) diag, class RandIter >
bool [test_pluq](#) (const [Field](#) &F, typename [Field::ConstElement_ptr](#) A, size_t r, size_t m, size_t n, size_t lda, RandIter &G)
Tests the LUdivine routine.
- template<class [Field](#) , [FFLAS_DIAG](#) diag, [FFLAS_TRANSPOSE](#) trans, class RandIter >
bool [launch_test](#) (const [Field](#) &F, size_t r, size_t m, size_t n, RandIter &G)
- template<class [Field](#) >
bool [run_with_field](#) (Givaro::Integer q, [uint64_t](#) b, size_t m, size_t n, size_t r, size_t iters, [uint64_t](#) seed)
- int [main](#) (int argc, char **argv)

Variables

- Givaro::Timer [tperm](#)
- Givaro::Timer [tgemm](#)
- Givaro::Timer [tBC](#)
- Givaro::Timer [ttrsm](#)
- Givaro::Timer [trest](#)
- Givaro::Timer [timtot](#)
- size_t [mvcnt](#) = 0

17.289.1 Macro Definition Documentation

17.289.1.1 BASECASE_K

```
#define BASECASE_K 37
```

17.289.1.2 __FFLASFFPACK_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

17.289.1.3 __LUDIVINE_CUTOFF

```
#define __LUDIVINE_CUTOFF 1
```

17.289.2 Function Documentation

17.289.2.1 test_LUdivine()

```
bool test_LUdivine (
    const Field & F,
    typename Field::ConstElement_ptr A,
    size_t lda,
    size_t r,
    size_t m,
    size_t n )
```

Tests the LUdivine routine.

Template Parameters

<i>Field</i>	Field
<i>Diag</i>	Unit diagonal in U
<i>Trans</i>	

Parameters

<i>F</i>	field
<i>A</i>	Matrix (preallocated)
<i>r</i>	rank of A
<i>m</i>	rows
<i>n</i>	cols
<i>lda</i>	leading dim of A

Returns

0 iff correct, 1 otherwise

17.289.2.2 verifPLUQ()

```
bool verifPLUQ (
    const Field & F,
    typename Field::ConstElement_ptr A,
    size_t lda,
    typename Field::Element_ptr PLUQ,
    size_t ldpluq,
    size_t * P,
    size_t * Q,
    size_t m,
    size_t n,
    size_t R )
```

Verifies that $B = PLUQ$ where A stores $[L\backslash U]$.

Template Parameters

<i>Field</i>	Field
<i>Diag</i>	Unit diagonal in U

Parameters

<i>F</i>	field
<i>A</i>	Matrix (preallocated)
<i>r</i>	rank of A
<i>m</i>	rows
<i>n</i>	cols
<i>lda</i>	leading dim of A

Returns

0 iff correct, 1 otherwise

17.289.2.3 test_pluq()

```
bool test_pluq (
    const Field & F,
    typename Field::ConstElement_ptr A,
    size_t r,
    size_t m,
    size_t n,
    size_t lda,
    RandIter & G )
```

Tests the LUdivine routine.

Template Parameters

<i>Field</i>	Field
<i>Diag</i>	Unit diagonal in U
<i>Trans</i>	

Parameters

<i>F</i>	field
<i>A</i>	Matrix (preallocated)
<i>r</i>	rank of A
<i>m</i>	rows
<i>n</i>	cols
<i>lda</i>	leading dim of A

Returns

0 iff correct, 1 otherwise

17.289.2.4 launch_test()

```
bool launch_test (
    const Field & F,
    size_t r,
    size_t m,
    size_t n,
    RandIter & G )
```

17.289.2.5 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t m,
    size_t n,
    size_t r,
    size_t iters,
    uint64_t seed )
```

17.289.2.6 main()

```
int main (
    int argc,
    char ** argv )
```

17.289.3 Variable Documentation

17.289.3.1 tperm

Givaro::Timer tperm

17.289.3.2 tgemm

Givaro::Timer tgemm

17.289.3.3 tBC

Givaro::Timer tBC

17.289.3.4 ttrsm

Givaro::Timer ttrsm

17.289.3.5 trest

Givaro::Timer trest

17.289.3.6 timtot

```
Givaro::Timer timtot
```

17.289.3.7 mvcnt

```
size_t mvcnt = 0
```

17.290 test-maxdelayeddim.C File Reference

```
#include <givaro/modular.h>
#include <recint/rint.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include <stdlib.h>
#include <stdio.h>
```

Macros

- #define [MAX_WITH_SIZE_T](#)(x) ((static_cast<uint64_t>(std::numeric_limits<size_t>::max()) < x)? std::numeric_limits<size_t>::max() : x)

Functions

- template<class [Field](#) >
bool [test](#) (Givaro::Integer p, size_t kmax)
- int [main](#) ()

17.290.1 Macro Definition Documentation**17.290.1.1 MAX_WITH_SIZE_T**

```
#define MAX_WITH_SIZE_T(  
    x ) ( (static_cast<uint64_t>(std::numeric_limits<size_t>::max()) < x)? std::  
::numeric_limits<size_t>::max() : x )
```

17.290.2 Function Documentation**17.290.2.1 test()**

```
bool test (  
    Givaro::Integer p,  
    size_t kmax )
```

17.290.2.2 main()

```
int main (  
    void )
```


17.291 test-minpoly.C File Reference

```
#include <iomanip>
#include <iostream>
#include <random>
#include <chrono>
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utlis/args-parser.h"
#include "fflas-ffpack/utlis/fflas_randommatrix.h"
#include "fflas-ffpack/utlis/test-utlis.h"
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <givaro/modular-integer.h>
#include <givaro/givpoly1factor.h>
#include <givaro/givpoly1.h>
```

Functions

- `template<typename Field , class Randler >`
`bool check_minpoly (const Field &F, size_t n, Randler &G)`
- `template<class Field >`
`bool run_with_field (Givaro::Integer q, size_t b, size_t n, size_t iters, uint64_t seed)`
- `int main (int argc, char **argv)`

17.291.1 Function Documentation

17.291.1.1 check_minpoly()

```
bool check_minpoly (
    const Field & F,
    size_t n,
    RandIter & G )
```

17.291.1.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t n,
    size_t iters,
    uint64_t seed )
```

17.291.1.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.292 test-multifile1.C File Reference

```
#include "fflas-ffpack/fflas-ffpack.h"
```

17.293 test-multifile2.C File Reference

```
#include "fflas-ffpack/fflas-ffpack.h"
```

Functions

- int [main](#) (void)

17.293.1 Function Documentation

17.293.1.1 main()

```
int main (
    void )
```

17.294 test-nullspace.C File Reference

```
#include <iomanip>
#include <iostream>
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/timer.h"
```

Functions

- template<class [Field](#) >
std::string [checkingMessage](#) (const [Field](#) &F)
- template<class [Field](#) >
[Field::Element_ptr](#) [readOrRandomMatrixWithRankAndRandomRPM](#) (const [Field](#) &F, std::string file, size_t m, size_t n, size_t lda, size_t r, [uint64_t](#) seed)
If file is not empty, read it and set m, n, lda and r.
- template<class [Field](#) >
bool [test_nullspace](#) ([Field](#) &F, [FFLAS::FFLAS_SIDE](#) side, size_t m, size_t n, size_t r, typename [Field::Element_ptr](#) A, size_t lda)
- template<class [Field](#) >
bool [run_with_field](#) (Givaro::Integer q, [uint64_t](#) b, size_t m, size_t n, size_t r, size_t iters, std::string file, [uint64_t](#) &seed)
- int [main](#) (int argc, char **argv)

17.294.1 Function Documentation

17.294.1.1 checkingMessage()

```
std::string checkingMessage (
    const Field & F )
```

17.294.1.2 readOrRandomMatrixWithRankAndRandomRPM()

```
Field::Element_ptr readOrRandomMatrixWithRankAndRandomRPM (
    const Field & F,
    std::string file,
    size_t & m,
    size_t & n,
    size_t & lda,
    size_t & r,
    uint64_t seed )
```

If file is not empty, read it and set m, n, lda and r.

Otherwise, generate a random matrix of size m x n with random lda.

17.294.1.3 test_nullspace()

```
bool test_nullspace (
    Field & F,
    FFLAS::FFLAS_SIDE side,
    size_t m,
    size_t n,
    size_t r,
    typename Field::Element_ptr A,
    size_t lda )
```

17.294.1.4 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t m,
    size_t n,
    size_t r,
    size_t iters,
    std::string file,
    uint64_t & seed )
```

17.294.1.5 main()

```
int main (
    int argc,
    char ** argv )
```

17.295 test-permutations.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include <iostream>
#include <givaro/modular.h>
#include "fflas-ffpack/ffpack/ffpack.h"
```

Functions

- bool `checkMonotonicApplyP` (`FFLAS_SIDE` Side, `FFLAS_TRANSPOSE` trans, size_t *P, size_t N, size_t R)
- int `main` ()

Variables

- Givaro::Timer `tperm`
- Givaro::Timer `tgemm`
- Givaro::Timer `tBC`
- Givaro::Timer `ttrsm`
- Givaro::Timer `trest`
- Givaro::Timer `timtot`

17.295.1 Function Documentation

17.295.1.1 `checkMonotonicApplyP()`

```
bool checkMonotonicApplyP (
    FFLAS_SIDE Side,
    FFLAS_TRANSPOSE trans,
    size_t * P,
    size_t N,
    size_t R )
```

17.295.1.2 `main()`

```
int main (
    void )
```

17.295.2 Variable Documentation

17.295.2.1 `tperm`

```
Givaro::Timer tperm
```

17.295.2.2 `tgemm`

```
Givaro::Timer tgemm
```

17.295.2.3 `tBC`

```
Givaro::Timer tBC
```

17.295.2.4 `ttrsm`

```
Givaro::Timer ttrsm
```

17.295.2.5 trest

```
Givaro::Timer trest
```

17.295.2.6 timtot

```
Givaro::Timer timtot
```

17.296 test-pluq-check.C File Reference

```
#include <iostream>
#include <stdlib.h>
#include <time.h>
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
```

Macros

- `#define` [ENABLE_ALL_CHECKINGS](#) 1

Functions

- `int` [main](#) (int argc, char **argv)

17.296.1 Macro Definition Documentation

17.296.1.1 ENABLE_ALL_CHECKINGS

```
#define ENABLE_ALL_CHECKINGS 1
```

17.296.2 Function Documentation

17.296.2.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.297 test-rankprofiles.C File Reference

```
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/ffpack/ffpack.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <iostream>
#include <iomanip>
#include <random>
#include <chrono>
```

Macros

- `#define __FFLASFFPACK_SEQUENTIAL`

Functions

- `template<class Field >`
`bool run_with_field (Givaro::Integer q, uint64_t b, size_t m, size_t n, size_t r, size_t iters, uint64_t seed, bool par)`
- `int main (int argc, char **argv)`

17.297.1 Macro Definition Documentation

17.297.1.1 __FFLASFFPACK_SEQUENTIAL

```
#define __FFLASFFPACK_SEQUENTIAL
```

17.297.2 Function Documentation

17.297.2.1 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    uint64_t b,
    size_t m,
    size_t n,
    size_t r,
    size_t iters,
    uint64_t seed,
    bool par )
```

17.297.2.2 main()

```
int main (
    int argc,
    char ** argv )
```

17.298 test-rpm.C File Reference

```
#include <iostream>
#include "givaro/modular.h"
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/ffpack/ffpack.h"
```

Functions

- `bool checkRPM (size_t M, size_t N, size_t R)`
- `bool checkSymmetricRPM (size_t N, size_t R)`
- `int main (int argc, char **argv)`

17.298.1 Function Documentation

17.298.1.1 checkRPM()

```
bool checkRPM (
    size_t M,
    size_t N,
    size_t R )
```

17.298.1.2 checkSymmetricRPM()

```
bool checkSymmetricRPM (
    size_t N,
    size_t R )
```

17.298.1.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.299 test-simd.C File Reference

```
#include "givaro/givinteger.h"
#include "givaro/givprint.h"
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/fflas/fflas_simd.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include "fflas-ffpack/utils/align-allocator.h"
#include <array>
#include <vector>
#include <random>
#include <string>
#include <functional>
#include <limits>
#include <type_traits>
#include <algorithm>
```

Data Structures

- struct [ScalFunctions](#)< Element, typename enable_if< is_floating_point< Element >::value >::type >
- struct [ScalFunctions](#)< Element, typename enable_if< is_integral< Element >::value >::type >

Macros

- #define [REGISTER_TYPE_NAME](#)(type) template<> const char *[TypeName](#)<type>(){return #type;}
- #define [TEST_ONE_OP](#)(name) btest &= [test_op](#)<simd> (simd::name, Scal::name, #name);

Typedefs

- typedef Givaro::Integer [integer](#)

Functions

- `template<typename... >`
`const char * TypeName ()`
- `REGISTER_TYPE_NAME (float)`
- `REGISTER_TYPE_NAME (double)`
- `REGISTER_TYPE_NAME (int16_t)`
- `REGISTER_TYPE_NAME (int32_t)`
- `REGISTER_TYPE_NAME (int64_t)`
- `REGISTER_TYPE_NAME (uint16_t)`
- `REGISTER_TYPE_NAME (uint32_t)`
- `REGISTER_TYPE_NAME (uint64_t)`
- `template<class Element , class Alloc >`
`enable_if< is_integral< Element >::value >::type generate_random_vector (vector< Element, Alloc > &a)`
- `template<class Element , class Alloc >`
`enable_if< is_floating_point< Element >::value >::type generate_random_vector (vector< Element, Alloc > &a)`
- `template<class Element >`
`enable_if< is_integral< Element >::value, bool >::type check_eq (Element x, Element y)`
- `template<class Element >`
`enable_if< is_floating_point< Element >::value, bool >::type check_eq (Element x, Element y)`
- `template<class Ret , class T >`
`Ret eval_func_on_array (function< Ret()> f, array< T, 0 > arr)`
- `template<class Ret , class T , class... TArgs>`
`Ret eval_func_on_array (function< Ret(T, TArgs...)> f, array< typename remove_reference< T >::type, sizeof...(TArgs)+1 > &arr)`
- `template<class Simd , class RScal , class... AScal, class RSimd , class... ASimd>`
`enable_if< sizeof...(AScal)==sizeof...(ASimd), bool >::type test_op (RSimd(&FSimd)(ASimd...), RScal(&FScal)(AScal...), string fname)`
- `template<class simd , class Element >`
`enable_if< is_floating_point< Element >::value, bool >::type test_impl ()`
- `template<class simd , class Element >`
`enable_if< is_integral< Element >::value, bool >::type test_impl ()`
- `template<class Element >`
`enable_if< is_integral< Element >::value, bool >::type test ()`
- `template<class Element >`
`enable_if< is_floating_point< Element >::value, bool >::type test ()`
- `int main (int argc, char *argv[])`

17.299.1 Macro Definition Documentation

17.299.1.1 REGISTER_TYPE_NAME

```
#define REGISTER_TYPE_NAME(  
    type )    template<> const char *TypeName<type>(){return #type;}
```

17.299.1.2 TEST_ONE_OP

```
#define TEST_ONE_OP(  
    name )    btest &= test\_op<simd> (simd::name, Scal::name, #name);
```

17.299.2 Typedef Documentation

17.299.2.1 integer

```
typedef Givaro::Integer integer
```

17.299.3 Function Documentation

17.299.3.1 TypeName()

```
const char * TypeName ( )
```

17.299.3.2 REGISTER_TYPE_NAME() [1/8]

```
REGISTER_TYPE_NAME (
    float )
```

17.299.3.3 REGISTER_TYPE_NAME() [2/8]

```
REGISTER_TYPE_NAME (
    double )
```

17.299.3.4 REGISTER_TYPE_NAME() [3/8]

```
REGISTER_TYPE_NAME (
    int16_t )
```

17.299.3.5 REGISTER_TYPE_NAME() [4/8]

```
REGISTER_TYPE_NAME (
    int32_t )
```

17.299.3.6 REGISTER_TYPE_NAME() [5/8]

```
REGISTER_TYPE_NAME (
    int64_t )
```

17.299.3.7 REGISTER_TYPE_NAME() [6/8]

```
REGISTER_TYPE_NAME (
    uint16_t )
```

17.299.3.8 REGISTER_TYPE_NAME() [7/8]

```
REGISTER_TYPE_NAME (
    uint32_t )
```

17.299.3.9 REGISTER_TYPE_NAME() [8/8]

```
REGISTER_TYPE_NAME (
    uint64_t )
```

17.299.3.10 generate_random_vector() [1/2]

```
enable_if< is_integral< Element >::value >::type generate_random_vector (
    vector< Element, Alloc > & a )
```

17.299.3.11 generate_random_vector() [2/2]

```
enable_if< is_floating_point< Element >::value >::type generate_random_vector (
    vector< Element, Alloc > & a )
```

17.299.3.12 check_eq() [1/2]

```
enable_if< is_integral< Element >::value, bool >::type check_eq (
    Element x,
    Element y )
```

17.299.3.13 check_eq() [2/2]

```
enable_if< is_floating_point< Element >::value, bool >::type check_eq (
    Element x,
    Element y )
```

17.299.3.14 eval_func_on_array() [1/2]

```
Ret eval_func_on_array (
    function< Ret()> f,
    array< T, 0 > arr )
```

17.299.3.15 eval_func_on_array() [2/2]

```
Ret eval_func_on_array (
    function< Ret(T, TArgs...)> f,
    array< typename remove_reference< T >::type, sizeof...(TArgs)+1 > & arr )
```

17.299.3.16 test_op()

```
enable_if< sizeof...(AScal)==sizeof...(ASimd), bool >::type test_op (
    RSimd(&)(ASimd...) FSimd,
    RScal(&)(AScal...) FScal,
    string fname )
```

17.299.3.17 test_impl() [1/2]

```
enable_if< is_floating_point< Element >::value, bool >::type test_impl ( )
```

17.299.3.18 test_impl() [2/2]

```
enable_if< is_integral< Element >::value, bool >::type test_impl ( )
```

17.299.3.19 test() [1/2]

```
enable_if< is_integral< Element >::value, bool >::type test ( )
```

17.299.3.20 test() [2/2]

```
enable_if< is_floating_point< Element >::value, bool >::type test ( )
```

17.299.3.21 main()

```
int main (
    int argc,
    char * argv[] )
```

17.300 test-solve.C File Reference

```
#include <givaro/modular-integer.h>
#include <iomanip>
#include <iostream>
#include "fflas-ffpack/utils/timer.h"
#include "fflas-ffpack/fflas/fflas.h"
#include "fflas-ffpack/utils/args-parser.h"
#include "fflas-ffpack/utils/test-utils.h"
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
```

Functions

- template<typename [Field](#) , class RandIter >
bool [check_solve](#) (const [Field](#) &F, size_t m, RandIter &Rand, bool isParallel)
- template<class [Field](#) >
bool [run_with_field](#) (Givaro::Integer q, size_t b, size_t m, size_t iters, [uint64_t](#) seed)
- int [main](#) (int argc, char **argv)

17.300.1 Function Documentation**17.300.1.1 check_solve()**

```
bool check_solve (
    const Field & F,
    size_t m,
    RandIter & Rand,
    bool isParallel )
```

17.300.1.2 run_with_field()

```
bool run_with_field (
    Givaro::Integer q,
    size_t b,
    size_t m,
    size_t iters,
    uint64\_t seed )
```

17.300.1.3 main()

```
int main (
    int argc,
    char ** argv )
```

17.301 101-fgemm.C File Reference

```
#include <fflas-ffpack/fflas-ffpack-config.h>
#include <givaro/modular-balanced.h>
#include <fflas-ffpack/fflas/fflas.h>
#include <fflas-ffpack/utils/timer.h>
#include <fflas-ffpack/utils/fflas_io.h>
#include <fflas-ffpack/utils/args-parser.h>
#include <iostream>
```

Functions

- int [main](#) (int argc, char **argv)

17.301.1 Function Documentation

17.301.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.302 2x2-fgemm.C File Reference

```
#include <fflas-ffpack/fflas-ffpack-config.h>
#include <givaro/modular-balanced.h>
#include <fflas-ffpack/fflas/fflas.h>
#include <fflas-ffpack/utils/timer.h>
#include <fflas-ffpack/utils/fflas_io.h>
#include <fflas-ffpack/utils/args-parser.h>
#include <iostream>
```

Functions

- int [main](#) (int argc, char **argv)

17.302.1 Function Documentation

17.302.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.303 2x2-fftrsv.C File Reference

```
#include <fflas-ffpack/fflas-ffpack-config.h>
#include <givaro/modular-balanced.h>
#include <fflas-ffpack/fflas/fflas.h>
#include <fflas-ffpack/utils/timer.h>
#include <fflas-ffpack/utils/fflas_io.h>
#include <fflas-ffpack/utils/args-parser.h>
#include <iostream>
#include <array>
```

Functions

- int [main](#) (int argc, char **argv)

17.303.1 Function Documentation

17.303.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.304 2x2-pluq.C File Reference

```
#include <iostream>
#include <vector>
#include <givaro/modular.h>
#include "fflas-ffpack/fflas-ffpack-config.h"
#include "fflas-ffpack/fflas-ffpack.h"
#include "fflas-ffpack/utils/fflas_io.h"
```

Functions

- int [main](#) (int argc, char **argv)

17.304.1 Function Documentation

17.304.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.305 fflas-101_1.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/fflas_io.h"
#include <iostream>
```

Functions

- int [main](#) (int argc, char **argv)

17.305.1 Function Documentation

17.305.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.306 fflas-101_3.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/fflas_io.h"
#include "fflas-ffpack/utils/fflas_randommatrix.h"
#include <iostream>
```

Functions

- int [main](#) (int argc, char **argv)

17.306.1 Function Documentation

17.306.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.307 fflas_101.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <iostream>
```

Functions

- int [main](#) (int argc, char **argv)

17.307.1 Function Documentation

17.307.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.308 fflas_101_lvl1.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include <iostream>
#include "fflas-ffpack/utils/fflas_io.h"
```

Functions

- int [main](#) (int argc, char **argv)

17.308.1 Function Documentation

17.308.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.309 ffpack-fgesv.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>
#include <givaro/modular.h>
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/fflas_io.h"
#include <fflas-ffpack/ffpack/ffpack.h>
#include <iostream>
```

Functions

- int [main](#) (int argc, char **argv)

17.309.1 Function Documentation

17.309.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

17.310 ffpack-solve.C File Reference

```
#include <fflas-ffpack/fflas/fflas.h>
#include <givaro/modular.h>
```

```
#include <givaro/modular-balanced.h>
#include "fflas-ffpack/utils/fflas_io.h"
#include <fflas-ffpack/ffpack/ffpack.h>
#include <iostream>
```

Functions

- int [main](#) (int argc, char **argv)

17.310.1 Function Documentation

17.310.1.1 main()

```
int main (
    int argc,
    char ** argv )
```

PS: the function Solve will modify the matrix A so here we used a duplicate matrix A2 otherwise $A \cdot x$ will not be equal to b for the later verification stage

Index

- [_F](#)
 - [RNSIntegerMod< RNS >, 554](#)
- [_M](#)
 - [rns_double, 532](#)
 - [rns_double_extended, 544](#)
- [_MAX_SIZE_MATRICES](#)
 - [benchmark-checkers.C, 771](#)
- [_MMi](#)
 - [rns_double, 532](#)
 - [rns_double_extended, 544](#)
- [_Mi](#)
 - [rns_double, 532](#)
 - [rns_double_extended, 544](#)
- [_Mi_modp_rns](#)
 - [RNSIntegerMod< RNS >, 554](#)
- [_NR_TESTS](#)
 - [benchmark-checkers.C, 771](#)
- [_PLUQ](#)
 - [FFPACK, 364](#)
- [_RNSdelayed](#)
 - [RNSIntegerMod< RNS >, 555](#)
- [__FFLASFFPACK_ARITHPROG_THRESHOLD](#)
 - [fflas-ffpack-default-thresholds.h, 819](#)
- [__FFLASFFPACK_CACHE_LINE_SIZE](#)
 - [fflas_sparse.h, 878](#)
- [__FFLASFFPACK_CHARPOLY_Danilevskii_LUKrylov_THRESHOLD](#)
 - [fflas-ffpack-default-thresholds.h, 819](#)
- [__FFLASFFPACK_CHARPOLY_LUKrylov_ArithProg_THRESHOLD](#)
 - [fflas-ffpack-default-thresholds.h, 819](#)
- [__FFLASFFPACK_CONFIGURATION](#)
 - [cblas.C, 1050](#)
 - [clapack.C, 1050](#)
 - [fblas.C, 1051](#)
 - [lapack.C, 1056](#)
- [__FFLASFFPACK_DIMKPENALTY](#)
 - [fflas_pfgemm.inl, 864](#)
- [__FFLASFFPACK_FORCE_SEQ](#)
 - [benchmark-charpoly-mp.C, 769](#)
- [__FFLASFFPACK_FSYRK_THRESHOLD](#)
 - [fflas-ffpack-default-thresholds.h, 819](#)
- [__FFLASFFPACK_FSYTRF_THRESHOLD](#)
 - [fflas-ffpack-default-thresholds.h, 819](#)
- [__FFLASFFPACK_FTRSSYR2K_THRESHOLD](#)
 - [ffpack.h, 916](#)
- [__FFLASFFPACK_FTRSTR_THRESHOLD](#)
 - [ffpack.h, 916](#)
- [__FFLASFFPACK_FTRTRI_THRESHOLD](#)
 - [fflas-ffpack-default-thresholds.h, 819](#)
- [__FFLASFFPACK_GAUSSJORDAN_BASECASE](#)
 - [ffpack_echelonforms.inl, 923](#)
 - [test-echelon.C, 1063](#)
- [__FFLASFFPACK_HAVE_BLAS](#)
 - [fflas-ffpack/config.h, 800](#)
- [__FFLASFFPACK_HAVE_CBLAS](#)
 - [cblas.C, 1050](#)
 - [fflas-ffpack/config.h, 800](#)
- [__FFLASFFPACK_HAVE_CLAPACK](#)
 - [clapack.C, 1050](#)
- [__FFLASFFPACK_HAVE_CXX11](#)
 - [fflas-ffpack/config.h, 801](#)
- [__FFLASFFPACK_HAVE_DGETRF](#)
 - [benchmark-dgetrf.C, 773](#)
- [__FFLASFFPACK_HAVE_DLFCN_H](#)
 - [fflas-ffpack/config.h, 801](#)
- [__FFLASFFPACK_HAVE_DTRTRI](#)
 - [benchmark-dtrtri.C, 776](#)
- [__FFLASFFPACK_HAVE_FLOAT_H](#)
 - [fflas-ffpack/config.h, 801](#)
- [__FFLASFFPACK_HAVE_INT128](#)
 - [fflas-ffpack/config.h, 801](#)
- [__FFLASFFPACK_HAVE_INTTYPES_H](#)
 - [fflas-ffpack/config.h, 801](#)
- [__FFLASFFPACK_HAVE_LAPACK](#)
 - [clapack.C, 1050](#)
 - [fflas-ffpack/config.h, 801](#)
 - [lapack.C, 1056](#)
- [__FFLASFFPACK_HAVE_LIMITS_H](#)
 - [fflas-ffpack/config.h, 801](#)
- [__FFLASFFPACK_HAVE_LITTLE_ENDIAN](#)
 - [fflas-ffpack/config.h, 801](#)
- [__FFLASFFPACK_HAVE_PTHREAD_H](#)
 - [fflas-ffpack/config.h, 801](#)
- [__FFLASFFPACK_HAVE_STDDEF_H](#)
 - [fflas-ffpack/config.h, 801](#)
- [__FFLASFFPACK_HAVE_STDINT_H](#)
 - [fflas-ffpack/config.h, 801](#)
- [__FFLASFFPACK_HAVE_STDIO_H](#)
 - [fflas-ffpack/config.h, 801](#)
- [__FFLASFFPACK_HAVE_STDLIB_H](#)
 - [fflas-ffpack/config.h, 802](#)
- [__FFLASFFPACK_HAVE_STRINGS_H](#)
 - [fflas-ffpack/config.h, 802](#)
- [__FFLASFFPACK_HAVE_STRING_H](#)
 - [fflas-ffpack/config.h, 802](#)
- [__FFLASFFPACK_HAVE_SYS_STAT_H](#)
 - [fflas-ffpack/config.h, 802](#)
- [__FFLASFFPACK_HAVE_SYS_TIME_H](#)
 - [fflas-ffpack/config.h, 802](#)

- __FFLASFFPACK_HAVE_SYS_TYPES_H
fflas-ffpack/config.h, [802](#)
- __FFLASFFPACK_HAVE_UNISTD_H
fflas-ffpack/config.h, [802](#)
- __FFLASFFPACK_KAAPI_ROUTINES_INL
kaapi_routines.inl, [1031](#)
- __FFLASFFPACK_LT_OBJDIR
fflas-ffpack/config.h, [802](#)
- __FFLASFFPACK_MINBLOCKCUTS
blockcuts.inl, [1030](#)
- __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET
benchmark-charpoly.C, [770](#)
benchmark-fadd-lvl2.C, [777](#)
benchmark-fdot.C, [778](#)
benchmark-fgemm-mp.C, [779](#)
benchmark-fgemm-rns.C, [780](#)
benchmark-fgemv-mp.C, [782](#)
benchmark-fgemv.C, [784](#)
benchmark-fgesv.C, [787](#)
benchmark-fsyrc.C, [787](#)
benchmark-fsytrf.C, [788](#)
benchmark-ftrsm-mp.C, [789](#)
benchmark-ftrsm.C, [790](#)
benchmark-ftrsv.C, [790](#)
benchmark-ftrtri.C, [791](#)
benchmark-pluq.C, [794](#)
- __FFLASFFPACK_OPENBLAS_NUM_THREADS
fflas-ffpack/config.h, [802](#)
- __FFLASFFPACK_PACKAGE
fflas-ffpack/config.h, [802](#)
- __FFLASFFPACK_PACKAGE_BUGREPORT
fflas-ffpack/config.h, [802](#)
- __FFLASFFPACK_PACKAGE_NAME
fflas-ffpack/config.h, [802](#)
- __FFLASFFPACK_PACKAGE_STRING
fflas-ffpack/config.h, [803](#)
- __FFLASFFPACK_PACKAGE_TARNAME
fflas-ffpack/config.h, [803](#)
- __FFLASFFPACK_PACKAGE_URL
fflas-ffpack/config.h, [803](#)
- __FFLASFFPACK_PACKAGE_VERSION
fflas-ffpack/config.h, [803](#)
- __FFLASFFPACK_PLUQ_THRESHOLD
fflas-ffpack-default-thresholds.h, [819](#)
test-echelon.C, [1063](#)
- __FFLASFFPACK_SEQPARTHRESHOLD
fflas_ptgemm.inl, [864](#)
- __FFLASFFPACK_SEQUENTIAL
parallel.h, [1032](#)
test-echelon.C, [1063](#)
test-ftrmm.C, [1083](#)
test-ftrmv.C, [1084](#)
test-ftrsm.C, [1086](#)
test-ftrsv.C, [1090](#)
test-ftrtri.C, [1091](#)
test-lu.C, [1094](#)
test-rankprofiles.C, [1104](#)
- __FFLASFFPACK_SIZEOF_CHAR
fflas-ffpack/config.h, [803](#)
- __FFLASFFPACK_SIZEOF_INT
fflas-ffpack/config.h, [803](#)
- __FFLASFFPACK_SIZEOF_LONG
fflas-ffpack/config.h, [803](#)
- __FFLASFFPACK_SIZEOF_LONG_LONG
fflas-ffpack/config.h, [803](#)
- __FFLASFFPACK_SIZEOF_SHORT
fflas-ffpack/config.h, [803](#)
- __FFLASFFPACK_SIZEOF__INT64
fflas-ffpack/config.h, [803](#)
- __FFLASFFPACK_STDC_HEADERS
fflas-ffpack/config.h, [803](#)
- __FFLASFFPACK_USE_OPENMP
fflas-ffpack/config.h, [803](#)
- __FFLASFFPACK_VERSION
fflas-ffpack/config.h, [804](#)
- __FFLASFFPACK_WINOTHRESHOLD
fflas-ffpack-default-thresholds.h, [818](#)
- __FFLASFFPACK_WINOTHRESHOLD_BAL
fflas-ffpack-default-thresholds.h, [818](#)
- __FFLASFFPACK_WINOTHRESHOLD_BAL_FLT
fflas-ffpack-default-thresholds.h, [819](#)
- __FFLASFFPACK_WINOTHRESHOLD_FLT
fflas-ffpack-default-thresholds.h, [818](#)
- __FFLASFFPACK_charpoly_INL
ffpack_charpoly.inl, [918](#)
- __FFLASFFPACK_checker_charpoly_INL
checker_charpoly.inl, [806](#)
- __FFLASFFPACK_checker_det_INL
checker_det.inl, [806](#)
- __FFLASFFPACK_checker_fgemm_INL
checker_fgemm.inl, [807](#)
- __FFLASFFPACK_checker_ftrsm_INL
checker_ftrsm.inl, [807](#)
- __FFLASFFPACK_checker_invert_INL
checker_invert.inl, [808](#)
- __FFLASFFPACK_checker_pluq_INL
checker_pluq.inl, [808](#)
- __FFLASFFPACK_fadd_INL
fflas_fadd.inl, [825](#)
- __FFLASFFPACK_fassign_INL
fflas_fassign.inl, [826](#)
- __FFLASFFPACK_faxpy_INL
fflas_faxpy.inl, [826](#)
- __FFLASFFPACK_fdot_INL
fflas_fdot.inl, [827](#)
- __FFLASFFPACK_fflas_blockcuts_INL
blockcuts.inl, [1030](#)
- __FFLASFFPACK_fflas_bounds_INL
fflas_bounds.inl, [822](#)
- __FFLASFFPACK_fflas_fflas_fgemm_classical_INL
fgemm_classical.inl, [830](#)
- __FFLASFFPACK_fflas_fflas_fgemm_winograd_INL
fgemm_winograd.inl, [833](#)
- __FFLASFFPACK_fflas_fflas_level1_INL
fflas_level1.inl, [858](#)
- __FFLASFFPACK_fflas_fflas_level2_INL

- fflas_level2.inl, [861](#)
- __FFLASFFPACK_fflas_fflas_level3_INL
- fflas_level3.inl, [863](#)
- __FFLASFFPACK_fflas_fflas_mmhelper_INL
- fflas_helpers.inl, [852](#)
- __FFLASFFPACK_fflas_fflas_sparse_INL
- fflas_sparse.inl, [881](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd128_INL
- simd128.inl, [867](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd128_double_INL
- simd128_double.inl, [868](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd128_float_INL
- simd128_float.inl, [868](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd128_int16_INL
- simd128_int16.inl, [868](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd128_int32_INL
- simd128_int32.inl, [869](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd128_int64_INL
- simd128_int64.inl, [869](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd256_INL
- simd256.inl, [870](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd256_double_INL
- simd256_double.inl, [870](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd256_float_INL
- simd256_float.inl, [870](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd256_int16_INL
- simd256_int16.inl, [871](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd256_int32_INL
- simd256_int32.inl, [871](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd256_int64_INL
- simd256_int64.inl, [872](#)
- __FFLASFFPACK_fflas_freduce_INL
- fflas_freduce.inl, [844](#)
- __FFLASFFPACK_fflas_freduce_mp_INL
- fflas_freduce_mp.inl, [844](#)
- __FFLASFFPACK_fflas_fsyr2k_INL
- fflas_fsyr2k.inl, [848](#)
- __FFLASFFPACK_fflas_fsyrrk_INL
- fflas_fsyrrk.inl, [849](#)
- __FFLASFFPACK_fflas_igemm_igemm_INL
- igemm.inl, [853](#)
- __FFLASFFPACK_fflas_igemm_igemm_kernels_INL
- igemm_kernels.inl, [855](#)
- __FFLASFFPACK_fflas_igemm_igemm_tools_INL
- igemm_tools.inl, [856](#)
- __FFLASFFPACK_fflas_pfgemm_INL
- fflas_pfgemm.inl, [864](#)
- __FFLASFFPACK_fflas_pftsrsm_INL
- fflas_pftsrsm.inl, [865](#)
- __FFLASFFPACK_fflas_sparse_CSR_HYB_pspmm_INL
- csr_hyb_pspmm.inl, [889](#)
- __FFLASFFPACK_fflas_sparse_CSR_HYB_pspmv_INL
- csr_hyb_pspmv.inl, [890](#)
- __FFLASFFPACK_fflas_sparse_CSR_HYB_spm INL
- csr_hyb_spm.inl, [891](#)
- __FFLASFFPACK_fflas_sparse_CSR_HYB_spmv_INL
- csr_hyb_spmv.inl, [891](#)
- __FFLASFFPACK_fflas_sparse_CSR_HYB_utils_INL
- csr_hyb_utils.inl, [892](#)
- __FFLASFFPACK_fflas_sparse_CSR_pspmm_INL
- csr_pspmm.inl, [885](#)
- __FFLASFFPACK_fflas_sparse_CSR_pspmv_INL
- csr_pspmv.inl, [886](#)
- __FFLASFFPACK_fflas_sparse_CSR_spm INL
- csr_spm.inl, [887](#)
- __FFLASFFPACK_fflas_sparse_CSR_spmv_INL
- csr_spmv.inl, [888](#)
- __FFLASFFPACK_fflas_sparse_ELL_pspmm_INL
- ell_pspmm.inl, [893](#)
- __FFLASFFPACK_fflas_sparse_ELL_pspmv_INL
- ell_pspmv.inl, [894](#)
- __FFLASFFPACK_fflas_sparse_ELL_simd_pspmv_INL
- ell_simd_pspmv.inl, [898](#)
- __FFLASFFPACK_fflas_sparse_ELL_simd_spmv_INL
- ell_simd_spmv.inl, [898](#)
- __FFLASFFPACK_fflas_sparse_ELL_simd_utils_INL
- ell_simd_utils.inl, [899](#)
- __FFLASFFPACK_fflas_sparse_ELL_spm INL
- ell_spm.inl, [895](#)
- __FFLASFFPACK_fflas_sparse_ELL_spmv_INL
- ell_spmv.inl, [896](#)
- __FFLASFFPACK_fflas_sparse_ELL_utils_INL
- ell_utils.inl, [896](#)
- __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmm_INL
- hyb_zo_pspmm.inl, [900](#)
- __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmv_INL
- hyb_zo_pspmv.inl, [900](#)
- __FFLASFFPACK_fflas_sparse_HYB_ZO_spm INL
- hyb_zo_spm.inl, [901](#)
- __FFLASFFPACK_fflas_sparse_HYB_ZO_spmv_INL
- hyb_zo_spmv.inl, [901](#)
- __FFLASFFPACK_fflas_sparse_HYB_ZO_utils_INL
- hyb_zo_utils.inl, [902](#)
- __FFLASFFPACK_fflas_sparse_coo_spm INL
- coo_spm.inl, [882](#)
- __FFLASFFPACK_fflas_sparse_coo_spmv_INL
- coo_spmv.inl, [883](#)
- __FFLASFFPACK_fflas_sparse_coo_utils_INL
- coo_utils.inl, [883](#)
- __FFLASFFPACK_fflas_sparse_sell_pspmv_INL
- sell_pspmv.inl, [904](#)
- __FFLASFFPACK_fflas_sparse_sell_spmv_INL
- sell_spmv.inl, [905](#)
- __FFLASFFPACK_fflas_sparse_sell_utils_INL
- sell_utils.inl, [906](#)
- __FFLASFFPACK_ffpack_INL
- ffpack.inl, [917](#)
- __FFLASFFPACK_ffpack_charpoly_danilveski_INL
- ffpack_charpoly_danilevski.inl, [918](#)
- __FFLASFFPACK_ffpack_charpoly_kgfast_INL
- ffpack_charpoly_kgfast.inl, [919](#)
- __FFLASFFPACK_ffpack_charpoly_kgfastgeneralized_INL
- ffpack_charpoly_kgfastgeneralized.inl, [920](#)
- __FFLASFFPACK_ffpack_charpoly_kglu_INL
- ffpack_charpoly_kglu.inl, [920](#)
- __FFLASFFPACK_ffpack_echelon_forms_INL

- ffpack_echelonforms.inl, [923](#)
- __FFLASFFPACK_ffpack_fgesv_INL
 - ffpack_fgesv.inl, [923](#)
- __FFLASFFPACK_ffpack_fgetrs_INL
 - ffpack_fgetrs.inl, [924](#)
- __FFLASFFPACK_ffpack_fsytrf_INL
 - ffpack_fsytrf.inl, [926](#)
- __FFLASFFPACK_ffpack_ftrssyr2k_INL
 - ffpack_ftrssyr2k.inl, [926](#)
- __FFLASFFPACK_ffpack_ftrstr_INL
 - ffpack_ftrstr.inl, [927](#)
- __FFLASFFPACK_ffpack_ftrtr_INL
 - ffpack_ftrtr.inl, [928](#)
- __FFLASFFPACK_ffpack_invert_INL
 - ffpack_invert.inl, [928](#)
- __FFLASFFPACK_ffpack_krylovelim_INL
 - ffpack_krylovelim.inl, [929](#)
- __FFLASFFPACK_ffpack_ludivine_INL
 - ffpack_ludivine.inl, [929](#)
- __FFLASFFPACK_ffpack_minpoly_INL
 - ffpack_minpoly.inl, [931](#)
- __FFLASFFPACK_ffpack_permutation_INL
 - ffpack_permutation.inl, [933](#)
- __FFLASFFPACK_ffpack_pluq_INL
 - ffpack_pluq.inl, [934](#)
- __FFLASFFPACK_ffpack_ppluq_INL
 - ffpack_ppluq.inl, [935](#)
- __FFLASFFPACK_ffpack_rank_profiles_INL
 - ffpack_rankprofiles.inl, [937](#)
- __FFLASFFPACK_fgemm_INL
 - fflas_fgemm.inl, [830](#)
- __FFLASFFPACK_fgemm_bini_INL
 - schedule_bini.inl, [834](#)
- __FFLASFFPACK_fgemm_winograd_INL
 - schedule_winograd.inl, [835](#)
- __FFLASFFPACK_fgemm_winograd_acc_INL
 - schedule_winograd_acc.inl, [835](#)
- __FFLASFFPACK_fgemm_winograd_acc_ip_INL
 - schedule_winograd_acc_ip.inl, [836](#)
- __FFLASFFPACK_fgemm_winograd_ip_INL
 - schedule_winograd_ip.inl, [837](#)
- __FFLASFFPACK_fgemv_INL
 - fflas_fgemv.inl, [838](#)
- __FFLASFFPACK_fgemv_mp_INL
 - fflas_fgemv_mp.inl, [839](#)
- __FFLASFFPACK_fger_INL
 - fflas_fger.inl, [840](#)
- __FFLASFFPACK_field_rns_INL
 - rns.inl, [943](#)
- __FFLASFFPACK_field_rns_double_INL
 - rns-double.inl, [941](#)
- __FFLASFFPACK_field_rns_double_recint_INL
 - rns-double-recint.inl, [940](#)
- __FFLASFFPACK_freivalds_INL
 - fflas_freivalds.inl, [845](#)
- __FFLASFFPACK_fscal_INL
 - fflas_fscal.inl, [846](#)
- __FFLASFFPACK_fscal_mp_INL
 - fflas_fscal_mp.inl, [847](#)
- __FFLASFFPACK_ftrmm_INL
 - fflas_ftrmm.inl, [849](#)
- __FFLASFFPACK_ftrsm_INL
 - fflas_ftrsm.inl, [850](#)
- __FFLASFFPACK_ftrsv_INL
 - fflas_ftrsv.inl, [851](#)
- __FFLASFFPACK_simd512_INL
 - simd512.inl, [872](#)
- __FFLASFFPACK_simd512_double_INL
 - simd512_double.inl, [873](#)
- __FFLASFFPACK_simd512_float_INL
 - simd512_float.inl, [873](#)
- __FFLASFFPACK_simd512_int32_INL
 - simd512_int32.inl, [873](#)
- __FFLAS_L1_INST_C
 - fflas_L1_inst.C, [957](#)
- __FFLAS_L2_INST_C
 - fflas_L2_inst.C, [960](#)
- __FFLAS_L3_INST_C
 - fflas_L3_inst.C, [965](#)
- __FFLAS__TRSM_READONLY
 - fflas_L3_inst_implem.inl, [967](#)
 - fflas_level3.inl, [863](#)
 - ffpack_ppluq.inl, [935](#)
- __FFPACK_FSYTRF_BC_CROUT
 - benchmark-fsytrf.C, [788](#)
- __FFPACK_INST_C
 - ffpack_inst.C, [1023](#)
- __FFPACK_charpoly_mp_INL
 - ffpack_charpoly_mp.inl, [921](#)
- __FFPACK_det_mp_INL
 - ffpack_det_mp.inl, [921](#)
- __FFPACK_fgemm_classical_INL
 - fgemm_classical_mp.inl, [832](#)
- __FFPACK_fger_mp_INL
 - fflas_fger_mp.inl, [841](#)
- __FFPACK_ftrsm_mp_INL
 - fflas_ftrsm_mp.inl, [851](#)
- __FFPACK_ludivine_mp_INL
 - ffpack_ludivine_mp.inl, [930](#)
- __FFPACK_pluq_mp_INL
 - ffpack_pluq_mp.inl, [935](#)
- __LUDIVINE_CUTOFF
 - test-lu.C, [1095](#)
- __has_builtin
 - bit_manipulation.h, [1041](#)
- _alloc
 - rns_double_elt, [534](#)
 - rns_double_elt_cstptr, [537](#)
 - rns_double_elt_ptr, [540](#)
- _basis
 - rns_double, [531](#)
 - rns_double_extended, [543](#)
- _basisMax
 - rns_double, [531](#)
 - rns_double_extended, [543](#)
- _coo

- SpMat< Field, flag >, 749
- _coo16
 - CooMat< Field >, 433
- _coo16_zo
 - CooMat< Field >, 433
- _coo32
 - CooMat< Field >, 433
- _coo32_zo
 - CooMat< Field >, 433
- _coo64
 - CooMat< Field >, 433
- _coo64_zo
 - CooMat< Field >, 433
- _crt_in
 - rns_double, 532
 - rns_double_extended, 544
- _crt_out
 - rns_double, 532
 - rns_double_extended, 544
- _csr
 - SpMat< Field, flag >, 749
- _csr16
 - CsrMat< Field >, 434
- _csr16_zo
 - CsrMat< Field >, 434
- _csr32
 - CsrMat< Field >, 434
- _csr32_zo
 - CsrMat< Field >, 434
- _csr64
 - CsrMat< Field >, 434
- _csr64_zo
 - CsrMat< Field >, 434
- _ell
 - SpMat< Field, flag >, 750
- _ell16
 - EllMat< Field >, 441
- _ell16_zo
 - EllMat< Field >, 441
- _ell32
 - EllMat< Field >, 441
- _ell32_zo
 - EllMat< Field >, 441
- _ell64
 - EllMat< Field >, 441
- _ell64_zo
 - EllMat< Field >, 441
- _errorStream
 - Failure, 443
- _field_rns
 - rns_double, 531
 - rns_double_extended, 544
- _iM_modp_rns
 - RNSIntegerMod< RNS >, 554
- _ibeg
 - ForStrategy2D< blocksize_t, Cut, Param >, 463
- _iend
 - ForStrategy2D< blocksize_t, Cut, Param >, 463
- _invbasis
 - rns_double, 531
 - rns_double_extended, 543
- _jbeg
 - ForStrategy2D< blocksize_t, Cut, Param >, 463
- _jend
 - ForStrategy2D< blocksize_t, Cut, Param >, 463
- _ldm
 - rns_double, 532
 - rns_double_extended, 544
- _mi_sum
 - rns_double, 532
- _negbasis
 - rns_double, 531
 - rns_double_extended, 543
- _p
 - RNSIntegerMod< RNS >, 554
- _pbits
 - rns_double, 532
 - rns_double_extended, 544
- _ptr
 - rns_double_elt, 534
 - rns_double_elt_cstptr, 537
 - rns_double_elt_ptr, 540
- _rns
 - RNSInteger< RNS >, 548
 - RNSIntegerMod< RNS >, 554
- _simd512_int64_INL
 - simd512_int64.inl, 874
- _size
 - rns_double, 532
 - rns_double_extended, 544
- _stride
 - rns_double_elt, 534
 - rns_double_elt_cstptr, 537
 - rns_double_elt_ptr, 540
- ~CheckerImplem_Det
 - CheckerImplem_Det< Field >, 413
- ~CheckerImplem_PLUQ
 - CheckerImplem_PLUQ< Field >, 417
- ~CheckerImplem_charpoly
 - CheckerImplem_charpoly< Field, Polynomial >, 412
- ~CheckerImplem_fgemm
 - CheckerImplem_fgemm< Field >, 414
- ~CheckerImplem_ftsm
 - CheckerImplem_ftsm< Field >, 415
- ~CheckerImplem_invert
 - CheckerImplem_invert< Field >, 416
- ~rns_double_elt
 - rns_double_elt, 533
- 101-fgemm.C, 1110
 - main, 1110
- 2x2-fgemm.C, 1110
 - main, 1110
- 2x2-ftsv.C, 1111
 - main, 1111
- 2x2-pluq.C, 1111
 - main, 1111

- main, 1111
- add
 - FFLAS::vectorised, 289
 - FieldSimd< _Field >, 446
 - RNSIntegerMod< RNS >, 552
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, 558
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, 562
 - Simd128_impl< true, true, false, 2 >, 573
 - Simd128_impl< true, true, false, 4 >, 581
 - Simd128_impl< true, true, false, 8 >, 590
 - Simd128_impl< true, true, true, 2 >, 598
 - Simd128_impl< true, true, true, 4 >, 606
 - Simd128_impl< true, true, true, 8 >, 615
 - Simd256_impl< true, false, true, 8 >, 626
 - Simd256_impl< true, true, false, 2 >, 636
 - Simd256_impl< true, true, false, 4 >, 650
 - Simd256_impl< true, true, false, 8 >, 661
 - Simd256_impl< true, true, true, 2 >, 668
 - Simd256_impl< true, true, true, 4 >, 678, 684
 - Simd256_impl< true, true, true, 8 >, 693
 - Simd512_impl< true, false, true, 8 >, 703
 - Simd512_impl< true, true, false, 8 >, 712
 - Simd512_impl< true, true, true, 8 >, 720
- add_r
 - FieldSimd< _Field >, 446
- addin
 - FieldSimd< _Field >, 446
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, 558
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, 562
 - Simd128_impl< true, true, false, 2 >, 573
 - Simd128_impl< true, true, false, 4 >, 582
 - Simd128_impl< true, true, false, 8 >, 590
 - Simd128_impl< true, true, true, 2 >, 598
 - Simd128_impl< true, true, true, 4 >, 606
 - Simd128_impl< true, true, true, 8 >, 615
 - Simd256_impl< true, false, true, 8 >, 626
 - Simd256_impl< true, true, false, 2 >, 636
 - Simd256_impl< true, true, false, 4 >, 650
 - Simd256_impl< true, true, false, 8 >, 661
 - Simd256_impl< true, true, true, 2 >, 668
 - Simd256_impl< true, true, true, 4 >, 678, 684
 - Simd256_impl< true, true, true, 8 >, 693
 - Simd512_impl< true, false, true, 8 >, 703
 - Simd512_impl< true, true, false, 8 >, 712
 - Simd512_impl< true, true, true, 8 >, 720
- addin_r
 - FieldSimd< _Field >, 447
- addp
 - FFLAS::vectorised, 288
- AlgoChooser< ModeCategories::ConvertTo< Element-Categories::RNSElementTag >, ParSeq >, 405
 - value, 405
- AlgoChooser< ModeT, ParSeq >, 405
 - value, 405
- align-allocator.h, 1039
- alignable
 - FFLAS, 196
- alignable< Givaro::Integer * >
 - FFLAS, 196
- alignment
 - FieldSimd< _Field >, 450
 - Simd128_impl< true, true, false, 2 >, 576
 - Simd128_impl< true, true, false, 4 >, 584
 - Simd128_impl< true, true, false, 8 >, 594
 - Simd128_impl< true, true, true, 2 >, 602
 - Simd128_impl< true, true, true, 4 >, 611
 - Simd128_impl< true, true, true, 8 >, 620
 - Simd256_impl< true, false, true, 8 >, 629
 - Simd256_impl< true, true, false, 2 >, 638
 - Simd256_impl< true, true, false, 4 >, 655
 - Simd256_impl< true, true, false, 8 >, 663
 - Simd256_impl< true, true, true, 2 >, 672
 - Simd256_impl< true, true, true, 4 >, 688
 - Simd256_impl< true, true, true, 8 >, 697
 - Simd512_impl< true, false, true, 8 >, 705
 - Simd512_impl< true, true, false, 8 >, 715
 - Simd512_impl< true, true, true, 8 >, 725
- Amax
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 502
- Amin
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 502
- applyP
 - FFPACK, 310, 311, 367
- applyP_block
 - FFPACK, 358
- applyP_modular_double
 - ffpack.C, 985
 - ffpack_c.h, 1009
- ArbitraryPreclntTag, 405
- areEqual
 - RNSIntegerMod< RNS >, 553
- AreEqual< X, X >, 406
 - value, 406
- AreEqual< X, Y >, 406
 - value, 406
- args-parser.h, 1039
 - ArgumentType, 1040
 - END_OF_ARGUMENTS, 1040
 - findArgument, 1041
 - getListArgs, 1041
 - printHelpMessage, 1040
 - TYPE_BOOL, 1040
 - TYPE_DOUBLE, 1040
 - TYPE_INT, 1040
 - TYPE_INTEGER, 1040
 - type_integer, 1040
 - TYPE_INTLIST, 1040

- TYPE_LONGLONG, 1040
- TYPE_NONE, 1040
- TYPE_STR, 1040
- TYPE_UINT64, 1040
- Argument, 406
 - c, 407
 - data, 407
 - example, 407
 - helpString, 407
 - type, 407
- ArgumentType
 - args-parser.h, 1040
- ArithProg
 - FFPACK::Protected, 399
- arithprog.C, 761
 - CUBE, 761
 - GFOPS, 761
 - main, 762
 - TTimer, 762
- assign
 - RNSInteger< RNS >, 548
 - RNSIntegerMod< RNS >, 552
- associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > >, 407
 - field, 408
 - type, 408
- associatedDelayedField< const Givaro::Modular< T, X > >, 408
 - field, 408
 - type, 408
- associatedDelayedField< const Givaro::ModularBalanced< T > >, 408
 - field, 409
 - type, 409
- associatedDelayedField< const Givaro::ZRing< T > >, 409
 - field, 409
 - type, 409
- associatedDelayedField< Field >, 407
 - field, 407
 - type, 407
- assume_aligned
 - fflas_sparse.h, 878
- AtlasConj
 - config-blas.h, 812
- Aunfit
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 501
- aut
 - HelperFlag, 472
- Auto, 409
- autotune/charpoly.C
 - CUBE, 762
 - GFOPS, 762
 - main, 763
 - TTimer, 763
- autotune/pluq.C
 - CUBE, 767
- GFOPS, 767
 - main, 767
 - TTimer, 767
- averageCol
 - StatsMatrix, 752
- averageColDifference
 - StatsMatrix, 752
- averageRow
 - StatsMatrix, 752
- averageRowDifference
 - StatsMatrix, 753
- axpy
 - FieldSimd< _Field >, 448, 449
- axpy_r
 - FieldSimd< _Field >, 449
- axpyin
 - FieldSimd< _Field >, 449
 - RNSIntegerMod< RNS >, 553
- axpyin_r
 - FieldSimd< _Field >, 449
- balanced
 - FieldTraits< FFPACK::RNSInteger< T > >, 451
 - FieldTraits< FFPACK::RNSIntegerMod< T > >, 452
 - FieldTraits< Field >, 450
 - FieldTraits< Givaro::Modular< Element > >, 452
 - FieldTraits< Givaro::ModularBalanced< Element > >, 453
 - FieldTraits< Givaro::ZRing< double > >, 453
 - FieldTraits< Givaro::ZRing< float > >, 454
 - FieldTraits< Givaro::ZRing< Givaro::Integer > >, 454
 - FieldTraits< Givaro::ZRing< int16_t > >, 455
 - FieldTraits< Givaro::ZRing< int32_t > >, 455
 - FieldTraits< Givaro::ZRing< int64_t > >, 456
 - FieldTraits< Givaro::ZRing< Reclnt::ruint< K > >, 457
 - FieldTraits< Givaro::ZRing< uint16_t > >, 457
 - FieldTraits< Givaro::ZRing< uint32_t > >, 458
 - FieldTraits< Givaro::ZRing< uint64_t > >, 458
 - winograd.C, 769
- BARRIER
 - parallel.h, 1032
- BASECASE_K
 - test-lu.C, 1094
- BaseTimer
 - FFLAS, 80
- BasisElement
 - rns_double, 528
 - rns_double_extended, 541
 - RNSInteger< RNS >, 546
 - RNSIntegerMod< RNS >, 550
- begin
 - ForStrategy1D< blocksize_t, Cut, Param >, 460
 - Info, 477, 478
- BEGIN_PARALLEL_MAIN
 - parallel.h, 1033
- benchmark-charpoly-mp.C, 769

- __FFLASFFPACK_FORCE_SEQ, 769
 - main, 769
- benchmark-charpoly.C, 770
 - __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET, 770
 - main, 770
 - run_with_field, 770
- benchmark-checkers.C, 771
 - _MAX_SIZE_MATRICES, 771
 - _NR_TESTS, 771
 - CUBE, 771
 - ENABLE_ALL_CHECKINGS, 771
 - main, 771
- benchmark-dgemm.C, 772
 - CBLAS_GEMM, 772
 - Floats, 772
 - main, 772
 - TTimer, 772
- benchmark-dgetrf.C, 773
 - __FFLASFFPACK_HAVE_DGETRF, 773
 - main, 773
 - TTimer, 773
- benchmark-dgetri.C, 773
 - main, 774
 - TTimer, 774
- benchmark-dsytrf.C, 774
 - EFFGFF, 774
 - main, 775
 - TTimer, 775
- benchmark-dtrsm.C, 775
 - main, 775
 - TTimer, 775
- benchmark-dtrtri.C, 776
 - __FFLASFFPACK_HAVE_DTRTRI, 776
 - main, 776
 - TTimer, 776
- benchmark-fadd-lvl2.C, 777
 - __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET, 777
 - main, 777
- benchmark-fdot.C, 777
 - __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET, 778
 - main, 778
 - run_with_field, 778
- benchmark-fgemm-mp.C, 778
 - __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET, 779
 - main, 779
 - MG_DEFAULT, 779
 - STD_RECINT_SIZE, 779
 - tmain, 779
- benchmark-fgemm-rns.C, 779
 - __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET, 780
 - ConstElement_ptr, 780
 - Element_ptr, 780
 - Field, 780
- GRAIN, 780
 - main, 781
- PSeq, 781
- RNS, 780
- THREADS, 780
- THREED, 781
- THREEDA, 781
- THREEDIP, 781
- TWOD, 780
- TWODA, 780
- benchmark-fgemm.C, 781
 - CLASSIC_HYBRID, 781
 - main, 782
- benchmark-fgemv-mp.C, 782
 - __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET, 782
 - main, 783
 - MG_DEFAULT, 782
 - STD_RECINT_SIZE, 782
 - tmain, 783
 - write_matrix, 783
- benchmark-fgemv.C, 783
 - __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET, 784
 - benchmark_disp, 785
 - benchmark_in_Field, 785
 - benchmark_with_field, 786
 - benchmark_with_timer, 785
 - check_result, 785
 - fill_value, 784
 - genData, 784
 - main, 786
- benchmark-fgesv.C, 786
 - __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET, 787
 - main, 787
- benchmark-fsyrk.C, 787
 - __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET, 787
 - CUBE, 788
 - main, 788
- benchmark-fsytrf.C, 788
 - __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET, 788
 - __FFPACK_FSYTRF_BC_CROUT, 788
 - CUBE, 788
 - main, 789
- benchmark-ftsrm-mp.C, 789
 - __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET, 789
 - main, 789
- benchmark-ftsrm.C, 789
 - __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET, 790
 - main, 790
- benchmark-ftsrv.C, 790
 - __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET, 790

- main, [790](#)
- benchmark-ftrtri.C, [791](#)
 - __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET, [791](#)
 - CUBE, [791](#)
 - main, [791](#)
- benchmark-inverse.C, [791](#)
 - CUBE, [792](#)
 - main, [792](#)
- benchmark-lqup-mp.C, [792](#)
 - main, [792](#)
- benchmark-lqup.C, [793](#)
 - CUBE, [793](#)
 - main, [793](#)
- benchmark-pluq.C, [793](#)
 - __FFLASFFPACK_OPENBLAS_NT_ALREADY_SET, [794](#)
 - CUBE, [794](#)
 - Field, [794](#)
 - main, [794](#)
 - Rec_Initialize, [794](#)
 - verification_PLUQ, [794](#)
- benchmark-wino.C, [795](#)
 - CUBE, [795](#)
 - launch_wino, [795](#)
 - main, [795](#)
- benchmark_disp
 - benchmark-fgemv.C, [785](#)
- benchmark_in_Field
 - benchmark-fgemv.C, [785](#)
- benchmark_with_field
 - benchmark-fgemv.C, [786](#)
- benchmark_with_timer
 - benchmark-fgemv.C, [785](#)
- Bini, [409](#)
 - FFLAS::BLAS3, [200](#)
- bit_manipulation.h, [1041](#)
 - __has_builtin, [1041](#)
 - clz, [1042](#)
 - ctz, [1042](#)
- bitsize
 - FFLAS, [145](#)
- bitsize< Givaro::ZRing< Givaro::Integer > >
 - FFLAS, [146](#)
- blas_enum
 - config-blas.h, [812](#)
- blend
 - Simd128_impl< true, true, false, 2 >, [573](#)
 - Simd128_impl< true, true, false, 4 >, [581](#)
 - Simd128_impl< true, true, false, 8 >, [590](#)
 - Simd128_impl< true, true, true, 2 >, [598](#)
 - Simd128_impl< true, true, true, 4 >, [606](#)
 - Simd128_impl< true, true, true, 8 >, [615](#)
 - Simd256_impl< true, false, true, 8 >, [626](#)
 - Simd256_impl< true, true, false, 4 >, [650](#)
 - Simd256_impl< true, true, false, 8 >, [661](#)
 - Simd256_impl< true, true, true, 4 >, [678](#)
 - Simd256_impl< true, true, true, 8 >, [693](#)
 - Simd512_impl< true, false, true, 8 >, [702](#)
 - Simd512_impl< true, true, false, 8 >, [712](#)
 - Simd512_impl< true, true, true, 8 >, [720](#)
- blend_twice
 - Simd256_impl< true, true, false, 2 >, [636](#)
 - Simd256_impl< true, true, true, 2 >, [668](#)
- blendv
 - Simd256_impl< true, false, true, 8 >, [626](#)
 - Simd512_impl< true, false, true, 8 >, [702](#)
- Block, [409](#)
- BlockCuts
 - FFLAS, [187](#), [189](#)
- BlockCuts< CuttingStrategy::Block, StrategyParameter::Fixed >
 - FFLAS, [189](#)
- BlockCuts< CuttingStrategy::Block, StrategyParameter::Grain >
 - FFLAS, [188](#)
- BlockCuts< CuttingStrategy::Block, StrategyParameter::Threads >
 - FFLAS, [189](#)
- BlockCuts< CuttingStrategy::Column, StrategyParameter::Fixed >
 - FFLAS, [188](#)
- BlockCuts< CuttingStrategy::Column, StrategyParameter::Grain >
 - FFLAS, [188](#)
- BlockCuts< CuttingStrategy::Column, StrategyParameter::Threads >
 - FFLAS, [189](#)
- BlockCuts< CuttingStrategy::Row, StrategyParameter::Fixed >
 - FFLAS, [188](#)
- BlockCuts< CuttingStrategy::Row, StrategyParameter::Grain >
 - FFLAS, [188](#)
- BlockCuts< CuttingStrategy::Row, StrategyParameter::Threads >
 - FFLAS, [189](#)
- BlockCuts< CuttingStrategy::Single, StrategyParameter::Threads >
 - FFLAS, [187](#)
- blockcuts.inl, [1029](#)
 - __FFLASFFPACK_MINBLOCKCUTS, [1030](#)
 - __FFLASFFPACK_fflas_blockcuts_INL, [1030](#)
- blockindex
 - ForStrategy1D< blocksize_t, Cut, Param >, [460](#)
 - ForStrategy2D< blocksize_t, Cut, Param >, [463](#)
- BlockingFactor
 - FFLAS::details, [214](#)
- BLOCKS
 - ForStrategy2D< blocksize_t, Cut, Param >, [464](#)
- Bmax
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, [502](#)
- Bmin
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, [502](#)

- build
 - ForStrategy1D< blocksize_t, Cut, Param >, [459](#)
- buildMatrix
 - FFPACK, [351](#)
- Bunfit
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [501](#)
- c
 - Argument, [407](#)
- callLUdivine_small< double >, [410](#)
 - operator(), [410](#)
- callLUdivine_small< Element >, [410](#)
 - operator(), [410](#)
- callLUdivine_small< float >, [411](#)
 - operator(), [411](#)
- cardinality
 - RNSInteger< RNS >, [547](#)
 - RNSIntegerMod< RNS >, [551](#)
- cast.h, [1042](#)
- category
 - FieldTraits< FFPACK::RNSInteger< T > >, [451](#)
 - FieldTraits< FFPACK::RNSIntegerMod< T > >, [451](#)
 - FieldTraits< Field >, [450](#)
 - FieldTraits< Givaro::Modular< Element > >, [452](#)
 - FieldTraits< Givaro::ModularBalanced< Element > >, [453](#)
 - FieldTraits< Givaro::ZRing< double > >, [453](#)
 - FieldTraits< Givaro::ZRing< float > >, [454](#)
 - FieldTraits< Givaro::ZRing< Givaro::Integer > >, [454](#)
 - FieldTraits< Givaro::ZRing< int16_t > >, [455](#)
 - FieldTraits< Givaro::ZRing< int32_t > >, [455](#)
 - FieldTraits< Givaro::ZRing< int64_t > >, [456](#)
 - FieldTraits< Givaro::ZRing< Reclnt::ruint< K > >, [456](#)
 - FieldTraits< Givaro::ZRing< uint16_t > >, [457](#)
 - FieldTraits< Givaro::ZRing< uint32_t > >, [457](#)
 - FieldTraits< Givaro::ZRing< uint64_t > >, [458](#)
- cblas.C, [1049](#)
 - __FFLASFFPACK_CONFIGURATION, [1050](#)
 - __FFLASFFPACK_HAVE_CBLAS, [1050](#)
 - main, [1050](#)
- CBLAS_DIAG
 - config-blas.h, [812](#)
- CBLAS_ENUM_DEFINED_H
 - config-blas.h, [812](#)
- CBLAS_EXTERNALS
 - config-blas.h, [812](#)
- CBLAS_GEMM
 - benchmark-dgemm.C, [772](#)
- cblas_imptrsm
 - FFLAS, [133](#)
- CBLAS_INT
 - config-blas.h, [811](#)
- CBLAS_ORDER
 - config-blas.h, [812](#)
- CBLAS_SIDE
 - config-blas.h, [813](#)
- CBLAS_TRANSPOSE
 - config-blas.h, [812](#)
- CBLAS_UPLO
 - config-blas.h, [812](#)
- CblasColMajor
 - config-blas.h, [812](#)
- CblasConjTrans
 - config-blas.h, [812](#)
- CblasLeft
 - config-blas.h, [813](#)
- CblasLower
 - config-blas.h, [812](#)
- CblasNonUnit
 - config-blas.h, [813](#)
- CblasNoTrans
 - config-blas.h, [812](#)
- CblasRight
 - config-blas.h, [813](#)
- CblasRowMajor
 - config-blas.h, [812](#)
- CblasTrans
 - config-blas.h, [812](#)
- CblasUnit
 - config-blas.h, [813](#)
- CblasUpper
 - config-blas.h, [812](#)
- ceil
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, [558](#)
 - Simd256_impl< true, false, true, 8 >, [629](#)
 - Simd512_impl< true, false, true, 8 >, [705](#)
- changeBS
 - ForStrategy1D< blocksize_t, Cut, Param >, [461](#)
- changeCBS
 - ForStrategy2D< blocksize_t, Cut, Param >, [464](#)
- changeRBS
 - ForStrategy2D< blocksize_t, Cut, Param >, [464](#)
- characteristic
 - RNSInteger< RNS >, [547](#)
 - RNSIntegerMod< RNS >, [551](#)
- CharPoly
 - FFPACK, [329](#), [330](#), [352](#), [372](#)
- charpoly.C, [762](#), [763](#)
- CharpolyFailed, [411](#)
- check
 - Checker_Empty< Field >, [412](#)
 - CheckerImplem_charpoly< Field, Polynomial >, [412](#)
 - CheckerImplem_Det< Field >, [413](#)
 - CheckerImplem_fgemm< Field >, [414](#)
 - CheckerImplem_ftsm< Field >, [416](#)
 - CheckerImplem_invert< Field >, [417](#)
 - CheckerImplem_PLUQ< Field >, [417](#)
- check1
 - regression-check.C, [1057](#)
- check2

- regression-check.C, [1057](#)
- check3
 - regression-check.C, [1057](#)
- check4
 - regression-check.C, [1057](#)
- CHECK_DEPENDENCIES
 - parallel.h, [1032](#)
- check_eq
 - test-simd.C, [1108](#)
- check_fdot
 - test-fdot.C, [1066](#)
- check_fger
 - test-fger.C, [1073](#)
- check_fsyr2k
 - test-fsyr2k.C, [1079](#)
- check_fsyrk
 - test-fsyrk.C, [1080](#)
- check_fsyrk_bkdiag
 - test-fsyrk.C, [1080](#)
- check_fsyrk_diag
 - test-fsyrk.C, [1080](#)
- check_ftrmm
 - test-ftrmm.C, [1083](#)
- check_ftrmv
 - test-ftrmv.C, [1084](#)
- check_ftrsm
 - test-ftrsm.C, [1086](#)
- check_ftrssyr2k
 - test-ftrssyr2k.C, [1088](#)
- check_ftrstr
 - test-ftrstr.C, [1089](#)
- check_ftrsv
 - test-ftrsv.C, [1090](#)
- check_ftrtri
 - test-ftrtri.C, [1091](#)
- check_minpoly
 - test-minpoly.C, [1099](#)
- check_MM
 - test-fgemm.C, [1069](#)
- check_MV
 - test-fgemv.C, [1071](#)
- check_result
 - benchmark-fgemv.C, [785](#)
- check_solve
 - test-solve.C, [1109](#)
- checkA
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [501](#)
- checkB
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [501](#)
- CHECKER, [49](#)
- Checker_charpoly
 - FFPACK, [309](#)
- checker_charpoly.inl, [805](#)
 - __FFLASFFPACK_checker_charpoly_INL, [806](#)
- Checker_Det
 - FFPACK, [309](#)
- checker_det.inl, [806](#)
 - __FFLASFFPACK_checker_det_INL, [806](#)
- Checker_Empty
 - Checker_Empty< Field >, [411](#)
- Checker_Empty< Field >, [411](#)
 - check, [412](#)
 - Checker_Empty, [411](#)
- checker_empty.h, [806](#)
- Checker_fgemm
 - FFLAS, [78](#)
- checker_fgemm.inl, [807](#)
 - __FFLASFFPACK_checker_fgemm_INL, [807](#)
- Checker_ftrsm
 - FFLAS, [78](#)
- checker_ftrsm.inl, [807](#)
 - __FFLASFFPACK_checker_ftrsm_INL, [807](#)
- Checker_invert
 - FFPACK, [309](#)
- checker_invert.inl, [807](#)
 - __FFLASFFPACK_checker_invert_INL, [808](#)
- Checker_PLUQ
 - FFPACK, [309](#)
- checker_pluq.inl, [808](#)
 - __FFLASFFPACK_checker_pluq_INL, [808](#)
- CheckerImplem_charpoly
 - CheckerImplem_charpoly< Field, Polynomial >, [412](#)
- CheckerImplem_charpoly< Field, Polynomial >, [412](#)
 - ~CheckerImplem_charpoly, [412](#)
 - check, [412](#)
 - CheckerImplem_charpoly, [412](#)
- CheckerImplem_Det
 - CheckerImplem_Det< Field >, [413](#)
- CheckerImplem_Det< Field >, [413](#)
 - ~CheckerImplem_Det, [413](#)
 - check, [413](#)
 - CheckerImplem_Det, [413](#)
- CheckerImplem_fgemm
 - CheckerImplem_fgemm< Field >, [414](#)
- CheckerImplem_fgemm< Field >, [414](#)
 - ~CheckerImplem_fgemm, [414](#)
 - check, [414](#)
 - CheckerImplem_fgemm, [414](#)
- CheckerImplem_ftrsm
 - CheckerImplem_ftrsm< Field >, [415](#)
- CheckerImplem_ftrsm< Field >, [415](#)
 - ~CheckerImplem_ftrsm, [415](#)
 - check, [416](#)
 - CheckerImplem_ftrsm, [415](#)
- CheckerImplem_invert
 - CheckerImplem_invert< Field >, [416](#)
- CheckerImplem_invert< Field >, [416](#)
 - ~CheckerImplem_invert, [416](#)
 - check, [417](#)
 - CheckerImplem_invert, [416](#)
- CheckerImplem_PLUQ
 - CheckerImplem_PLUQ< Field >, [417](#)
- CheckerImplem_PLUQ< Field >, [417](#)

- ~CheckerImplem_PLUQ, [417](#)
- check, [417](#)
- CheckerImplem_PLUQ, [417](#)
- checkers.doxy, [808](#)
- checkers_fflas.h, [808](#)
- checkers_fflas.inl, [809](#)
 - FFLASFFPACK_checkers_fflas_inl_H, [809](#)
- checkers_ffpack.h, [809](#)
- checkers_ffpack.inl, [810](#)
 - FFLASFFPACK_checkers_ffpack_inl_H, [810](#)
- checkingMessage
 - test-nullspace.C, [1100](#)
- checkMonotonicApplyP
 - test-permutations.C, [1102](#)
- checkOut
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [501](#)
- checkRPM
 - test-rpm.C, [1105](#)
- checkSymmetricRPM
 - test-rpm.C, [1105](#)
- checkZeroDimCharpoly
 - regression-check.C, [1057](#)
- checkZeroDimMinPoly
 - regression-check.C, [1057](#)
- chooseField
 - FFPACK, [394](#)
- chooseField< Givaro::ZRing< double > >
 - FFPACK, [395](#)
- chooseField< Givaro::ZRing< float > >
 - FFPACK, [395](#)
- chooseField< Givaro::ZRing< int32_t > >
 - FFPACK, [394](#)
- chooseField< Givaro::ZRing< int64_t > >
 - FFPACK, [395](#)
- chunk
 - Sparse< _Field, SparseMatrix_t::ELL_simd >, [739](#)
 - Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >, [741](#)
 - Sparse< _Field, SparseMatrix_t::SELL >, [746](#)
 - Sparse< _Field, SparseMatrix_t::SELL_ZO >, [748](#)
- chunkSize
 - Sparse< _Field, SparseMatrix_t::SELL >, [747](#)
 - Sparse< _Field, SparseMatrix_t::SELL_ZO >, [749](#)
- clapack.C, [1050](#)
 - __FFLASFFPACK_CONFIGURATION, [1050](#)
 - __FFLASFFPACK_HAVE_CLAPACK, [1050](#)
 - __FFLASFFPACK_HAVE_LAPACK, [1050](#)
 - main, [1051](#)
- Classic, [418](#)
- CLASSIC_HYBRID
 - benchmark-fgemm.C, [781](#)
- clz
 - bit_manipulation.h, [1042](#)
- Cmax
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [502](#)
- Cmin
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [502](#)
- col
 - Coo< Field >, [431](#)
 - Coo< ValT, IdxT >, [429](#), [433](#)
 - Sparse< _Field, SparseMatrix_t::COO >, [729](#)
 - Sparse< _Field, SparseMatrix_t::COO_ZO >, [730](#)
 - Sparse< _Field, SparseMatrix_t::CSR >, [733](#)
 - Sparse< _Field, SparseMatrix_t::CSR_HYB >, [734](#)
 - Sparse< _Field, SparseMatrix_t::CSR_ZO >, [736](#)
 - Sparse< _Field, SparseMatrix_t::ELL >, [738](#)
 - Sparse< _Field, SparseMatrix_t::ELL_simd >, [740](#)
 - Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >, [741](#)
 - Sparse< _Field, SparseMatrix_t::ELL_ZO >, [743](#)
 - Sparse< _Field, SparseMatrix_t::SELL >, [747](#)
 - Sparse< _Field, SparseMatrix_t::SELL_ZO >, [749](#)
- colblockindex
 - ForStrategy2D< blocksize_t, Cut, Param >, [463](#)
- colBlockSize
 - ForStrategy2D< blocksize_t, Cut, Param >, [463](#)
- coldim
 - StatsMatrix, [751](#)
- colnumblocks
 - ForStrategy2D< blocksize_t, Cut, Param >, [462](#)
- ColRankProfileSubmatrix
 - FFPACK, [342](#), [377](#)
- ColRankProfileSubmatrix_modular_double
 - ffpack.C, [999](#)
 - ffpack_c.h, [1020](#)
- ColRankProfileSubmatrixIndices
 - FFPACK, [341](#), [377](#)
- ColRankProfileSubmatrixIndices_modular_double
 - ffpack.C, [998](#)
 - ffpack_c.h, [1020](#)
- Column, [418](#)
- ColumnEchelonForm
 - FFPACK, [322](#), [323](#), [371](#)
- ColumnEchelonForm_modular_double
 - ffpack.C, [988](#)
 - ffpack_c.h, [1012](#)
- ColumnEchelonForm_modular_float
 - ffpack.C, [989](#)
 - ffpack_c.h, [1012](#)
- ColumnEchelonForm_modular_int32_t
 - ffpack.C, [990](#)
 - ffpack_c.h, [1013](#)
- ColumnRankProfile
 - FFPACK, [338](#), [339](#), [376](#)
- ColumnRankProfile_modular_double
 - ffpack.C, [997](#)
 - ffpack_c.h, [1019](#)
- COMMA
 - parallel.h, [1035](#)
- CompactElement< double >, [418](#)
 - type, [419](#)
- CompactElement< Element >, [418](#)

- type, [418](#)
- CompactElement< float >, [419](#)
 - type, [419](#)
- CompactElement< int16_t >, [419](#)
 - type, [419](#)
- CompactElement< int32_t >, [419](#)
 - type, [419](#)
- CompactElement< int64_t >, [420](#)
 - type, [420](#)
- compatible_data_type< Field >, [420](#)
 - value, [420](#)
- compatible_data_type< Givaro::ZRing< double > >, [420](#)
 - value, [420](#)
- compatible_data_type< Givaro::ZRing< float > >, [420](#)
 - value, [421](#)
- compliant
 - NoSimd< T >, [521](#)
 - Simd128_impl< true, true, false, 2 >, [572](#)
 - Simd128_impl< true, true, false, 4 >, [581](#)
 - Simd128_impl< true, true, false, 8 >, [589](#)
 - Simd128_impl< true, true, true, 2 >, [596](#)
 - Simd128_impl< true, true, true, 4 >, [605](#)
 - Simd128_impl< true, true, true, 8 >, [613](#)
 - Simd256_impl< true, false, true, 8 >, [624](#)
 - Simd256_impl< true, true, false, 2 >, [635](#)
 - Simd256_impl< true, true, false, 4 >, [648](#)
 - Simd256_impl< true, true, false, 8 >, [660](#)
 - Simd256_impl< true, true, true, 2 >, [666](#)
 - Simd256_impl< true, true, true, 4 >, [676](#), [682](#)
 - Simd256_impl< true, true, true, 8 >, [691](#)
 - Simd512_impl< true, false, true, 8 >, [701](#)
 - Simd512_impl< true, true, false, 8 >, [711](#)
 - Simd512_impl< true, true, true, 8 >, [718](#)
- Compose
 - Compose< H1, H2 >, [421](#)
- Compose< H1, H2 >, [421](#)
 - Compose, [421](#)
 - first_component, [422](#)
 - operator<<, [422](#)
 - second_component, [422](#)
- composePermutationsLLL
 - FFPACK, [361](#)
 - ffpack.C, [985](#)
 - ffpack_c.h, [1008](#)
- composePermutationsLLM
 - FFPACK, [362](#)
 - ffpack.C, [984](#)
 - ffpack_c.h, [1008](#)
- composePermutationsMLM
 - FFPACK, [362](#)
 - ffpack.C, [985](#)
 - ffpack_c.h, [1008](#)
- CompressRows
 - FFPACK::Protected, [401](#)
- CompressRowsQA
 - FFPACK::Protected, [402](#)
- CompressRowsQK
 - FFPACK::Protected, [401](#)
- computeDeviation
 - FFLAS, [159](#)
- computeFactorClassic
 - FFLAS::Protected, [219](#)
- config-blas.h, [811](#)
 - AtlasConj, [812](#)
 - blas_enum, [812](#)
 - CBLAS_DIAG, [812](#)
 - CBLAS_ENUM_DEFINED_H, [812](#)
 - CBLAS_EXTERNALS, [812](#)
 - CBLAS_INT, [811](#)
 - CBLAS_ORDER, [812](#)
 - CBLAS_SIDE, [813](#)
 - CBLAS_TRANSPOSE, [812](#)
 - CBLAS_UPLO, [812](#)
 - CblasColMajor, [812](#)
 - CblasConjTrans, [812](#)
 - CblasLeft, [813](#)
 - CblasLower, [812](#)
 - CblasNonUnit, [813](#)
 - CblasNoTrans, [812](#)
 - CblasRight, [813](#)
 - CblasRowMajor, [812](#)
 - CblasTrans, [812](#)
 - CblasUnit, [813](#)
 - CblasUpper, [812](#)
- dasum_, [814](#)
- daxpy_, [813](#)
- dcopy_, [815](#)
- ddot_, [813](#)
- dgemm_, [817](#)
- dgemv_, [814](#)
- dger_, [815](#)
- dnrm2_, [814](#)
- dscal_, [815](#)
- dtrmm_, [816](#)
- dtrsm_, [816](#)
- idamax_, [814](#)
- saxpy_, [813](#)
- scopy_, [815](#)
- sdot_, [813](#)
- sgemm_, [817](#)
- sgemv_, [814](#)
- sger_, [815](#)
- sscal_, [816](#)
- strmm_, [817](#)
- strsm_, [816](#)
- config.h, [796](#), [800](#)
 - HAVE_BLAS, [796](#)
 - HAVE_CBLAS, [796](#)
 - HAVE_CXX11, [796](#)
 - HAVE_DLFCN_H, [797](#)
 - HAVE_FLOAT_H, [797](#)
 - HAVE_INT128, [797](#)
 - HAVE_INTPTR_T, [797](#)
 - HAVE_LAPACK, [797](#)
 - HAVE_LIMITS_H, [797](#)

- HAVE_LITTLE_ENDIAN, [797](#)
- HAVE_PTHREAD_H, [797](#)
- HAVE_STDDEF_H, [797](#)
- HAVE_STDINT_H, [797](#)
- HAVE_STDIO_H, [797](#)
- HAVE_STDLIB_H, [797](#)
- HAVE_STRING_H, [798](#)
- HAVE_STRINGS_H, [798](#)
- HAVE_SYS_STAT_H, [798](#)
- HAVE_SYS_TIME_H, [798](#)
- HAVE_SYS_TYPES_H, [798](#)
- HAVE_UNISTD_H, [798](#)
- LT_OBJDIR, [798](#)
- OPENBLAS_NUM_THREADS, [798](#)
- PACKAGE, [798](#)
- PACKAGE_BUGREPORT, [798](#)
- PACKAGE_NAME, [798](#)
- PACKAGE_STRING, [798](#)
- PACKAGE_TARNAME, [799](#)
- PACKAGE_URL, [799](#)
- PACKAGE_VERSION, [799](#)
- SIZEOF__INT64, [799](#)
- SIZEOF_CHAR, [799](#)
- SIZEOF_INT, [799](#)
- SIZEOF_LONG, [799](#)
- SIZEOF_LONG_LONG, [799](#)
- SIZEOF_SHORT, [799](#)
- STDC_HEADERS, [799](#)
- USE_OPENMP, [799](#)
- VERSION, [799](#)
- CONST
 - fflas_simd.h, [866](#)
- const_int
 - instrset.h, [1053](#)
- Const_int_t< n >, [422](#)
- const_uint
 - instrset.h, [1053](#)
- Const_uint_t< n >, [422](#)
- ConstElement_ptr
 - benchmark-fgemm-rns.C, [780](#)
 - rns_double, [529](#)
 - rns_double_extended, [541](#)
 - RNSInteger< RNS >, [546](#)
 - RNSIntegerMod< RNS >, [550](#)
- CONSTREFERENCE
 - parallel.h, [1033](#)
- convert
 - rns_double, [530](#), [531](#)
 - rns_double_extended, [542](#), [543](#)
 - RNSInteger< RNS >, [547](#)
 - RNSIntegerMod< RNS >, [552](#)
- convert_transpose
 - rns_double, [530](#)
- ConvertTo< T >, [428](#)
- COO
 - FFLAS, [83](#)
- Coo
 - Coo< Field >, [430](#)
 - Coo< ValT, IdxT >, [429](#), [432](#)
- coo
 - HelperFlag, [472](#)
- Coo< Field >, [430](#)
 - col, [431](#)
 - Coo, [430](#)
 - deleted, [431](#)
 - operator=, [430](#), [431](#)
 - row, [431](#)
 - val, [431](#)
- Coo< ValT, IdxT >, [428](#), [431](#)
 - col, [429](#), [433](#)
 - Coo, [429](#), [432](#)
 - operator=, [429](#), [432](#)
 - row, [429](#), [432](#)
 - Self, [428](#), [432](#)
 - val, [429](#), [432](#)
- coo.h, [881](#)
- coo_spmv.inl, [881](#)
 - __FFLASFFPACK_fflas_sparse_coo_spmv_INL, [882](#)
- coo_spmv.inl, [882](#)
 - __FFLASFFPACK_fflas_sparse_coo_spmv_INL, [883](#)
- coo_utils.inl, [883](#)
 - __FFLASFFPACK_fflas_sparse_coo_utils_INL, [883](#)
- COO_ZO
 - FFLAS, [83](#)
- CooMat< Field >, [433](#)
 - _coo16, [433](#)
 - _coo16_zo, [433](#)
 - _coo32, [433](#)
 - _coo32_zo, [433](#)
 - _coo64, [433](#)
 - _coo64_zo, [433](#)
- CROUT
 - ffpack_pluq.inl, [934](#)
- CSC
 - FFLAS, [83](#)
- CSC_ZO
 - FFLAS, [83](#)
- CSR
 - FFLAS, [83](#)
- csr
 - HelperFlag, [472](#)
- csr.h, [884](#)
- CSR_HYB
 - FFLAS, [83](#)
- csr_hyb.h, [888](#)
- csr_hyb_pspmm.inl, [889](#)
 - __FFLASFFPACK_fflas_sparse_CSR_HYB_pspmm_INL, [889](#)
- csr_hyb_pspmv.inl, [890](#)
 - __FFLASFFPACK_fflas_sparse_CSR_HYB_pspmv_INL, [890](#)
- csr_hyb_spmv.inl, [890](#)

- __FFLASFFPACK_fflas_sparse_CSR_HYB_spmv_INL, ForStrategy2D< blocksize_t, Cut, Param >, [464](#)
 - [891](#)
- csr_hyb_spmv.inl, [891](#)
 - __FFLASFFPACK_fflas_sparse_CSR_HYB_spmv_INL, [891](#)
- csr_hyb_utils.inl, [891](#)
 - __FFLASFFPACK_fflas_sparse_CSR_HYB_utils_INL, [892](#)
- csr_pspmm.inl, [884](#)
 - __FFLASFFPACK_fflas_sparse_CSR_pspmm_INL, [885](#)
- csr_pspmv.inl, [885](#)
 - __FFLASFFPACK_fflas_sparse_CSR_pspmv_INL, [886](#)
- csr_spm.inl, [886](#)
 - __FFLASFFPACK_fflas_sparse_CSR_spm_INL, [887](#)
- csr_spmv.inl, [887](#)
 - __FFLASFFPACK_fflas_sparse_CSR_spmv_INL, [888](#)
- csr_utils.inl, [888](#)
- CSR_ZO
 - FFLAS, [83](#)
- CsrMat< Field >, [434](#)
 - _csr16, [434](#)
 - _csr16_zo, [434](#)
 - _csr32, [434](#)
 - _csr32_zo, [434](#)
 - _csr64, [434](#)
 - _csr64_zo, [434](#)
- cst
 - Sparse< _Field, SparseMatrix_t::COO_ZO >, [730](#)
 - Sparse< _Field, SparseMatrix_t::CSR_ZO >, [736](#)
 - Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >, [740](#)
 - Sparse< _Field, SparseMatrix_t::ELL_ZO >, [742](#)
 - Sparse< _Field, SparseMatrix_t::SELL_ZO >, [748](#)
- ctz
 - bit_manipulation.h, [1042](#)
- CUBE
 - arithprog.C, [761](#)
 - autotune/charpoly.C, [762](#)
 - autotune/pluq.C, [767](#)
 - benchmark-checkers.C, [771](#)
 - benchmark-fsyk.C, [788](#)
 - benchmark-fsytrf.C, [788](#)
 - benchmark-ftsri.C, [791](#)
 - benchmark-inverse.C, [792](#)
 - benchmark-lqp.C, [793](#)
 - benchmark-pluq.C, [794](#)
 - benchmark-wino.C, [795](#)
 - fsyk.C, [764](#)
 - fsytrf.C, [765](#)
 - ftsri.C, [766](#)
- cuda.C, [1051](#)
 - main, [1051](#)
- current
 - ForStrategy1D< blocksize_t, Cut, Param >, [460](#)
- Cut
 - Parallel< C, P >, [522](#)
 - cyclic_shift_col
 - FFPACK, [363](#), [366](#)
 - cyclic_shift_col_modular_double
 - ffpack.C, [985](#)
 - ffpack_c.h, [1009](#)
 - cyclic_shift_mathPerm
 - FFPACK, [362](#)
 - ffpack.C, [985](#)
 - ffpack_c.h, [1008](#)
 - cyclic_shift_row
 - FFPACK, [363](#), [366](#)
 - cyclic_shift_row_col
 - FFPACK, [363](#), [366](#)
 - cyclic_shift_row_modular_double
 - ffpack.C, [985](#)
 - ffpack_c.h, [1008](#)
- Danilevski
 - FFPACK, [351](#)
 - FFPACK::Protected, [399](#)
- dasum_
 - config-blas.h, [814](#)
- dat
 - Sparse< _Field, SparseMatrix_t::COO >, [729](#)
 - Sparse< _Field, SparseMatrix_t::COO_ZO >, [731](#)
 - Sparse< _Field, SparseMatrix_t::CSR >, [733](#)
 - Sparse< _Field, SparseMatrix_t::CSR_HYB >, [734](#)
 - Sparse< _Field, SparseMatrix_t::CSR_ZO >, [737](#)
 - Sparse< _Field, SparseMatrix_t::ELL >, [738](#)
 - Sparse< _Field, SparseMatrix_t::ELL_simd >, [740](#)
 - Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >, [741](#)
 - Sparse< _Field, SparseMatrix_t::ELL_ZO >, [743](#)
 - Sparse< _Field, SparseMatrix_t::HYB_ZO >, [744](#)
 - Sparse< _Field, SparseMatrix_t::SELL >, [747](#)
 - Sparse< _Field, SparseMatrix_t::SELL_ZO >, [749](#)
- data
 - Argument, [407](#)
- daxpy_
 - config-blas.h, [813](#)
- dcopy_
 - config-blas.h, [815](#)
- ddot_
 - config-blas.h, [813](#)
- debug.h, [1042](#)
 - FFLASFFPACK_abort, [1043](#)
 - FFLASFFPACK_check, [1043](#)
- DeCompressRows
 - FFPACK::Protected, [401](#)
- DeCompressRowsQA
 - FFPACK::Protected, [402](#)
- DeCompressRowsQK
 - FFPACK::Protected, [401](#)
- DefaultBoundedTag, [434](#)
- DefaultTag, [435](#)

- delayed
 - RNSIntegerMod< RNS >, 550
 - Sparse< _Field, SparseMatrix_t::COO >, 729
 - Sparse< _Field, SparseMatrix_t::COO_ZO >, 731
 - Sparse< _Field, SparseMatrix_t::CSR >, 732
 - Sparse< _Field, SparseMatrix_t::CSR_HYB >, 734
 - Sparse< _Field, SparseMatrix_t::CSR_ZO >, 736
 - Sparse< _Field, SparseMatrix_t::ELL >, 737
 - Sparse< _Field, SparseMatrix_t::ELL_simd >, 739
 - Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >, 740
 - Sparse< _Field, SparseMatrix_t::ELL_ZO >, 742
 - Sparse< _Field, SparseMatrix_t::HYB_ZO >, 744
 - Sparse< _Field, SparseMatrix_t::SELL >, 746
 - Sparse< _Field, SparseMatrix_t::SELL_ZO >, 748
- DelayedField
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 499
- delayedField
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 503
- DelayedField_t
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 499
- DelayedTag, 435
- deleted
 - Coo< Field >, 431
- DENSE_THRESHOLD
 - fflas_sparse.h, 878
- denseCols
 - StatsMatrix, 753
- denseRows
 - StatsMatrix, 753
- Det
 - FFPACK, 334, 352, 374, 375
- det.C, 804
 - main, 804
- Det_modular_double
 - ffpack.C, 996
 - ffpack_c.h, 1017
- deviationCol
 - StatsMatrix, 752
- deviationColDifference
 - StatsMatrix, 752
- deviationRow
 - StatsMatrix, 752
- deviationRowDifference
 - StatsMatrix, 753
- DFElt
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 499
- dgemm_
 - config-blas.h, 817
 - fblas.C, 1052
- dgemv_
 - config-blas.h, 814
- dger_
 - config-blas.h, 815
- digits
 - limits< char >, 486
 - limits< double >, 487
 - limits< float >, 488
 - limits< int >, 489
 - limits< long >, 490
 - limits< long long >, 491
 - limits< short int >, 493
 - limits< signed char >, 493
 - limits< unsigned char >, 494
 - limits< unsigned int >, 495
 - limits< unsigned long >, 496
 - limits< unsigned long long >, 496
 - limits< unsigned short int >, 497
- div
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, 559
 - Simd256_impl< true, false, true, 8 >, 627
 - Simd512_impl< true, false, true, 8 >, 703
- dnrm2_
 - config-blas.h, 814
- DNS_BIN_VER
 - read_sparse.h, 903
- doApplyS
 - FFPACK, 358
- doApplyT
 - FFPACK, 360
- DotProdBoundClassic
 - FFLAS::Protected, 220
- DOUBLE_TO_FLOAT_CROSSOVER
 - fflas.h, 821
 - winograd.C, 768
- dscal_
 - config-blas.h, 815
- dtrmm_
 - config-blas.h, 816
- dtrsm_
 - config-blas.h, 816
- DynamicPeeling
 - FFLAS::Protected, 224
- DynamicPeeling2
 - FFLAS::Protected, 225
- EFFGFF
 - benchmark-dsytrf.C, 774
- Element
 - FieldSimd< _Field >, 445
 - readMyMachineType< Field, mpz_t >, 526
 - readMyMachineType< Field, T >, 525
 - rns_double, 528
 - rns_double_extended, 541
 - RNSInteger< RNS >, 546
 - RNSIntegerMod< RNS >, 550
- Element_ptr
 - benchmark-fgemm-rns.C, 780
 - readMyMachineType< Field, mpz_t >, 526
 - readMyMachineType< Field, T >, 526

- rns_double, 528
- rns_double_extended, 541
- RNSInteger< RNS >, 546
- RNSIntegerMod< RNS >, 550
- ElementTraits< double >, 435
 - value, 436
- ElementTraits< Element >, 435
 - value, 435
- ElementTraits< FFPACK::rns_double_elt >, 436
 - value, 436
- ElementTraits< float >, 436
 - value, 436
- ElementTraits< Givaro::Integer >, 436
 - value, 437
- ElementTraits< int16_t >, 437
 - value, 437
- ElementTraits< int32_t >, 437
 - value, 437
- ElementTraits< int64_t >, 437
 - value, 438
- ElementTraits< int8_t >, 438
 - value, 438
- ElementTraits< Reclnt::rint< K > >, 438
 - value, 438
- ElementTraits< Reclnt::rmin< K, MG > >, 438
 - value, 439
- ElementTraits< Reclnt::ruint< K > >, 439
 - value, 439
- ElementTraits< uint16_t >, 439
 - value, 439
- ElementTraits< uint32_t >, 439
 - value, 440
- ElementTraits< uint64_t >, 440
 - value, 440
- ElementTraits< uint8_t >, 440
 - value, 440
- ELL
 - FFLAS, 83
- ell
 - HelperFlag, 472
- ell.h, 892
- ell_pspmm.inl, 892
 - __FFLASFFPACK_fflas_sparse_ELL_pspmm_INL, 893
- ell_pspmv.inl, 893
 - __FFLASFFPACK_fflas_sparse_ELL_pspmv_INL, 894
- ELL_simd
 - FFLAS, 83
- ell_simd.h, 896
- ell_simd_pspmv.inl, 897
 - __FFLASFFPACK_fflas_sparse_ELL_simd_pspmv_INL, 898
- ell_simd_spmv.inl, 898
 - __FFLASFFPACK_fflas_sparse_ELL_simd_spmv_INL, 898
- ell_simd_utils.inl, 899
 - __FFLASFFPACK_fflas_sparse_ELL_simd_utils_INL, 899
- ELL_simd_ZO
 - FFLAS, 83
- ell_spm.inl, 894
 - __FFLASFFPACK_fflas_sparse_ELL_spm_INL, 895
- ell_spmv.inl, 895
 - __FFLASFFPACK_fflas_sparse_ELL_spmv_INL, 896
- ell_utils.inl, 896
 - __FFLASFFPACK_fflas_sparse_ELL_utils_INL, 896
- ELL_ZO
 - FFLAS, 83
- EllMat< Field >, 440
 - _ell16, 441
 - _ell16_zo, 441
 - _ell32, 441
 - _ell32_zo, 441
 - _ell64, 441
 - _ell64_zo, 441
- ENABLE_ALL_CHECKINGS
 - benchmark-checkers.C, 771
 - ffpack_ftrtr.inl, 928
 - test-fdot.C, 1066
 - test-fgemm-check.C, 1067
 - test-fsyr2k.C, 1078
 - test-fsyrk.C, 1080
 - test-ftrmv.C, 1084
 - test-ftrsm-check.C, 1085
 - test-ftrsm.C, 1086
 - test-ftrssyr2k.C, 1087
 - test-ftrstr.C, 1089
 - test-ftrsv.C, 1090
 - test-ftrtri.C, 1091
 - test-invert-check.C, 1092
 - test-pluq-check.C, 1103
- ENABLE_CHECKER_charpoly
 - test-charpoly-check.C, 1058
- ENABLE_CHECKER_Det
 - test-det-check.C, 1061
- ENABLE_CHECKER_fgemm
 - test-fgemm.C, 1069
- end
 - ForStrategy1D< blocksize_t, Cut, Param >, 460
- END_OF_ARGUMENTS
 - args-parser.h, 1040
- END_PARALLEL_MAIN
 - parallel.h, 1033
- eq
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, 560
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, 565
- Simd128_impl< true, true, false, 2 >, 575
- Simd128_impl< true, true, false, 4 >, 583

- Simd128_impl< true, true, false, 8 >, [592](#)
- Simd128_impl< true, true, true, 2 >, [600](#)
- Simd128_impl< true, true, true, 4 >, [609](#)
- Simd128_impl< true, true, true, 8 >, [618](#)
- Simd256_impl< true, false, true, 8 >, [628](#)
- Simd256_impl< true, true, false, 2 >, [637](#)
- Simd256_impl< true, true, false, 4 >, [653](#)
- Simd256_impl< true, true, false, 8 >, [662](#)
- Simd256_impl< true, true, true, 2 >, [671](#)
- Simd256_impl< true, true, true, 4 >, [681](#), [686](#)
- Simd256_impl< true, true, true, 8 >, [696](#)
- Simd512_impl< true, false, true, 8 >, [704](#)
- Simd512_impl< true, true, false, 8 >, [714](#)
- Simd512_impl< true, true, true, 8 >, [723](#)
- eval_func_on_array
 - test-simd.C, [1108](#)
- example
 - Argument, [407](#)
- examples/charpoly.C
 - main, [763](#)
- examples/pluq.C
 - main, [768](#)
- fadd
 - FFLAS, [85–87](#), [90](#), [170](#), [171](#), [178](#), [179](#)
 - FFLAS::details, [207](#), [208](#)
- fadd_1_modular_double
 - fflas_c.h, [950](#)
 - fflas_lvl1.C, [971](#)
- fadd_2_modular_double
 - fflas_c.h, [953](#)
 - fflas_lvl2.C, [976](#)
- faddin
 - FFLAS, [85](#), [89](#), [170](#), [180](#)
- faddin_1_modular_double
 - fflas_c.h, [950](#)
 - fflas_lvl1.C, [971](#)
- faddin_2_modular_double
 - fflas_c.h, [954](#)
 - fflas_lvl2.C, [977](#)
- Failure, [441](#)
 - _errorStream, [443](#)
 - Failure, [442](#)
 - operator(), [442](#)
 - print, [443](#)
 - setErrorStream, [442](#)
- failure
 - FFPACK, [381](#)
- FailureCharpolyCheck, [443](#)
- FailureDetCheck, [443](#)
- FailureFgemmCheck, [443](#)
- FailureInvertCheck, [443](#)
- FailurePLUQCheck, [444](#)
- FailureTrsmCheck, [444](#)
- fassign
 - FFLAS, [91](#), [92](#), [166](#), [171](#)
- fassign_1_modular_double
 - fflas_c.h, [948](#)
 - fflas_lvl1.C, [970](#)
- fassign_2_modular_double
 - fflas_c.h, [951](#)
 - fflas_lvl2.C, [973](#)
- faxpby
 - FFLAS, [138](#), [144](#)
- faxpy
 - FFLAS, [93](#), [94](#), [168](#), [176](#)
- faxpy_1_modular_double
 - fflas_c.h, [949](#)
 - fflas_lvl1.C, [970](#)
- faxpy_2_modular_double
 - fflas_c.h, [953](#)
 - fflas_lvl2.C, [975](#)
- fblas.C, [1051](#)
 - __FFLASFFPACK_CONFIGURATION, [1051](#)
 - dgemm_, [1052](#)
 - main, [1052](#)
- fconvert
 - FFLAS, [135](#), [143](#), [164](#)
- fconvert_rns
 - FFLAS, [161](#), [162](#)
- fconvert_trans_rns
 - FFLAS, [161](#)
- fdot
 - FFLAS, [94–96](#), [139](#), [169](#), [190](#)
- fdot_1_modular_double
 - fflas_c.h, [949](#)
 - fflas_lvl1.C, [971](#)
- fequal
 - FFLAS, [138](#), [141](#), [166](#), [172](#)
- fequal_1_modular_double
 - fflas_c.h, [948](#)
 - fflas_lvl1.C, [970](#)
- fequal_2_modular_double
 - fflas_c.h, [951](#)
 - fflas_lvl2.C, [973](#)
- FFLAS, [50](#), [53](#)
 - alignable, [196](#)
 - alignable< Givaro::Integer * >, [196](#)
 - BaseTimer, [80](#)
 - bitsize, [145](#)
 - bitsize< Givaro::ZRing< Givaro::Integer > >, [146](#)
 - BlockCuts, [187](#), [189](#)
 - BlockCuts< CuttingStrategy::Block, StrategyParameter::Fixed >, [189](#)
 - BlockCuts< CuttingStrategy::Block, StrategyParameter::Grain >, [188](#)
 - BlockCuts< CuttingStrategy::Block, StrategyParameter::Threads >, [189](#)
 - BlockCuts< CuttingStrategy::Column, StrategyParameter::Fixed >, [188](#)
 - BlockCuts< CuttingStrategy::Column, StrategyParameter::Grain >, [188](#)
 - BlockCuts< CuttingStrategy::Column, StrategyParameter::Threads >, [189](#)
 - BlockCuts< CuttingStrategy::Row, StrategyParameter::Fixed >, [188](#)

- BlockCuts< CuttingStrategy::Row, StrategyParameter::Grain >, 188
- BlockCuts< CuttingStrategy::Row, StrategyParameter::Threads >, 189
- BlockCuts< CuttingStrategy::Single, StrategyParameter::Threads >, 187
- cblas_imprsm, 133
- Checker_fgemm, 78
- Checker_ftrsm, 78
- computeDeviation, 159
- COO, 83
- COO_ZO, 83
- CSC, 83
- CSC_ZO, 83
- CSR, 83
- CSR_HYB, 83
- CSR_ZO, 83
- ELL, 83
- ELL_simd, 83
- ELL_simd_ZO, 83
- ELL_ZO, 83
- fadd, 85–87, 90, 170, 171, 178, 179
- faddin, 85, 89, 170, 180
- fassign, 91, 92, 166, 171
- faxpby, 138, 144
- faxpy, 93, 94, 168, 176
- fconvert, 135, 143, 164
- fconvert_rns, 161, 162
- fconvert_trans_rns, 161
- fdot, 94–96, 139, 169, 190
- fequal, 138, 141, 166, 172
- FFLAS_BASE, 82
- fflas_delete, 160, 197
- FFLAS_DIAG, 82
- FFLAS_FORMAT, 83
- fflas_new, 160–162, 197
- FFLAS_ORDER, 81
- FFLAS_SIDE, 82
- FFLAS_TRANSPOSE, 81
- FFLAS_UPLO, 81
- FflasAuto, 84
- FflasBinary, 84
- FflasColMajor, 81
- FflasDense, 84
- FflasDouble, 83
- FflasFloat, 83
- FflasGeneric, 83
- FflasLeft, 82
- FflasLower, 82
- FflasMaple, 84
- FflasMath, 84
- FflasNonUnit, 82
- FflasNoTrans, 81
- FflasRight, 82
- FflasRowMajor, 81
- FflasSageMath, 84
- FflasSMS, 84
- FflasTrans, 81
- FflasUnit, 82
- FflasUpper, 82
- fgemm, 97–99, 101–106, 149, 185, 186
- fgemv, 106–112, 180, 193
- fger, 112–116, 182
- fidentity, 142, 173
- finit, 117, 119, 120, 135, 142, 163, 174
- finit_rns, 160, 162
- finit_trans_rns, 161
- fiszero, 138, 141, 166, 172
- fmove, 145, 177
- fneg, 136, 144, 165, 175
- fnegin, 136, 143, 164, 175
- ForceCheck_fgemm, 78
- ForceCheck_ftrsm, 78
- frand, 137, 140
- freduce, 116–118, 120, 162, 163, 173, 174
- freduce_constoverride, 117, 119
- freivalds, 120
- fscal, 122–126, 167, 176
- fscaln, 121, 123–126, 167, 176
- fspmm, 150
- fspmv, 150, 158
- fsquare, 99–101, 187
- fsub, 85, 89, 170, 178
- fsubin, 85, 90, 179
- fswap, 139, 169
- fsyr2k, 126
- fsyrk, 127–129
- ftrmm, 130, 131, 184
- ftrmv, 146
- ftrsm, 132, 133, 146, 149, 150, 183
- ftrsv, 134, 182
- fzero, 137, 140, 165, 171
- getDataTypes, 157
- getSeed, 198
- getStat, 159
- getTLBSize, 198
- has_equal, 80
- has_minus, 79
- has_minus_eq, 80
- has_mul, 80
- has_mul_eq, 80
- has_plus, 79
- has_plus_eq, 80
- HYB_ZO, 83
- igemm_, 134
- InfNorm, 84
- max3, 84
- max4, 84
- min3, 84
- min4, 84
- MKLSparseMatrixFormat, 79
- none, 83
- NoSimdSparseMatrix, 79
- NotMKLSparseMatrixFormat, 79
- NotZOSparseMatrix, 79
- number_kind, 83

- one, [83](#)
- operator<<, [156](#)
- other, [83](#)
- parseArguments, [194](#)
- pfadd, [86](#)
- pfaddin, [87](#)
- pfgemm, [147](#), [190–192](#)
- pfgemm_1D_rec, [147](#)
- pfgemm_2D_rec, [148](#)
- pfgemm_3D_rec, [148](#)
- pfgemm_3D_rec2, [149](#)
- pfrand, [190](#)
- pfreduce, [118](#)
- pfsub, [86](#)
- pfsubin, [87](#)
- pfzero, [190](#)
- preamble, [195](#)
- prefetch, [197](#)
- queryCacheSizes, [198](#)
- queryL1CacheSize, [198](#)
- queryTopLevelCacheSize, [198](#)
- readDnsFormat, [158](#)
- readMachineType, [157](#)
- ReadMatrix, [195](#)
- readSmsFormat, [156](#)
- readSprFormat, [157](#)
- SELL, [83](#)
- SELL_ZO, [83](#)
- SimdSparseMatrix, [79](#)
- sparse_delete, [151](#), [152](#), [154–156](#), [158](#)
- sparse_init, [151–156](#), [159](#)
- sparse_print, [152](#), [156](#), [159](#)
- SparseMatrix_t, [83](#)
- SysTimer, [81](#)
- Timer, [80](#)
- UserTimer, [81](#)
- writeCommandString, [194](#)
- writeDnsFormat, [158](#)
- WriteMatrix, [194](#), [196](#)
- WritePermutation, [196](#)
- zero, [83](#)
- ZOSparseMatrix, [79](#)
- fflas-101_1.C, [1111](#)
 - main, [1112](#)
- fflas-101_3.C, [1112](#)
 - main, [1112](#)
- FFLAS-FFPACK, [49](#)
- FFLAS-FFPACK fields, [51](#)
- fflas-ffpack-config.h, [817](#)
 - GCC_VERSION, [818](#)
- fflas-ffpack-default-thresholds.h, [818](#)
 - __FFLASFFPACK_ARITHPROG_THRESHOLD, [819](#)
 - __FFLASFFPACK_CHARPOLY_Danilevskii_LUKrylov_ArithProg_THRESHOLD, [819](#)
 - __FFLASFFPACK_CHARPOLY_LUKrylov_ArithProg_THRESHOLD, [819](#)
 - __FFLASFFPACK_FSYRK_THRESHOLD, [819](#)
 - __FFLASFFPACK_FSYTRF_THRESHOLD, [819](#)
 - __FFLASFFPACK_FTRTRI_THRESHOLD, [819](#)
 - __FFLASFFPACK_PLUQ_THRESHOLD, [819](#)
 - __FFLASFFPACK_WINOTHRESHOLD, [818](#)
 - __FFLASFFPACK_WINOTHRESHOLD_BAL, [818](#)
 - __FFLASFFPACK_WINOTHRESHOLD_BAL_FLT, [819](#)
 - __FFLASFFPACK_WINOTHRESHOLD_FLT, [818](#)
- fflas-ffpack-thresholds.h, [819](#)
- fflas-ffpack.doxy, [819](#)
- fflas-ffpack.h, [819](#)
- fflas-ffpack/config.h
 - __FFLASFFPACK_HAVE_BLAS, [800](#)
 - __FFLASFFPACK_HAVE_CBLAS, [800](#)
 - __FFLASFFPACK_HAVE_CXX11, [801](#)
 - __FFLASFFPACK_HAVE_DLFCN_H, [801](#)
 - __FFLASFFPACK_HAVE_FLOAT_H, [801](#)
 - __FFLASFFPACK_HAVE_INT128, [801](#)
 - __FFLASFFPACK_HAVE_INTTYPES_H, [801](#)
 - __FFLASFFPACK_HAVE_LAPACK, [801](#)
 - __FFLASFFPACK_HAVE_LIMITS_H, [801](#)
 - __FFLASFFPACK_HAVE_LITTLE_ENDIAN, [801](#)
 - __FFLASFFPACK_HAVE_PTHREAD_H, [801](#)
 - __FFLASFFPACK_HAVE_STDDEF_H, [801](#)
 - __FFLASFFPACK_HAVE_STDINT_H, [801](#)
 - __FFLASFFPACK_HAVE_STDIO_H, [801](#)
 - __FFLASFFPACK_HAVE_STDLIB_H, [802](#)
 - __FFLASFFPACK_HAVE_STRINGS_H, [802](#)
 - __FFLASFFPACK_HAVE_STRING_H, [802](#)
 - __FFLASFFPACK_HAVE_SYS_STAT_H, [802](#)
 - __FFLASFFPACK_HAVE_SYS_TIME_H, [802](#)
 - __FFLASFFPACK_HAVE_SYS_TYPES_H, [802](#)
 - __FFLASFFPACK_HAVE_UNISTD_H, [802](#)
 - __FFLASFFPACK_LT_OBJDIR, [802](#)
 - __FFLASFFPACK_OPENBLAS_NUM_THREADS, [802](#)
 - __FFLASFFPACK_PACKAGE, [802](#)
 - __FFLASFFPACK_PACKAGE_BUGREPORT, [802](#)
 - __FFLASFFPACK_PACKAGE_NAME, [802](#)
 - __FFLASFFPACK_PACKAGE_STRING, [803](#)
 - __FFLASFFPACK_PACKAGE_TARNAME, [803](#)
 - __FFLASFFPACK_PACKAGE_URL, [803](#)
 - __FFLASFFPACK_PACKAGE_VERSION, [803](#)
 - __FFLASFFPACK_SIZEOF_CHAR, [803](#)
 - __FFLASFFPACK_SIZEOF_INT, [803](#)
 - __FFLASFFPACK_SIZEOF_LONG, [803](#)
 - __FFLASFFPACK_SIZEOF_LONG_LONG, [803](#)
 - __FFLASFFPACK_SIZEOF_SHORT, [803](#)
 - __FFLASFFPACK_SIZEOF__INT64, [803](#)
 - __FFLASFFPACK_STDC_HEADERS, [803](#)
 - __FFLASFFPACK_USE_OPENMP, [803](#)
 - __FFLASFFPACK_VERSION, [804](#)
- fflas.doxy, [820](#)
- fflas.thresholds
 - DOUBLE_TO_FLOAT_CROSSOVER, [821](#)
 - WINO_THRESHOLD, [821](#)
- FFLAS::BLAS3, [199](#)
- Bini, [200](#)

- Winograd, [201](#)
- Winograd_L_S, [204](#)
- Winograd_LR_S, [204](#)
- Winograd_R_S, [205](#)
- WinogradAcc_2_24, [202](#)
- WinogradAcc_2_27, [202](#)
- WinogradAcc_3_21, [202](#)
- WinogradAcc_3_23, [201](#)
- WinogradAcc_L_S, [204](#)
- WinogradAcc_LR, [203](#)
- WinogradAcc_R_S, [203](#)
- WinoPar, [200](#)
- FFLAS::csr_hyb_details, [205](#)
- FFLAS::CuttingStrategy, [205](#)
 - RNSModulus, [206](#)
- FFLAS::details, [206](#)
 - BlockingFactor, [214](#)
 - fadd, [207](#), [208](#)
 - freduce, [209](#)
 - fscal, [210](#)
 - fscaln, [210](#)
 - gebp, [213](#)
 - igebb11, [212](#)
 - igebb14, [211](#)
 - igebb21, [212](#)
 - igebb24, [211](#)
 - igebb41, [211](#)
 - igebb44, [211](#)
 - igebp, [212](#)
 - pack_lhs, [213](#)
 - pack_rhs, [213](#)
- FFLAS::details_spmv, [214](#)
- FFLAS::ElementCategories, [214](#)
- FFLAS::FieldCategories, [215](#)
- FFLAS::MMHelperAlgo, [215](#)
- FFLAS::ModeCategories, [215](#)
- FFLAS::ParSeqHelper, [216](#)
- FFLAS::Protected, [216](#)
 - computeFactorClassic, [219](#)
 - DotProdBoundClassic, [220](#)
 - DynamicPeeling, [224](#)
 - DynamicPeeling2, [225](#)
 - fgemm_convert, [220](#)
 - fgemv_convert, [225](#)
 - fger_convert, [226](#)
 - fsquareCommon, [223](#)
 - igemm, [228](#)
 - igemm_colmajor, [228](#)
 - MatF2MatD_Triangular, [229](#)
 - MatF2MatFI_Triangular, [229](#)
 - min_types, [226](#), [227](#)
 - NeedDoublePreAddReduction, [222](#)
 - NeedPreAddReduction, [221](#)
 - NeedPreSubReduction, [221](#)
 - ScalAndReduce, [222](#)
 - TRSMBound, [220](#)
 - unfit, [227](#)
 - WinogradCalc, [225](#)
 - WinogradSteps, [224](#)
 - WinogradThreshold, [223](#), [224](#)
- FFLAS::sell_details, [229](#)
- FFLAS::sparse_details, [230](#)
 - fspmm, [236–238](#)
 - fspmm_dispatch, [236](#)
 - fspmv, [233–235](#), [243](#), [244](#)
 - fspmv_dispatch, [233](#)
 - init_y, [232](#), [233](#)
 - pfspmm, [239–241](#)
 - pfspmm_dispatch, [239](#)
 - pfspmv, [242](#), [243](#)
- FFLAS::sparse_details_impl, [244](#)
 - fspmm, [252](#), [253](#), [260](#), [261](#), [267](#), [271](#), [272](#), [281](#)
 - fspmm_mone, [254](#), [262](#), [272](#), [273](#)
 - fspmm_mone_simd_aligned, [255](#), [262](#), [274](#)
 - fspmm_mone_simd_unaligned, [255](#), [263](#), [274](#)
 - fspmm_one, [254](#), [261](#), [272](#), [273](#)
 - fspmm_one_simd_aligned, [254](#), [262](#), [273](#)
 - fspmm_one_simd_unaligned, [254](#), [262](#), [273](#)
 - fspmm_simd_aligned, [253](#), [261](#)
 - fspmm_simd_unaligned, [253](#), [261](#)
 - fspmv, [255](#), [256](#), [263](#), [267](#), [268](#), [274](#), [275](#), [277](#), [278](#), [281–284](#)
 - fspmv_mone, [256](#), [264](#), [275](#), [278](#), [279](#), [285](#)
 - fspmv_mone_simd, [279](#), [285](#)
 - fspmv_one, [256](#), [264](#), [275](#), [278](#), [284](#), [285](#)
 - fspmv_one_simd, [279](#), [285](#)
 - fspmv_simd, [277](#), [278](#), [284](#)
 - pfspmm, [257](#), [264–266](#), [268](#), [269](#), [279](#), [280](#)
 - pfspmm_mone, [258](#)
 - pfspmm_one, [257](#), [258](#)
 - pfspmm_zo, [269](#), [270](#)
 - pfspmv, [258](#), [259](#), [266](#), [270](#), [276](#), [280](#), [282](#)
 - pfspmv_mone, [259](#), [260](#), [271](#), [276](#), [277](#), [283](#)
 - pfspmv_one, [259](#), [260](#), [271](#), [276](#), [277](#), [283](#)
 - pfspmv_task, [259](#)
- FFLAS::StrategyParameter, [286](#)
- FFLAS::StructureHelper, [286](#)
- FFLAS::vectorised, [286](#)
 - add, [289](#)
 - addp, [288](#)
 - modp, [291](#)
 - reduce, [289–291](#)
 - scalp, [291](#)
 - sub, [289](#)
 - subp, [288](#)
 - VEC_ADD, [288](#)
 - VEC_SUB, [288](#)
- FFLAS::vectorised::unswitch, [292](#)
 - modp, [292](#)
 - scalp, [293](#)
- fflas_101.C, [1112](#)
 - main, [1112](#)
- fflas_101_lml1.C, [1113](#)
 - main, [1113](#)
- FFLAS_BASE
 - FFLAS, [82](#)

fflas_bounds.inl, 821
 __FFLASFFPACK_fflas_bounds_INL, 822
 FFLAS_INT_TYPE, 822
 fflas_c.h, 943
 fadd_1_modular_double, 950
 fadd_2_modular_double, 953
 faddin_1_modular_double, 950
 faddin_2_modular_double, 954
 fassign_1_modular_double, 948
 fassign_2_modular_double, 951
 faxpy_1_modular_double, 949
 faxpy_2_modular_double, 953
 fdot_1_modular_double, 949
 fequal_1_modular_double, 948
 fequal_2_modular_double, 951
 FFLAS_C_BASE, 947
 FFLAS_C_DIAG, 946
 FFLAS_C_ORDER, 946
 FFLAS_C_SIDE, 947
 FFLAS_C_TRANSPOSE, 946
 FFLAS_C_UPLO, 946
 FFLAS_COMPILED, 945
 FflasColMajor, 946
 FflasDouble, 947
 FflasFloat, 947
 FflasGeneric, 947
 FflasLeft, 947
 FflasLower, 946
 FflasNonUnit, 947
 FflasNoTrans, 946
 FflasRight, 947
 FflasRowMajor, 946
 FflasTrans, 946
 FflasUnit, 947
 FflasUpper, 946
 fgemm_3_modular_double, 956
 fgemv_2_modular_double, 954
 fger_2_modular_double, 955
 fidentity_2_modular_double, 951
 fiszero_1_modular_double, 948
 fiszero_2_modular_double, 951
 fmove_2_modular_double, 953
 fneg_1_modular_double, 948
 fneg_2_modular_double, 952
 fnegin_1_modular_double, 948
 fnegin_2_modular_double, 952
 freduce_1_modular_double, 947
 freduce_2_modular_double, 952
 freducein_1_modular_double, 947
 freducein_2_modular_double, 952
 fscal_1_modular_double, 949
 fscal_2_modular_double, 953
 fscalin_1_modular_double, 949
 fscalin_2_modular_double, 952
 fsquare_3_modular_double, 956
 fsub_1_modular_double, 950
 fsub_2_modular_double, 954
 fsubin_1_modular_double, 950
 fsubin_2_modular_double, 954
 fswap_1_modular_double, 949
 ftrmm_3_modular_double, 955
 ftrsm_3_modular_double, 955
 ftrsv_2_modular_double, 955
 fzero_1_modular_double, 948
 fzero_2_modular_double, 951
 FFLAS_C_BASE
 fflas_c.h, 947
 FFLAS_C_DIAG
 fflas_c.h, 946
 ffpack_c.h, 1005
 FFLAS_C_ORDER
 fflas_c.h, 946
 ffpack_c.h, 1005
 FFLAS_C_SIDE
 fflas_c.h, 947
 ffpack_c.h, 1006
 FFLAS_C_TRANSPOSE
 fflas_c.h, 946
 ffpack_c.h, 1005
 FFLAS_C_UPLO
 fflas_c.h, 946
 ffpack_c.h, 1005
 FFLAS_COMPILED
 fflas_c.h, 945
 ffpack_inst.C, 1023
 ffpack_inst.h, 1024
 fflas_const_cast
 FFPACK, 366, 380
 fflas_delete
 FFLAS, 160, 197
 FFLAS_DIAG
 FFLAS, 82
 FFLAS_ELT
 fflas_L1_inst.C, 957, 958
 fflas_L1_inst.h, 958, 959
 fflas_L2_inst.C, 961
 fflas_L2_inst.h, 962
 fflas_L3_inst.C, 965
 fflas_L3_inst.h, 966
 ffpack_inst.C, 1023, 1024
 ffpack_inst.h, 1025
 fflas_enum.h, 822
 fflas_fadd.h, 823
 fflas_fadd.inl, 824
 __FFLASFFPACK_fadd_INL, 825
 fflas_fassign.h, 825
 fflas_fassign.inl, 825
 __FFLASFFPACK_fassign_INL, 826
 fflas_faxpy.inl, 826
 __FFLASFFPACK_faxpy_INL, 826
 fflas_fdot.inl, 827
 __FFLASFFPACK_fdot_INL, 827
 fflas_fgemm.inl, 828
 __FFLASFFPACK_fgemm_INL, 830
 fflas_fgemv.inl, 837
 __FFLASFFPACK_fgemv_INL, 838

fflas_fgmv_mp.inl, 839
 __FFLASFFPACK_fgmv_mp_INL, 839
 fflas_fger.inl, 839
 __FFLASFFPACK_fger_INL, 840
 fflas_fger_mp.inl, 841
 __FFPACK_fger_mp_INL, 841
 FFLAS_FIELD
 fflas_L1_inst.C, 957
 fflas_L1_inst.h, 958
 fflas_L2_inst.C, 961
 fflas_L2_inst.h, 962
 fflas_L3_inst.C, 965
 fflas_L3_inst.h, 966
 ffpack_inst.C, 1023, 1024
 ffpack_inst.h, 1025
 FFLAS_FORMAT
 FFLAS, 83
 fflas_freduce.h, 841
 fflas_freduce.inl, 842
 __FFLASFFPACK_fflas_freduce_INL, 844
 FFLASFFPACK_COPY_REDUCE, 844
 fflas_freduce_mp.inl, 844
 __FFLASFFPACK_fflas_freduce_mp_INL, 844
 fflas_freivalds.inl, 844
 __FFLASFFPACK_freivalds_INL, 845
 fflas_fscal.h, 845
 fflas_fscal.inl, 845
 __FFLASFFPACK_fscal_INL, 846
 fflas_fscal_mp.inl, 847
 __FFLASFFPACK_fscal_mp_INL, 847
 fflas_fsyr2k.inl, 847
 __FFLASFFPACK_fflas_fsyr2k_INL, 848
 fflas_fsyrk.inl, 848
 __FFLASFFPACK_fflas_fsyrk_INL, 849
 fflas_ftrmm.inl, 849
 __FFLASFFPACK_ftrmm_INL, 849
 fflas_ftrsm.inl, 849
 __FFLASFFPACK_ftrsm_INL, 850
 fflas_ftrsm_mp.inl, 850
 __FFPACK_ftrsm_mp_INL, 851
 fflas_ftrsv.inl, 851
 __FFLASFFPACK_ftrsv_INL, 851
 fflas_helpers.inl, 851
 __FFLASFFPACK_fflas_fflas_mmhelper_INL, 852
 FFLAS_INT_TYPE
 fflas_bounds.inl, 822
 fflas_intrinsic.h, 1043
 fflas_io.h, 1043
 fflas_L1_inst.C, 956
 __FFLAS_L1_INST_C, 957
 FFLAS_ELT, 957, 958
 FFLAS_FIELD, 957
 INST_OR_DECL, 957
 fflas_L1_inst.h, 958
 FFLAS_ELT, 958, 959
 FFLAS_FIELD, 958
 INST_OR_DECL, 958
 fflas_L1_inst_implem.inl, 959
 fflas_L2_inst.C, 960
 __FFLAS_L2_INST_C, 960
 FFLAS_ELT, 961
 FFLAS_FIELD, 961
 INST_OR_DECL, 961
 fflas_L2_inst.h, 961
 FFLAS_ELT, 962
 FFLAS_FIELD, 962
 INST_OR_DECL, 962
 fflas_L2_inst_implem.inl, 963
 fflas_L3_inst.C, 964
 __FFLAS_L3_INST_C, 965
 FFLAS_ELT, 965
 FFLAS_FIELD, 965
 INST_OR_DECL, 965
 fflas_L3_inst.h, 965
 FFLAS_ELT, 966
 FFLAS_FIELD, 966
 INST_OR_DECL, 966
 fflas_L3_inst_implem.inl, 967
 __FFLAS__TRSM_READONLY, 967
 fflas_level1.inl, 856
 __FFLASFFPACK_fflas_fflas_level1_INL, 858
 fflas_level2.inl, 858
 __FFLASFFPACK_fflas_fflas_level2_INL, 861
 fflas_level3.inl, 861
 __FFLASFFPACK_fflas_fflas_level3_INL, 863
 __FFLAS__TRSM_READONLY, 863
 fflas_lvl1.C, 968
 fadd_1_modular_double, 971
 faddin_1_modular_double, 971
 fassign_1_modular_double, 970
 faxpy_1_modular_double, 970
 fdot_1_modular_double, 971
 fequal_1_modular_double, 970
 fiszero_1_modular_double, 969
 fneg_1_modular_double, 969
 fnegin_1_modular_double, 969
 freduce_1_modular_double, 969
 freducein_1_modular_double, 968
 fscal_1_modular_double, 970
 fscalin_1_modular_double, 970
 fsub_1_modular_double, 971
 fsubin_1_modular_double, 972
 fswap_1_modular_double, 971
 fzero_1_modular_double, 969
 fflas_lvl2.C, 972
 fadd_2_modular_double, 976
 faddin_2_modular_double, 977
 fassign_2_modular_double, 973
 faxpy_2_modular_double, 975
 fequal_2_modular_double, 973
 fgemv_2_modular_double, 977
 fger_2_modular_double, 977
 fidentity_2_modular_double, 974
 fiszero_2_modular_double, 974
 fmove_2_modular_double, 976
 fneg_2_modular_double, 975

- fnegin_2_modular_double, 974
- freduce_2_modular_double, 974
- freducein_2_modular_double, 974
- fscal_2_modular_double, 975
- fscalin_2_modular_double, 975
- fsub_2_modular_double, 976
- fsubin_2_modular_double, 976
- ftsv_2_modular_double, 977
- fzero_2_modular_double, 973
- fflas_lvl3.C, 978
 - fgemm_3_modular_double, 979
 - fsquare_3_modular_double, 979
 - ftmm_3_modular_double, 979
 - ftsm_3_modular_double, 978
- fflas_memory.h, 1044
- fflas_new
 - FFLAS, 160–162, 197
- FFLAS_ORDER
 - FFLAS, 81
- fflas_pfgemm.inl, 863
 - __FFLASFFPACK_DIMKPENALTY, 864
 - __FFLASFFPACK_SEQPARTHRESHOLD, 864
 - __FFLASFFPACK_fflas_pfgemm_INL, 864
- fflas_pftsm.inl, 864
 - __FFLASFFPACK_fflas_pftsm_INL, 865
 - PTRSM_HYBRID_THRESHOLD, 865
- fflas_plevel1.h, 1030
- fflas_randommatrix.h, 1045
- FFLAS_SIDE
 - FFLAS, 82
- fflas_simd.h, 865
 - CONST, 866
 - FLOAT_MOD, 866
 - INLINE, 866
 - NORML_MOD, 866
 - PURE, 866
 - Simd, 867
 - SIMD_INT, 866
- fflas_sparse.C, 980
- fflas_sparse.h, 874
 - __FFLASFFPACK_CACHE_LINE_SIZE, 878
 - assume_aligned, 878
 - DENSE_THRESHOLD, 878
 - index_t, 878
 - ROUND_DOWN, 878
- fflas_sparse.inl, 879
 - __FFLASFFPACK_fflas_fflas_sparse_INL, 881
- FFLAS_TRANSPOSE
 - FFLAS, 81
- FFLAS_UPLO
 - FFLAS, 81
- FflasAuto
 - FFLAS, 84
- FflasBinary
 - FFLAS, 84
- FflasColMajor
 - FFLAS, 81
 - fflas_c.h, 946
- ffpack_c.h, 1005
- FflasDense
 - FFLAS, 84
- FflasDouble
 - FFLAS, 83
 - fflas_c.h, 947
- FFLASFFPACK_abort
 - debug.h, 1043
- FFLASFFPACK_check
 - debug.h, 1043
- FFLASFFPACK_checkers_fflas_inl_H
 - checkers_fflas.inl, 809
- FFLASFFPACK_checkers_ffpack_inl_H
 - checkers_ffpack.inl, 810
- FFLASFFPACK_COPY_REDUCE
 - fflas_freduce.inl, 844
- FFLASFFPACK_PERM_BKSIZE
 - ffpack_permutation.inl, 933
- FflasFloat
 - FFLAS, 83
 - fflas_c.h, 947
- FflasGeneric
 - FFLAS, 83
 - fflas_c.h, 947
- FflasLeft
 - FFLAS, 82
 - fflas_c.h, 947
 - ffpack_c.h, 1006
- FflasLower
 - FFLAS, 82
 - fflas_c.h, 946
 - ffpack_c.h, 1005
- FflasMaple
 - FFLAS, 84
- FflasMath
 - FFLAS, 84
- FflasNonUnit
 - FFLAS, 82
 - fflas_c.h, 947
 - ffpack_c.h, 1006
- FflasNoTrans
 - FFLAS, 81
 - fflas_c.h, 946
 - ffpack_c.h, 1005
- FflasRight
 - FFLAS, 82
 - fflas_c.h, 947
 - ffpack_c.h, 1006
- FflasRowMajor
 - FFLAS, 81
 - fflas_c.h, 946
 - ffpack_c.h, 1005
- FflasSageMath
 - FFLAS, 84
- FflasSMS
 - FFLAS, 84
- FflasTrans
 - FFLAS, 81

- fflas_c.h, [946](#)
- ffpack_c.h, [1005](#)
- FflasUnit
 - FFLAS, [82](#)
 - fflas_c.h, [947](#)
 - ffpack_c.h, [1006](#)
- FflasUpper
 - FFLAS, [82](#)
 - fflas_c.h, [946](#)
 - ffpack_c.h, [1005](#)
- FFPACK, [50](#), [293](#)
 - _PLUQ, [364](#)
 - applyP, [310](#), [311](#), [367](#)
 - applyP_block, [358](#)
 - buildMatrix, [351](#)
 - CharPoly, [329](#), [330](#), [352](#), [372](#)
 - Checker_charpoly, [309](#)
 - Checker_Det, [309](#)
 - Checker_invert, [309](#)
 - Checker_PLUQ, [309](#)
 - chooseField, [394](#)
 - chooseField< Givaro::ZRing< double > >, [395](#)
 - chooseField< Givaro::ZRing< float > >, [395](#)
 - chooseField< Givaro::ZRing< int32_t > >, [394](#)
 - chooseField< Givaro::ZRing< int64_t > >, [395](#)
 - ColRankProfileSubmatrix, [342](#), [377](#)
 - ColRankProfileSubmatrixIndices, [341](#), [377](#)
 - ColumnEchelonForm, [322](#), [323](#), [371](#)
 - ColumnRankProfile, [338](#), [339](#), [376](#)
 - composePermutationsLLL, [361](#)
 - composePermutationsLLM, [362](#)
 - composePermutationsMLM, [362](#)
 - cyclic_shift_col, [363](#), [366](#)
 - cyclic_shift_mathPerm, [362](#)
 - cyclic_shift_row, [363](#), [366](#)
 - cyclic_shift_row_col, [363](#), [366](#)
 - Danilevski, [351](#)
 - Det, [334](#), [352](#), [374](#), [375](#)
 - doApplyS, [358](#)
 - doApplyT, [360](#)
 - failure, [381](#)
 - fflas_const_cast, [366](#), [380](#)
 - fgesv, [314](#), [315](#), [368](#)
 - fgetrs, [313](#), [367](#)
 - ForceCheck_charpoly, [310](#)
 - ForceCheck_Det, [309](#)
 - ForceCheck_invert, [309](#)
 - ForceCheck_PLUQ, [309](#)
 - fsytrf, [318](#), [319](#)
 - fsytrf_BC_Crout, [353](#)
 - fsytrf_BC_RL, [353](#)
 - fsytrf_LOW_RPM_BC_Crout, [353](#)
 - fsytrf_nonunit, [319](#), [354](#)
 - fsytrf_RPM, [355](#)
 - fsytrf_UP_RPM, [354](#)
 - fsytrf_UP_RPM_BC_Crout, [354](#)
 - fsytrf_UP_RPM_BC_RL, [353](#)
 - ftssyr2k, [317](#)
 - ftstr, [317](#)
 - fttrtri, [316](#), [368](#)
 - fttrrm, [316](#), [369](#)
 - getEchelonForm, [345](#)
 - getEchelonForm< FFLAS_FIELD< FFLAS_ELT > >, [378](#), [379](#)
 - getEchelonTransform, [346](#)
 - getEchelonTransform< FFLAS_FIELD< FFLAS_ELT > >, [379](#)
 - getReducedEchelonForm, [347](#), [348](#)
 - getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > >, [379](#), [380](#)
 - getReducedEchelonTransform, [348](#)
 - getReducedEchelonTransform< FFLAS_FIELD< FFLAS_ELT > >, [380](#)
 - getTriangular, [343](#), [344](#)
 - getTriangular< FFLAS_FIELD< FFLAS_ELT > >, [378](#)
 - getTridiagonal, [355](#)
 - Invert, [327](#), [328](#), [371](#)
 - Invert2, [328](#), [372](#)
 - isOdd, [381](#)
 - IsSingular, [333](#), [374](#)
 - KrylovElim, [373](#)
 - LAPACKPerm2MathPerm, [310](#)
 - LeadingSubmatrixRankProfiles, [340](#)
 - LQUPtoInverseOfFullRankMinor, [349](#), [380](#)
 - LUdivine, [321](#), [356](#), [369](#)
 - LUdivine_gauss, [355](#), [370](#)
 - LUdivine_small, [355](#), [369](#)
 - MathPerm2LAPACKPerm, [310](#)
 - MatrixApplyS, [358](#), [359](#)
 - MatrixApplyT, [360](#), [361](#)
 - MatVecMinPoly, [331](#), [373](#)
 - maxFieldElt, [394](#)
 - maxFieldElt< Givaro::ZRing< Givaro::Integer > >, [394](#)
 - MinPoly, [331](#), [373](#)
 - MonotonicApplyP, [312](#)
 - MonotonicCompress, [356](#)
 - MonotonicCompressCycles, [357](#)
 - MonotonicCompressMorePivots, [357](#)
 - MonotonicExpand, [357](#)
 - NonZeroRandomMatrix, [381](#), [382](#)
 - NullSpaceBasis, [336](#), [376](#)
 - pColumnEchelonForm, [323](#)
 - pColumnRankProfile, [339](#)
 - pDet, [334](#)
 - PermApplyS, [359](#)
 - PermApplyT, [361](#)
 - PLUQ, [320](#), [321](#), [365](#), [369](#)
 - PLUQ_basecaseCrout, [364](#)
 - PLUQ_basecaseV2, [364](#)
 - PLUQ_basecaseV3, [364](#)
 - PLUQtoEchelonPermutation, [349](#)
 - pPLUQ, [320](#)
 - pRank, [332](#)
 - pReducedColumnEchelonForm, [325](#)

- pReducedRowEchelonForm, 326
- pRowEchelonForm, 324
- pRowRankProfile, 338
- pSolve, 336
- RandInt, 385
- RandomIndexSubset, 387
- RandomMatrix, 382, 383
- RandomMatrixWithDet, 393
- RandomMatrixWithRank, 385, 386
- RandomMatrixWithRankandRandomRPM, 391
- RandomMatrixWithRankandRPM, 388, 389
- RandomNullSpaceVector, 336, 350, 376
- RandomPermutation, 387
- RandomRankProfileMatrix, 387
- RandomSymmetricMatrix, 385
- RandomSymmetricMatrixWithRankandRandomRPM, 392
- RandomSymmetricMatrixWithRankandRPM, 390
- RandomSymmetricRankProfileMatrix, 388
- RandomTriangularMatrix, 383, 384
- Rank, 332, 333, 374
- RankProfileFromLU, 339
- ReducedColumnEchelonForm, 324, 325, 371
- ReducedRowEchelonForm, 326, 327, 370
- RowEchelonForm, 323, 324, 370
- RowRankProfile, 337, 338, 376
- RowRankProfileSubmatrix, 342, 377
- RowRankProfileSubmatrixIndices, 340, 377
- Solve, 335, 375
- solveLB, 351, 375
- solveLB2, 351, 375
- SpecRankProfile, 374
- swapval, 388
- threads_fgemm, 365
- threads_ftsm, 365
- trinv_left, 316, 368
- ffpack-fgesv.C, 1113
 - main, 1113
- ffpack-solve.C, 1113
 - main, 1114
- ffpack.C, 980
 - applyP_modular_double, 985
 - ColRankProfileSubmatrix_modular_double, 999
 - ColRankProfileSubmatrixIndices_modular_double, 998
 - ColumnEchelonForm_modular_double, 988
 - ColumnEchelonForm_modular_float, 989
 - ColumnEchelonForm_modular_int32_t, 990
 - ColumnRankProfile_modular_double, 997
 - composePermutationsLLL, 985
 - composePermutationsLLM, 984
 - composePermutationsMLM, 985
 - cyclic_shift_col_modular_double, 985
 - cyclic_shift_mathPerm, 985
 - cyclic_shift_row_modular_double, 985
 - Det_modular_double, 996
 - fgesv_modular_double, 987
 - fgesvin_modular_double, 986
 - fgetrsin_modular_double, 986
 - fgetrsv_modular_double, 986
 - fttrtri_modular_double, 987
 - fttrrm_modular_double, 987
 - getEchelonForm_modular_double, 999
 - getEchelonFormin_modular_double, 1000
 - getEchelonTransform_modular_double, 1000
 - getReducedEchelonForm_modular_double, 1000
 - getReducedEchelonFormin_modular_double, 1001
 - getReducedEchelonTransform_modular_double, 1001
 - getTriangular_modular_double, 999
 - getTriangularin_modular_double, 999
 - Invert2_modular_double, 995
 - Invert_modular_double, 994
 - Invertin_modular_double, 994
 - IsSingular_modular_double, 995
 - KrylovElim_modular_double, 995
 - LAPACKPerm2MathPerm, 983
 - LeadingSubmatrixRankProfiles, 998
 - LUdivine_modular_double, 988
 - MathPerm2LAPACKPerm, 983
 - MatrixApplyS_modular_double, 983
 - MatrixApplyT_modular_double, 984
 - NullSpaceBasis_modular_double, 997
 - pColumnEchelonForm_modular_double, 991
 - pColumnEchelonForm_modular_float, 992
 - pColumnEchelonForm_modular_int32_t, 993
 - PermApplyS_double, 984
 - PermApplyT_double, 984
 - PLUQ_modular_double, 987
 - PLUQtoEchelonPermutation, 1001
 - pReducedColumnEchelonForm_modular_double, 992
 - pReducedColumnEchelonForm_modular_float, 993
 - pReducedColumnEchelonForm_modular_int32_t, 994
 - pReducedRowEchelonForm_modular_double, 992
 - pReducedRowEchelonForm_modular_float, 993
 - pReducedRowEchelonForm_modular_int32_t, 994
 - pRowEchelonForm_modular_double, 991
 - pRowEchelonForm_modular_float, 992
 - pRowEchelonForm_modular_int32_t, 993
 - RandomNullSpaceVector_modular_double, 997
 - Rank_modular_double, 995
 - RankProfileFromLU, 998
 - ReducedColumnEchelonForm_modular_double, 989
 - ReducedColumnEchelonForm_modular_float, 990
 - ReducedColumnEchelonForm_modular_int32_t, 991
 - ReducedRowEchelonForm_modular_double, 989
 - ReducedRowEchelonForm_modular_float, 990
 - ReducedRowEchelonForm_modular_int32_t, 991
 - RowEchelonForm_modular_double, 988
 - RowEchelonForm_modular_float, 989

- RowEchelonForm_modular_int32_t, 990
- RowRankProfile_modular_double, 997
- RowRankProfileSubmatrix_modular_double, 998
- RowRankProfileSubmatrixIndices_modular_double, 998
- Solve_modular_double, 996
- solveLB2_modular_double, 996
- solveLB_modular_double, 996
- SpecRankProfile_modular_double, 995
- trinv_left_modular_double, 987
- ffpack.dox, 908
- ffpack.h, 908
 - __FFLASFFPACK_FTRSSYR2K_THRESHOLD, 916
 - __FFLASFFPACK_FTRSTR_THRESHOLD, 916
- ffpack.inl, 916
 - __FFLASFFPACK_ffpack_INL, 917
- FFPACK::Protected, 395
 - ArithProg, 399
 - CompressRows, 401
 - CompressRowsQA, 402
 - CompressRowsQK, 401
 - Danilevski, 399
 - DeCompressRows, 401
 - DeCompressRowsQA, 402
 - DeCompressRowsQK, 401
 - fgemv_kgf, 398
 - GaussJordan, 397
 - Hybrid_KGF_LUK_MinPoly, 400
 - KellerGehrig, 398
 - KGFast, 398
 - KGFast_generalized, 398
 - LUdivine_construct, 397, 402
 - LUKrylov, 399
 - LUKrylov_KGFast, 400
 - MatVecMinPoly, 400
 - newD, 401
 - RandomKrylovPrecond, 399
 - updatedD, 400
- ffpack_c.h, 1001
 - applyP_modular_double, 1009
 - ColRankProfileSubmatrix_modular_double, 1020
 - ColRankProfileSubmatrixIndices_modular_double, 1020
 - ColumnEchelonForm_modular_double, 1012
 - ColumnEchelonForm_modular_float, 1012
 - ColumnEchelonForm_modular_int32_t, 1013
 - ColumnRankProfile_modular_double, 1019
 - composePermutationsLLL, 1008
 - composePermutationsLLM, 1008
 - composePermutationsMLM, 1008
 - cyclic_shift_col_modular_double, 1009
 - cyclic_shift_mathPerm, 1008
 - cyclic_shift_row_modular_double, 1008
 - Det_modular_double, 1017
 - FFLAS_C_DIAG, 1005
 - FFLAS_C_ORDER, 1005
 - FFLAS_C_SIDE, 1006
 - FFLAS_C_TRANSPOSE, 1005
 - FFLAS_C_UPLO, 1005
 - FflasColMajor, 1005
 - FflasLeft, 1006
 - FflasLower, 1005
 - FflasNonUnit, 1006
 - FflasNoTrans, 1005
 - FflasRight, 1006
 - FflasRowMajor, 1005
 - FflasTrans, 1005
 - FflasUnit, 1006
 - FflasUpper, 1005
 - FFPACK_C_CHARPOLY_TAG, 1006
 - FFPACK_C_LU_TAG, 1006
 - FFPACK_C_MINPOLY_TAG, 1006
 - FFPACK_COMPILED, 1005
 - FfpackArithProg, 1006
 - FfpackDanilevski, 1006
 - FfpackDense, 1007
 - FfpackHybrid, 1006
 - FfpackKG, 1006
 - FfpackKGF, 1007
 - FfpackKGFast, 1006
 - FfpackKGFastG, 1006
 - FfpackLUK, 1006
 - FfpackSingular, 1006
 - FfpackSlabRecursive, 1006
 - FfpackTileRecursive, 1006
 - fgesv_modular_double, 1010
 - fgesvin_modular_double, 1010
 - fgetrs_modular_double, 1009
 - fgetrsin_modular_double, 1009
 - fttrtri_modular_double, 1010
 - fttrrm_modular_double, 1011
 - getEchelonForm_modular_double, 1021
 - getEchelonFormin_modular_double, 1021
 - getEchelonTransform_modular_double, 1021
 - getReducedEchelonForm_modular_double, 1022
 - getReducedEchelonFormin_modular_double, 1022
 - getReducedEchelonTransform_modular_double, 1022
 - getTriangular_modular_double, 1020
 - getTriangularin_modular_double, 1020
 - Invert2_modular_double, 1016
 - Invert_modular_double, 1016
 - Invertin_modular_double, 1015
 - IsSingular_modular_double, 1017
 - KrylovElim_modular_double, 1016
 - LAPACKPerm2MathPerm, 1007
 - LeadingSubmatrixRankProfiles, 1019
 - LUdivine_gauss_modular_double, 1012
 - LUdivine_modular_double, 1011
 - LUdivine_small_modular_double, 1011
 - MathPerm2LAPACKPerm, 1007
 - MatrixApplyS_modular_double, 1007
 - MatrixApplyT_modular_double, 1007
 - NullSpaceBasis_modular_double, 1018

- PermApplyS_double, [1007](#)
- PermApplyT_double, [1008](#)
- PLUQ_modular_double, [1011](#)
- PLUQtoEchelonPermutation, [1022](#)
- RandomNullSpaceVector_modular_double, [1018](#)
- Rank_modular_double, [1017](#)
- RankProfileFromLU, [1019](#)
- ReducedColumnEchelonForm_modular_double, [1013](#)
- ReducedColumnEchelonForm_modular_float, [1014](#)
- ReducedColumnEchelonForm_modular_int32_t, [1014](#)
- ReducedRowEchelonForm2_modular_double, [1015](#)
- ReducedRowEchelonForm_modular_double, [1014](#)
- ReducedRowEchelonForm_modular_float, [1014](#)
- ReducedRowEchelonForm_modular_int32_t, [1015](#)
- REF_modular_double, [1015](#)
- RowEchelonForm_modular_double, [1012](#)
- RowEchelonForm_modular_float, [1013](#)
- RowEchelonForm_modular_int32_t, [1013](#)
- RowRankProfile_modular_double, [1018](#)
- RowRankProfileSubmatrix_modular_double, [1020](#)
- RowRankProfileSubmatrixIndices_modular_double, [1019](#)
- Solve_modular_double, [1017](#)
- solveLB2_modular_double, [1018](#)
- solveLB_modular_double, [1017](#)
- SpecRankProfile_modular_double, [1016](#)
- trinv_left_modular_double, [1011](#)
- FFPACK_C_CHARPOLY_TAG
 - ffpack_c.h, [1006](#)
- FFPACK_C_LU_TAG
 - ffpack_c.h, [1006](#)
- FFPACK_C_MINPOLY_TAG
 - ffpack_c.h, [1006](#)
- ffpack_charpoly.inl, [917](#)
 - __FFLASFFPACK_charpoly_INL, [918](#)
- ffpack_charpoly_danilevski.inl, [918](#)
 - __FFLASFFPACK_ffpack_charpoly_danilveski_INL, [918](#)
- ffpack_charpoly_kgfast.inl, [919](#)
 - __FFLASFFPACK_ffpack_charpoly_kgfast_INL, [919](#)
- ffpack_charpoly_kgfastgeneralized.inl, [919](#)
 - __FFLASFFPACK_ffpack_charpoly_kgfastgeneralized_INL, [920](#)
- ffpack_charpoly_kglu.inl, [920](#)
 - __FFLASFFPACK_ffpack_charpoly_kglu_INL, [920](#)
- ffpack_charpoly_mp.inl, [920](#)
 - __FFPACK_charpoly_mp_INL, [921](#)
- FFPACK_COMPILED
 - ffpack_c.h, [1005](#)
- ffpack_det_mp.inl, [921](#)
 - __FFPACK_det_mp_INL, [921](#)
- ffpack_echelonforms.inl, [922](#)
 - __FFLASFFPACK_GAUSSJORDAN_BASECASE, [923](#)
 - __FFLASFFPACK_ffpack_echelon_forms_INL, [923](#)
- ffpack_fgesv.inl, [923](#)
 - __FFLASFFPACK_ffpack_fgesv_INL, [923](#)
- ffpack_fgetrs.inl, [924](#)
 - __FFLASFFPACK_ffpack_fgetrs_INL, [924](#)
- ffpack_frobenius.inl, [924](#)
- ffpack_fsytrf.inl, [925](#)
 - __FFLASFFPACK_ffpack_fsytrf_INL, [926](#)
- ffpack_ftrssyr2k.inl, [926](#)
 - __FFLASFFPACK_ffpack_ftrssyr2k_INL, [926](#)
- ffpack_ftrstr.inl, [927](#)
 - __FFLASFFPACK_ffpack_ftrstr_INL, [927](#)
- ffpack_fttr.inl, [927](#)
 - __FFLASFFPACK_ffpack_fttr_INL, [928](#)
- ENABLE_ALL_CHECKINGS, [928](#)
- ffpack_inst.C, [1023](#)
 - __FFPACK_INST_C, [1023](#)
 - FFLAS_COMPILED, [1023](#)
 - FFLAS_ELT, [1023](#), [1024](#)
 - FFLAS_FIELD, [1023](#), [1024](#)
 - INST_OR_DECL, [1023](#)
- ffpack_inst.h, [1024](#)
 - FFLAS_COMPILED, [1024](#)
 - FFLAS_ELT, [1025](#)
 - FFLAS_FIELD, [1025](#)
 - INST_OR_DECL, [1024](#)
- ffpack_inst_implem.inl, [1025](#)
- ffpack_invert.inl, [928](#)
 - __FFLASFFPACK_ffpack_invert_INL, [928](#)
- ffpack_krylovelim.inl, [928](#)
 - __FFLASFFPACK_ffpack_krylovelim_INL, [929](#)
- ffpack_ludivine.inl, [929](#)
 - __FFLASFFPACK_ffpack_ludivine_INL, [929](#)
- ffpack_ludivine_mp.inl, [930](#)
 - __FFPACK_ludivine_mp_INL, [930](#)
- ffpack_minpoly.inl, [930](#)
 - __FFLASFFPACK_ffpack_minpoly_INL, [931](#)
- ffpack_permutation.inl, [931](#)
 - __FFLASFFPACK_ffpack_permutation_INL, [933](#)
- FFLASFFPACK_PERM_BKSIZE, [933](#)
- ffpack_pluq.inl, [933](#)
 - __FFLASFFPACK_ffpack_pluq_INL, [934](#)
- CROUT, [934](#)
- ffpack_pluq_mp.inl, [934](#)
 - __FFPACK_pluq_mp_INL, [935](#)
- ffpack_ppluq.inl, [935](#)
 - __FFLASFFPACK_ffpack_ppluq_INL, [935](#)
 - __FFLAS_TRSM_READONLY, [935](#)
- PBASECASE_K, [935](#)
- ffpack_rankprofiles.inl, [936](#)
 - __FFLASFFPACK_ffpack_rank_profiles_INL, [937](#)
- FpackArithProg
 - ffpack_c.h, [1006](#)
- FpackDanilevski
 - ffpack_c.h, [1006](#)

- FpackDense
 - ffpack_c.h, [1007](#)
- FpackHybrid
 - ffpack_c.h, [1006](#)
- FpackKG
 - ffpack_c.h, [1006](#)
- FpackKGF
 - ffpack_c.h, [1007](#)
- FpackKGFast
 - ffpack_c.h, [1006](#)
- FpackKGFastG
 - ffpack_c.h, [1006](#)
- FpackLUK
 - ffpack_c.h, [1006](#)
- FpackSingular
 - ffpack_c.h, [1006](#)
- FpackSlabRecursive
 - ffpack_c.h, [1006](#)
- FpackTileRecursive
 - ffpack_c.h, [1006](#)
- fgemm
 - FFLAS, [97–99](#), [101–106](#), [149](#), [185](#), [186](#)
- fgemm_3_modular_double
 - fflas_c.h, [956](#)
 - fflas_lvl3.C, [979](#)
- fgemm_classical.inl, [830](#)
 - __FFLASFFPACK_fflas_fflas_fgemm_classical_INL, [830](#)
- fgemm_classical_mp.inl, [830](#)
 - __FFPACK_fgemm_classical_INL, [832](#)
- fgemm_convert
 - FFLAS::Protected, [220](#)
- fgemm_winograd.inl, [832](#)
 - __FFLASFFPACK_fflas_fflas_fgemm_winograd_INL, [833](#)
 - NEWWINO, [833](#)
- fgemv
 - FFLAS, [106–112](#), [180](#), [193](#)
- fgemv_2_modular_double
 - fflas_c.h, [954](#)
 - fflas_lvl2.C, [977](#)
- fgemv_convert
 - FFLAS::Protected, [225](#)
- fgemv_kgf
 - FFPACK::Protected, [398](#)
- fger
 - FFLAS, [112–116](#), [182](#)
- fger_2_modular_double
 - fflas_c.h, [955](#)
 - fflas_lvl2.C, [977](#)
- fger_convert
 - FFLAS::Protected, [226](#)
- fgesv
 - FFPACK, [314](#), [315](#), [368](#)
- fgesv_modular_double
 - ffpack.C, [987](#)
 - ffpack_c.h, [1010](#)
- fgesvin_modular_double
 - ffpack.C, [986](#)
 - ffpack_c.h, [1010](#)
- fgetrs
 - FFPACK, [313](#), [367](#)
- fgetrs_modular_double
 - ffpack_c.h, [1009](#)
- fgetrsin_modular_double
 - ffpack.C, [986](#)
 - ffpack_c.h, [1009](#)
- fgetrsv_modular_double
 - ffpack.C, [986](#)
- fidentity
 - FFLAS, [142](#), [173](#)
- fidentity_2_modular_double
 - fflas_c.h, [951](#)
 - fflas_lvl2.C, [974](#)
- Field
 - benchmark-fgemm-rns.C, [780](#)
 - benchmark-pluq.C, [794](#)
 - FieldSimd< _Field >, [445](#)
 - Sparse< _Field, SparseMatrix_t::COO >, [729](#)
 - Sparse< _Field, SparseMatrix_t::COO_ZO >, [730](#)
 - Sparse< _Field, SparseMatrix_t::CSR >, [732](#)
 - Sparse< _Field, SparseMatrix_t::CSR_HYB >, [734](#)
 - Sparse< _Field, SparseMatrix_t::CSR_ZO >, [735](#)
 - Sparse< _Field, SparseMatrix_t::ELL >, [737](#)
 - Sparse< _Field, SparseMatrix_t::ELL_ZO >, [742](#)
 - Sparse< _Field, SparseMatrix_t::HYB_ZO >, [744](#)
 - Sparse< _Field, SparseMatrix_t::SELL >, [745](#)
 - Sparse< _Field, SparseMatrix_t::SELL_ZO >, [748](#)
 - test-compressQ.C, [1060](#)
- field
 - associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > >, [408](#)
 - associatedDelayedField< const Givaro::Modular< T, X > >, [408](#)
 - associatedDelayedField< const Givaro::ModularBalanced< T > >, [409](#)
 - associatedDelayedField< const Givaro::ZRing< T > >, [409](#)
 - associatedDelayedField< Field >, [407](#)
- field-traits.h, [937](#)
- field.doxy, [939](#)
- FieldMax
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [502](#)
- FieldMin
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [502](#)
- FieldSimd
 - FieldSimd< _Field >, [445](#)
- FieldSimd< _Field >, [444](#)
 - add, [446](#)
 - add_r, [446](#)
 - addin, [446](#)
 - addin_r, [447](#)
 - alignment, [450](#)

- axpy, [448](#), [449](#)
- axpy_r, [449](#)
- axpyin, [449](#)
- axpyin_r, [449](#)
- Element, [445](#)
- Field, [445](#)
- FieldSimd, [445](#)
- init, [446](#)
- maxpy, [449](#)
- maxpyin, [450](#)
- mod, [448](#)
- mul, [448](#)
- mul_r, [448](#)
- mulin, [448](#)
- operator=, [446](#)
- scalar_t, [445](#)
- simd, [445](#)
- sub, [447](#)
- sub_r, [447](#)
- subin, [447](#)
- subin_r, [447](#)
- vect_size, [450](#)
- vect_t, [445](#)
- zero, [447](#), [448](#)
- FieldTraits< FFPACK::RNSInteger< T > >, [451](#)
 - balanced, [451](#)
 - category, [451](#)
- FieldTraits< FFPACK::RNSIntegerMod< T > >, [451](#)
 - balanced, [452](#)
 - category, [451](#)
- FieldTraits< Field >, [450](#)
 - balanced, [450](#)
 - category, [450](#)
- FieldTraits< Givaro::Modular< Element > >, [452](#)
 - balanced, [452](#)
 - category, [452](#)
- FieldTraits< Givaro::ModularBalanced< Element > >, [452](#)
 - balanced, [453](#)
 - category, [453](#)
- FieldTraits< Givaro::ZRing< double > >, [453](#)
 - balanced, [453](#)
 - category, [453](#)
- FieldTraits< Givaro::ZRing< float > >, [453](#)
 - balanced, [454](#)
 - category, [454](#)
- FieldTraits< Givaro::ZRing< Givaro::Integer > >, [454](#)
 - balanced, [454](#)
 - category, [454](#)
- FieldTraits< Givaro::ZRing< int16_t > >, [455](#)
 - balanced, [455](#)
 - category, [455](#)
- FieldTraits< Givaro::ZRing< int32_t > >, [455](#)
 - balanced, [455](#)
 - category, [455](#)
- FieldTraits< Givaro::ZRing< int64_t > >, [456](#)
 - balanced, [456](#)
 - category, [456](#)
- FieldTraits< Givaro::ZRing< RecInt::ruint< K > > >, [456](#)
 - balanced, [457](#)
 - category, [456](#)
- FieldTraits< Givaro::ZRing< uint16_t > >, [457](#)
 - balanced, [457](#)
 - category, [457](#)
- FieldTraits< Givaro::ZRing< uint32_t > >, [457](#)
 - balanced, [458](#)
 - category, [457](#)
- FieldTraits< Givaro::ZRing< uint64_t > >, [458](#)
 - balanced, [458](#)
 - category, [458](#)
- fill_value
 - benchmark-fgemv.C, [784](#)
- findArgument
 - args-parser.h, [1041](#)
- finit
 - FFLAS, [117](#), [119](#), [120](#), [135](#), [142](#), [163](#), [174](#)
- finit_rns
 - FFLAS, [160](#), [162](#)
- finit_trans_rns
 - FFLAS, [161](#)
- first_component
 - Compose< H1, H2 >, [422](#)
- firstBlockSize
 - ForStrategy1D< blocksize_t, Cut, Param >, [460](#)
- fiszero
 - FFLAS, [138](#), [141](#), [166](#), [172](#)
- fiszero_1_modular_double
 - fflas_c.h, [948](#)
 - fflas_lvl1.C, [969](#)
- fiszero_2_modular_double
 - fflas_c.h, [951](#)
 - fflas_lvl2.C, [974](#)
- Fixed, [458](#)
- FixedPreIntTag, [458](#)
- flimits.h, [1047](#)
 - in_range, [1047](#), [1048](#)
- FLOAT_MOD
 - fflas_simd.h, [866](#)
- Floats
 - benchmark-dgemm.C, [772](#)
- floor
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, [558](#)
 - Simd256_impl< true, false, true, 8 >, [629](#)
 - Simd512_impl< true, false, true, 8 >, [705](#)
- fmaddd
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, [559](#)
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [563](#)
 - Simd128_impl< true, true, false, 2 >, [574](#)
 - Simd128_impl< true, true, false, 4 >, [582](#)
 - Simd128_impl< true, true, false, 8 >, [591](#)


```

Simd128_impl< true, true, true, 2 >, 599
Simd128_impl< true, true, true, 4 >, 607
Simd128_impl< true, true, true, 8 >, 616
Simd256_impl< true, false, true, 8 >, 627
Simd256_impl< true, true, false, 2 >, 637
Simd256_impl< true, true, false, 4 >, 651
Simd256_impl< true, true, false, 8 >, 662
Simd256_impl< true, true, true, 2 >, 669
Simd256_impl< true, true, true, 4 >, 679, 685
Simd256_impl< true, true, true, 8 >, 694
Simd512_impl< true, false, true, 8 >, 703
Simd512_impl< true, true, false, 8 >, 713
Simd512_impl< true, true, true, 8 >, 721

fmaddin
ScalFunctions< Element, typename enable_if<
    is_floating_point< Element >::value >::type
>, 559
ScalFunctions< Element, typename enable_if<
    is_integral< Element >::value >::type >, 563
Simd128_impl< true, true, false, 2 >, 574
Simd128_impl< true, true, false, 4 >, 582
Simd128_impl< true, true, false, 8 >, 591
Simd128_impl< true, true, true, 2 >, 599
Simd128_impl< true, true, true, 4 >, 607
Simd128_impl< true, true, true, 8 >, 616
Simd256_impl< true, false, true, 8 >, 627
Simd256_impl< true, true, false, 2 >, 637
Simd256_impl< true, true, false, 4 >, 651, 652
Simd256_impl< true, true, false, 8 >, 662
Simd256_impl< true, true, true, 2 >, 669
Simd256_impl< true, true, true, 4 >, 679, 685
Simd256_impl< true, true, true, 8 >, 694
Simd512_impl< true, false, true, 8 >, 703
Simd512_impl< true, true, false, 8 >, 713
Simd512_impl< true, true, true, 8 >, 721

fmadddx
ScalFunctions< Element, typename enable_if<
    is_integral< Element >::value >::type >, 563
Simd128_impl< true, true, false, 2 >, 571
Simd128_impl< true, true, false, 4 >, 580
Simd128_impl< true, true, false, 8 >, 588
Simd128_impl< true, true, true, 2 >, 599
Simd128_impl< true, true, true, 4 >, 608
Simd128_impl< true, true, true, 8 >, 616
Simd256_impl< true, true, false, 2 >, 634
Simd256_impl< true, true, false, 4 >, 644, 646
Simd256_impl< true, true, false, 8 >, 659
Simd256_impl< true, true, true, 2 >, 669
Simd256_impl< true, true, true, 4 >, 680, 685
Simd256_impl< true, true, true, 8 >, 694
Simd512_impl< true, true, false, 8 >, 710
Simd512_impl< true, true, true, 8 >, 721

fmadddxin
ScalFunctions< Element, typename enable_if<
    is_integral< Element >::value >::type >, 563
Simd128_impl< true, true, false, 2 >, 571
Simd128_impl< true, true, false, 4 >, 580
Simd128_impl< true, true, false, 8 >, 589

```

- Simd512_impl< true, true, false, 8 >, [713](#)
- Simd512_impl< true, true, true, 8 >, [722](#)
- fmsubx
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [564](#)
 - Simd128_impl< true, true, false, 2 >, [572](#)
 - Simd128_impl< true, true, false, 4 >, [580](#)
 - Simd128_impl< true, true, false, 8 >, [589](#)
 - Simd128_impl< true, true, true, 2 >, [600](#)
 - Simd128_impl< true, true, true, 4 >, [609](#)
 - Simd128_impl< true, true, true, 8 >, [617](#)
 - Simd256_impl< true, true, false, 2 >, [634](#)
 - Simd256_impl< true, true, false, 4 >, [644](#), [647](#)
 - Simd256_impl< true, true, false, 8 >, [659](#)
 - Simd256_impl< true, true, true, 2 >, [671](#)
 - Simd256_impl< true, true, true, 4 >, [681](#), [686](#)
 - Simd256_impl< true, true, true, 8 >, [695](#)
 - Simd512_impl< true, true, false, 8 >, [710](#)
 - Simd512_impl< true, true, true, 8 >, [722](#)
- fmsubxin
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [564](#)
 - Simd128_impl< true, true, false, 2 >, [572](#)
 - Simd128_impl< true, true, false, 4 >, [580](#)
 - Simd128_impl< true, true, false, 8 >, [589](#), [592](#)
 - Simd128_impl< true, true, true, 2 >, [600](#)
 - Simd128_impl< true, true, true, 4 >, [609](#)
 - Simd128_impl< true, true, true, 8 >, [617](#)
 - Simd256_impl< true, true, false, 2 >, [634](#)
 - Simd256_impl< true, true, false, 4 >, [644](#), [647](#)
 - Simd256_impl< true, true, false, 8 >, [659](#)
 - Simd256_impl< true, true, true, 2 >, [671](#)
 - Simd256_impl< true, true, true, 4 >, [681](#), [686](#)
 - Simd256_impl< true, true, true, 8 >, [695](#)
 - Simd512_impl< true, true, false, 8 >, [710](#)
 - Simd512_impl< true, true, true, 8 >, [722](#)
- fneg
 - FFLAS, [136](#), [144](#), [165](#), [175](#)
- fneg_1_modular_double
 - fflas_c.h, [948](#)
 - fflas_lvl1.C, [969](#)
- fneg_2_modular_double
 - fflas_c.h, [952](#)
 - fflas_lvl2.C, [975](#)
- fnegin
 - FFLAS, [136](#), [143](#), [164](#), [175](#)
- fnegin_1_modular_double
 - fflas_c.h, [948](#)
 - fflas_lvl1.C, [969](#)
- fnegin_2_modular_double
 - fflas_c.h, [952](#)
 - fflas_lvl2.C, [974](#)
- fnmadd
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, [559](#)
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [564](#)
- Simd128_impl< true, true, false, 2 >, [574](#)
- Simd128_impl< true, true, false, 4 >, [582](#)
- Simd128_impl< true, true, false, 8 >, [591](#)
- Simd128_impl< true, true, true, 2 >, [599](#)
- Simd128_impl< true, true, true, 4 >, [608](#)
- Simd128_impl< true, true, true, 8 >, [616](#)
- Simd256_impl< true, false, true, 8 >, [627](#)
- Simd256_impl< true, true, false, 2 >, [637](#)
- Simd256_impl< true, true, false, 4 >, [652](#)
- Simd256_impl< true, true, false, 8 >, [662](#)
- Simd256_impl< true, true, true, 2 >, [670](#)
- Simd256_impl< true, true, true, 4 >, [680](#), [685](#)
- Simd256_impl< true, true, true, 8 >, [694](#)
- Simd512_impl< true, false, true, 8 >, [704](#)
- Simd512_impl< true, true, false, 8 >, [713](#)
- Simd512_impl< true, true, true, 8 >, [721](#)
- fnmaddin
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, [559](#)
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [564](#)
 - Simd128_impl< true, true, false, 2 >, [574](#)
 - Simd128_impl< true, true, false, 4 >, [583](#)
 - Simd128_impl< true, true, false, 8 >, [591](#)
 - Simd128_impl< true, true, true, 2 >, [599](#)
 - Simd128_impl< true, true, true, 4 >, [608](#)
 - Simd128_impl< true, true, true, 8 >, [617](#)
 - Simd256_impl< true, false, true, 8 >, [627](#)
 - Simd256_impl< true, true, false, 2 >, [637](#)
 - Simd256_impl< true, true, false, 4 >, [652](#)
 - Simd256_impl< true, true, false, 8 >, [662](#)
 - Simd256_impl< true, true, true, 2 >, [670](#)
 - Simd256_impl< true, true, true, 4 >, [680](#), [685](#)
 - Simd256_impl< true, true, true, 8 >, [695](#)
 - Simd512_impl< true, false, true, 8 >, [704](#)
 - Simd512_impl< true, true, false, 8 >, [713](#)
 - Simd512_impl< true, true, true, 8 >, [722](#)
- fnmaddx
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [564](#)
 - Simd128_impl< true, true, false, 2 >, [572](#)
 - Simd128_impl< true, true, false, 4 >, [580](#)
 - Simd128_impl< true, true, false, 8 >, [589](#)
 - Simd128_impl< true, true, true, 2 >, [600](#)
 - Simd128_impl< true, true, true, 4 >, [608](#)
 - Simd128_impl< true, true, true, 8 >, [617](#)
 - Simd256_impl< true, true, false, 2 >, [634](#)
 - Simd256_impl< true, true, false, 4 >, [644](#), [647](#)
 - Simd256_impl< true, true, false, 8 >, [659](#)
 - Simd256_impl< true, true, true, 2 >, [670](#)
 - Simd256_impl< true, true, true, 4 >, [680](#), [686](#)
 - Simd256_impl< true, true, true, 8 >, [695](#)
 - Simd512_impl< true, true, false, 8 >, [710](#)
 - Simd512_impl< true, true, true, 8 >, [722](#)
- fnmaddxin
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [564](#)

- Simd128_impl< true, true, false, 2 >, [572](#)
- Simd128_impl< true, true, false, 4 >, [580](#)
- Simd128_impl< true, true, false, 8 >, [589](#)
- Simd128_impl< true, true, true, 2 >, [600](#)
- Simd128_impl< true, true, true, 4 >, [608](#)
- Simd128_impl< true, true, true, 8 >, [617](#)
- Simd256_impl< true, true, false, 2 >, [634](#)
- Simd256_impl< true, true, false, 4 >, [644](#), [647](#)
- Simd256_impl< true, true, false, 8 >, [659](#)
- Simd256_impl< true, true, true, 2 >, [670](#)
- Simd256_impl< true, true, true, 4 >, [680](#), [686](#)
- Simd256_impl< true, true, true, 8 >, [695](#)
- Simd512_impl< true, true, false, 8 >, [710](#)
- Simd512_impl< true, true, true, 8 >, [722](#)
- FOR1D
 - parallel.h, [1033](#)
- FOR2D
 - parallel.h, [1034](#)
- FORBLOCK1D
 - parallel.h, [1033](#)
- FORBLOCK2D
 - parallel.h, [1034](#)
- ForceCheck_charpoly
 - FFPACK, [310](#)
- ForceCheck_Det
 - FFPACK, [309](#)
- ForceCheck_fgemm
 - FFLAS, [78](#)
- ForceCheck_ftsm
 - FFLAS, [78](#)
- ForceCheck_invert
 - FFPACK, [309](#)
- ForceCheck_PLUQ
 - FFPACK, [309](#)
- ForStrategy1D
 - ForStrategy1D< blocksize_t, Cut, Param >, [459](#)
- ForStrategy1D< blocksize_t, Cut, Param >, [459](#)
 - begin, [460](#)
 - blockindex, [460](#)
 - build, [459](#)
 - changeBS, [461](#)
 - current, [460](#)
 - end, [460](#)
 - firstBlockSize, [460](#)
 - ForStrategy1D, [459](#)
 - ibeg, [460](#)
 - iend, [460](#)
 - initialize, [460](#)
 - isTerminated, [460](#)
 - lastBlockSize, [461](#)
 - numBlock, [461](#)
 - numblocks, [460](#)
 - operator++, [460](#)
- ForStrategy2D
 - ForStrategy2D< blocksize_t, Cut, Param >, [462](#)
- ForStrategy2D< blocksize_t, Cut, Param >, [461](#)
 - _ibeg, [463](#)
 - _iend, [463](#)
 - _jbeg, [463](#)
 - _jend, [463](#)
 - blockindex, [463](#)
 - BLOCKS, [464](#)
 - changeCBS, [464](#)
 - changeRBS, [464](#)
 - colblockindex, [463](#)
 - colBlockSize, [463](#)
 - colnumblocks, [462](#)
 - current, [464](#)
 - ForStrategy2D, [462](#)
 - ibegin, [462](#)
 - iend, [462](#)
 - initialize, [462](#)
 - isTerminated, [462](#)
 - jbegin, [462](#)
 - jend, [462](#)
 - lastCBS, [464](#)
 - lastRBS, [464](#)
 - numColBlock, [464](#)
 - numRowBlock, [464](#)
 - operator<<, [463](#)
 - operator++, [462](#)
 - rowblockindex, [463](#)
 - rowBlockSize, [463](#)
 - rownumblocks, [462](#)
- frand
 - FFLAS, [137](#), [140](#)
- freduce
 - FFLAS, [116–118](#), [120](#), [162](#), [163](#), [173](#), [174](#)
 - FFLAS::details, [209](#)
- freduce_1_modular_double
 - fflas_c.h, [947](#)
 - fflas_lvl1.C, [969](#)
- freduce_2_modular_double
 - fflas_c.h, [952](#)
 - fflas_lvl2.C, [974](#)
- freduce_constoverride
 - FFLAS, [117](#), [119](#)
- freducein_1_modular_double
 - fflas_c.h, [947](#)
 - fflas_lvl1.C, [968](#)
- freducein_2_modular_double
 - fflas_c.h, [952](#)
 - fflas_lvl2.C, [974](#)
- freivalds
 - FFLAS, [120](#)
- fscal
 - FFLAS, [122–126](#), [167](#), [176](#)
 - FFLAS::details, [210](#)
- fscal_1_modular_double
 - fflas_c.h, [949](#)
 - fflas_lvl1.C, [970](#)
- fscal_2_modular_double
 - fflas_c.h, [953](#)
 - fflas_lvl2.C, [975](#)
- fscaln
 - FFLAS, [121](#), [123–126](#), [167](#), [176](#)

- FFLAS::details, 210
- fscalin_1_modular_double
 - fflas_c.h, 949
 - fflas_lvl1.C, 970
- fscalin_2_modular_double
 - fflas_c.h, 952
 - fflas_lvl2.C, 975
- fspmm
 - FFLAS, 150
 - FFLAS::sparse_details, 236–238
 - FFLAS::sparse_details_impl, 252, 253, 260, 261, 267, 271, 272, 281
- fspmm_dispatch
 - FFLAS::sparse_details, 236
- fspmm_mone
 - FFLAS::sparse_details_impl, 254, 262, 272, 273
- fspmm_mone_simd_aligned
 - FFLAS::sparse_details_impl, 255, 262, 274
- fspmm_mone_simd_unaligned
 - FFLAS::sparse_details_impl, 255, 263, 274
- fspmm_one
 - FFLAS::sparse_details_impl, 254, 261, 272, 273
- fspmm_one_simd_aligned
 - FFLAS::sparse_details_impl, 254, 262, 273
- fspmm_one_simd_unaligned
 - FFLAS::sparse_details_impl, 254, 262, 273
- fspmm_simd_aligned
 - FFLAS::sparse_details_impl, 253, 261
- fspmm_simd_unaligned
 - FFLAS::sparse_details_impl, 253, 261
- fspmv
 - FFLAS, 150, 158
 - FFLAS::sparse_details, 233–235, 243, 244
 - FFLAS::sparse_details_impl, 255, 256, 263, 267, 268, 274, 275, 277, 278, 281–284
- fspmv_dispatch
 - FFLAS::sparse_details, 233
- fspmv_mone
 - FFLAS::sparse_details_impl, 256, 264, 275, 278, 279, 285
- fspmv_mone_simd
 - FFLAS::sparse_details_impl, 279, 285
- fspmv_one
 - FFLAS::sparse_details_impl, 256, 264, 275, 278, 284, 285
- fspmv_one_simd
 - FFLAS::sparse_details_impl, 279, 285
- fspmv_simd
 - FFLAS::sparse_details_impl, 277, 278, 284
- fsquare
 - FFLAS, 99–101, 187
- fsquare_3_modular_double
 - fflas_c.h, 956
 - fflas_lvl3.C, 979
- fsquareCommon
 - FFLAS::Protected, 223
- fsub
 - FFLAS, 85, 89, 170, 178
- fsub_1_modular_double
 - fflas_c.h, 950
 - fflas_lvl1.C, 971
- fsub_2_modular_double
 - fflas_c.h, 954
 - fflas_lvl2.C, 976
- fsubin
 - FFLAS, 85, 90, 179
- fsubin_1_modular_double
 - fflas_c.h, 950
 - fflas_lvl1.C, 972
- fsubin_2_modular_double
 - fflas_c.h, 954
 - fflas_lvl2.C, 976
- fswap
 - FFLAS, 139, 169
- fswap_1_modular_double
 - fflas_c.h, 949
 - fflas_lvl1.C, 971
- fsyr2k
 - FFLAS, 126
- fsyrk
 - FFLAS, 127–129
- fsyrk.C, 763
 - CUBE, 764
 - GFOPS, 764
 - main, 764
 - TTimer, 764
- fsytrf
 - FFPACK, 318, 319
- fsytrf.C, 764
 - CUBE, 765
 - GFOPS, 765
 - main, 765
 - TTimer, 765
- fsytrf_BC_Crout
 - FFPACK, 353
- fsytrf_BC_RL
 - FFPACK, 353
- fsytrf_LOW_RPM_BC_Crout
 - FFPACK, 353
- fsytrf_nonunit
 - FFPACK, 319, 354
- fsytrf_RPM
 - FFPACK, 355
- fsytrf_UP_RPM
 - FFPACK, 354
- fsytrf_UP_RPM_BC_Crout
 - FFPACK, 354
- fsytrf_UP_RPM_BC_RL
 - FFPACK, 353
- ftmrm
 - FFLAS, 130, 131, 184
- ftmrm_3_modular_double
 - fflas_c.h, 955
 - fflas_lvl3.C, 979
- ftmrmLeftLowerNoTransNonUnit< Element >, 464
- ftmrmLeftLowerNoTransUnit< Element >, 464

- ftmmLeftLowerTransNonUnit< Element >, 465
- ftmmLeftLowerTransUnit< Element >, 465
- ftmmLeftUpperNoTransNonUnit< Element >, 465
- ftmmLeftUpperNoTransUnit< Element >, 465
- ftmmLeftUpperTransNonUnit< Element >, 465
- ftmmLeftUpperTransUnit< Element >, 465
- ftmmRightLowerNoTransNonUnit< Element >, 465
- ftmmRightLowerNoTransUnit< Element >, 465
- ftmmRightLowerTransNonUnit< Element >, 466
- ftmmRightLowerTransUnit< Element >, 466
- ftmmRightUpperNoTransNonUnit< Element >, 466
- ftmmRightUpperNoTransUnit< Element >, 466
- ftmmRightUpperTransNonUnit< Element >, 466
- ftmmRightUpperTransUnit< Element >, 466
- ftmv
 - FFLAS, 146
- ftsm
 - FFLAS, 132, 133, 146, 149, 150, 183
- ftsm_3_modular_double
 - fflas_c.h, 955
 - fflas_lvl3.C, 978
- ftsmLeftLowerNoTransNonUnit< Element >, 466
- ftsmLeftLowerNoTransUnit< Element >, 466
- ftsmLeftLowerTransNonUnit< Element >, 467
- ftsmLeftLowerTransUnit< Element >, 467
- ftsmLeftUpperNoTransNonUnit< Element >, 467
- ftsmLeftUpperNoTransUnit< Element >, 467
- ftsmLeftUpperTransNonUnit< Element >, 467
- ftsmLeftUpperTransUnit< Element >, 467
- ftsmRightLowerNoTransNonUnit< Element >, 468
- ftsmRightLowerNoTransUnit< Element >, 468
- ftsmRightLowerTransNonUnit< Element >, 468
- ftsmRightLowerTransUnit< Element >, 468
- ftsmRightUpperNoTransNonUnit< Element >, 468
- ftsmRightUpperNoTransUnit< Element >, 468
- ftsmRightUpperTransNonUnit< Element >, 468
- ftsmRightUpperTransUnit< Element >, 468
- ftssyr2k
 - FFPACK, 317
- ftstr
 - FFPACK, 317
- ftsv
 - FFLAS, 134, 182
- ftsv_2_modular_double
 - fflas_c.h, 955
 - fflas_lvl2.C, 977
- fttri
 - FFPACK, 316, 368
- fttri.C, 765
 - CUBE, 766
 - GFOPS, 766
 - main, 766
 - TTimer, 766
- fttri_modular_double
 - ffpack.C, 987
 - ffpack_c.h, 1010
- fttrm
 - FFPACK, 316, 369
- fttrm_modular_double
 - ffpack.C, 987
 - ffpack_c.h, 1011
- fzero
 - FFLAS, 137, 140, 165, 171
- fzero_1_modular_double
 - fflas_c.h, 948
 - fflas_lvl1.C, 969
- fzero_2_modular_double
 - fflas_c.h, 951
 - fflas_lvl2.C, 973
- gather
 - Simd128_impl< true, true, false, 2 >, 570
 - Simd128_impl< true, true, false, 4 >, 578
 - Simd128_impl< true, true, false, 8 >, 587
 - Simd128_impl< true, true, true, 2 >, 596
 - Simd128_impl< true, true, true, 4 >, 605
 - Simd128_impl< true, true, true, 8 >, 614
 - Simd256_impl< true, false, true, 8 >, 625
 - Simd256_impl< true, true, false, 2 >, 632
 - Simd256_impl< true, true, false, 4 >, 642, 645
 - Simd256_impl< true, true, false, 8 >, 657
 - Simd256_impl< true, true, true, 2 >, 666
 - Simd256_impl< true, true, true, 4 >, 676, 683
 - Simd256_impl< true, true, true, 8 >, 691
 - Simd512_impl< true, false, true, 8 >, 701
 - Simd512_impl< true, true, false, 8 >, 708
 - Simd512_impl< true, true, true, 8 >, 718
- GaussJordan
 - FFPACK::Protected, 397
- GCC_VERSION
 - fflas-ffpack-config.h, 818
- gebp
 - FFLAS::details, 213
- genData
 - benchmark-fgemv.C, 784
- generate_random_vector
 - test-simd.C, 1107, 1108
- GenericTag, 469
- get
 - Simd128_impl< true, true, false, 8 >, 590
 - Simd128_impl< true, true, true, 8 >, 614
 - Simd256_impl< true, true, false, 8 >, 660
 - Simd256_impl< true, true, true, 8 >, 691
- getDataType
 - FFLAS, 157
- getEchelonForm
 - FFPACK, 345
- getEchelonForm< FFLAS_FIELD< FFLAS_ELT > >
 - FFPACK, 378, 379
- getEchelonForm_modular_double
 - ffpack.C, 999
 - ffpack_c.h, 1021
- getEchelonFormin_modular_double
 - ffpack.C, 1000
 - ffpack_c.h, 1021
- getEchelonTransform
 - FFPACK, 346

[getEchelonTransform< FFLAS_FIELD< FFLAS_ELT > >](#)
[FFPACK, 379](#)
[getEchelonTransform_modular_double](#)
[ffpack.C, 1000](#)
[ffpack_c.h, 1021](#)
[getListArgs](#)
[args-parser.h, 1041](#)
[getReducedEchelonForm](#)
[FFPACK, 347, 348](#)
[getReducedEchelonForm< FFLAS_FIELD< FFLAS_ELT > >](#)
[FFPACK, 379, 380](#)
[getReducedEchelonForm_modular_double](#)
[ffpack.C, 1000](#)
[ffpack_c.h, 1022](#)
[getReducedEchelonFormin_modular_double](#)
[ffpack.C, 1001](#)
[ffpack_c.h, 1022](#)
[getReducedEchelonTransform](#)
[FFPACK, 348](#)
[getReducedEchelonTransform< FFLAS_FIELD< FFLAS_ELT > >](#)
[FFPACK, 380](#)
[getReducedEchelonTransform_modular_double](#)
[ffpack.C, 1001](#)
[ffpack_c.h, 1022](#)
[getSeed](#)
[FFLAS, 198](#)
[getStat](#)
[FFLAS, 159](#)
[getTLBSize](#)
[FFLAS, 198](#)
[getTriangular](#)
[FFPACK, 343, 344](#)
[getTriangular< FFLAS_FIELD< FFLAS_ELT > >](#)
[FFPACK, 378](#)
[getTriangular_modular_double](#)
[ffpack.C, 999](#)
[ffpack_c.h, 1020](#)
[getTriangularin_modular_double](#)
[ffpack.C, 999](#)
[ffpack_c.h, 1020](#)
[getTridiagonal](#)
[FFPACK, 355](#)
[gf2ModularBalanced](#)
[regression-check.C, 1057](#)
[GFOPS](#)
[arithprog.C, 761](#)
[autotune/charpoly.C, 762](#)
[autotune/pluq.C, 767](#)
[fsyrk.C, 764](#)
[fsytrf.C, 765](#)
[ftrtri.C, 766](#)
[winograd.C, 768](#)
[Givaro, 403](#)
[gmp.C, 1052](#)
[main, 1052](#)

[GRAIN](#)
[benchmark-fgemm-rns.C, 780](#)
[Grain, 469](#)
[greater](#)
[ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, 560](#)
[ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, 565](#)
[Simd128_impl< true, true, false, 2 >, 571](#)
[Simd128_impl< true, true, false, 4 >, 579](#)
[Simd128_impl< true, true, false, 8 >, 588](#)
[Simd128_impl< true, true, true, 2 >, 600](#)
[Simd128_impl< true, true, true, 4 >, 609](#)
[Simd128_impl< true, true, true, 8 >, 618](#)
[Simd256_impl< true, false, true, 8 >, 628](#)
[Simd256_impl< true, true, false, 2 >, 633](#)
[Simd256_impl< true, true, false, 4 >, 643, 646](#)
[Simd256_impl< true, true, false, 8 >, 658](#)
[Simd256_impl< true, true, true, 2 >, 671](#)
[Simd256_impl< true, true, true, 4 >, 681, 687](#)
[Simd256_impl< true, true, true, 8 >, 696](#)
[Simd512_impl< true, false, true, 8 >, 704](#)
[Simd512_impl< true, true, false, 8 >, 709](#)
[Simd512_impl< true, true, true, 8 >, 723](#)
[greater_eq](#)
[ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, 560](#)
[ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, 565](#)
[Simd128_impl< true, true, false, 2 >, 571](#)
[Simd128_impl< true, true, false, 4 >, 579](#)
[Simd128_impl< true, true, false, 8 >, 588](#)
[Simd128_impl< true, true, true, 2 >, 601](#)
[Simd128_impl< true, true, true, 4 >, 609](#)
[Simd128_impl< true, true, true, 8 >, 618](#)
[Simd256_impl< true, false, true, 8 >, 628](#)
[Simd256_impl< true, true, false, 2 >, 633](#)
[Simd256_impl< true, true, false, 4 >, 643, 646](#)
[Simd256_impl< true, true, false, 8 >, 658](#)
[Simd256_impl< true, true, true, 2 >, 671](#)
[Simd256_impl< true, true, true, 4 >, 681, 687](#)
[Simd256_impl< true, true, true, 8 >, 696](#)
[Simd512_impl< true, false, true, 8 >, 705](#)
[Simd512_impl< true, true, false, 8 >, 709](#)
[Simd512_impl< true, true, true, 8 >, 723](#)
[hadd](#)
[Simd256_impl< true, false, true, 8 >, 629](#)
[Simd512_impl< true, false, true, 8 >, 705](#)
[hadd_to_scal](#)
[Simd128_impl< true, true, false, 2 >, 572](#)
[Simd128_impl< true, true, false, 4 >, 581](#)
[Simd128_impl< true, true, false, 8 >, 589](#)
[Simd128_impl< true, true, true, 2 >, 601](#)
[Simd128_impl< true, true, true, 4 >, 610](#)
[Simd128_impl< true, true, true, 8 >, 618](#)
[Simd256_impl< true, false, true, 8 >, 629](#)

- Simd256_impl< true, true, false, 2 >, [634](#)
- Simd256_impl< true, true, false, 4 >, [644](#), [647](#)
- Simd256_impl< true, true, false, 8 >, [660](#)
- Simd256_impl< true, true, true, 2 >, [671](#)
- Simd256_impl< true, true, true, 4 >, [682](#), [687](#)
- Simd256_impl< true, true, true, 8 >, [696](#)
- Simd512_impl< true, false, true, 8 >, [705](#)
- Simd512_impl< true, true, false, 8 >, [711](#)
- Simd512_impl< true, true, true, 8 >, [723](#)
- half_t
 - Simd256_impl< true, true, false, 2 >, [632](#)
 - Simd256_impl< true, true, false, 4 >, [642](#)
 - Simd256_impl< true, true, false, 8 >, [657](#)
 - Simd256_impl< true, true, true, 2 >, [665](#)
 - Simd256_impl< true, true, true, 4 >, [675](#), [676](#)
 - Simd256_impl< true, true, true, 8 >, [690](#)
 - Simd512_impl< true, true, false, 8 >, [708](#)
 - Simd512_impl< true, true, true, 8 >, [717](#)
- has_equal
 - FFLAS, [80](#)
- has_minus
 - FFLAS, [79](#)
- has_minus_eq
 - FFLAS, [80](#)
- has_minus_eq_impl< C >, [469](#)
 - value, [469](#)
- has_minus_impl< C >, [469](#)
 - value, [470](#)
- has_mul
 - FFLAS, [80](#)
- has_mul_eq
 - FFLAS, [80](#)
- has_mul_eq_impl< C >, [470](#)
 - value, [470](#)
- has_mul_impl< C >, [470](#)
 - value, [470](#)
- has_operation< T >, [470](#)
 - value, [471](#)
- has_plus
 - FFLAS, [79](#)
- has_plus_eq
 - FFLAS, [80](#)
- has_plus_eq_impl< C >, [471](#)
 - value, [471](#)
- has_plus_impl< C >, [471](#)
 - value, [471](#)
- hasAVX512ER
 - instrset.h, [1055](#)
 - instrset_detect.cpp, [1056](#)
- hasF16C
 - instrset_detect.cpp, [1055](#)
- hasFMA3
 - instrset.h, [1054](#)
 - instrset_detect.cpp, [1055](#)
- hasFMA4
 - instrset.h, [1054](#)
 - instrset_detect.cpp, [1055](#)
- hasXOP
 - instrset.h, [1055](#)
 - instrset_detect.cpp, [1055](#)
- HAVE_BLAS
 - config.h, [796](#)
- HAVE_CBLAS
 - config.h, [796](#)
- HAVE_CXX11
 - config.h, [796](#)
- HAVE_DLFCN_H
 - config.h, [797](#)
- HAVE_FLOAT_H
 - config.h, [797](#)
- HAVE_INT128
 - config.h, [797](#)
- HAVE_INTPTR_T
 - config.h, [797](#)
- HAVE_LAPACK
 - config.h, [797](#)
- HAVE_LIMITS_H
 - config.h, [797](#)
- HAVE_LITTLE_ENDIAN
 - config.h, [797](#)
- HAVE_PTHREAD_H
 - config.h, [797](#)
- HAVE_STDDEF_H
 - config.h, [797](#)
- HAVE_STDINT_H
 - config.h, [797](#)
- HAVE_STDIO_H
 - config.h, [797](#)
- HAVE_STDLIB_H
 - config.h, [797](#)
- HAVE_STRING_H
 - config.h, [798](#)
- HAVE_STRINGS_H
 - config.h, [798](#)
- HAVE_SYS_STAT_H
 - config.h, [798](#)
- HAVE_SYS_TIME_H
 - config.h, [798](#)
- HAVE_SYS_TYPES_H
 - config.h, [798](#)
- HAVE_UNISTD_H
 - config.h, [798](#)
- HelperFlag, [471](#)
 - aut, [472](#)
 - coo, [472](#)
 - csr, [472](#)
 - ell, [472](#)
 - none, [472](#)
 - pm1, [472](#)
- HelperMod
 - HelperMod< Field, ElementCategories::MachineIntTag >, [473](#)
 - HelperMod< Field, FFLAS::ElementCategories::ArbitraryPrecIntTag >, [474](#)
 - HelperMod< Field, FFLAS::ElementCategories::FixedPrecIntTag >, [474](#)

- HelperMod< Field, FFLAS::ElementCategories::MachineIntTag
>, 475
- HelperMod< Field, ElementCategories::MachineIntTag
>, 472
- HelperMod, 473
- invp, 473
- max, 473
- min, 473
- p, 473
- pow50rem, 473
- HelperMod< Field, ElementTraits >, 472
- HelperMod< Field, FFLAS::ElementCategories::ArbitraryPrecisionIntTag
>, 474
- HelperMod, 474
- p, 474
- HelperMod< Field, FFLAS::ElementCategories::FixedPrecisionIntTag
>, 474
- HelperMod, 474
- p, 475
- HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag
>, 475
- HelperMod, 475
- invp, 475
- max, 476
- min, 475
- p, 475
- helpString
 - Argument, 407
- HYB_ZO
 - FFLAS, 83
- hyb_zo.h, 899
- hyb_zo_pspmm.inl, 899
 - __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmm_INL, range
900
- hyb_zo_pspmv.inl, 900
 - __FFLASFFPACK_fflas_sparse_HYB_ZO_pspmv_INL, range
900
- hyb_zo_spm.inl, 901
 - __FFLASFFPACK_fflas_sparse_HYB_ZO_spm_INL, range
901
- hyb_zo_spmv.inl, 901
 - __FFLASFFPACK_fflas_sparse_HYB_ZO_spmv_INL, range
901
- hyb_zo_utils.inl, 902
 - __FFLASFFPACK_fflas_sparse_HYB_ZO_utils_INL, range
902
- Hybrid, 476
- Hybrid_KGF_LUK_MinPoly
 - FFPACK::Protected, 400
- ibeg
 - ForStrategy1D< blocksize_t, Cut, Param >, 460
- ibegin
 - ForStrategy2D< blocksize_t, Cut, Param >, 462
- idamax
 - config-blas.h, 814
- iend
 - ForStrategy1D< blocksize_t, Cut, Param >, 460
 - ForStrategy2D< blocksize_t, Cut, Param >, 462
- FFLAS::details, 212
- igebb14
 - FFLAS::details, 211
- igebb21
 - FFLAS::details, 212
- igebb24
 - FFLAS::details, 211
- igebb41
 - FFLAS::details, 211
- igebb44
 - FFLAS::details, 211
- igebp
 - FFLAS::details, 212
- igemm
 - FFLAS::Protected, 228
 - igemm.doxy, 852
 - igemm.h, 852
 - igemm.inl, 853
- FFLASFFPACK_fflas_igemm_igemm_INL, 853
- igemm_
 - FFLAS, 134
- igemm_colmajor
 - FFLAS::Protected, 228
- igemm_kernels.h, 854
- igemm_kernels.inl, 854
- __FFLASFFPACK_fflas_igemm_igemm_kernels_INL, 855
- igemm_tools.h, 855
- igemm_tools.inl, 855
- __FFLASFFPACK_fflas_igemm_igemm_tools_INL, 856
- inl_range
 - flimits.h, 1047, 1048
- index_t
 - fflas_sparse.h, 878
 - parallel.h, 1032
- InfNorm
 - FFLAS, 84
- Info, 476, 477
 - begin, 477, 478
 - Info, 476, 478
 - operator=, 477, 478
 - perm, 477, 478
 - size, 477, 478
- init
 - FieldSimd< _Field >, 446
 - rns_double, 529–531
 - rns_double_extended, 542, 543
 - RNSInteger< RNS >, 547
 - RNSIntegerMod< RNS >, 551, 552
- init_transpose
 - rns_double, 530
- init_y
 - FFLAS::sparse_details, 232, 233
- initA
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 500

- initB
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [500](#)
- initC
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [500](#)
- initialize
 - ForStrategy1D< blocksize_t, Cut, Param >, [460](#)
 - ForStrategy2D< blocksize_t, Cut, Param >, [462](#)
- initOut
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [500](#)
- INLINE
 - fflas_simd.h, [866](#)
- INST_OR_DECL
 - fflas_L1_inst.C, [957](#)
 - fflas_L1_inst.h, [958](#)
 - fflas_L2_inst.C, [961](#)
 - fflas_L2_inst.h, [962](#)
 - fflas_L3_inst.C, [965](#)
 - fflas_L3_inst.h, [966](#)
 - ffpack_inst.C, [1023](#)
 - ffpack_inst.h, [1024](#)
- INSTRSET
 - instrset.h, [1053](#)
- instrset.h, [1052](#)
 - const_int, [1053](#)
 - const_uint, [1053](#)
 - hasAVX512ER, [1055](#)
 - hasFMA3, [1054](#)
 - hasFMA4, [1054](#)
 - hasXOP, [1055](#)
 - INSTRSET, [1053](#)
 - instrset_detect, [1054](#)
 - INSTRSET_H, [1053](#)
 - int16_t, [1054](#)
 - int32_t, [1054](#)
 - int64_t, [1054](#)
 - int8_t, [1053](#)
 - intptr_t, [1054](#)
 - uint16_t, [1054](#)
 - uint32_t, [1054](#)
 - uint64_t, [1054](#)
 - uint8_t, [1054](#)
- instrset_detect
 - instrset.h, [1054](#)
 - instrset_detect.cpp, [1055](#)
- instrset_detect.cpp, [1055](#)
 - hasAVX512ER, [1056](#)
 - hasF16C, [1055](#)
 - hasFMA3, [1055](#)
 - hasFMA4, [1055](#)
 - hasXOP, [1055](#)
 - instrset_detect, [1055](#)
- INSTRSET_H
 - instrset.h, [1053](#)
- int16_t
 - instrset.h, [1054](#)
- int32_t
 - instrset.h, [1054](#)
- int64_t
 - instrset.h, [1054](#)
- int8_t
 - instrset.h, [1053](#)
- integer
 - rns_double, [528](#)
 - rns_double_extended, [541](#)
 - RNSInteger< RNS >, [546](#)
 - RNSIntegerMod< RNS >, [550](#)
 - test-simd.C, [1106](#)
- Interfaces, [51](#)
- interfaces.doxy, [943](#)
- intptr_t
 - instrset.h, [1054](#)
- inv
 - RNSIntegerMod< RNS >, [553](#)
- Invert
 - FFPACK, [327](#), [328](#), [371](#)
- Invert2
 - FFPACK, [328](#), [372](#)
- Invert2_modular_double
 - ffpack.C, [995](#)
 - ffpack_c.h, [1016](#)
- Invert_modular_double
 - ffpack.C, [994](#)
 - ffpack_c.h, [1016](#)
- Invertin_modular_double
 - ffpack.C, [994](#)
 - ffpack_c.h, [1015](#)
- invp
 - HelperMod< Field, ElementCategories::MachineIntTag >, [473](#)
 - HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag >, [475](#)
- is_simd< T >, [479](#)
 - type, [479](#)
 - value, [479](#)
- isMOne
 - RNSInteger< RNS >, [547](#)
 - RNSIntegerMod< RNS >, [551](#)
- isOdd
 - FFPACK, [381](#)
- isOne
 - RNSInteger< RNS >, [546](#)
 - RNSIntegerMod< RNS >, [551](#)
- IsSingular
 - FFPACK, [333](#), [374](#)
- IsSingular_modular_double
 - ffpack.C, [995](#)
 - ffpack_c.h, [1017](#)
- isSparseMatrix< Field, M >, [479](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO > >, [480](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >, [480](#)

- isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR > >, [480](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_HYB > >, [480](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >, [481](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL > >, [481](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd > >, [481](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >, [482](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >, [482](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::HYB_ZO > >, [482](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL > >, [483](#)
- isSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >, [483](#)
- isSparseMatrixMKLFormat< F, M >, [483](#)
- isSparseMatrixSimdFormat< F, M >, [483](#)
- isTerminated
 - ForStrategy1D< blocksize_t, Cut, Param >, [460](#)
 - ForStrategy2D< blocksize_t, Cut, Param >, [462](#)
- isZero
 - RNSInteger< RNS >, [547](#)
 - RNSIntegerMod< RNS >, [551](#)
- isZOSparseMatrix< F, M >, [484](#)
- isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::COO_ZO > >, [484](#)
- isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::CSR_ZO > >, [484](#)
- isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_simd_ZO > >, [485](#)
- isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::ELL_ZO > >, [485](#)
- isZOSparseMatrix< Field, Sparse< Field, SparseMatrix_t::SELL_ZO > >, [485](#)
- Iterative, [485](#)
- jbegin
 - ForStrategy2D< blocksize_t, Cut, Param >, [462](#)
- jend
 - ForStrategy2D< blocksize_t, Cut, Param >, [462](#)
- kaapi_routines.inl, [1031](#)
- __FFLASFFPACK_KAAPI_ROUTINES_INL, [1031](#)
- KellerGehrig
 - FFPACK::Protected, [398](#)
- KGFast
 - FFPACK::Protected, [398](#)
- KGFast_generalized
 - FFPACK::Protected, [398](#)
- kmax
 - Sparse< _Field, SparseMatrix_t::COO >, [729](#)
 - Sparse< _Field, SparseMatrix_t::COO_ZO >, [731](#)
 - Sparse< _Field, SparseMatrix_t::CSR >, [732](#)
 - Sparse< _Field, SparseMatrix_t::CSR_HYB >, [734](#)
 - Sparse< _Field, SparseMatrix_t::CSR_ZO >, [736](#)
 - Sparse< _Field, SparseMatrix_t::ELL >, [737](#)
 - Sparse< _Field, SparseMatrix_t::ELL_simd >, [739](#)
 - Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >, [741](#)
 - Sparse< _Field, SparseMatrix_t::ELL_ZO >, [742](#)
 - Sparse< _Field, SparseMatrix_t::HYB_ZO >, [744](#)
 - Sparse< _Field, SparseMatrix_t::SELL >, [746](#)
 - Sparse< _Field, SparseMatrix_t::SELL_ZO >, [748](#)
- KrylovElim
 - FFPACK, [373](#)
- KrylovElim_modular_double
 - ffpack.C, [995](#)
 - ffpack_c.h, [1016](#)
- lapack.C, [1056](#)
- __FFLASFFPACK_CONFIGURATION, [1056](#)
- __FFLASFFPACK_HAVE_LAPACK, [1056](#)
- main, [1056](#)
- LAPACKPerm2MathPerm
 - FFPACK, [310](#)
 - ffpack.C, [983](#)
 - ffpack_c.h, [1007](#)
- lastBlockSize
 - ForStrategy1D< blocksize_t, Cut, Param >, [461](#)
- lastCBS
 - ForStrategy2D< blocksize_t, Cut, Param >, [464](#)
- lastRBS
 - ForStrategy2D< blocksize_t, Cut, Param >, [464](#)
- launch_fger
 - test-fger.C, [1073](#)
- launch_fger_dispatch
 - test-fger.C, [1074](#)
- launch_MM
 - test-fgemm.C, [1069](#)
- launch_MM_dispatch
 - test-fgemm-check.C, [1067](#)
 - test-fgemm.C, [1070](#)
- launch_MV
 - test-fgemv.C, [1071](#)
- launch_MV_dispatch
 - test-fgemv.C, [1072](#)
- launch_test
 - test-charpoly.C, [1059](#)
 - test-lu.C, [1096](#)
- launch_wino
 - benchmark-wino.C, [795](#)
- LazyTag, [486](#)
- ld
 - Sparse< _Field, SparseMatrix_t::ELL >, [738](#)
 - Sparse< _Field, SparseMatrix_t::ELL_simd >, [739](#)
 - Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >, [741](#)
 - Sparse< _Field, SparseMatrix_t::ELL_ZO >, [743](#)
- LeadingSubmatrixRankProfiles
 - FFPACK, [340](#)
 - ffpack.C, [998](#)

- ffpack_c.h, [1019](#)
- lesser
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, [560](#)
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [565](#)
 - Simd128_impl< true, true, false, 2 >, [571](#)
 - Simd128_impl< true, true, false, 4 >, [579](#)
 - Simd128_impl< true, true, false, 8 >, [588](#)
 - Simd128_impl< true, true, true, 2 >, [601](#)
 - Simd128_impl< true, true, true, 4 >, [609](#)
 - Simd128_impl< true, true, true, 8 >, [618](#)
 - Simd256_impl< true, false, true, 8 >, [628](#)
 - Simd256_impl< true, true, false, 2 >, [633](#)
 - Simd256_impl< true, true, false, 4 >, [643](#), [646](#)
 - Simd256_impl< true, true, false, 8 >, [658](#)
 - Simd256_impl< true, true, true, 2 >, [671](#)
 - Simd256_impl< true, true, true, 4 >, [681](#), [687](#)
 - Simd256_impl< true, true, true, 8 >, [696](#)
 - Simd512_impl< true, false, true, 8 >, [704](#)
 - Simd512_impl< true, true, false, 8 >, [709](#)
 - Simd512_impl< true, true, true, 8 >, [723](#)
- lesser_eq
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, [560](#)
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [565](#)
 - Simd128_impl< true, true, false, 2 >, [571](#)
 - Simd128_impl< true, true, false, 4 >, [579](#)
 - Simd128_impl< true, true, false, 8 >, [588](#)
 - Simd128_impl< true, true, true, 2 >, [601](#)
 - Simd128_impl< true, true, true, 4 >, [609](#)
 - Simd128_impl< true, true, true, 8 >, [618](#)
 - Simd256_impl< true, false, true, 8 >, [628](#)
 - Simd256_impl< true, true, false, 2 >, [633](#)
 - Simd256_impl< true, true, false, 4 >, [643](#), [646](#)
 - Simd256_impl< true, true, false, 8 >, [658](#)
 - Simd256_impl< true, true, true, 2 >, [671](#)
 - Simd256_impl< true, true, true, 4 >, [681](#), [687](#)
 - Simd256_impl< true, true, true, 8 >, [696](#)
 - Simd512_impl< true, false, true, 8 >, [704](#)
 - Simd512_impl< true, true, false, 8 >, [709](#)
 - Simd512_impl< true, true, true, 8 >, [723](#)
- limits< char >, [486](#)
 - digits, [486](#)
 - max, [486](#)
 - min, [486](#)
 - T, [486](#)
- limits< double >, [487](#)
 - digits, [487](#)
 - max, [487](#)
 - min, [487](#)
 - T, [487](#)
- limits< float >, [487](#)
 - digits, [488](#)
 - max, [488](#)
- min, [488](#)
 - T, [488](#)
- limits< Givaro::Integer >, [488](#)
 - max, [488](#)
 - min, [488](#)
 - T, [488](#)
- limits< int >, [489](#)
 - digits, [489](#)
 - max, [489](#)
 - min, [489](#)
 - T, [489](#)
- limits< long >, [489](#)
 - digits, [490](#)
 - max, [490](#)
 - min, [490](#)
 - T, [490](#)
- limits< long long >, [490](#)
 - digits, [491](#)
 - max, [491](#)
 - min, [491](#)
 - T, [490](#)
- limits< Reclnt::rint< K > >, [491](#)
 - max, [491](#)
 - min, [491](#)
 - T, [491](#)
- limits< Reclnt::ruint< K > >, [492](#)
 - max, [492](#)
 - min, [492](#)
 - T, [492](#)
- limits< short int >, [492](#)
 - digits, [493](#)
 - max, [493](#)
 - min, [493](#)
 - T, [492](#)
- limits< signed char >, [493](#)
 - digits, [493](#)
 - max, [493](#)
 - min, [493](#)
 - T, [493](#)
- limits< T >, [486](#)
- limits< unsigned char >, [494](#)
 - digits, [494](#)
 - max, [494](#)
 - min, [494](#)
 - T, [494](#)
- limits< unsigned int >, [494](#)
 - digits, [495](#)
 - max, [495](#)
 - min, [495](#)
 - T, [495](#)
- limits< unsigned long >, [495](#)
 - digits, [496](#)
 - max, [496](#)
 - min, [496](#)
 - T, [495](#)
- limits< unsigned long long >, [496](#)
 - digits, [496](#)
 - max, [496](#)

- min, [496](#)
- T, [496](#)
- limits< unsigned short int >, [497](#)
 - digits, [497](#)
 - max, [497](#)
 - min, [497](#)
 - T, [497](#)
- load
 - Simd128_impl< true, true, false, 2 >, [570](#)
 - Simd128_impl< true, true, false, 4 >, [578](#)
 - Simd128_impl< true, true, false, 8 >, [587](#)
 - Simd128_impl< true, true, true, 2 >, [596](#)
 - Simd128_impl< true, true, true, 4 >, [605](#)
 - Simd128_impl< true, true, true, 8 >, [614](#)
 - Simd256_impl< true, false, true, 8 >, [625](#)
 - Simd256_impl< true, true, false, 2 >, [632](#)
 - Simd256_impl< true, true, false, 4 >, [642](#), [645](#)
 - Simd256_impl< true, true, false, 8 >, [657](#)
 - Simd256_impl< true, true, true, 2 >, [666](#)
 - Simd256_impl< true, true, true, 4 >, [676](#), [683](#)
 - Simd256_impl< true, true, true, 8 >, [691](#)
 - Simd512_impl< true, false, true, 8 >, [701](#)
 - Simd512_impl< true, true, false, 8 >, [708](#)
 - Simd512_impl< true, true, true, 8 >, [718](#)
- loadu
 - Simd128_impl< true, true, false, 2 >, [570](#)
 - Simd128_impl< true, true, false, 4 >, [578](#)
 - Simd128_impl< true, true, false, 8 >, [587](#)
 - Simd128_impl< true, true, true, 2 >, [596](#)
 - Simd128_impl< true, true, true, 4 >, [605](#)
 - Simd128_impl< true, true, true, 8 >, [614](#)
 - Simd256_impl< true, false, true, 8 >, [625](#)
 - Simd256_impl< true, true, false, 2 >, [632](#)
 - Simd256_impl< true, true, false, 4 >, [642](#), [645](#)
 - Simd256_impl< true, true, false, 8 >, [657](#)
 - Simd256_impl< true, true, true, 2 >, [667](#)
 - Simd256_impl< true, true, true, 4 >, [677](#), [683](#)
 - Simd256_impl< true, true, true, 8 >, [691](#)
 - Simd512_impl< true, false, true, 8 >, [701](#)
 - Simd512_impl< true, true, false, 8 >, [708](#)
 - Simd512_impl< true, true, true, 8 >, [718](#)
- LQUPtoInverseOfFullRankMinor
 - FFPACK, [349](#), [380](#)
- LT_OBJDIR
 - config.h, [798](#)
- LUdivine
 - FFPACK, [321](#), [356](#), [369](#)
- LUdivine_construct
 - FFPACK::Protected, [397](#), [402](#)
- LUdivine_gauss
 - FFPACK, [355](#), [370](#)
- LUdivine_gauss_modular_double
 - ffpack_c.h, [1012](#)
- LUdivine_modular_double
 - ffpack.C, [988](#)
 - ffpack_c.h, [1011](#)
- LUdivine_small
 - FFPACK, [355](#), [369](#)
- LUdivine_small_modular_double
 - ffpack_c.h, [1011](#)
- LUKrylov
 - FFPACK::Protected, [399](#)
- LUKrylov_KGFast
 - FFPACK::Protected, [400](#)
- m
 - Sparse< _Field, SparseMatrix_t::COO >, [729](#)
 - Sparse< _Field, SparseMatrix_t::COO_ZO >, [731](#)
 - Sparse< _Field, SparseMatrix_t::CSR >, [732](#)
 - Sparse< _Field, SparseMatrix_t::CSR_HYB >, [734](#)
 - Sparse< _Field, SparseMatrix_t::CSR_ZO >, [736](#)
 - Sparse< _Field, SparseMatrix_t::ELL >, [738](#)
 - Sparse< _Field, SparseMatrix_t::ELL_simd >, [739](#)
 - Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >, [741](#)
 - Sparse< _Field, SparseMatrix_t::ELL_ZO >, [742](#)
 - Sparse< _Field, SparseMatrix_t::HYB_ZO >, [744](#)
 - Sparse< _Field, SparseMatrix_t::SELL >, [746](#)
 - Sparse< _Field, SparseMatrix_t::SELL_ZO >, [748](#)
- MachineFloatTag, [497](#)
- MachineIntTag, [498](#)
- main
 - 101-fgemv.C, [1110](#)
 - 2x2-fgemv.C, [1110](#)
 - 2x2-ftsv.C, [1111](#)
 - 2x2-pluq.C, [1111](#)
 - arithprog.C, [762](#)
 - autotune/charpoly.C, [763](#)
 - autotune/pluq.C, [767](#)
 - benchmark-charpoly-mp.C, [769](#)
 - benchmark-charpoly.C, [770](#)
 - benchmark-checkers.C, [771](#)
 - benchmark-dgemm.C, [772](#)
 - benchmark-dgetrf.C, [773](#)
 - benchmark-dgetri.C, [774](#)
 - benchmark-dsytrf.C, [775](#)
 - benchmark-dtrsm.C, [775](#)
 - benchmark-dtrtri.C, [776](#)
 - benchmark-fadd-lvl2.C, [777](#)
 - benchmark-fdot.C, [778](#)
 - benchmark-fgemm-mp.C, [779](#)
 - benchmark-fgemm-rns.C, [781](#)
 - benchmark-fgemm.C, [782](#)
 - benchmark-fgemv-mp.C, [783](#)
 - benchmark-fgemv.C, [786](#)
 - benchmark-fgesv.C, [787](#)
 - benchmark-fsyrf.C, [788](#)
 - benchmark-fsytrf.C, [789](#)
 - benchmark-ftsm-mp.C, [789](#)
 - benchmark-ftsm.C, [790](#)
 - benchmark-ftsv.C, [790](#)
 - benchmark-fttri.C, [791](#)
 - benchmark-inverse.C, [792](#)
 - benchmark-lqup-mp.C, [792](#)
 - benchmark-lqup.C, [793](#)
 - benchmark-pluq.C, [794](#)

- benchmark-wino.C, [795](#)
- cblas.C, [1050](#)
- clapack.C, [1051](#)
- cuda.C, [1051](#)
- det.C, [804](#)
- examples/charpoly.C, [763](#)
- examples/pluq.C, [768](#)
- fblas.C, [1052](#)
- fflas-101_1.C, [1112](#)
- fflas-101_3.C, [1112](#)
- fflas_101.C, [1112](#)
- fflas_101_lvl1.C, [1113](#)
- ffpack-fgesv.C, [1113](#)
- ffpack-solve.C, [1114](#)
- fsyrk.C, [764](#)
- fsytrf.C, [765](#)
- fttrtri.C, [766](#)
- gmp.C, [1052](#)
- lapack.C, [1056](#)
- matmul.C, [804](#)
- rank.C, [805](#)
- regression-check.C, [1057](#)
- solve.C, [805](#)
- test-charpoly-check.C, [1058](#)
- test-charpoly.C, [1059](#)
- test-compressQ.C, [1060](#)
- test-det-check.C, [1061](#)
- test-det.C, [1062](#)
- test-echelon.C, [1064](#)
- test-fadd.C, [1065](#)
- test-fdot.C, [1067](#)
- test-fgemm-check.C, [1068](#)
- test-fgemm.C, [1070](#)
- test-fgemv.C, [1072](#)
- test-fger.C, [1074](#)
- test-fgesv.C, [1075](#)
- test-finit.C, [1076](#)
- test-fscal.C, [1078](#)
- test-fsyr2k.C, [1079](#)
- test-fsyrk.C, [1081](#)
- test-fsytrf.C, [1082](#)
- test-ftmrm.C, [1083](#)
- test-ftmrmv.C, [1085](#)
- test-ftmrm-check.C, [1085](#)
- test-ftmrm.C, [1087](#)
- test-ftmrsyr2k.C, [1088](#)
- test-ftmstr.C, [1089](#)
- test-ftmrv.C, [1090](#)
- test-fttrtri.C, [1091](#)
- test-interfaces-c.c, [1092](#)
- test-invert-check.C, [1092](#)
- test-io.C, [1093](#)
- test-lu.C, [1097](#)
- test-maxdelayeddim.C, [1098](#)
- test-minpoly.C, [1099](#)
- test-multifile2.C, [1100](#)
- test-nullspace.C, [1101](#)
- test-permutations.C, [1102](#)
- test-pluq-check.C, [1103](#)
- test-rankprofiles.C, [1104](#)
- test-rpm.C, [1105](#)
- test-simd.C, [1109](#)
- test-solve.C, [1109](#)
- winograd.C, [769](#)
- mainpage.doxy, [804](#)
- mask_high
 - Simd128_impl< true, true, false, 8 >, [592](#)
 - Simd128_impl< true, true, true, 8 >, [618](#)
 - Simd256_impl< true, true, false, 8 >, [663](#)
 - Simd256_impl< true, true, true, 8 >, [696](#)
 - Simd512_impl< true, true, false, 8 >, [714](#)
 - Simd512_impl< true, true, true, 8 >, [723](#)
- mask_t
 - read_sparse.h, [903](#)
- maskstore
 - Simd512_impl< true, true, false, 8 >, [709](#)
 - Simd512_impl< true, true, true, 8 >, [719](#)
- MatF2MatD_Triangular
 - FFLAS::Protected, [229](#)
- MatF2MatFI_Triangular
 - FFLAS::Protected, [229](#)
- MathPerm2LAPACKPerm
 - FFPACK, [310](#)
 - ffpack.C, [983](#)
 - ffpack_c.h, [1007](#)
- Matio.h, [1048](#)
 - read_field, [1048](#)
 - write_field, [1048](#)
- matmul.C, [804](#)
 - main, [804](#)
- matmul.doxy, [833](#)
- Matrix Multiplication Algorithms, [50](#)
- MatrixApplyS
 - FFPACK, [358](#), [359](#)
- MatrixApplyS_modular_double
 - ffpack.C, [983](#)
 - ffpack_c.h, [1007](#)
- MatrixApplyT
 - FFPACK, [360](#), [361](#)
- MatrixApplyT_modular_double
 - ffpack.C, [984](#)
 - ffpack_c.h, [1007](#)
- MatVecMinPoly
 - FFPACK, [331](#), [373](#)
 - FFPACK::Protected, [400](#)
- max
 - HelperMod< Field, ElementCategories::MachineIntTag >, [473](#)
 - HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag >, [476](#)
 - limits< char >, [486](#)
 - limits< double >, [487](#)
 - limits< float >, [488](#)
 - limits< Givaro::Integer >, [488](#)
 - limits< int >, [489](#)
 - limits< long >, [490](#)

- limits< long long >, [491](#)
- limits< RecInt::rint< K > >, [491](#)
- limits< RecInt::ruint< K > >, [492](#)
- limits< short int >, [493](#)
- limits< signed char >, [493](#)
- limits< unsigned char >, [494](#)
- limits< unsigned int >, [495](#)
- limits< unsigned long >, [496](#)
- limits< unsigned long long >, [496](#)
- limits< unsigned short int >, [497](#)
- max3
 - FFLAS, [84](#)
- max4
 - FFLAS, [84](#)
- MAX_THREADS
 - parallel.h, [1032](#)
- MAX_WITH_SIZE_T
 - test-maxdelayeddim.C, [1098](#)
- maxCol
 - StatsMatrix, [752](#)
- maxColDifference
 - StatsMatrix, [752](#)
- MaxDelayedDim
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [500](#)
- maxElement
 - RNSIntegerMod< RNS >, [551](#)
- maxFieldElt
 - FFPACK, [394](#)
- maxFieldElt< Givaro::ZRing< Givaro::Integer > >
 - FFPACK, [394](#)
- maxpy
 - FieldSimd< _Field >, [449](#)
- maxpyin
 - FieldSimd< _Field >, [450](#)
- maxRow
 - StatsMatrix, [751](#)
- maxrow
 - Sparse< _Field, SparseMatrix_t::COO >, [730](#)
 - Sparse< _Field, SparseMatrix_t::COO_ZO >, [731](#)
 - Sparse< _Field, SparseMatrix_t::CSR >, [733](#)
 - Sparse< _Field, SparseMatrix_t::CSR_HYB >, [734](#)
 - Sparse< _Field, SparseMatrix_t::CSR_ZO >, [736](#)
 - Sparse< _Field, SparseMatrix_t::ELL >, [738](#)
 - Sparse< _Field, SparseMatrix_t::ELL_simd >, [739](#)
 - Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >, [741](#)
 - Sparse< _Field, SparseMatrix_t::ELL_ZO >, [743](#)
 - Sparse< _Field, SparseMatrix_t::HYB_ZO >, [744](#)
 - Sparse< _Field, SparseMatrix_t::SELL >, [746](#)
 - Sparse< _Field, SparseMatrix_t::SELL_ZO >, [748](#)
- maxRowDifference
 - StatsMatrix, [752](#)
- MaxStorableValue
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, [503](#)
- MG_DEFAULT
 - benchmark-fgemm-mp.C, [779](#)
 - benchmark-fgemv-mp.C, [782](#)
- min
 - HelperMod< Field, ElementCategories::MachineIntTag >, [473](#)
 - HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag >, [475](#)
 - limits< char >, [486](#)
 - limits< double >, [487](#)
 - limits< float >, [488](#)
 - limits< Givaro::Integer >, [488](#)
 - limits< int >, [489](#)
 - limits< long >, [490](#)
 - limits< long long >, [491](#)
 - limits< RecInt::rint< K > >, [491](#)
 - limits< RecInt::ruint< K > >, [492](#)
 - limits< short int >, [493](#)
 - limits< signed char >, [493](#)
 - limits< unsigned char >, [494](#)
 - limits< unsigned int >, [495](#)
 - limits< unsigned long >, [496](#)
 - limits< unsigned long long >, [496](#)
 - limits< unsigned short int >, [497](#)
- min3
 - FFLAS, [84](#)
- min4
 - FFLAS, [84](#)
- min_types
 - FFLAS::Protected, [226](#), [227](#)
- minCol
 - StatsMatrix, [752](#)
- minColDifference
 - StatsMatrix, [752](#)
- minElement
 - RNSIntegerMod< RNS >, [551](#)
- MinPoly
 - FFPACK, [331](#), [373](#)
- minRow
 - StatsMatrix, [751](#)
- minRowDifference
 - StatsMatrix, [752](#)
- MKL_CONFIG, [403](#)
- MKLSparseMatrixFormat
 - FFLAS, [79](#)
- MMHelper
 - MMHelper< FFPACK::RNSInteger< E >, Algo-Trait, ModeCategories::DefaultTag, ParSeq-Trait >, [504](#)
 - MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeq-Trait >, [506](#)
 - MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< Dest >, ParSeqTrait >, [508](#)
 - MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeqTrait >, [509](#), [510](#)
 - MMHelper< Field, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, [512](#)

- MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, [499](#), [500](#)
- MMHelper< FFPACK::RNSInteger< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, [503](#)
- MMHelper, [504](#)
- normA, [505](#)
- normB, [505](#)
- operator<<, [504](#)
- parseq, [505](#)
- recLevel, [505](#)
- Self_t, [503](#)
- setNorm, [504](#)
- MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, [505](#)
- MMHelper, [506](#)
- normA, [507](#)
- normB, [507](#)
- operator<<, [507](#)
- parseq, [507](#)
- recLevel, [507](#)
- Self_t, [506](#)
- setNorm, [506](#)
- MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo<mod Dest >, ParSeqTrait >, [507](#)
- MMHelper, [508](#)
- operator<<, [508](#)
- parseq, [508](#)
- recLevel, [508](#)
- Self_t, [508](#)
- MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo<ElementCategories::RNSElementTag >, ParSeqTrait >, [509](#)
- MMHelper, [509](#), [510](#)
- normA, [510](#)
- normB, [510](#)
- operator<<, [510](#)
- parseq, [511](#)
- recLevel, [511](#)
- Self_t, [509](#)
- setNorm, [510](#)
- MMHelper< Field, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, [511](#)
- MMHelper, [512](#)
- operator<<, [512](#)
- parseq, [512](#)
- recLevel, [512](#)
- Self_t, [511](#)
- MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, [498](#)
- Amax, [502](#)
- Amin, [502](#)
- Aunfit, [501](#)
- Bmax, [502](#)
- Bmin, [502](#)
- Bunfit, [501](#)
- checkA, [501](#)
- checkB, [501](#)
- checkOut, [501](#)
- Cmax, [502](#)
- Cmin, [502](#)
- DelayedField, [499](#)
- delayedField, [503](#)
- DelayedField_t, [499](#)
- DFElt, [499](#)
- FieldMax, [502](#)
- FieldMin, [502](#)
- initA, [500](#)
- initB, [500](#)
- initC, [500](#)
- initOut, [500](#)
- MaxDelayedDim, [500](#)
- MaxStorableValue, [503](#)
- MMHelper, [499](#), [500](#)
- operator<<, [501](#)
- Outmax, [502](#)
- Outmin, [502](#)
- parseq, [503](#)
- recLevel, [502](#)
- Self_t, [499](#)
- setOutBounds, [501](#)
- FieldSimd< _Field >, [448](#)
- Simd128_impl< true, true, false, 2 >, [575](#)
- Simd128_impl< true, true, false, 4 >, [583](#)
- Simd128_impl< true, true, false, 8 >, [592](#)
- Simd128_impl< true, true, true, 2 >, [601](#)
- Simd128_impl< true, true, true, 4 >, [610](#)
- Simd128_impl< true, true, true, 8 >, [619](#)
- Simd256_impl< true, false, true, 8 >, [629](#)
- Simd256_impl< true, true, false, 2 >, [638](#)
- Simd256_impl< true, true, false, 4 >, [653](#)
- Simd256_impl< true, true, false, 8 >, [663](#)
- Simd256_impl< true, true, true, 2 >, [672](#)
- Simd256_impl< true, true, true, 4 >, [682](#), [687](#)
- Simd256_impl< true, true, true, 8 >, [697](#)
- Simd512_impl< true, true, false, 8 >, [714](#)
- Simd512_impl< true, true, true, 8 >, [724](#)
- MODE
- parallel.h, [1035](#)
- ModeTraits< Field >, [513](#)
- value, [513](#)
- ModeTraits< Givaro::Modular< Element, Compute > >, [513](#)
- value, [513](#)
- ModeTraits< Givaro::Modular< Givaro::Integer, Compute > >, [513](#)
- value, [514](#)
- ModeTraits< Givaro::Modular< int16_t, Compute > >, [514](#)
- value, [514](#)
- ModeTraits< Givaro::Modular< int32_t, Compute > >, [514](#)
- value, [514](#)

- ModeTraits< Givaro::Modular< int8_t, Compute > >, 514
 - value, 515
- ModeTraits< Givaro::Modular< Reclnt::ruint< K >, Compute > >, 515
 - value, 515
- ModeTraits< Givaro::Modular< uint16_t, Compute > >, 515
 - value, 515
- ModeTraits< Givaro::Modular< uint32_t, Compute > >, 516
 - value, 516
- ModeTraits< Givaro::Modular< uint8_t, Compute > >, 516
 - value, 516
- ModeTraits< Givaro::ModularBalanced< Element > >, 516
 - value, 516
- ModeTraits< Givaro::ModularBalanced< Givaro::Integer > >, 517
 - value, 517
- ModeTraits< Givaro::ModularBalanced< int16_t > >, 517
 - value, 517
- ModeTraits< Givaro::ModularBalanced< int32_t > >, 517
 - value, 518
- ModeTraits< Givaro::ModularBalanced< int8_t > >, 518
 - value, 518
- ModeTraits< Givaro::Montgomery< T > >, 518
 - value, 518
- ModeTraits< Givaro::ZRing< double > >, 518
 - value, 519
- ModeTraits< Givaro::ZRing< float > >, 519
 - value, 519
- ModeTraits< Givaro::ZRing< Givaro::Integer > >, 519
 - value, 519
- ModField
 - rns_double, 528
 - rns_double_extended, 541
 - RNSIntegerMod< RNS >, 550
- modp
 - FFLAS::vectorised, 291
 - FFLAS::vectorised::unswitch, 292
- ModularBalanced< T >, 519
- ModularTag, 520
- mOne
 - RNSInteger< RNS >, 548
 - RNSIntegerMod< RNS >, 555
- mone
 - FFLAS, 83
 - Sparse< _Field, SparseMatrix_t::HYB_ZO >, 745
- MonotonicApplyP
 - FFPACK, 312
- MonotonicCompress
 - FFPACK, 356
- MonotonicCompressCycles
 - FFPACK, 357
- MonotonicCompressMorePivots
 - FFPACK, 357
- MonotonicExpand
 - FFPACK, 357
- Montgomery< T >, 520
- mul
 - FieldSimd< _Field >, 448
 - RNSIntegerMod< RNS >, 553
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, 558
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, 562
 - Simd128_impl< true, true, false, 2 >, 574
 - Simd128_impl< true, true, false, 4 >, 582
 - Simd128_impl< true, true, false, 8 >, 591
 - Simd128_impl< true, true, true, 2 >, 598
 - Simd128_impl< true, true, true, 4 >, 607
 - Simd128_impl< true, true, true, 8 >, 616
 - Simd256_impl< true, false, true, 8 >, 626
 - Simd256_impl< true, true, false, 2 >, 636
 - Simd256_impl< true, true, false, 4 >, 651
 - Simd256_impl< true, true, false, 8 >, 661
 - Simd256_impl< true, true, true, 2 >, 669
 - Simd256_impl< true, true, true, 4 >, 679, 684
 - Simd256_impl< true, true, true, 8 >, 694
 - Simd512_impl< true, false, true, 8 >, 703
 - Simd512_impl< true, true, false, 8 >, 713
 - Simd512_impl< true, true, true, 8 >, 721
- mul_r
 - FieldSimd< _Field >, 448
- mulhi
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, 563
 - Simd128_impl< true, true, false, 2 >, 571
 - Simd128_impl< true, true, false, 4 >, 579
 - Simd128_impl< true, true, true, 2 >, 598
 - Simd128_impl< true, true, true, 4 >, 607
 - Simd256_impl< true, true, false, 2 >, 633
 - Simd256_impl< true, true, false, 4 >, 643, 646
 - Simd256_impl< true, true, true, 2 >, 669
 - Simd256_impl< true, true, true, 4 >, 679, 685
- mulhi_fast
 - Simd128_impl< true, true, false, 8 >, 592
 - Simd128_impl< true, true, true, 8 >, 618
 - Simd256_impl< true, true, false, 8 >, 663
 - Simd256_impl< true, true, true, 8 >, 696
 - Simd512_impl< true, true, false, 8 >, 714
 - Simd512_impl< true, true, true, 8 >, 723
- mulin
 - FieldSimd< _Field >, 448
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, 559
 - Simd256_impl< true, false, true, 8 >, 626
 - Simd512_impl< true, false, true, 8 >, 703
- mullo

- ScalFunctions< Element, typename enable_if<
is_integral< Element >::value >::type >, 562
- Simd128_impl< true, true, false, 2 >, 573
- Simd128_impl< true, true, false, 4 >, 582
- Simd128_impl< true, true, false, 8 >, 588
- Simd128_impl< true, true, true, 2 >, 598
- Simd128_impl< true, true, true, 4 >, 607
- Simd128_impl< true, true, true, 8 >, 616
- Simd256_impl< true, true, false, 2 >, 636
- Simd256_impl< true, true, false, 4 >, 651
- Simd256_impl< true, true, false, 8 >, 658
- Simd256_impl< true, true, true, 2 >, 669
- Simd256_impl< true, true, true, 4 >, 679, 684
- Simd256_impl< true, true, true, 8 >, 694
- Simd512_impl< true, true, false, 8 >, 710
- Simd512_impl< true, true, true, 8 >, 721
- mulx
 - ScalFunctions< Element, typename enable_if<
is_integral< Element >::value >::type >, 563
 - Simd128_impl< true, true, false, 2 >, 571
 - Simd128_impl< true, true, false, 4 >, 580
 - Simd128_impl< true, true, false, 8 >, 588
 - Simd128_impl< true, true, true, 2 >, 599
 - Simd128_impl< true, true, true, 4 >, 607
 - Simd128_impl< true, true, true, 8 >, 616
 - Simd256_impl< true, true, false, 2 >, 634
 - Simd256_impl< true, true, false, 4 >, 644, 646
 - Simd256_impl< true, true, false, 8 >, 659
 - Simd256_impl< true, true, true, 2 >, 669
 - Simd256_impl< true, true, true, 4 >, 679, 685
 - Simd256_impl< true, true, true, 8 >, 694
 - Simd512_impl< true, true, false, 8 >, 710
 - Simd512_impl< true, true, true, 8 >, 721
- mvcnt
 - test-lu.C, 1098
- n
 - Sparse< _Field, SparseMatrix_t::COO >, 729
 - Sparse< _Field, SparseMatrix_t::COO_ZO >, 731
 - Sparse< _Field, SparseMatrix_t::CSR >, 732
 - Sparse< _Field, SparseMatrix_t::CSR_HYB >, 734
 - Sparse< _Field, SparseMatrix_t::CSR_ZO >, 736
 - Sparse< _Field, SparseMatrix_t::ELL >, 738
 - Sparse< _Field, SparseMatrix_t::ELL_simd >, 739
 - Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >, 741
 - Sparse< _Field, SparseMatrix_t::ELL_ZO >, 743
 - Sparse< _Field, SparseMatrix_t::HYB_ZO >, 744
 - Sparse< _Field, SparseMatrix_t::SELL >, 746
 - Sparse< _Field, SparseMatrix_t::SELL_ZO >, 748
- nChunks
 - Sparse< _Field, SparseMatrix_t::ELL_simd >, 740
 - Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >, 741
 - Sparse< _Field, SparseMatrix_t::SELL >, 746
 - Sparse< _Field, SparseMatrix_t::SELL_ZO >, 748
- nDenseCols
 - StatsMatrix, 753
- nDenseRows
 - StatsMatrix, 753
- need_field_characteristic< Field >, 520
 - value, 520
- need_field_characteristic< Givaro::Modular< Field >
>, 520
 - value, 520
- need_field_characteristic< Givaro::ModularBalanced<
Field > >, 520
 - value, 521
- NeedDoublePreAddReduction
 - FFLAS::Protected, 222
- NeedPreAddReduction
 - FFLAS::Protected, 221
- NeedPreSubReduction
 - FFLAS::Protected, 221
- neg
 - RNSIntegerMod< RNS >, 553
- nElements
 - Sparse< _Field, SparseMatrix_t::COO >, 729
 - Sparse< _Field, SparseMatrix_t::COO_ZO >, 731
 - Sparse< _Field, SparseMatrix_t::CSR >, 733
 - Sparse< _Field, SparseMatrix_t::CSR_HYB >, 734
 - Sparse< _Field, SparseMatrix_t::CSR_ZO >, 736
 - Sparse< _Field, SparseMatrix_t::ELL >, 738
 - Sparse< _Field, SparseMatrix_t::ELL_simd >, 739
 - Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >, 741
 - Sparse< _Field, SparseMatrix_t::ELL_ZO >, 743
 - Sparse< _Field, SparseMatrix_t::HYB_ZO >, 744
 - Sparse< _Field, SparseMatrix_t::SELL >, 746
 - Sparse< _Field, SparseMatrix_t::SELL_ZO >, 749
- nEmptyCols
 - StatsMatrix, 753
- nEmptyColsEnd
 - StatsMatrix, 753
- nEmptyRows
 - StatsMatrix, 753
- newD
 - FFPACK::Protected, 401
- NEWWINO
 - fgemm_winograd.inl, 833
- nMOnes
 - Sparse< _Field, SparseMatrix_t::CSR_HYB >, 735
 - StatsMatrix, 751
- nnz
 - Sparse< _Field, SparseMatrix_t::COO >, 729
 - Sparse< _Field, SparseMatrix_t::COO_ZO >, 731
 - Sparse< _Field, SparseMatrix_t::CSR >, 732
 - Sparse< _Field, SparseMatrix_t::CSR_HYB >, 734
 - Sparse< _Field, SparseMatrix_t::CSR_ZO >, 736
 - Sparse< _Field, SparseMatrix_t::ELL >, 738
 - Sparse< _Field, SparseMatrix_t::ELL_simd >, 739
 - Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >, 741

- Sparse< _Field, SparseMatrix_t::ELL_ZO >, 743
- Sparse< _Field, SparseMatrix_t::HYB_ZO >, 744
- Sparse< _Field, SparseMatrix_t::SELL >, 746
- Sparse< _Field, SparseMatrix_t::SELL_ZO >, 749
- StatsMatrix, 751
- none
 - HelperFlag, 472
- nOnes
 - Sparse< _Field, SparseMatrix_t::CSR_HYB >, 735
 - StatsMatrix, 751
- NonZeroRandomMatrix
 - FFPACK, 381, 382
- normA
 - MMHelper< FFPACK::RNSInteger< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, 505
 - MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, 507
 - MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeqTrait >, 510
- normB
 - MMHelper< FFPACK::RNSInteger< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, 505
 - MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, 507
 - MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeqTrait >, 510
- NORML_MOD
 - fflas_simd.h, 866
- NoSimd< T >, 521
 - compliant, 521
 - scalar_t, 521
 - type_string, 521
 - valid, 521
 - vect_size, 522
 - vect_t, 521
- NoSimdSparseMatrix
 - FFLAS, 79
- NOSPLIT
 - parallel.h, 1037
- nOthers
 - Sparse< _Field, SparseMatrix_t::CSR_HYB >, 735
 - StatsMatrix, 751
- NotMKLSparseMatrixFormat
 - FFLAS, 79
- NotZOSparseMatrix
 - FFLAS, 79
- NullSpaceBasis
 - FFPACK, 336, 376
- NullSpaceBasis_modular_double
 - ffpack.C, 997
- ffpack_c.h, 1018
- NUM_THREADS
 - parallel.h, 1032
- NUMARGS
 - parallel.h, 1035
- number_kind
 - FFLAS, 83
- numBlock
 - ForStrategy1D< blocksize_t, Cut, Param >, 461
- numblocks
 - ForStrategy1D< blocksize_t, Cut, Param >, 460
- numColBlock
 - ForStrategy2D< blocksize_t, Cut, Param >, 464
- numRowBlock
 - ForStrategy2D< blocksize_t, Cut, Param >, 464
- numthreads
 - Parallel< C, P >, 522
 - Sequential, 566
- one
 - FFLAS, 83
 - RNSInteger< RNS >, 548
 - RNSIntegerMod< RNS >, 555
 - Sparse< _Field, SparseMatrix_t::HYB_ZO >, 745
- OPENBLAS_NUM_THREADS
 - config.h, 798
- operator!=
 - rns_double_elt_cstptr, 536
 - rns_double_elt_ptr, 539
- operator<
 - rns_double_elt_cstptr, 536
 - rns_double_elt_ptr, 539
- operator<<
 - Compose< H1, H2 >, 422
 - FFLAS, 156
 - ForStrategy2D< blocksize_t, Cut, Param >, 463
 - MMHelper< FFPACK::RNSInteger< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, 504
 - MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, 507
 - MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< Dest >, ParSeqTrait >, 508
 - MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeqTrait >, 510
 - MMHelper< Field, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, 512
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, 501
 - Parallel< C, P >, 523
 - Sequential, 566
 - test-fsytrf.C, 1081
- operator*
 - rns_double_elt_cstptr, 535
 - rns_double_elt_ptr, 538
- operator()
 - callLUdivine_small< double >, 410

- callLdivine_small< Element >, 410
- callLdivine_small< float >, 411
- Failure, 442
- readMyMachineType< Field, mpz_t >, 526
- readMyMachineType< Field, T >, 526
- RNSInteger< RNS >::RandIter, 524
- RNSIntegerMod< RNS >::RandIter, 525
- rnsRandIter< RNS >, 556
- tfn_minus, 756
- tfn_minus_eq, 756
- tfn_mul, 756
- tfn_mul_eq, 757
- tfn_plus, 757
- tfn_plus_eq, 757
- operator+
 - rns_double_elt_cstptr, 536
 - rns_double_elt_ptr, 539
- operator++
 - ForStrategy1D< blocksize_t, Cut, Param >, 460
 - ForStrategy2D< blocksize_t, Cut, Param >, 462
 - rns_double_elt_cstptr, 536
 - rns_double_elt_ptr, 539
- operator+=
 - rns_double_elt_cstptr, 536
 - rns_double_elt_ptr, 539
- operator-
 - rns_double_elt_cstptr, 536
 - rns_double_elt_ptr, 539
- operator--
 - rns_double_elt_cstptr, 536
 - rns_double_elt_ptr, 539
- operator-=
 - rns_double_elt_cstptr, 536
 - rns_double_elt_ptr, 539
- operator=
 - Coo< Field >, 430, 431
 - Coo< ValT, IdxT >, 429, 432
 - FieldSimd< _Field >, 446
 - Info, 477, 478
 - rns_double_elt_cstptr, 536
 - rns_double_elt_ptr, 539
- operator&
 - rns_double_elt, 533
 - rns_double_elt_cstptr, 535, 536
 - rns_double_elt_ptr, 538, 539
- operator[]
 - rns_double_elt_cstptr, 535
 - rns_double_elt_ptr, 538
- other
 - FFLAS, 83
 - rns_double_elt_cstptr, 537
 - rns_double_elt_ptr, 540
- Outmax
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 502
- Outmin
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-Trait >, 502
- p
 - HelperMod< Field, ElementCategories::MachineIntTag >, 473
 - HelperMod< Field, FFLAS::ElementCategories::ArbitraryPrecIntTag >, 474
 - HelperMod< Field, FFLAS::ElementCategories::FixedPrecIntTag >, 475
 - HelperMod< Field, FFLAS::ElementCategories::MachineFloatTag >, 475
- pack_lhs
 - FFLAS::details, 213
- pack_rhs
 - FFLAS::details, 213
- PACKAGE
 - config.h, 798
- PACKAGE_BUGREPORT
 - config.h, 798
- PACKAGE_NAME
 - config.h, 798
- PACKAGE_STRING
 - config.h, 798
- PACKAGE_TARNAME
 - config.h, 799
- PACKAGE_URL
 - config.h, 799
- PACKAGE_VERSION
 - config.h, 799
- PAR_BLOCK
 - parallel.h, 1032
- Parallel
 - Parallel< C, P >, 522
- Parallel< C, P >, 522
 - Cut, 522
 - numthreads, 522
 - operator<<, 523
 - Parallel, 522
 - Param, 522
 - set_numthreads, 523
- parallel.h, 1031
 - __FFLASFFPACK_SEQUENTIAL, 1032
 - BARRIER, 1032
 - BEGIN_PARALLEL_MAIN, 1033
 - CHECK_DEPENDENCIES, 1032
 - COMMA, 1035
 - CONSTREFERENCE, 1033
 - END_PARALLEL_MAIN, 1033
 - FOR1D, 1033
 - FOR2D, 1034
 - FORBLOCK1D, 1033
 - FORBLOCK2D, 1034
 - index_t, 1032
 - MAX_THREADS, 1032
 - MODE, 1035
 - NOSPLIT, 1037
 - NUM_THREADS, 1032
 - NUMARGS, 1035
 - PAR_BLOCK, 1032
 - PARFOR1D, 1034

- PARFOR2D, [1035](#)
- PARFORBLOCK1D, [1034](#)
- PARFORBLOCK2D, [1035](#)
- PP_ARG_N, [1035](#)
- PP_NARG_, [1035](#)
- PP_RSEQ_N, [1037](#)
- READ, [1033](#)
- READWRITE, [1033](#)
- RETURNPARAM, [1035](#)
- splitt, [1037](#)
- SPLITTER, [1037](#)
- splitting_0, [1037](#)
- splitting_1, [1037](#)
- splitting_2, [1037](#)
- splitting_3, [1037](#)
- SYNCH_GROUP, [1032](#)
- TASK, [1032](#)
- VALUE, [1033](#)
- WAIT, [1032](#)
- WRITE, [1033](#)
- Param
 - Parallel< C, P >, [522](#)
- PARFOR1D
 - parallel.h, [1034](#)
- PARFOR2D
 - parallel.h, [1035](#)
- PARFORBLOCK1D
 - parallel.h, [1034](#)
- PARFORBLOCK2D
 - parallel.h, [1035](#)
- parseArguments
 - FFLAS, [194](#)
- parseq
 - MMHelper< FFPACK::RNSInteger< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, [505](#)
 - MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, [507](#)
 - MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo, ParSeqTrait >, [508](#)
 - MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo, ElementCategories::RNSElementTag >, [511](#)
 - MMHelper< Field, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, [512](#)
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, [503](#)
 - TRSMHelper< ReclterTrait, ParSeqTrait >, [759](#)
- PBASECASE_K
 - ffpack_ppluq.inl, [935](#)
- pColumnEchelonForm
 - FFPACK, [323](#)
- pColumnEchelonForm_modular_double
 - ffpack.C, [991](#)
- pColumnEchelonForm_modular_float
 - ffpack.C, [992](#)
- pColumnEchelonForm_modular_int32_t
 - ffpack.C, [993](#)
- pColumnRankProfile
 - FFPACK, [339](#)
- pDet
 - FFPACK, [334](#)
- perm
 - Info, [477](#), [478](#)
 - Sparse< _Field, SparseMatrix_t::SELL >, [746](#)
 - Sparse< _Field, SparseMatrix_t::SELL_ZO >, [749](#)
- PermApplyS
 - FFPACK, [359](#)
- PermApplyS_double
 - ffpack.C, [984](#)
 - ffpack_c.h, [1007](#)
- PermApplyT
 - FFPACK, [361](#)
- PermApplyT_double
 - ffpack.C, [984](#)
 - ffpack_c.h, [1008](#)
- pfadd
 - FFLAS, [86](#)
- pfaddin
 - FFLAS, [87](#)
- pfgemm
 - FFLAS, [147](#), [190–192](#)
- pfgemm_1D_rec
 - FFLAS, [147](#)
- pfgemm_2D_rec
 - FFLAS, [148](#)
- pfgemm_3D_rec
 - FFLAS, [148](#)
- pfgemm_3D_rec2
 - FFLAS, [149](#)
- pfgemm_variants.inl, [1038](#)
- pfgemv.inl, [1039](#)
- pftrand
 - FFLAS, [190](#)
- pfreduce
 - FFLAS, [118](#)
- pfspmm
 - FFLAS::sparse_details, [239–241](#)
 - FFLAS::sparse_details_impl, [257](#), [264–266](#), [268](#), [269](#), [279](#), [280](#)
- pfspmm_dispatch
 - FFLAS::sparse_details, [239](#)
- pfspmm_mone
 - FFLAS::sparse_details_impl, [258](#)
- pfspmm_one
 - FFLAS::sparse_details_impl, [257](#), [258](#)
- pfspmm_zo
 - FFLAS::sparse_details_impl, [269](#), [270](#)
- pfspmv
 - FFLAS::sparse_details, [242](#), [243](#)
 - FFLAS::sparse_details_impl, [258](#), [259](#), [266](#), [270](#), [276](#), [280](#), [282](#)
- pfspmv_mone
 - FFLAS::sparse_details_impl, [259](#), [260](#), [271](#), [276](#), [277](#), [283](#)

- pfspmv_one
 - FFLAS::sparse_details_impl, [259](#), [260](#), [271](#), [276](#), [277](#), [283](#)
- pfspmv_task
 - FFLAS::sparse_details_impl, [259](#)
- pfsb
 - FFLAS, [86](#)
- pfsubin
 - FFLAS, [87](#)
- pfzero
 - FFLAS, [190](#)
- PLUQ
 - FFPACK, [320](#), [321](#), [365](#), [369](#)
- pluq.C, [766](#), [767](#)
- PLUQ_basecaseCrout
 - FFPACK, [364](#)
- PLUQ_basecaseV2
 - FFPACK, [364](#)
- PLUQ_basecaseV3
 - FFPACK, [364](#)
- PLUQ_modular_double
 - ffpack.C, [987](#)
 - ffpack_c.h, [1011](#)
- PLUQtoEchelonPermutation
 - FFPACK, [349](#)
 - ffpack.C, [1001](#)
 - ffpack_c.h, [1022](#)
- pm1
 - HelperFlag, [472](#)
- pMMH
 - TRSMHelper< ReclterTrait, ParSeqTrait >, [759](#)
- pow50rem
 - HelperMod< Field, ElementCategories::MachineIntTag >, [473](#)
- PP_ARG_N
 - parallel.h, [1035](#)
- PP_NARG_
 - parallel.h, [1035](#)
- PP_RSEQ_N
 - parallel.h, [1037](#)
- pPLUQ
 - FFPACK, [320](#)
- pRank
 - FFPACK, [332](#)
- preamble
 - FFLAS, [195](#)
- precompute_cst
 - rns_double, [529](#)
 - rns_double_extended, [542](#)
- pReducedColumnEchelonForm
 - FFPACK, [325](#)
- pReducedColumnEchelonForm_modular_double
 - ffpack.C, [992](#)
- pReducedColumnEchelonForm_modular_float
 - ffpack.C, [993](#)
- pReducedColumnEchelonForm_modular_int32_t
 - ffpack.C, [994](#)
- pReducedRowEchelonForm
 - FFPACK, [326](#)
- pReducedRowEchelonForm_modular_double
 - ffpack.C, [992](#)
- pReducedRowEchelonForm_modular_float
 - ffpack.C, [993](#)
- pReducedRowEchelonForm_modular_int32_t
 - ffpack.C, [994](#)
- prefetch
 - FFLAS, [197](#)
- print
 - Failure, [443](#)
- printHelpMessage
 - args-parser.h, [1040](#)
- printPolynomial
 - test-charpoly-check.C, [1058](#)
- printvect
 - test-compressQ.C, [1060](#)
- pRowEchelonForm
 - FFPACK, [324](#)
- pRowEchelonForm_modular_double
 - ffpack.C, [991](#)
- pRowEchelonForm_modular_float
 - ffpack.C, [992](#)
- pRowEchelonForm_modular_int32_t
 - ffpack.C, [993](#)
- pRowRankProfile
 - FFPACK, [338](#)
- PSeq
 - benchmark-fgemm-rns.C, [781](#)
- pSolve
 - FFPACK, [336](#)
- PTRSM_HYBRID_THRESHOLD
 - fflas_pfrsm.inl, [865](#)
- PURE
 - fflas_simd.h, [866](#)
- queryCacheSizes
 - FFLAS, [198](#)
- queryL1CacheSize
 - FFLAS, [198](#)
- queryTopLevelCacheSize
 - FFLAS, [198](#)
- RandInt
 - FFPACK, [385](#)
- RandIter
 - RNSInteger< RNS >::RandIter, [523](#)
 - RNSIntegerMod< RNS >::RandIter, [524](#)
- random
 - RNSInteger< RNS >::RandIter, [523](#), [524](#)
 - RNSIntegerMod< RNS >::RandIter, [525](#)
 - rnsRandIter< RNS >, [556](#)
- RandomIndexSubset
 - FFPACK, [387](#)
- RandomKrylovPrecond
 - FFPACK::Protected, [399](#)
- RandomMatrix
 - FFPACK, [382](#), [383](#)
- RandomMatrixWithDet

- FFPACK, [393](#)
- RandomMatrixWithRank
 - FFPACK, [385](#), [386](#)
- RandomMatrixWithRankandRandomRPM
 - FFPACK, [391](#)
- RandomMatrixWithRankandRPM
 - FFPACK, [388](#), [389](#)
- RandomNullSpaceVector
 - FFPACK, [336](#), [350](#), [376](#)
- RandomNullSpaceVector_modular_double
 - ffpack.C, [997](#)
 - ffpack_c.h, [1018](#)
- RandomPermutation
 - FFPACK, [387](#)
- RandomRankProfileMatrix
 - FFPACK, [387](#)
- RandomSymmetricMatrix
 - FFPACK, [385](#)
- RandomSymmetricMatrixWithRankandRandomRPM
 - FFPACK, [392](#)
- RandomSymmetricMatrixWithRankandRPM
 - FFPACK, [390](#)
- RandomSymmetricRankProfileMatrix
 - FFPACK, [388](#)
- RandomTriangularMatrix
 - FFPACK, [383](#), [384](#)
- Rank
 - FFPACK, [332](#), [333](#), [374](#)
- rank.C, [805](#)
 - main, [805](#)
- Rank_modular_double
 - ffpack.C, [995](#)
 - ffpack_c.h, [1017](#)
- RankProfileFromLU
 - FFPACK, [339](#)
 - ffpack.C, [998](#)
 - ffpack_c.h, [1019](#)
- READ
 - parallel.h, [1033](#)
- read_field
 - Matio.h, [1048](#)
- read_sparse.h, [902](#)
 - DNS_BIN_VER, [903](#)
 - mask_t, [903](#)
- readDnsFormat
 - FFLAS, [158](#)
- readMachineType
 - FFLAS, [157](#)
- ReadMatrix
 - FFLAS, [195](#)
- readMyMachineType< Field, mpz_t >, [526](#)
 - Element, [526](#)
 - Element_ptr, [526](#)
 - operator(), [526](#)
- readMyMachineType< Field, T >, [525](#)
 - Element, [525](#)
 - Element_ptr, [526](#)
 - operator(), [526](#)
- readOrRandomMatrixWithRankAndRandomRPM
 - test-nullspace.C, [1101](#)
- readSmsFormat
 - FFLAS, [156](#)
- readSprFormat
 - FFLAS, [157](#)
- READWRITE
 - parallel.h, [1033](#)
- Rec_Initialize
 - benchmark-pluq.C, [794](#)
- RecInt, [403](#)
- recLevel
 - MMHelper< FFPACK::RNSInteger< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, [505](#)
 - MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, [507](#)
 - MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< Dest >, ParSeqTrait >, [508](#)
 - MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeqTrait >, [511](#)
 - MMHelper< Field, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, [512](#)
 - MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, [502](#)
- Recursive, [527](#)
- reduce
 - FFLAS::vectorised, [289–291](#)
 - rns_double, [530](#)
 - rns_double_extended, [543](#)
 - RNSInteger< RNS >, [547](#)
 - RNSIntegerMod< RNS >, [552](#)
- reduce_modp
 - RNSIntegerMod< RNS >, [553](#), [554](#)
- reduce_modp_rnsmajor
 - RNSIntegerMod< RNS >, [554](#)
- ReducedColumnEchelonForm
 - FFPACK, [324](#), [325](#), [371](#)
- ReducedColumnEchelonForm_modular_double
 - ffpack.C, [989](#)
 - ffpack_c.h, [1013](#)
- ReducedColumnEchelonForm_modular_float
 - ffpack.C, [990](#)
 - ffpack_c.h, [1014](#)
- ReducedColumnEchelonForm_modular_int32_t
 - ffpack.C, [991](#)
 - ffpack_c.h, [1014](#)
- ReducedRowEchelonForm
 - FFPACK, [326](#), [327](#), [370](#)
- ReducedRowEchelonForm2_modular_double
 - ffpack_c.h, [1015](#)
- ReducedRowEchelonForm_modular_double
 - ffpack.C, [989](#)
 - ffpack_c.h, [1014](#)
- ReducedRowEchelonForm_modular_float
 - ffpack.C, [990](#)

- ffpack_c.h, 1014
- ReducedRowEchelonForm_modular_int32_t
 - ffpack.C, 991
 - ffpack_c.h, 1015
- REF_modular_double
 - ffpack_c.h, 1015
- REGISTER_TYPE_NAME
 - test-simd.C, 1106, 1107
- regression-check.C, 1056
 - check1, 1057
 - check2, 1057
 - check3, 1057
 - check4, 1057
 - checkZeroDimCharpoly, 1057
 - checkZeroDimMinPoly, 1057
 - gf2ModularBalanced, 1057
 - main, 1057
- RETURNPARAM
 - parallel.h, 1035
- ring
 - RNSInteger< RNS >::RandIter, 524
 - RNSIntegerMod< RNS >::RandIter, 525
 - rnsRandIter< RNS >, 556
- rint< K >, 527
- RNS, 51
 - benchmark-fgemm-rns.C, 780
- rns
 - RNSInteger< RNS >, 546
 - RNSIntegerMod< RNS >, 550
- rns-double-elt.h, 939
- rns-double-recint.inl, 940
 - __FFLASFFPACK_field_rns_double_recint_INL, 940
- rns-double.h, 940
 - ROUND_DOWN, 941
- rns-double.inl, 941
 - __FFLASFFPACK_field_rns_double_INL, 941
- rns-integer-mod.h, 941
- rns-integer.h, 942
- rns.h, 943
- rns.inl, 943
 - __FFLASFFPACK_field_rns_INL, 943
- rns_double, 527
 - _M, 532
 - _MMi, 532
 - _Mi, 532
 - _basis, 531
 - _basisMax, 531
 - _crt_in, 532
 - _crt_out, 532
 - _field_rns, 531
 - _invbasis, 531
 - _ldm, 532
 - _mi_sum, 532
 - _negbasis, 531
 - _pbits, 532
 - _size, 532
 - BasisElement, 528
 - ConstElement_ptr, 529
 - convert, 530, 531
 - convert_transpose, 530
 - Element, 528
 - Element_ptr, 528
 - init, 529–531
 - init_transpose, 530
 - integer, 528
 - ModField, 528
 - precompute_cst, 529
 - reduce, 530
 - rns_double, 529
 - rns_double_elt, 532
 - _alloc, 534
 - _ptr, 534
 - _stride, 534
 - ~rns_double_elt, 533
 - operator&, 533
 - rns_double_elt, 533
 - rns_double_elt_cstptr, 534
 - _alloc, 537
 - _ptr, 537
 - _stride, 537
 - operator!=, 536
 - operator<, 536
 - operator*, 535
 - operator+, 536
 - operator++, 536
 - operator+&, 536
 - operator-, 536
 - operator--, 536
 - operator=, 536
 - operator=, 536
 - operator&, 535, 536
 - operator[], 535
 - other, 537
 - rns_double_elt_cstptr, 535
- rns_double_elt_ptr, 537
 - _alloc, 540
 - _ptr, 540
 - _stride, 540
 - operator!=, 539
 - operator<, 539
 - operator*, 538
 - operator+, 539
 - operator++, 539
 - operator+&, 539
 - operator-, 539
 - operator--, 539
 - operator=, 539
 - operator=, 539
 - operator&, 538, 539
 - operator[], 538
 - other, 540
 - rns_double_elt_ptr, 538
- rns_double_extended, 540
 - _M, 544
 - _MMi, 544

- [_Mi](#), 544
- [_basis](#), 543
- [_basisMax](#), 543
- [_crt_in](#), 544
- [_crt_out](#), 544
- [_field_rns](#), 544
- [_invbasis](#), 543
- [_ldm](#), 544
- [_negbasis](#), 543
- [_pbits](#), 544
- [_size](#), 544
- [BasisElement](#), 541
- [ConstElement_ptr](#), 541
- [convert](#), 542, 543
- [Element](#), 541
- [Element_ptr](#), 541
- [init](#), 542, 543
- [integer](#), 541
- [ModField](#), 541
- [precompute_cst](#), 542
- [reduce](#), 543
- [rns_double_extended](#), 541, 542
- [RNSElementTag](#), 544
- [RNSInteger](#)
 - [RNSInteger< RNS >](#), 546
- [RNSInteger< RNS >](#), 545
 - [_rns](#), 548
 - [assign](#), 548
 - [BasisElement](#), 546
 - [cardinality](#), 547
 - [characteristic](#), 547
 - [ConstElement_ptr](#), 546
 - [convert](#), 547
 - [Element](#), 546
 - [Element_ptr](#), 546
 - [init](#), 547
 - [integer](#), 546
 - [isMOne](#), 547
 - [isOne](#), 546
 - [isZero](#), 547
 - [mOne](#), 548
 - [one](#), 548
 - [reduce](#), 547
 - [rns](#), 546
 - [RNSInteger](#), 546
 - [size](#), 546
 - [write](#), 548
 - [zero](#), 548
- [RNSInteger< RNS >::RandIter](#), 523
 - [operator\(\)](#), 524
 - [RandIter](#), 523
 - [random](#), 523, 524
 - [ring](#), 524
- [RNSIntegerMod](#)
 - [RNSIntegerMod< RNS >](#), 550
- [RNSIntegerMod< RNS >](#), 548
 - [_F](#), 554
 - [_Mi_modp_rns](#), 554
 - [_RNSdelayed](#), 555
 - [_iM_modp_rns](#), 554
 - [_p](#), 554
 - [_rns](#), 554
 - [add](#), 552
 - [areEqual](#), 553
 - [assign](#), 552
 - [axpyin](#), 553
 - [BasisElement](#), 550
 - [cardinality](#), 551
 - [characteristic](#), 551
 - [ConstElement_ptr](#), 550
 - [convert](#), 552
 - [delayed](#), 550
 - [Element](#), 550
 - [Element_ptr](#), 550
 - [init](#), 551, 552
 - [integer](#), 550
 - [inv](#), 553
 - [isMOne](#), 551
 - [isOne](#), 551
 - [isZero](#), 551
 - [maxElement](#), 551
 - [minElement](#), 551
 - [ModField](#), 550
 - [mOne](#), 555
 - [mul](#), 553
 - [neg](#), 553
 - [one](#), 555
 - [reduce](#), 552
 - [reduce_modp](#), 553, 554
 - [reduce_modp_rnsmajor](#), 554
 - [rns](#), 550
 - [RNSIntegerMod](#), 550
 - [size](#), 551
 - [sub](#), 552
 - [write](#), 553
 - [write_matrix](#), 553
 - [write_matrix_long](#), 554
 - [zero](#), 555
- [RNSIntegerMod< RNS >::RandIter](#), 524
 - [operator\(\)](#), 525
 - [RandIter](#), 524
 - [random](#), 525
 - [ring](#), 525
- [RNSModulus](#)
 - [FFLAS::CuttingStrategy](#), 206
- [rnsRandIter](#)
 - [rnsRandIter< RNS >](#), 555
- [rnsRandIter< RNS >](#), 555
 - [operator\(\)](#), 556
 - [random](#), 556
 - [ring](#), 556
 - [rnsRandIter](#), 555
- [round](#)
 - [ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >](#), 558

- ScalFunctions< Element, typename enable_if<
is_integral< Element >::value >::type >, 561
- Simd128_impl< true, true, false, 2 >, 575
- Simd128_impl< true, true, false, 4 >, 583
- Simd128_impl< true, true, false, 8 >, 592
- Simd128_impl< true, true, true, 2 >, 601
- Simd128_impl< true, true, true, 4 >, 610
- Simd128_impl< true, true, true, 8 >, 618
- Simd256_impl< true, false, true, 8 >, 629
- Simd256_impl< true, true, false, 2 >, 638
- Simd256_impl< true, true, false, 4 >, 653
- Simd256_impl< true, true, false, 8 >, 663
- Simd256_impl< true, true, true, 2 >, 671
- Simd256_impl< true, true, true, 4 >, 682, 687
- Simd256_impl< true, true, true, 8 >, 696
- Simd512_impl< true, false, true, 8 >, 705
- Simd512_impl< true, true, false, 8 >, 714
- Simd512_impl< true, true, true, 8 >, 723
- ROUND_DOWN
 - fflas_sparse.h, 878
 - rns-double.h, 941
- Row, 556
- row
 - Coo< Field >, 431
 - Coo< ValT, IdxT >, 429, 432
 - Sparse< _Field, SparseMatrix_t::COO >, 729
 - Sparse< _Field, SparseMatrix_t::COO_ZO >, 731
- rowblockindex
 - ForStrategy2D< blocksize_t, Cut, Param >, 463
- rowBlockSize
 - ForStrategy2D< blocksize_t, Cut, Param >, 463
- rowdim
 - StatsMatrix, 751
- RowEchelonForm
 - FFPACK, 323, 324, 370
- RowEchelonForm_modular_double
 - ffpack.C, 988
 - ffpack_c.h, 1012
- RowEchelonForm_modular_float
 - ffpack.C, 989
 - ffpack_c.h, 1013
- RowEchelonForm_modular_int32_t
 - ffpack.C, 990
 - ffpack_c.h, 1013
- rownumblocks
 - ForStrategy2D< blocksize_t, Cut, Param >, 462
- RowRankProfile
 - FFPACK, 337, 338, 376
- RowRankProfile_modular_double
 - ffpack.C, 997
 - ffpack_c.h, 1018
- RowRankProfileSubmatrix
 - FFPACK, 342, 377
- RowRankProfileSubmatrix_modular_double
 - ffpack.C, 998
 - ffpack_c.h, 1020
- RowRankProfileSubmatrixIndices
 - FFPACK, 340, 377
- RowRankProfileSubmatrixIndices_modular_double
 - ffpack.C, 998
 - ffpack_c.h, 1019
- ruint< K >, 556
- run_with_field
 - benchmark-charpoly.C, 770
 - benchmark-fdot.C, 778
 - test-charpoly.C, 1059
 - test-echelon.C, 1064
 - test-fdot.C, 1066
 - test-fgemm-check.C, 1068
 - test-fgemm.C, 1070
 - test-fgemv.C, 1072
 - test-fger.C, 1074
 - test-fgesv.C, 1075
 - test-finit.C, 1076
 - test-fsyr2k.C, 1079
 - test-fsyrk.C, 1081
 - test-fsytrf.C, 1082
 - test-ftrmm.C, 1083
 - test-ftrmv.C, 1085
 - test-ftrsm.C, 1087
 - test-ftrssyr2k.C, 1088
 - test-ftrstr.C, 1089
 - test-ftrsv.C, 1090
 - test-ftrtri.C, 1091
 - test-io.C, 1093
 - test-lu.C, 1097
 - test-minpoly.C, 1099
 - test-nullspace.C, 1101
 - test-rankprofiles.C, 1104
 - test-solve.C, 1109
- run_with_Integer
 - test-fdot.C, 1067
- saxpy_
 - config-blas.h, 813
- ScalAndReduce
 - FFLAS::Protected, 222
- scalar_t
 - FieldSimd< _Field >, 445
 - NoSimd< T >, 521
 - Simd128_impl< true, true, false, 2 >, 569
 - Simd128_impl< true, true, false, 4 >, 578
 - Simd128_impl< true, true, false, 8 >, 586
 - Simd128_impl< true, true, true, 2 >, 596
 - Simd128_impl< true, true, true, 4 >, 604
 - Simd128_impl< true, true, true, 8 >, 613
 - Simd256_impl< true, false, true, 8 >, 624
 - Simd256_impl< true, true, false, 2 >, 631
 - Simd256_impl< true, true, false, 4 >, 641
 - Simd256_impl< true, true, false, 8 >, 657
 - Simd256_impl< true, true, true, 2 >, 665
 - Simd256_impl< true, true, true, 4 >, 675, 676
 - Simd256_impl< true, true, true, 8 >, 690
 - Simd512_impl< true, false, true, 8 >, 700
 - Simd512_impl< true, true, false, 8 >, 708
 - Simd512_impl< true, true, true, 8 >, 717
- ScalFunctions< Element, Enable >, 556

- ScalFunctions< Element, typename enable_if<
 is_floating_point< Element >::value >::type
 >, 557
- add, 558
- addin, 558
- ceil, 558
- div, 559
- eq, 560
- floor, 558
- fmadd, 559
- fmaddin, 559
- fmsub, 559
- fmsubin, 559
- fnmadd, 559
- fnmaddin, 559
- greater, 560
- greater_eq, 560
- lesser, 560
- lesser_eq, 560
- mul, 558
- mulin, 559
- round, 558
- sub, 558
- subin, 558
- vand, 557
- vandnot, 558
- vor, 557
- vxor, 557
- zero, 557
- ScalFunctions< Element, typename enable_if<
 is_integral< Element >::value >::type >,
 560
- add, 562
- addin, 562
- eq, 565
- fmadd, 563
- fmaddin, 563
- fmaddx, 563
- fmaddxin, 563
- fmsub, 563
- fmsubin, 563
- fmsubx, 564
- fmsubxin, 564
- fnmadd, 564
- fnmaddin, 564
- fnmaddx, 564
- fnmaddxin, 564
- greater, 565
- greater_eq, 565
- lesser, 565
- lesser_eq, 565
- mul, 562
- mulhi, 563
- mullo, 562
- mulx, 563
- round, 561
- sll, 565
- sra, 564, 565
- srl, 565
- sub, 562
- subin, 562
- vand, 561
- vandnot, 562
- vor, 561
- vxor, 562
- zero, 561
- scalp
 FFLAS::vectorised, 291
 FFLAS::vectorised::unswitch, 293
- schedule_bini.inl, 834
 __FFLASFFPACK_fgemm_bini_INL, 834
- schedule_winograd.inl, 834
 __FFLASFFPACK_fgemm_winograd_INL, 835
- schedule_winograd_acc.inl, 835
 __FFLASFFPACK_fgemm_winograd_acc_INL,
 835
- schedule_winograd_acc_ip.inl, 836
 __FFLASFFPACK_fgemm_winograd_acc_ip_INL,
 836
- schedule_winograd_ip.inl, 836
 __FFLASFFPACK_fgemm_winograd_ip_INL, 837
- scopy_
 config-blas.h, 815
- sdot_
 config-blas.h, 813
- second_component
 Compose< H1, H2 >, 422
- Self
 Coo< ValT, IdxT >, 428, 432
- Self_t
 MMHelper< FFPACK::RNSInteger< E >, Algo-
 Trait, ModeCategories::DefaultTag, ParSeq-
 Trait >, 503
- MMHelper< FFPACK::RNSIntegerMod< E >, Al-
 goTrait, ModeCategories::DefaultTag, ParSeq-
 Trait >, 506
- MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo<
 Dest >, ParSeqTrait >, 508
- MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo<
 ElementCategories::RNSElementTag >,
 ParSeqTrait >, 509
- MMHelper< Field, AlgoTrait, ModeCategories::DefaultTag,
 ParSeqTrait >, 511
- MMHelper< Field, AlgoTrait, ModeTrait, ParSeq-
 Trait >, 499
- Sparse< _Field, SparseMatrix_t::HYB_ZO >, 744
- SELL
 FFLAS, 83
- sell.h, 903
- sell_pspmv.inl, 904
 __FFLASFFPACK_fflas_sparse_sell_pspmv_INL,
 904
- sell_spmv.inl, 904
 __FFLASFFPACK_fflas_sparse_sell_spmv_INL,
 905
- sell_utils.inl, 905

- __FFLASFFPACK_fflas_sparse_sell_utils_INL, 906
- SELL_ZO
 - FFLAS, 83
- Sequential, 566
 - numthreads, 566
 - operator<<, 566
 - Sequential, 566
- set
 - Simd128_impl< true, true, false, 2 >, 570
 - Simd128_impl< true, true, false, 4 >, 578
 - Simd128_impl< true, true, false, 8 >, 587
 - Simd128_impl< true, true, true, 2 >, 596
 - Simd128_impl< true, true, true, 4 >, 605
 - Simd128_impl< true, true, true, 8 >, 613
 - Simd256_impl< true, false, true, 8 >, 624
 - Simd256_impl< true, true, false, 2 >, 632
 - Simd256_impl< true, true, false, 4 >, 642, 645, 648
 - Simd256_impl< true, true, false, 8 >, 657
 - Simd256_impl< true, true, true, 2 >, 666
 - Simd256_impl< true, true, true, 4 >, 676, 682
 - Simd256_impl< true, true, true, 8 >, 691
 - Simd512_impl< true, false, true, 8 >, 701
 - Simd512_impl< true, true, false, 8 >, 708, 711
 - Simd512_impl< true, true, true, 8 >, 718
- set1
 - Simd128_impl< true, true, false, 2 >, 569
 - Simd128_impl< true, true, false, 4 >, 578
 - Simd128_impl< true, true, false, 8 >, 587
 - Simd128_impl< true, true, true, 2 >, 596
 - Simd128_impl< true, true, true, 4 >, 605
 - Simd128_impl< true, true, true, 8 >, 613
 - Simd256_impl< true, false, true, 8 >, 624
 - Simd256_impl< true, true, false, 2 >, 632
 - Simd256_impl< true, true, false, 4 >, 642, 645
 - Simd256_impl< true, true, false, 8 >, 657
 - Simd256_impl< true, true, true, 2 >, 666
 - Simd256_impl< true, true, true, 4 >, 676, 682
 - Simd256_impl< true, true, true, 8 >, 691
 - Simd512_impl< true, false, true, 8 >, 701
 - Simd512_impl< true, true, false, 8 >, 708
 - Simd512_impl< true, true, true, 8 >, 718
- set_numthreads
 - Parallel< C, P >, 523
- setErrorStream
 - Failure, 442
- setNorm
 - MMHelper< FFPACK::RNSInteger< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, 504
 - MMHelper< FFPACK::RNSIntegerMod< E >, AlgoTrait, ModeCategories::DefaultTag, ParSeqTrait >, 506
 - MMHelper< Field, AlgoTrait, ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeqTrait >, 510
- setOutBounds
- MMHelper< Field, AlgoTrait, ModeTrait, ParSeqTrait >, 501
- sgemm_
 - config-blas.h, 817
- sgemv_
 - config-blas.h, 814
- sger_
 - config-blas.h, 815
- shuffle
 - Simd128_impl< true, true, false, 2 >, 573
 - Simd128_impl< true, true, false, 4 >, 581
 - Simd128_impl< true, true, false, 8 >, 590
 - Simd128_impl< true, true, true, 2 >, 597
 - Simd128_impl< true, true, true, 4 >, 606
 - Simd128_impl< true, true, true, 8 >, 615
 - Simd256_impl< true, true, false, 2 >, 635
 - Simd256_impl< true, true, false, 4 >, 649
 - Simd256_impl< true, true, false, 8 >, 660
 - Simd256_impl< true, true, true, 2 >, 667
 - Simd256_impl< true, true, true, 4 >, 677, 684
 - Simd256_impl< true, true, true, 8 >, 692
 - Simd512_impl< true, false, true, 8 >, 702
 - Simd512_impl< true, true, false, 8 >, 711
 - Simd512_impl< true, true, true, 8 >, 719
- shuffle_twice
 - Simd256_impl< true, true, false, 4 >, 649
 - Simd256_impl< true, true, true, 4 >, 677, 684
- sigma
 - Sparse< _Field, SparseMatrix_t::SELL >, 746
 - Sparse< _Field, SparseMatrix_t::SELL_ZO >, 748
- signbits
 - Simd128_impl< true, true, false, 8 >, 593
 - Simd128_impl< true, true, true, 8 >, 619
 - Simd256_impl< true, true, false, 8 >, 663
 - Simd256_impl< true, true, true, 8 >, 697
 - Simd512_impl< true, true, false, 8 >, 714
 - Simd512_impl< true, true, true, 8 >, 724
- Simd
 - fflas_simd.h, 867
- simd
 - FieldSimd< _Field >, 445
- SIMD wrapper, 50
- simd.dox, 867
- Simd128
 - simd128.inl, 867
- simd128.inl, 867
 - __FFLASFFPACK_fflas_ffpack_utils_simd128_INL, 867
 - Simd128, 867
- simd128_double.inl, 867
 - __FFLASFFPACK_fflas_ffpack_utils_simd128_double_INL, 868
- simd128_float.inl, 868
 - __FFLASFFPACK_fflas_ffpack_utils_simd128_float_INL, 868
- Simd128_impl< ArithType, Int, Signed, Size >, 567
- Simd128_impl< true, false, true, 4 >, 567
- type_string, 567

- Simd128_impl< true, false, true, 8 >, 567
 - type_string, 567
- Simd128_impl< true, true, false, 2 >, 568
 - add, 573
 - addin, 573
 - alignment, 576
 - blend, 573
 - compliant, 572
 - eq, 575
 - fmadd, 574
 - fmaddin, 574
 - fmaddx, 571
 - fmaddxin, 571
 - fmsub, 574
 - fmsubin, 574
 - fmsubx, 572
 - fmsubxin, 572
 - fnmadd, 574
 - fnmaddin, 574
 - fnmaddx, 572
 - fnmaddxin, 572
 - gather, 570
 - greater, 571
 - greater_eq, 571
 - hadd_to_scal, 572
 - lesser, 571
 - lesser_eq, 571
 - load, 570
 - loadu, 570
 - mod, 575
 - mul, 574
 - mulhi, 571
 - mullo, 573
 - mulx, 571
 - round, 575
 - scalar_t, 569
 - set, 570
 - set1, 569
 - shuffle, 573
 - sll, 572
 - sll128, 575
 - sra, 570
 - srl, 572
 - srl128, 575
 - store, 570
 - storeu, 570
 - stream, 570
 - sub, 573
 - subin, 573
 - type_string, 575
 - unpackhi, 573
 - unpacklo, 573
 - valid, 572
 - vand, 575
 - vandnot, 576
 - vect_size, 576
 - vect_t, 569
 - vor, 575
 - vxor, 576
 - zero, 575
- Simd128_impl< true, true, false, 2 >::Converter, 422
 - t, 422
 - v, 422
- Simd128_impl< true, true, false, 4 >, 576
 - add, 581
 - addin, 582
 - alignment, 584
 - blend, 581
 - compliant, 581
 - eq, 583
 - fmadd, 582
 - fmaddin, 582
 - fmaddx, 580
 - fmaddxin, 580
 - fmsub, 583
 - fmsubin, 583
 - fmsubx, 580
 - fmsubxin, 580
 - fnmadd, 582
 - fnmaddin, 583
 - fnmaddx, 580
 - fnmaddxin, 580
 - gather, 578
 - greater, 579
 - greater_eq, 579
 - hadd_to_scal, 581
 - lesser, 579
 - lesser_eq, 579
 - load, 578
 - loadu, 578
 - mod, 583
 - mul, 582
 - mulhi, 579
 - mullo, 582
 - mulx, 580
 - round, 583
 - scalar_t, 578
 - set, 578
 - set1, 578
 - shuffle, 581
 - sll, 581
 - sll128, 584
 - sra, 579
 - srl, 581
 - srl128, 584
 - store, 579
 - storeu, 579
 - stream, 579
 - sub, 582
 - subin, 582
 - type_string, 583
 - unpackhi, 581
 - unpacklo, 581
 - valid, 581
 - vand, 584
 - vandnot, 584

- vect_size, [584](#)
- vect_t, [578](#)
- vor, [584](#)
- vxor, [584](#)
- zero, [584](#)
- Simd128_impl< true, true, false, 4 >::Converter, [423](#)
 - t, [423](#)
 - v, [423](#)
- Simd128_impl< true, true, false, 8 >, [585](#)
 - add, [590](#)
 - addin, [590](#)
 - alignment, [594](#)
 - blend, [590](#)
 - compliant, [589](#)
 - eq, [592](#)
 - fmadd, [591](#)
 - fmaddin, [591](#)
 - fmaddx, [588](#)
 - fmaddxin, [589](#)
 - fmsub, [591](#)
 - fmsubin, [592](#)
 - fmsubx, [589](#)
 - fmsubxin, [589](#), [592](#)
 - fnmadd, [591](#)
 - fnmaddin, [591](#)
 - fnmaddx, [589](#)
 - fnmaddxin, [589](#)
 - gather, [587](#)
 - get, [590](#)
 - greater, [588](#)
 - greater_eq, [588](#)
 - hadd_to_scal, [589](#)
 - lesser, [588](#)
 - lesser_eq, [588](#)
 - load, [587](#)
 - loadu, [587](#)
 - mask_high, [592](#)
 - mod, [592](#)
 - mul, [591](#)
 - mulhi_fast, [592](#)
 - mullo, [588](#)
 - mulx, [588](#)
 - round, [592](#)
 - scalar_t, [586](#)
 - set, [587](#)
 - set1, [587](#)
 - shuffle, [590](#)
 - signbits, [593](#)
 - sll, [590](#)
 - sll128, [593](#)
 - sra, [588](#)
 - srl, [590](#)
 - srl128, [593](#)
 - store, [587](#)
 - storeu, [587](#)
 - stream, [587](#)
 - sub, [591](#)
 - subin, [591](#)
 - type_string, [593](#)
 - unpackhi, [590](#)
 - unpacklo, [590](#)
 - valid, [589](#)
 - vand, [593](#)
 - vandnot, [593](#)
 - vect_size, [594](#)
 - vect_t, [587](#)
 - vor, [593](#)
 - vxor, [593](#)
 - zero, [593](#)
 - Simd128_impl< true, true, false, 8 >::Converter, [423](#)
 - t, [423](#)
 - v, [423](#)
 - Simd128_impl< true, true, true, 2 >, [594](#)
 - add, [598](#)
 - addin, [598](#)
 - alignment, [602](#)
 - blend, [598](#)
 - compliant, [596](#)
 - eq, [600](#)
 - fmadd, [599](#)
 - fmaddin, [599](#)
 - fmaddx, [599](#)
 - fmaddxin, [599](#)
 - fmsub, [600](#)
 - fmsubin, [600](#)
 - fmsubx, [600](#)
 - fmsubxin, [600](#)
 - fnmadd, [599](#)
 - fnmaddin, [599](#)
 - fnmaddx, [600](#)
 - fnmaddxin, [600](#)
 - gather, [596](#)
 - greater, [600](#)
 - greater_eq, [601](#)
 - hadd_to_scal, [601](#)
 - lesser, [601](#)
 - lesser_eq, [601](#)
 - load, [596](#)
 - loadu, [596](#)
 - mod, [601](#)
 - mul, [598](#)
 - mulhi, [598](#)
 - mullo, [598](#)
 - mulx, [599](#)
 - round, [601](#)
 - scalar_t, [596](#)
 - set, [596](#)
 - set1, [596](#)
 - shuffle, [597](#)
 - sll, [597](#)
 - sll128, [602](#)
 - sra, [597](#)
 - srl, [597](#)
 - srl128, [602](#)
 - store, [597](#)
 - storeu, [597](#)

- stream, [597](#)
- sub, [598](#)
- subin, [598](#)
- type_string, [601](#)
- unpackhi, [597](#)
- unpacklo, [597](#)
- valid, [596](#)
- vand, [602](#)
- vandnot, [602](#)
- vect_size, [602](#)
- vect_t, [595](#)
- vor, [602](#)
- vxor, [602](#)
- zero, [601](#)
- Simd128_impl< true, true, true, 2 >::Converter, [423](#)
- t, [424](#)
- v, [424](#)
- Simd128_impl< true, true, true, 4 >, [603](#)
- add, [606](#)
- addin, [606](#)
- alignment, [611](#)
- blend, [606](#)
- compliant, [605](#)
- eq, [609](#)
- fmadd, [607](#)
- fmaddin, [607](#)
- fmaddx, [608](#)
- fmaddxin, [608](#)
- fmsub, [608](#)
- fmsubin, [609](#)
- fmsubx, [609](#)
- fmsubxin, [609](#)
- fnmadd, [608](#)
- fnmaddin, [608](#)
- fnmaddx, [608](#)
- fnmaddxin, [608](#)
- gather, [605](#)
- greater, [609](#)
- greater_eq, [609](#)
- hadd_to_scal, [610](#)
- lesser, [609](#)
- lesser_eq, [609](#)
- load, [605](#)
- loadu, [605](#)
- mod, [610](#)
- mul, [607](#)
- mulhi, [607](#)
- mullo, [607](#)
- mulx, [607](#)
- round, [610](#)
- scalar_t, [604](#)
- set, [605](#)
- set1, [605](#)
- shuffle, [606](#)
- sll, [606](#)
- sll128, [610](#)
- sra, [606](#)
- srl, [606](#)
- srl128, [610](#)
- store, [605](#)
- storeu, [605](#)
- stream, [605](#)
- sub, [607](#)
- subin, [607](#)
- type_string, [610](#)
- unpackhi, [606](#)
- unpacklo, [606](#)
- valid, [604](#)
- vand, [610](#)
- vandnot, [611](#)
- vect_size, [611](#)
- vect_t, [604](#)
- vor, [610](#)
- vxor, [611](#)
- zero, [610](#)
- Simd128_impl< true, true, true, 4 >::Converter, [424](#)
- t, [424](#)
- v, [424](#)
- Simd128_impl< true, true, true, 8 >, [611](#)
- add, [615](#)
- addin, [615](#)
- alignment, [620](#)
- blend, [615](#)
- compliant, [613](#)
- eq, [618](#)
- fmadd, [616](#)
- fmaddin, [616](#)
- fmaddx, [616](#)
- fmaddxin, [616](#)
- fmsub, [617](#)
- fmsubin, [617](#)
- fmsubx, [617](#)
- fmsubxin, [617](#)
- fnmadd, [616](#)
- fnmaddin, [617](#)
- fnmaddx, [617](#)
- fnmaddxin, [617](#)
- gather, [614](#)
- get, [614](#)
- greater, [618](#)
- greater_eq, [618](#)
- hadd_to_scal, [618](#)
- lesser, [618](#)
- lesser_eq, [618](#)
- load, [614](#)
- loadu, [614](#)
- mask_high, [618](#)
- mod, [619](#)
- mul, [616](#)
- mulhi_fast, [618](#)
- mullo, [616](#)
- mulx, [616](#)
- round, [618](#)
- scalar_t, [613](#)
- set, [613](#)
- set1, [613](#)

- shuffle, [615](#)
- signbits, [619](#)
- sll, [614](#)
- sll128, [619](#)
- sra, [615](#)
- srl, [614](#)
- srl128, [619](#)
- store, [614](#)
- storeu, [614](#)
- stream, [614](#)
- sub, [615](#)
- subin, [615](#)
- type_string, [619](#)
- unpackhi, [615](#)
- unpacklo, [615](#)
- valid, [613](#)
- vand, [619](#)
- vandnot, [620](#)
- vect_size, [620](#)
- vect_t, [613](#)
- vor, [619](#)
- vxor, [620](#)
- zero, [619](#)
- Simd128_impl< true, true, true, 8 >::Converter, [424](#)
- t, [424](#)
- v, [424](#)
- simd128_int16.inl, [868](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd128_int16_INL, [868](#)
- simd128_int32.inl, [868](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd128_int32_INL, [869](#)
- simd128_int64.inl, [869](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd128_int64_INL, [869](#)
- vect_t, [869](#)
- Simd128fp_base, [620](#)
- type_string, [620](#)
- Simd128i_base, [621](#)
- sll128, [621](#)
- srl128, [621](#)
- type_string, [621](#)
- vand, [622](#)
- vandnot, [622](#)
- vect_t, [621](#)
- vor, [622](#)
- vxor, [622](#)
- zero, [621](#)
- Simd256
- simd256.inl, [870](#)
- simd256.inl, [869](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd256_INL, [870](#)
- Simd256, [870](#)
- simd256_double.inl, [870](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd256_double_INL, [870](#)
- simd256_float.inl, [870](#)
- __FFLASFFPACK_fflas_ffpack_utils_simd256_float_INL, [870](#)
- Simd256_impl< ArithType, Int, Signed, Size >, [622](#)
- Simd256_impl< true, false, true, 4 >, [622](#)
- Simd256_impl< true, false, true, 8 >, [623](#)
- add, [626](#)
- addin, [626](#)
- alignment, [629](#)
- blend, [626](#)
- blendv, [626](#)
- ceil, [629](#)
- compliant, [624](#)
- div, [627](#)
- eq, [628](#)
- floor, [629](#)
- fmadd, [627](#)
- fmaddin, [627](#)
- fmsub, [627](#)
- fmsubin, [627](#)
- fnmadd, [627](#)
- fnmaddin, [627](#)
- gather, [625](#)
- greater, [628](#)
- greater_eq, [628](#)
- hadd, [629](#)
- hadd_to_scal, [629](#)
- lesser, [628](#)
- lesser_eq, [628](#)
- load, [625](#)
- loadu, [625](#)
- mod, [629](#)
- mul, [626](#)
- mulin, [626](#)
- round, [629](#)
- scalar_t, [624](#)
- set, [624](#)
- set1, [624](#)
- store, [625](#)
- storeu, [625](#)
- stream, [625](#)
- sub, [626](#)
- subin, [626](#)
- unpackhi_twice, [625](#)
- unpacklo_twice, [625](#)
- valid, [624](#)
- vand, [628](#)
- vandnot, [628](#)
- vect_size, [629](#)
- vect_t, [624](#)
- vor, [628](#)
- vxor, [628](#)
- zero, [624](#)
- Simd256_impl< true, true, false, 2 >, [630](#)
- add, [636](#)
- addin, [636](#)
- alignment, [638](#)
- blend_twice, [636](#)
- compliant, [635](#)

- eq, [637](#)
- fmadd, [637](#)
- fmaddin, [637](#)
- fmaddx, [634](#)
- fmaddxin, [634](#)
- fmsub, [637](#)
- fmsubin, [637](#)
- fmsubx, [634](#)
- fmsubxin, [634](#)
- fnmadd, [637](#)
- fnmaddin, [637](#)
- fnmaddx, [634](#)
- fnmaddxin, [634](#)
- gather, [632](#)
- greater, [633](#)
- greater_eq, [633](#)
- hadd_to_scal, [634](#)
- half_t, [632](#)
- lesser, [633](#)
- lesser_eq, [633](#)
- load, [632](#)
- loadu, [632](#)
- mod, [638](#)
- mul, [636](#)
- mulhi, [633](#)
- mullo, [636](#)
- mulx, [634](#)
- round, [638](#)
- scalar_t, [631](#)
- set, [632](#)
- set1, [632](#)
- shuffle, [635](#)
- simdHalf, [631](#)
- sll, [635](#)
- sra, [633](#)
- srl, [635](#)
- store, [632](#)
- storeu, [633](#)
- stream, [633](#)
- sub, [636](#)
- subin, [636](#)
- type_string, [638](#)
- unpackhi, [635](#)
- unpackhi_twice, [635](#)
- unpacklo, [635](#)
- unpacklo_twice, [635](#)
- unpacklohi, [636](#)
- valid, [635](#)
- vect_size, [638](#)
- vect_t, [631](#)
- zero, [638](#)
- Simd256_impl< true, true, false, 2 >::Converter, [425](#)
 - t, [425](#)
 - v, [425](#)
- Simd256_impl< true, true, false, 4 >, [638](#)
 - add, [650](#)
 - addin, [650](#)
 - alignment, [655](#)
 - blend, [650](#)
 - compliant, [648](#)
 - eq, [653](#)
 - fmadd, [651](#)
 - fmaddin, [651](#), [652](#)
 - fmaddx, [644](#), [646](#)
 - fmaddxin, [644](#), [647](#)
 - fmsub, [652](#)
 - fmsubin, [653](#)
 - fmsubx, [644](#), [647](#)
 - fmsubxin, [644](#), [647](#)
 - fnmadd, [652](#)
 - fnmaddin, [652](#)
 - fnmaddx, [644](#), [647](#)
 - fnmaddxin, [644](#), [647](#)
 - gather, [642](#), [645](#)
 - greater, [643](#), [646](#)
 - greater_eq, [643](#), [646](#)
 - hadd_to_scal, [644](#), [647](#)
 - half_t, [642](#)
 - lesser, [643](#), [646](#)
 - lesser_eq, [643](#), [646](#)
 - load, [642](#), [645](#)
 - loadu, [642](#), [645](#)
 - mod, [653](#)
 - mul, [651](#)
 - mulhi, [643](#), [646](#)
 - mullo, [651](#)
 - mulx, [644](#), [646](#)
 - round, [653](#)
 - scalar_t, [641](#)
 - set, [642](#), [645](#), [648](#)
 - set1, [642](#), [645](#)
 - shuffle, [649](#)
 - shuffle_twice, [649](#)
 - simdHalf, [641](#)
 - sll, [648](#)
 - sra, [643](#), [646](#)
 - srl, [648](#)
 - store, [642](#), [645](#)
 - storeu, [643](#), [645](#)
 - stream, [643](#), [645](#)
 - sub, [650](#)
 - subin, [650](#), [651](#)
 - type_string, [654](#)
 - unpackhi, [649](#)
 - unpackhi_twice, [649](#)
 - unpacklo, [649](#)
 - unpacklo_twice, [649](#)
 - unpacklohi, [649](#)
 - valid, [647](#)
 - vand, [654](#)
 - vandnot, [654](#)
 - vect_size, [655](#)
 - vect_t, [641](#), [642](#)
 - vor, [654](#)
 - vxor, [654](#)
 - zero, [654](#)

- Simd256_impl< true, true, false, 4 >::Converter, [425](#)
 - t, [425](#)
 - v, [425](#)
- Simd256_impl< true, true, false, 8 >, [655](#)
 - add, [661](#)
 - addin, [661](#)
 - alignment, [663](#)
 - blend, [661](#)
 - compliant, [660](#)
 - eq, [662](#)
 - fmadd, [662](#)
 - fmaddin, [662](#)
 - fmaddx, [659](#)
 - fmaddxin, [659](#)
 - fmsub, [662](#)
 - fmsubin, [662](#)
 - fmsubx, [659](#)
 - fmsubxin, [659](#)
 - fnmadd, [662](#)
 - fnmaddin, [662](#)
 - fnmaddx, [659](#)
 - fnmaddxin, [659](#)
 - gather, [657](#)
 - get, [660](#)
 - greater, [658](#)
 - greater_eq, [658](#)
 - hadd_to_scal, [660](#)
 - half_t, [657](#)
 - lesser, [658](#)
 - lesser_eq, [658](#)
 - load, [657](#)
 - loadu, [657](#)
 - mask_high, [663](#)
 - mod, [663](#)
 - mul, [661](#)
 - mulhi_fast, [663](#)
 - mullo, [658](#)
 - mulx, [659](#)
 - round, [663](#)
 - scalar_t, [657](#)
 - set, [657](#)
 - set1, [657](#)
 - shuffle, [660](#)
 - signbits, [663](#)
 - simdHalf, [657](#)
 - sll, [660](#)
 - sra, [658](#)
 - srl, [660](#)
 - store, [658](#)
 - storeu, [658](#)
 - stream, [658](#)
 - sub, [661](#)
 - subin, [661](#)
 - type_string, [663](#)
 - unpackhi, [661](#)
 - unpackhi_twice, [660](#)
 - unpacklo, [660](#)
 - unpacklo_twice, [660](#)
 - unpacklohi, [661](#)
 - valid, [660](#)
 - vect_size, [663](#)
 - vect_t, [657](#)
 - zero, [663](#)
- Simd256_impl< true, true, false, 8 >::Converter, [425](#)
 - t, [426](#)
 - v, [425](#)
- Simd256_impl< true, true, true, 2 >, [664](#)
 - add, [668](#)
 - addin, [668](#)
 - alignment, [672](#)
 - blend_twice, [668](#)
 - compliant, [666](#)
 - eq, [671](#)
 - fmadd, [669](#)
 - fmaddin, [669](#)
 - fmaddx, [669](#)
 - fmaddxin, [670](#)
 - fmsub, [670](#)
 - fmsubin, [670](#)
 - fmsubx, [671](#)
 - fmsubxin, [671](#)
 - fnmadd, [670](#)
 - fnmaddin, [670](#)
 - fnmaddx, [670](#)
 - fnmaddxin, [670](#)
 - gather, [666](#)
 - greater, [671](#)
 - greater_eq, [671](#)
 - hadd_to_scal, [671](#)
 - half_t, [665](#)
 - lesser, [671](#)
 - lesser_eq, [671](#)
 - load, [666](#)
 - loadu, [667](#)
 - mod, [672](#)
 - mul, [669](#)
 - mulhi, [669](#)
 - mullo, [669](#)
 - mulx, [669](#)
 - round, [671](#)
 - scalar_t, [665](#)
 - set, [666](#)
 - set1, [666](#)
 - shuffle, [667](#)
 - simdHalf, [666](#)
 - sll, [667](#)
 - sra, [667](#)
 - srl, [667](#)
 - store, [667](#)
 - storeu, [667](#)
 - stream, [667](#)
 - sub, [668](#)
 - subin, [669](#)
 - type_string, [672](#)
 - unpackhi, [668](#)
 - unpackhi_twice, [668](#)

- unpacklo, 668
- unpacklo_twice, 667
- unpacklohi, 668
- valid, 666
- vect_size, 672
- vect_t, 665
- zero, 672
- Simd256_impl< true, true, true, 2 >::Converter, 426
 - t, 426
 - v, 426
- Simd256_impl< true, true, true, 4 >, 672
 - add, 678, 684
 - addin, 678, 684
 - alignment, 688
 - blend, 678
 - compliant, 676, 682
 - eq, 681, 686
 - fmadd, 679, 685
 - fmaddin, 679, 685
 - fmaddx, 680, 685
 - fmaddxin, 680, 685
 - fmsub, 680, 686
 - fmsubin, 681, 686
 - fmsubx, 681, 686
 - fmsubxin, 681, 686
 - fnmadd, 680, 685
 - fnmaddin, 680, 685
 - fnmaddx, 680, 686
 - fnmaddxin, 680, 686
 - gather, 676, 683
 - greater, 681, 687
 - greater_eq, 681, 687
 - hadd_to_scal, 682, 687
 - half_t, 675, 676
 - lesser, 681, 687
 - lesser_eq, 681, 687
 - load, 676, 683
 - loadu, 677, 683
 - mod, 682, 687
 - mul, 679, 684
 - mulhi, 679, 685
 - mullo, 679, 684
 - mulx, 679, 685
 - round, 682, 687
 - scalar_t, 675, 676
 - set, 676, 682
 - set1, 676, 682
 - shuffle, 677, 684
 - shuffle_twice, 677, 684
 - simdHalf, 675, 676
 - sll, 677, 683
 - sra, 677, 684
 - srl, 677, 683
 - store, 677, 683
 - storeu, 677, 683
 - stream, 677, 683
 - sub, 679, 684
 - subin, 679, 684
 - type_string, 687, 688
 - unpackhi, 678
 - unpackhi_twice, 678
 - unpacklo, 678
 - unpacklo_twice, 678
 - unpacklohi, 678
 - valid, 676, 682
 - vand, 688
 - vandnot, 688
 - vect_size, 688
 - vect_t, 675
 - vor, 688
 - vxor, 688
 - zero, 687, 688
- Simd256_impl< true, true, true, 4 >::Converter, 426
 - t, 426
 - v, 426
- Simd256_impl< true, true, true, 8 >, 689
 - add, 693
 - addin, 693
 - alignment, 697
 - blend, 693
 - compliant, 691
 - eq, 696
 - fmadd, 694
 - fmaddin, 694
 - fmaddx, 694
 - fmaddxin, 694
 - fmsub, 695
 - fmsubin, 695
 - fmsubx, 695
 - fmsubxin, 695
 - fnmadd, 694
 - fnmaddin, 695
 - fnmaddx, 695
 - fnmaddxin, 695
 - gather, 691
 - get, 691
 - greater, 696
 - greater_eq, 696
 - hadd_to_scal, 696
 - half_t, 690
 - lesser, 696
 - lesser_eq, 696
 - load, 691
 - loadu, 691
 - mask_high, 696
 - mod, 697
 - mul, 694
 - mulhi_fast, 696
 - mullo, 694
 - mulx, 694
 - round, 696
 - scalar_t, 690
 - set, 691
 - set1, 691
 - shuffle, 692
 - signbits, 697

- simdHalf, 691
- sll, 692
- sra, 692
- srl, 692
- store, 692
- storeu, 692
- stream, 692
- sub, 693
- subin, 693
- type_string, 697
- unpackhi, 693
- unpackhi_twice, 692
- unpacklo, 693
- unpacklo_twice, 692
- unpacklohi, 693
- valid, 691
- vect_size, 697
- vect_t, 690
- zero, 697
- Simd256_impl< true, true, true, 8 >::Converter, 427
 - t, 427
 - v, 427
- simd256_int16.inl, 871
 - __FFLASFFPACK_fflas_ffpack_utils_simd256_int16_INL, 871
- simd256_int32.inl, 871
 - __FFLASFFPACK_fflas_ffpack_utils_simd256_int32_INL, 871
- simd256_int64.inl, 871
 - __FFLASFFPACK_fflas_ffpack_utils_simd256_int64_INL, 872
 - vect_t, 872
- Simd256fp_base, 697
- Simd256i_base, 698
 - type_string, 698
 - vect_t, 698
 - zero, 698
- Simd512
 - simd512.inl, 872
- simd512.inl, 872
 - __FFLASFFPACK_simd512_INL, 872
 - Simd512, 872
- simd512_double.inl, 872
 - __FFLASFFPACK_simd512_double_INL, 873
- simd512_float.inl, 873
 - __FFLASFFPACK_simd512_float_INL, 873
- Simd512_impl< ArithType, Int, Signed, Size >, 699
- Simd512_impl< true, false, true, 4 >, 699
 - type_string, 699
- Simd512_impl< true, false, true, 8 >, 699
 - add, 703
 - addin, 703
 - alignment, 705
 - blend, 702
 - blendv, 702
 - ceil, 705
 - compliant, 701
 - div, 703
 - eq, 704
 - floor, 705
 - fmadd, 703
 - fmaddin, 703
 - fmsub, 704
 - fmsubin, 704
 - fnmadd, 704
 - fnmaddin, 704
 - gather, 701
 - greater, 704
 - greater_eq, 705
 - hadd, 705
 - hadd_to_scal, 705
 - lesser, 704
 - lesser_eq, 704
 - load, 701
 - loadu, 701
 - mul, 703
 - mulin, 703
 - round, 705
 - scalar_t, 700
 - set, 701
 - set1, 701
 - shuffle, 702
 - store, 702
 - storeu, 702
 - stream, 702
 - sub, 703
 - subin, 703
 - type_string, 705
 - unpackhi_twice, 702
 - unpacklo_twice, 702
 - valid, 701
 - vect_size, 705
 - vect_t, 700
 - zero, 701
- Simd512_impl< true, true, false, 8 >, 706
 - add, 712
 - addin, 712
 - alignment, 715
 - blend, 712
 - compliant, 711
 - eq, 714
 - fmadd, 713
 - fmaddin, 713
 - fmaddx, 710
 - fmaddxin, 710
 - fmsub, 713
 - fmsubin, 713
 - fmsubx, 710
 - fmsubxin, 710
 - fnmadd, 713
 - fnmaddin, 713
 - fnmaddx, 710
 - fnmaddxin, 710
 - gather, 708
 - greater, 709
 - greater_eq, 709

- hadd_to_scal, 711
- half_t, 708
- lesser, 709
- lesser_eq, 709
- load, 708
- loadu, 708
- mask_high, 714
- maskstore, 709
- mod, 714
- mul, 713
- mulhi_fast, 714
- mullo, 710
- mulx, 710
- round, 714
- scalar_t, 708
- set, 708, 711
- set1, 708
- shuffle, 711
- signbits, 714
- simdHalf, 708
- sll, 711
- sra, 709
- srl, 711
- store, 709
- storeu, 709
- stream, 709
- sub, 712
- subin, 712
- type_string, 714
- unpackhi, 712
- unpackhi_twice, 711
- unpacklo, 712
- unpacklo_twice, 711
- unpacklohi, 712
- valid, 711
- vand, 715
- vandnot, 715
- vect_size, 715
- vect_t, 708
- vor, 714
- vxor, 715
- zero, 714
- Simd512_impl< true, true, false, 8 >::Converter, 427
 - t, 427
 - v, 427
- Simd512_impl< true, true, true, 8 >, 715
 - add, 720
 - addin, 720
 - alignment, 725
 - blend, 720
 - compliant, 718
 - eq, 723
 - fmadd, 721
 - fmaddin, 721
 - fmaddx, 721
 - fmaddxin, 721
 - fmsub, 722
 - fmsubin, 722
 - fmsubx, 722
 - fmsubxin, 722
 - fnmadd, 721
 - fnmaddin, 722
 - fnmaddx, 722
 - fnmaddxin, 722
 - gather, 718
 - greater, 723
 - greater_eq, 723
 - hadd_to_scal, 723
 - half_t, 717
 - lesser, 723
 - lesser_eq, 723
 - load, 718
 - loadu, 718
 - mask_high, 723
 - maskstore, 719
 - mod, 724
 - mul, 721
 - mulhi_fast, 723
 - mullo, 721
 - mulx, 721
 - round, 723
 - scalar_t, 717
 - set, 718
 - set1, 718
 - shuffle, 719
 - signbits, 724
 - simdHalf, 717
 - sll, 719
 - sra, 719
 - srl, 719
 - store, 718
 - storeu, 719
 - stream, 719
 - sub, 720
 - subin, 720
 - type_string, 724
 - unpackhi, 720
 - unpackhi_twice, 719
 - unpacklo, 720
 - unpacklo_twice, 719
 - unpacklohi, 720
 - valid, 717
 - vand, 724
 - vandnot, 724
 - vect_size, 725
 - vect_t, 717
 - vor, 724
 - vxor, 724
 - zero, 724
- Simd512_impl< true, true, true, 8 >::Converter, 427
 - t, 428
 - v, 427
- simd512_int32.inl, 873
 - __FFLASFFPACK_simd512_int32_INL, 873
- simd512_int64.inl, 874
 - _simd512_int64_INL, 874

- vect_t, [874](#)
- Simd512fp_base, [725](#)
 - type_string, [725](#)
- Simd512i_base, [725](#)
 - type_string, [726](#)
 - vand, [726](#)
 - vandnot, [726](#)
 - vect_t, [726](#)
 - vor, [726](#)
 - vxor, [726](#)
 - zero, [726](#)
- SIMD_INT
 - fflas_simd.h, [866](#)
- simd_modular.inl, [874](#)
- SimdChooser< T, bool, bool >, [727](#)
- SimdChooser< T, false, b >, [727](#)
 - value, [727](#)
- SimdChooser< T, true, false >, [727](#)
 - value, [727](#)
- SimdChooser< T, true, true >, [727](#)
 - value, [728](#)
- simdHalf
 - Simd256_impl< true, true, false, 2 >, [631](#)
 - Simd256_impl< true, true, false, 4 >, [641](#)
 - Simd256_impl< true, true, false, 8 >, [657](#)
 - Simd256_impl< true, true, true, 2 >, [666](#)
 - Simd256_impl< true, true, true, 4 >, [675](#), [676](#)
 - Simd256_impl< true, true, true, 8 >, [691](#)
 - Simd512_impl< true, true, false, 8 >, [708](#)
 - Simd512_impl< true, true, true, 8 >, [717](#)
- SimdSparseMatrix
 - FFLAS, [79](#)
- simdToType< T >, [728](#)
- Single, [728](#)
- size
 - Info, [477](#), [478](#)
 - RNSInteger< RNS >, [546](#)
 - RNSIntegerMod< RNS >, [551](#)
- SIZEOF___INT64
 - config.h, [799](#)
- SIZEOF_CHAR
 - config.h, [799](#)
- SIZEOF_INT
 - config.h, [799](#)
- SIZEOF_LONG
 - config.h, [799](#)
- SIZEOF_LONG_LONG
 - config.h, [799](#)
- SIZEOF_SHORT
 - config.h, [799](#)
- sll
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [565](#)
 - Simd128_impl< true, true, false, 2 >, [572](#)
 - Simd128_impl< true, true, false, 4 >, [581](#)
 - Simd128_impl< true, true, false, 8 >, [590](#)
 - Simd128_impl< true, true, true, 2 >, [597](#)
 - Simd128_impl< true, true, true, 4 >, [606](#)
 - Simd128_impl< true, true, true, 8 >, [614](#)
 - Simd256_impl< true, true, false, 2 >, [635](#)
 - Simd256_impl< true, true, false, 4 >, [648](#)
 - Simd256_impl< true, true, false, 8 >, [660](#)
 - Simd256_impl< true, true, true, 2 >, [667](#)
 - Simd256_impl< true, true, true, 4 >, [677](#), [683](#)
 - Simd256_impl< true, true, true, 8 >, [692](#)
 - Simd512_impl< true, true, false, 8 >, [711](#)
 - Simd512_impl< true, true, true, 8 >, [719](#)
- sll128
 - Simd128_impl< true, true, false, 2 >, [575](#)
 - Simd128_impl< true, true, false, 4 >, [584](#)
 - Simd128_impl< true, true, false, 8 >, [593](#)
 - Simd128_impl< true, true, true, 2 >, [602](#)
 - Simd128_impl< true, true, true, 4 >, [610](#)
 - Simd128_impl< true, true, true, 8 >, [619](#)
 - Simd128i_base, [621](#)
- Solve
 - FFPACK, [335](#), [375](#)
- solve.C, [805](#)
 - main, [805](#)
- Solve_modular_double
 - ffpack.C, [996](#)
 - ffpack_c.h, [1017](#)
- solveLB
 - FFPACK, [351](#), [375](#)
- solveLB2
 - FFPACK, [351](#), [375](#)
- solveLB2_modular_double
 - ffpack.C, [996](#)
 - ffpack_c.h, [1018](#)
- solveLB_modular_double
 - ffpack.C, [996](#)
 - ffpack_c.h, [1017](#)
- Sparse< _Field, SparseMatrix_t::COO >, [728](#)
 - col, [729](#)
 - dat, [729](#)
 - delayed, [729](#)
 - Field, [729](#)
 - kmax, [729](#)
 - m, [729](#)
 - maxrow, [730](#)
 - n, [729](#)
 - nElements, [729](#)
 - nnz, [729](#)
 - row, [729](#)
- Sparse< _Field, SparseMatrix_t::COO_ZO >, [730](#)
 - col, [730](#)
 - cst, [730](#)
 - dat, [731](#)
 - delayed, [731](#)
 - Field, [730](#)
 - kmax, [731](#)
 - m, [731](#)
 - maxrow, [731](#)
 - n, [731](#)
 - nElements, [731](#)
 - nnz, [731](#)

- row, [731](#)
- Sparse< _Field, SparseMatrix_t::CSR >, [731](#)
 - col, [733](#)
 - dat, [733](#)
 - delayed, [732](#)
 - Field, [732](#)
 - kmax, [732](#)
 - m, [732](#)
 - maxrow, [733](#)
 - n, [732](#)
 - nElements, [733](#)
 - nnz, [732](#)
 - st, [733](#)
 - stend, [733](#)
- Sparse< _Field, SparseMatrix_t::CSR_HYB >, [733](#)
 - col, [734](#)
 - dat, [734](#)
 - delayed, [734](#)
 - Field, [734](#)
 - kmax, [734](#)
 - m, [734](#)
 - maxrow, [734](#)
 - n, [734](#)
 - nElements, [734](#)
 - nMOnes, [735](#)
 - nnz, [734](#)
 - nOnes, [735](#)
 - nOthers, [735](#)
 - st, [734](#)
- Sparse< _Field, SparseMatrix_t::CSR_ZO >, [735](#)
 - col, [736](#)
 - cst, [736](#)
 - dat, [737](#)
 - delayed, [736](#)
 - Field, [735](#)
 - kmax, [736](#)
 - m, [736](#)
 - maxrow, [736](#)
 - n, [736](#)
 - nElements, [736](#)
 - nnz, [736](#)
 - st, [736](#)
 - stend, [736](#)
- Sparse< _Field, SparseMatrix_t::ELL >, [737](#)
 - col, [738](#)
 - dat, [738](#)
 - delayed, [737](#)
 - Field, [737](#)
 - kmax, [737](#)
 - ld, [738](#)
 - m, [738](#)
 - maxrow, [738](#)
 - n, [738](#)
 - nElements, [738](#)
 - nnz, [738](#)
- Sparse< _Field, SparseMatrix_t::ELL_simd >, [738](#)
 - chunk, [739](#)
 - col, [740](#)
 - dat, [740](#)
 - delayed, [739](#)
 - kmax, [739](#)
 - ld, [739](#)
 - m, [739](#)
 - maxrow, [739](#)
 - n, [739](#)
 - nChunks, [740](#)
 - nElements, [739](#)
 - nnz, [739](#)
- Sparse< _Field, SparseMatrix_t::ELL_simd_ZO >, [740](#)
 - chunk, [741](#)
 - col, [741](#)
 - cst, [740](#)
 - dat, [741](#)
 - delayed, [740](#)
 - kmax, [741](#)
 - ld, [741](#)
 - m, [741](#)
 - maxrow, [741](#)
 - n, [741](#)
 - nChunks, [741](#)
 - nElements, [741](#)
 - nnz, [741](#)
- Sparse< _Field, SparseMatrix_t::ELL_ZO >, [742](#)
 - col, [743](#)
 - cst, [742](#)
 - dat, [743](#)
 - delayed, [742](#)
 - Field, [742](#)
 - kmax, [742](#)
 - ld, [743](#)
 - m, [742](#)
 - maxrow, [743](#)
 - n, [743](#)
 - nElements, [743](#)
 - nnz, [743](#)
- Sparse< _Field, SparseMatrix_t::HYB_ZO >, [743](#)
 - dat, [744](#)
 - delayed, [744](#)
 - Field, [744](#)
 - kmax, [744](#)
 - m, [744](#)
 - maxrow, [744](#)
 - mone, [745](#)
 - n, [744](#)
 - nElements, [744](#)
 - nnz, [744](#)
 - one, [745](#)
 - Self_t, [744](#)
- Sparse< _Field, SparseMatrix_t::SELL >, [745](#)
 - chunk, [746](#)
 - chunkSize, [747](#)
 - col, [747](#)
 - dat, [747](#)
 - delayed, [746](#)
 - Field, [745](#)
 - kmax, [746](#)

- m, [746](#)
- maxrow, [746](#)
- n, [746](#)
- nChunks, [746](#)
- nElements, [746](#)
- nnz, [746](#)
- perm, [746](#)
- sigma, [746](#)
- st, [747](#)
- Sparse< _Field, SparseMatrix_t::SELL_ZO >, [747](#)
 - chunk, [748](#)
 - chunkSize, [749](#)
 - col, [749](#)
 - cst, [748](#)
 - dat, [749](#)
 - delayed, [748](#)
 - Field, [748](#)
 - kmax, [748](#)
 - m, [748](#)
 - maxrow, [748](#)
 - n, [748](#)
 - nChunks, [748](#)
 - nElements, [749](#)
 - nnz, [749](#)
 - perm, [749](#)
 - sigma, [748](#)
 - st, [749](#)
- Sparse< Field, SparseMatrix_t, IdxT, PtrT >, [728](#)
- sparse_delete
 - FFLAS, [151](#), [152](#), [154–156](#), [158](#)
- sparse_init
 - FFLAS, [151–156](#), [159](#)
- sparse_matrix_traits.h, [906](#)
- sparse_print
 - FFLAS, [152](#), [156](#), [159](#)
- SparseMatrix_t
 - FFLAS, [83](#)
- SpecRankProfile
 - FFPACK, [374](#)
- SpecRankProfile_modular_double
 - ffpack.C, [995](#)
 - ffpack_c.h, [1016](#)
- splitt
 - parallel.h, [1037](#)
- SPLITTER
 - parallel.h, [1037](#)
- splitting_0
 - parallel.h, [1037](#)
- splitting_1
 - parallel.h, [1037](#)
- splitting_2
 - parallel.h, [1037](#)
- splitting_3
 - parallel.h, [1037](#)
- SpMat< Field, flag >, [749](#)
 - _coo, [749](#)
 - _csr, [749](#)
 - _ell, [750](#)
- sra
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [564](#), [565](#)
 - Simd128_impl< true, true, false, 2 >, [570](#)
 - Simd128_impl< true, true, false, 4 >, [579](#)
 - Simd128_impl< true, true, false, 8 >, [588](#)
 - Simd128_impl< true, true, true, 2 >, [597](#)
 - Simd128_impl< true, true, true, 4 >, [606](#)
 - Simd128_impl< true, true, true, 8 >, [615](#)
 - Simd256_impl< true, true, false, 2 >, [633](#)
 - Simd256_impl< true, true, false, 4 >, [643](#), [646](#)
 - Simd256_impl< true, true, false, 8 >, [658](#)
 - Simd256_impl< true, true, true, 2 >, [667](#)
 - Simd256_impl< true, true, true, 4 >, [677](#), [684](#)
 - Simd256_impl< true, true, true, 8 >, [692](#)
 - Simd512_impl< true, true, false, 8 >, [709](#)
 - Simd512_impl< true, true, true, 8 >, [719](#)
- srl
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [565](#)
 - Simd128_impl< true, true, false, 2 >, [572](#)
 - Simd128_impl< true, true, false, 4 >, [581](#)
 - Simd128_impl< true, true, false, 8 >, [590](#)
 - Simd128_impl< true, true, true, 2 >, [597](#)
 - Simd128_impl< true, true, true, 4 >, [606](#)
 - Simd128_impl< true, true, true, 8 >, [614](#)
 - Simd256_impl< true, true, false, 2 >, [635](#)
 - Simd256_impl< true, true, false, 4 >, [648](#)
 - Simd256_impl< true, true, false, 8 >, [660](#)
 - Simd256_impl< true, true, true, 2 >, [667](#)
 - Simd256_impl< true, true, true, 4 >, [677](#), [683](#)
 - Simd256_impl< true, true, true, 8 >, [692](#)
 - Simd512_impl< true, true, false, 8 >, [711](#)
 - Simd512_impl< true, true, true, 8 >, [719](#)
- srl128
 - Simd128_impl< true, true, false, 2 >, [575](#)
 - Simd128_impl< true, true, false, 4 >, [584](#)
 - Simd128_impl< true, true, false, 8 >, [593](#)
 - Simd128_impl< true, true, true, 2 >, [602](#)
 - Simd128_impl< true, true, true, 4 >, [610](#)
 - Simd128_impl< true, true, true, 8 >, [619](#)
 - Simd128i_base, [621](#)
- sscal_
 - config-blas.h, [816](#)
- st
 - Sparse< _Field, SparseMatrix_t::CSR >, [733](#)
 - Sparse< _Field, SparseMatrix_t::CSR_HYB >, [734](#)
 - Sparse< _Field, SparseMatrix_t::CSR_ZO >, [736](#)
 - Sparse< _Field, SparseMatrix_t::SELL >, [747](#)
 - Sparse< _Field, SparseMatrix_t::SELL_ZO >, [749](#)
- Static_error_check
 - Static_error_check< bool >, [750](#)
- Static_error_check< bool >, [750](#)
 - Static_error_check, [750](#)
- Static_error_check< false >, [750](#)
- StatsMatrix, [750](#)

- averageCol, [752](#)
- averageColDifference, [752](#)
- averageRow, [752](#)
- averageRowDifference, [753](#)
- coldim, [751](#)
- denseCols, [753](#)
- denseRows, [753](#)
- deviationCol, [752](#)
- deviationColDifference, [752](#)
- deviationRow, [752](#)
- deviationRowDifference, [753](#)
- maxCol, [752](#)
- maxColDifference, [752](#)
- maxRow, [751](#)
- maxRowDifference, [752](#)
- minCol, [752](#)
- minColDifference, [752](#)
- minRow, [751](#)
- minRowDifference, [752](#)
- nDenseCols, [753](#)
- nDenseRows, [753](#)
- nEmptyCols, [753](#)
- nEmptyColsEnd, [753](#)
- nEmptyRows, [753](#)
- nMOnes, [751](#)
- nnz, [751](#)
- nOnes, [751](#)
- nOthers, [751](#)
- rowdim, [751](#)
- STD_RECINT_SIZE
 - benchmark-fgemm-mp.C, [779](#)
 - benchmark-fgemv-mp.C, [782](#)
- STDC_HEADERS
 - config.h, [799](#)
- stend
 - Sparse< _Field, SparseMatrix_t::CSR >, [733](#)
 - Sparse< _Field, SparseMatrix_t::CSR_ZO >, [736](#)
- store
 - Simd128_impl< true, true, false, 2 >, [570](#)
 - Simd128_impl< true, true, false, 4 >, [579](#)
 - Simd128_impl< true, true, false, 8 >, [587](#)
 - Simd128_impl< true, true, true, 2 >, [597](#)
 - Simd128_impl< true, true, true, 4 >, [605](#)
 - Simd128_impl< true, true, true, 8 >, [614](#)
 - Simd256_impl< true, false, true, 8 >, [625](#)
 - Simd256_impl< true, true, false, 2 >, [632](#)
 - Simd256_impl< true, true, false, 4 >, [642](#), [645](#)
 - Simd256_impl< true, true, false, 8 >, [658](#)
 - Simd256_impl< true, true, true, 2 >, [667](#)
 - Simd256_impl< true, true, true, 4 >, [677](#), [683](#)
 - Simd256_impl< true, true, true, 8 >, [692](#)
 - Simd512_impl< true, false, true, 8 >, [702](#)
 - Simd512_impl< true, true, false, 8 >, [709](#)
 - Simd512_impl< true, true, true, 8 >, [718](#)
- storeu
 - Simd128_impl< true, true, false, 2 >, [570](#)
 - Simd128_impl< true, true, false, 4 >, [579](#)
 - Simd128_impl< true, true, false, 8 >, [587](#)
- Simd128_impl< true, true, true, 2 >, [597](#)
- Simd128_impl< true, true, true, 4 >, [605](#)
- Simd128_impl< true, true, true, 8 >, [614](#)
- Simd256_impl< true, false, true, 8 >, [625](#)
- Simd256_impl< true, true, false, 2 >, [633](#)
- Simd256_impl< true, true, false, 4 >, [643](#), [645](#)
- Simd256_impl< true, true, false, 8 >, [658](#)
- Simd256_impl< true, true, true, 2 >, [667](#)
- Simd256_impl< true, true, true, 4 >, [677](#), [683](#)
- Simd256_impl< true, true, true, 8 >, [692](#)
- Simd512_impl< true, false, true, 8 >, [702](#)
- Simd512_impl< true, true, false, 8 >, [709](#)
- Simd512_impl< true, true, true, 8 >, [719](#)
- stream
 - Simd128_impl< true, true, false, 2 >, [570](#)
 - Simd128_impl< true, true, false, 4 >, [579](#)
 - Simd128_impl< true, true, false, 8 >, [587](#)
 - Simd128_impl< true, true, true, 2 >, [597](#)
 - Simd128_impl< true, true, true, 4 >, [605](#)
 - Simd128_impl< true, true, true, 8 >, [614](#)
 - Simd256_impl< true, false, true, 8 >, [625](#)
 - Simd256_impl< true, true, false, 2 >, [633](#)
 - Simd256_impl< true, true, false, 4 >, [643](#), [645](#)
 - Simd256_impl< true, true, false, 8 >, [658](#)
 - Simd256_impl< true, true, true, 2 >, [667](#)
 - Simd256_impl< true, true, true, 4 >, [677](#), [683](#)
 - Simd256_impl< true, true, true, 8 >, [692](#)
 - Simd512_impl< true, false, true, 8 >, [702](#)
 - Simd512_impl< true, true, false, 8 >, [709](#)
 - Simd512_impl< true, true, true, 8 >, [719](#)
- strmm_
 - config-blas.h, [817](#)
- strsm_
 - config-blas.h, [816](#)
- sub
 - FFLAS::vectorised, [289](#)
 - FieldSimd< _Field >, [447](#)
 - RNSIntegerMod< RNS >, [552](#)
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, [558](#)
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [562](#)
 - Simd128_impl< true, true, false, 2 >, [573](#)
 - Simd128_impl< true, true, false, 4 >, [582](#)
 - Simd128_impl< true, true, false, 8 >, [591](#)
 - Simd128_impl< true, true, true, 2 >, [598](#)
 - Simd128_impl< true, true, true, 4 >, [607](#)
 - Simd128_impl< true, true, true, 8 >, [615](#)
 - Simd256_impl< true, false, true, 8 >, [626](#)
 - Simd256_impl< true, true, false, 2 >, [636](#)
 - Simd256_impl< true, true, false, 4 >, [650](#)
 - Simd256_impl< true, true, false, 8 >, [661](#)
 - Simd256_impl< true, true, true, 2 >, [668](#)
 - Simd256_impl< true, true, true, 4 >, [679](#), [684](#)
 - Simd256_impl< true, true, true, 8 >, [693](#)
 - Simd512_impl< true, false, true, 8 >, [703](#)
 - Simd512_impl< true, true, false, 8 >, [712](#)

- Simd512_impl< true, true, true, 8 >, [720](#)
- sub_r
 - FieldSimd< _Field >, [447](#)
- subin
 - FieldSimd< _Field >, [447](#)
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, [558](#)
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [562](#)
 - Simd128_impl< true, true, false, 2 >, [573](#)
 - Simd128_impl< true, true, false, 4 >, [582](#)
 - Simd128_impl< true, true, false, 8 >, [591](#)
 - Simd128_impl< true, true, true, 2 >, [598](#)
 - Simd128_impl< true, true, true, 4 >, [607](#)
 - Simd128_impl< true, true, true, 8 >, [615](#)
 - Simd256_impl< true, false, true, 8 >, [626](#)
 - Simd256_impl< true, true, false, 2 >, [636](#)
 - Simd256_impl< true, true, false, 4 >, [650](#), [651](#)
 - Simd256_impl< true, true, false, 8 >, [661](#)
 - Simd256_impl< true, true, true, 2 >, [669](#)
 - Simd256_impl< true, true, true, 4 >, [679](#), [684](#)
 - Simd256_impl< true, true, true, 8 >, [693](#)
 - Simd512_impl< true, false, true, 8 >, [703](#)
 - Simd512_impl< true, true, false, 8 >, [712](#)
 - Simd512_impl< true, true, true, 8 >, [720](#)
- subin_r
 - FieldSimd< _Field >, [447](#)
- subp
 - FFLAS::vectorised, [288](#)
- support_fast_mod< double >, [754](#)
- support_fast_mod< float >, [754](#)
- support_fast_mod< int64_t >, [754](#)
- support_fast_mod< T >, [753](#)
- support_simd< T >, [755](#)
- support_simd_add< T >, [755](#)
- support_simd_mod< T >, [755](#)
- swapval
 - FFPACK, [388](#)
- SYNCH_GROUP
 - parallel.h, [1032](#)
- SysTimer
 - FFLAS, [81](#)
- T
 - limits< char >, [486](#)
 - limits< double >, [487](#)
 - limits< float >, [488](#)
 - limits< Givaro::Integer >, [488](#)
 - limits< int >, [489](#)
 - limits< long >, [490](#)
 - limits< long long >, [490](#)
 - limits< Reclnt::rint< K > >, [491](#)
 - limits< Reclnt::ruint< K > >, [492](#)
 - limits< short int >, [492](#)
 - limits< signed char >, [493](#)
 - limits< unsigned char >, [494](#)
 - limits< unsigned int >, [495](#)
 - limits< unsigned long >, [495](#)
 - limits< unsigned long long >, [496](#)
 - limits< unsigned short int >, [497](#)
- t
 - Simd128_impl< true, true, false, 2 >::Converter, [422](#)
 - Simd128_impl< true, true, false, 4 >::Converter, [423](#)
 - Simd128_impl< true, true, false, 8 >::Converter, [423](#)
 - Simd128_impl< true, true, true, 2 >::Converter, [424](#)
 - Simd128_impl< true, true, true, 4 >::Converter, [424](#)
 - Simd128_impl< true, true, true, 8 >::Converter, [424](#)
 - Simd256_impl< true, true, false, 2 >::Converter, [425](#)
 - Simd256_impl< true, true, false, 4 >::Converter, [425](#)
 - Simd256_impl< true, true, false, 8 >::Converter, [426](#)
 - Simd256_impl< true, true, true, 2 >::Converter, [426](#)
 - Simd256_impl< true, true, true, 4 >::Converter, [426](#)
 - Simd256_impl< true, true, true, 8 >::Converter, [427](#)
 - Simd512_impl< true, true, false, 8 >::Converter, [427](#)
 - Simd512_impl< true, true, true, 8 >::Converter, [428](#)
- TASK
 - parallel.h, [1032](#)
- tBC
 - test-lu.C, [1097](#)
 - test-permutations.C, [1102](#)
- test
 - test-maxdelayeddim.C, [1098](#)
 - test-simd.C, [1108](#), [1109](#)
- test-charpoly-check.C, [1058](#)
 - ENABLE_CHECKER_charpoly, [1058](#)
 - main, [1058](#)
 - printPolynomial, [1058](#)
 - TIME_CHECKER_CHARPOLY, [1058](#)
- test-charpoly.C, [1058](#)
 - launch_test, [1059](#)
 - main, [1059](#)
 - run_with_field, [1059](#)
- test-compressQ.C, [1059](#)
 - Field, [1060](#)
 - main, [1060](#)
 - printvect, [1060](#)
- test-det-check.C, [1060](#)
 - ENABLE_CHECKER_Det, [1061](#)
 - main, [1061](#)
 - TIME_CHECKER_Det, [1061](#)
- test-det.C, [1061](#)
 - main, [1062](#)

- test_det, 1061
- test-echelon.C, 1062
 - __FFLASFFPACK_GAUSSJORDAN_BASECASE, 1063
 - __FFLASFFPACK_PLUQ_THRESHOLD, 1063
 - __FFLASFFPACK_SEQUENTIAL, 1063
 - main, 1064
 - run_with_field, 1064
 - test_colechelon, 1063
 - test_redcoechelon, 1063
 - test_redrowechelon, 1064
 - test_rowechelon, 1063
- test-fadd.C, 1064
 - main, 1065
 - test_fadd, 1065
 - test_faddin, 1065
 - test_fsub, 1065
 - test_fsubin, 1065
- test-fdot.C, 1066
 - check_fdot, 1066
 - ENABLE_ALL_CHECKINGS, 1066
 - main, 1067
 - run_with_field, 1066
 - run_with_Integer, 1067
- test-fgemm-check.C, 1067
 - ENABLE_ALL_CHECKINGS, 1067
 - launch_MM_dispatch, 1067
 - main, 1068
 - run_with_field, 1068
- test-fgemm.C, 1068
 - check_MM, 1069
 - ENABLE_CHECKER_fgemm, 1069
 - launch_MM, 1069
 - launch_MM_dispatch, 1070
 - main, 1070
 - run_with_field, 1070
- test-fgemv.C, 1071
 - check_MV, 1071
 - launch_MV, 1071
 - launch_MV_dispatch, 1072
 - main, 1072
 - run_with_field, 1072
- test-fger.C, 1072
 - check_fger, 1073
 - launch_fger, 1073
 - launch_fger_dispatch, 1074
 - main, 1074
 - run_with_field, 1074
 - TIME, 1073
- test-fgesv.C, 1074
 - main, 1075
 - run_with_field, 1075
 - test_rect_fgesv, 1075
 - test_square_fgesv, 1075
- test-finit.C, 1076
 - main, 1076
 - run_with_field, 1076
 - test_freduce, 1076
- test-fscal.C, 1077
 - main, 1078
 - test_fscal, 1077
 - test_fscaln, 1077, 1078
- test-fsyr2k.C, 1078
 - check_fsyr2k, 1079
 - ENABLE_ALL_CHECKINGS, 1078
 - main, 1079
 - run_with_field, 1079
- test-fsyrk.C, 1079
 - check_fsyrk, 1080
 - check_fsyrk_bkdiag, 1080
 - check_fsyrk_diag, 1080
 - ENABLE_ALL_CHECKINGS, 1080
 - main, 1081
 - run_with_field, 1081
- test-fsytrf.C, 1081
 - main, 1082
 - operator<<, 1081
 - run_with_field, 1082
 - test_generic_fsytrf, 1082
 - test_RPM_fsytrf, 1082
- test-ftmm.C, 1082
 - __FFLASFFPACK_SEQUENTIAL, 1083
 - check_ftmm, 1083
 - main, 1083
 - run_with_field, 1083
- test-ftmmv.C, 1084
 - __FFLASFFPACK_SEQUENTIAL, 1084
 - check_ftmmv, 1084
 - ENABLE_ALL_CHECKINGS, 1084
 - main, 1085
 - run_with_field, 1085
- test-ftsm-check.C, 1085
 - ENABLE_ALL_CHECKINGS, 1085
 - main, 1085
- test-ftsm.C, 1086
 - __FFLASFFPACK_SEQUENTIAL, 1086
 - check_ftsm, 1086
 - ENABLE_ALL_CHECKINGS, 1086
 - main, 1087
 - run_with_field, 1087
- test-ftssyr2k.C, 1087
 - check_ftssyr2k, 1088
 - ENABLE_ALL_CHECKINGS, 1087
 - main, 1088
 - run_with_field, 1088
- test-ftstr.C, 1088
 - check_ftstr, 1089
 - ENABLE_ALL_CHECKINGS, 1089
 - main, 1089
 - run_with_field, 1089
- test-ftsv.C, 1089
 - __FFLASFFPACK_SEQUENTIAL, 1090
 - check_ftsv, 1090
 - ENABLE_ALL_CHECKINGS, 1090
 - main, 1090
 - run_with_field, 1090

- test-ftsrti.C, 1090
 - __FFLASFFPACK_SEQUENTIAL, 1091
 - check_ftsrti, 1091
 - ENABLE_ALL_CHECKINGS, 1091
 - main, 1091
 - run_with_field, 1091
- test-interfaces-c.c, 1092
 - main, 1092
- test-invert-check.C, 1092
 - ENABLE_ALL_CHECKINGS, 1092
 - main, 1092
- test-io.C, 1093
 - main, 1093
 - run_with_field, 1093
- test-lu.C, 1094
 - __FFLASFFPACK_SEQUENTIAL, 1094
 - __LUDIVINE_CUTOFF, 1095
 - BASECASE_K, 1094
 - launch_test, 1096
 - main, 1097
 - mvcnt, 1098
 - run_with_field, 1097
 - tBC, 1097
 - test_LUdivine, 1095
 - test_pluq, 1096
 - tgemm, 1097
 - timtot, 1097
 - tperm, 1097
 - trest, 1097
 - ttrsm, 1097
 - verifPLUQ, 1095
- test-maxdelayeddim.C, 1098
 - main, 1098
 - MAX_WITH_SIZE_T, 1098
 - test, 1098
- test-minpoly.C, 1099
 - check_minpoly, 1099
 - main, 1099
 - run_with_field, 1099
- test-multifile1.C, 1100
- test-multifile2.C, 1100
 - main, 1100
- test-nullspace.C, 1100
 - checkingMessage, 1100
 - main, 1101
 - readOrRandomMatrixWithRankAndRandomRPM, 1101
 - run_with_field, 1101
 - test_nullspace, 1101
- test-permutations.C, 1101
 - checkMonotonicApplyP, 1102
 - main, 1102
 - tBC, 1102
 - tgemm, 1102
 - timtot, 1103
 - tperm, 1102
 - trest, 1102
 - ttrsm, 1102
- test-pluq-check.C, 1103
 - ENABLE_ALL_CHECKINGS, 1103
 - main, 1103
- test-rankprofiles.C, 1103
 - __FFLASFFPACK_SEQUENTIAL, 1104
 - main, 1104
 - run_with_field, 1104
- test-rpm.C, 1104
 - checkRPM, 1105
 - checkSymmetricRPM, 1105
 - main, 1105
- test-simd.C, 1105
 - check_eq, 1108
 - eval_func_on_array, 1108
 - generate_random_vector, 1107, 1108
 - integer, 1106
 - main, 1109
 - REGISTER_TYPE_NAME, 1106, 1107
 - test, 1108, 1109
 - test_impl, 1108
 - TEST_ONE_OP, 1106
 - test_op, 1108
 - TypeName, 1107
- test-solve.C, 1109
 - check_solve, 1109
 - main, 1109
 - run_with_field, 1109
- test-utils.h, 1048
- test_colechelon
 - test-echelon.C, 1063
- test_det
 - test-det.C, 1061
- test_fadd
 - test-fadd.C, 1065
- test_faddin
 - test-fadd.C, 1065
- test_freduce
 - test-finit.C, 1076
- test_fscal
 - test-fscal.C, 1077
- test_fscalin
 - test-fscal.C, 1077, 1078
- test_fsub
 - test-fadd.C, 1065
- test_fsubin
 - test-fadd.C, 1065
- test_generic_fsytrf
 - test-fsytrf.C, 1082
- test_impl
 - test-simd.C, 1108
- test_LUdivine
 - test-lu.C, 1095
- test_nullspace
 - test-nullspace.C, 1101
- TEST_ONE_OP
 - test-simd.C, 1106
- test_op
 - test-simd.C, 1108

- test_pluq
 - test-lu.C, 1096
- test_rect_fgesv
 - test-fgesv.C, 1075
- test_redcoechelon
 - test-echelon.C, 1063
- test_redrowechelon
 - test-echelon.C, 1064
- test_rowechelon
 - test-echelon.C, 1063
- test_RPM_fsytrf
 - test-fsytrf.C, 1082
- test_square_fgesv
 - test-fgesv.C, 1075
- tfn_minus, 755
 - operator(), 756
- tfn_minus_eq, 756
 - operator(), 756
- tfn_mul, 756
 - operator(), 756
- tfn_mul_eq, 757
 - operator(), 757
- tfn_plus, 757
 - operator(), 757
- tfn_plus_eq, 757
 - operator(), 757
- tgemm
 - test-lu.C, 1097
 - test-permutations.C, 1102
- THREADS
 - benchmark-fgemm-rns.C, 780
- Threads, 758
- threads_fgemm
 - FFPACK, 365
- threads_ftsm
 - FFPACK, 365
- THREED
 - benchmark-fgemm-rns.C, 781
- ThreeD, 758
- THREEDA
 - benchmark-fgemm-rns.C, 781
- ThreeDAdaptive, 758
- ThreeDInPlace, 758
- THREEDIP
 - benchmark-fgemm-rns.C, 781
- TIME
 - test-fger.C, 1073
- TIME_CHECKER_CHARPOLY
 - test-charpoly-check.C, 1058
- TIME_CHECKER_Det
 - test-det-check.C, 1061
- Timer
 - FFLAS, 80
- timer.h, 1049
- timtot
 - test-lu.C, 1097
 - test-permutations.C, 1103
- tmain
 - benchmark-fgemm-mp.C, 779
 - benchmark-fgemv-mp.C, 783
- tperm
 - test-lu.C, 1097
 - test-permutations.C, 1102
- trest
 - test-lu.C, 1097
 - test-permutations.C, 1102
- trinv_left
 - FFPACK, 316, 368
- trinv_left_modular_double
 - ffpack.C, 987
 - ffpack_c.h, 1011
- TRSMBound
 - FFLAS::Protected, 220
- TRSMHelper
 - TRSMHelper< ReclterTrait, ParSeqTrait >, 759
- TRSMHelper< ReclterTrait, ParSeqTrait >, 758
 - parseq, 759
 - pMMH, 759
 - TRSMHelper, 759
- TTimer
 - arithprog.C, 762
 - autotune/charpoly.C, 763
 - autotune/pluq.C, 767
 - benchmark-dgemm.C, 772
 - benchmark-dgetrf.C, 773
 - benchmark-dgetri.C, 774
 - benchmark-dsytrf.C, 775
 - benchmark-dtrsm.C, 775
 - benchmark-dtrtri.C, 776
 - fsyrk.C, 764
 - fsytrf.C, 765
 - fttrtri.C, 766
 - winograd.C, 768
- ttrsm
 - test-lu.C, 1097
 - test-permutations.C, 1102
- TWOD
 - benchmark-fgemm-rns.C, 780
- TwoD, 760
- TWODA
 - benchmark-fgemm-rns.C, 780
- TwoDAdaptive, 760
- type
 - Argument, 407
 - associatedDelayedField< const FFPACK::RNSIntegerMod< RNS > >, 408
 - associatedDelayedField< const Givaro::Modular< T, X > >, 408
 - associatedDelayedField< const Givaro::ModularBalanced< T > >, 409
 - associatedDelayedField< const Givaro::ZRing< T > >, 409
 - associatedDelayedField< Field >, 407
 - CompactElement< double >, 419
 - CompactElement< Element >, 418
 - CompactElement< float >, 419

- CompactElement< int16_t >, [419](#)
- CompactElement< int32_t >, [419](#)
- CompactElement< int64_t >, [420](#)
- is_simd< T >, [479](#)
- TYPE_BOOL
 - args-parser.h, [1040](#)
- TYPE_DOUBLE
 - args-parser.h, [1040](#)
- TYPE_INT
 - args-parser.h, [1040](#)
- TYPE_INTEGER
 - args-parser.h, [1040](#)
- type_integer
 - args-parser.h, [1040](#)
- TYPE_INTLIST
 - args-parser.h, [1040](#)
- TYPE_LONGLONG
 - args-parser.h, [1040](#)
- TYPE_NONE
 - args-parser.h, [1040](#)
- TYPE_STR
 - args-parser.h, [1040](#)
- type_string
 - NoSimd< T >, [521](#)
 - Simd128_impl< true, false, true, 4 >, [567](#)
 - Simd128_impl< true, false, true, 8 >, [567](#)
 - Simd128_impl< true, true, false, 2 >, [575](#)
 - Simd128_impl< true, true, false, 4 >, [583](#)
 - Simd128_impl< true, true, false, 8 >, [593](#)
 - Simd128_impl< true, true, true, 2 >, [601](#)
 - Simd128_impl< true, true, true, 4 >, [610](#)
 - Simd128_impl< true, true, true, 8 >, [619](#)
 - Simd128fp_base, [620](#)
 - Simd128i_base, [621](#)
 - Simd256_impl< true, true, false, 2 >, [638](#)
 - Simd256_impl< true, true, false, 4 >, [654](#)
 - Simd256_impl< true, true, false, 8 >, [663](#)
 - Simd256_impl< true, true, true, 2 >, [672](#)
 - Simd256_impl< true, true, true, 4 >, [687](#), [688](#)
 - Simd256_impl< true, true, true, 8 >, [697](#)
 - Simd256i_base, [698](#)
 - Simd512_impl< true, false, true, 4 >, [699](#)
 - Simd512_impl< true, false, true, 8 >, [705](#)
 - Simd512_impl< true, true, false, 8 >, [714](#)
 - Simd512_impl< true, true, true, 8 >, [724](#)
 - Simd512fp_base, [725](#)
 - Simd512i_base, [726](#)
- TYPE_UINT64
 - args-parser.h, [1040](#)
- TypeName
 - test-simd.C, [1107](#)
- uint16_t
 - instrset.h, [1054](#)
- uint32_t
 - instrset.h, [1054](#)
- uint64_t
 - instrset.h, [1054](#)
- uint8_t
 - instrset.h, [1054](#)
- unfit
 - FFLAS::Protected, [227](#)
- unpackhi
 - Simd128_impl< true, true, false, 2 >, [573](#)
 - Simd128_impl< true, true, false, 4 >, [581](#)
 - Simd128_impl< true, true, false, 8 >, [590](#)
 - Simd128_impl< true, true, true, 2 >, [597](#)
 - Simd128_impl< true, true, true, 4 >, [606](#)
 - Simd128_impl< true, true, true, 8 >, [615](#)
 - Simd256_impl< true, true, false, 2 >, [635](#)
 - Simd256_impl< true, true, false, 4 >, [649](#)
 - Simd256_impl< true, true, false, 8 >, [661](#)
 - Simd256_impl< true, true, true, 2 >, [668](#)
 - Simd256_impl< true, true, true, 4 >, [678](#)
 - Simd256_impl< true, true, true, 8 >, [693](#)
 - Simd512_impl< true, true, false, 8 >, [712](#)
 - Simd512_impl< true, true, true, 8 >, [720](#)
- unpackhi_twice
 - Simd256_impl< true, false, true, 8 >, [625](#)
 - Simd256_impl< true, true, false, 2 >, [635](#)
 - Simd256_impl< true, true, false, 4 >, [649](#)
 - Simd256_impl< true, true, false, 8 >, [660](#)
 - Simd256_impl< true, true, true, 2 >, [668](#)
 - Simd256_impl< true, true, true, 4 >, [678](#)
 - Simd256_impl< true, true, true, 8 >, [692](#)
 - Simd512_impl< true, false, true, 8 >, [702](#)
 - Simd512_impl< true, true, false, 8 >, [711](#)
 - Simd512_impl< true, true, true, 8 >, [719](#)
- unpacklo
 - Simd128_impl< true, true, false, 2 >, [573](#)
 - Simd128_impl< true, true, false, 4 >, [581](#)
 - Simd128_impl< true, true, false, 8 >, [590](#)
 - Simd128_impl< true, true, true, 2 >, [597](#)
 - Simd128_impl< true, true, true, 4 >, [606](#)
 - Simd128_impl< true, true, true, 8 >, [615](#)
 - Simd256_impl< true, true, false, 2 >, [635](#)
 - Simd256_impl< true, true, false, 4 >, [649](#)
 - Simd256_impl< true, true, false, 8 >, [660](#)
 - Simd256_impl< true, true, true, 2 >, [668](#)
 - Simd256_impl< true, true, true, 4 >, [678](#)
 - Simd256_impl< true, true, true, 8 >, [693](#)
 - Simd512_impl< true, true, false, 8 >, [712](#)
 - Simd512_impl< true, true, true, 8 >, [720](#)
- unpacklo_twice
 - Simd256_impl< true, false, true, 8 >, [625](#)
 - Simd256_impl< true, true, false, 2 >, [635](#)
 - Simd256_impl< true, true, false, 4 >, [649](#)
 - Simd256_impl< true, true, false, 8 >, [660](#)
 - Simd256_impl< true, true, true, 2 >, [667](#)
 - Simd256_impl< true, true, true, 4 >, [678](#)
 - Simd256_impl< true, true, true, 8 >, [692](#)
 - Simd512_impl< true, false, true, 8 >, [702](#)
 - Simd512_impl< true, true, false, 8 >, [711](#)
 - Simd512_impl< true, true, true, 8 >, [719](#)
- unpacklohi
 - Simd256_impl< true, true, false, 2 >, [636](#)
 - Simd256_impl< true, true, false, 4 >, [649](#)

- Simd256_impl< true, true, false, 8 >, [661](#)
- Simd256_impl< true, true, true, 2 >, [668](#)
- Simd256_impl< true, true, true, 4 >, [678](#)
- Simd256_impl< true, true, true, 8 >, [693](#)
- Simd512_impl< true, true, false, 8 >, [712](#)
- Simd512_impl< true, true, true, 8 >, [720](#)
- UnparametricTag, [760](#)
- updateD
 - FFPACK::Protected, [400](#)
- USE_OPENMP
 - config.h, [799](#)
- UserTimer
 - FFLAS, [81](#)
- utils.h, [907](#)
- v
 - Simd128_impl< true, true, false, 2 >::Converter, [422](#)
 - Simd128_impl< true, true, false, 4 >::Converter, [423](#)
 - Simd128_impl< true, true, false, 8 >::Converter, [423](#)
 - Simd128_impl< true, true, true, 2 >::Converter, [424](#)
 - Simd128_impl< true, true, true, 4 >::Converter, [424](#)
 - Simd128_impl< true, true, true, 8 >::Converter, [424](#)
 - Simd256_impl< true, true, false, 2 >::Converter, [425](#)
 - Simd256_impl< true, true, false, 4 >::Converter, [425](#)
 - Simd256_impl< true, true, false, 8 >::Converter, [425](#)
 - Simd256_impl< true, true, true, 2 >::Converter, [426](#)
 - Simd256_impl< true, true, true, 4 >::Converter, [426](#)
 - Simd256_impl< true, true, true, 8 >::Converter, [427](#)
 - Simd512_impl< true, true, false, 8 >::Converter, [427](#)
 - Simd512_impl< true, true, true, 8 >::Converter, [427](#)
- val
 - Coo< Field >, [431](#)
 - Coo< ValT, IdxT >, [429](#), [432](#)
- valid
 - NoSimd< T >, [521](#)
 - Simd128_impl< true, true, false, 2 >, [572](#)
 - Simd128_impl< true, true, false, 4 >, [581](#)
 - Simd128_impl< true, true, false, 8 >, [589](#)
 - Simd128_impl< true, true, true, 2 >, [596](#)
 - Simd128_impl< true, true, true, 4 >, [604](#)
 - Simd128_impl< true, true, true, 8 >, [613](#)
 - Simd256_impl< true, false, true, 8 >, [624](#)
 - Simd256_impl< true, true, false, 2 >, [635](#)
 - Simd256_impl< true, true, false, 4 >, [647](#)
 - Simd256_impl< true, true, false, 8 >, [660](#)
 - Simd256_impl< true, true, true, 2 >, [666](#)
 - Simd256_impl< true, true, true, 4 >, [676](#), [682](#)
 - Simd256_impl< true, true, true, 8 >, [691](#)
 - Simd512_impl< true, false, true, 8 >, [701](#)
 - Simd512_impl< true, true, false, 8 >, [711](#)
 - Simd512_impl< true, true, true, 8 >, [717](#)
- VALUE
 - parallel.h, [1033](#)
- value
 - AlgoChooser< ModeCategories::ConvertTo< ElementCategories::RNSElementTag >, ParSeq >, [405](#)
 - AlgoChooser< ModeT, ParSeq >, [405](#)
 - AreEqual< X, X >, [406](#)
 - AreEqual< X, Y >, [406](#)
 - compatible_data_type< Field >, [420](#)
 - compatible_data_type< Givaro::ZRing< double > >, [420](#)
 - compatible_data_type< Givaro::ZRing< float > >, [421](#)
 - ElementTraits< double >, [436](#)
 - ElementTraits< Element >, [435](#)
 - ElementTraits< FFPACK::rns_double_elt >, [436](#)
 - ElementTraits< float >, [436](#)
 - ElementTraits< Givaro::Integer >, [437](#)
 - ElementTraits< int16_t >, [437](#)
 - ElementTraits< int32_t >, [437](#)
 - ElementTraits< int64_t >, [438](#)
 - ElementTraits< int8_t >, [438](#)
 - ElementTraits< Reclnt::rint< K > >, [438](#)
 - ElementTraits< Reclnt::rmint< K, MG > >, [439](#)
 - ElementTraits< Reclnt::ruint< K > >, [439](#)
 - ElementTraits< uint16_t >, [439](#)
 - ElementTraits< uint32_t >, [440](#)
 - ElementTraits< uint64_t >, [440](#)
 - ElementTraits< uint8_t >, [440](#)
 - has_minus_eq_impl< C >, [469](#)
 - has_minus_impl< C >, [470](#)
 - has_mul_eq_impl< C >, [470](#)
 - has_mul_impl< C >, [470](#)
 - has_operation< T >, [471](#)
 - has_plus_eq_impl< C >, [471](#)
 - has_plus_impl< C >, [471](#)
 - is_simd< T >, [479](#)
 - ModeTraits< Field >, [513](#)
 - ModeTraits< Givaro::Modular< Element, Compute > >, [513](#)
 - ModeTraits< Givaro::Modular< Givaro::Integer, Compute > >, [514](#)
 - ModeTraits< Givaro::Modular< int16_t, Compute > >, [514](#)
 - ModeTraits< Givaro::Modular< int32_t, Compute > >, [514](#)
 - ModeTraits< Givaro::Modular< int8_t, Compute > >, [515](#)
 - ModeTraits< Givaro::Modular< Reclnt::ruint< K >, Compute > >, [515](#)
 - ModeTraits< Givaro::Modular< uint16_t, Compute

- > >, [515](#)
- ModeTraits< Givaro::Modular< uint32_t, Compute > >, [516](#)
- ModeTraits< Givaro::Modular< uint8_t, Compute > >, [516](#)
- ModeTraits< Givaro::ModularBalanced< Element > >, [516](#)
- ModeTraits< Givaro::ModularBalanced< Givaro::Integer > >, [517](#)
- ModeTraits< Givaro::ModularBalanced< int16_t > >, [517](#)
- ModeTraits< Givaro::ModularBalanced< int32_t > >, [518](#)
- ModeTraits< Givaro::ModularBalanced< int8_t > >, [518](#)
- ModeTraits< Givaro::Montgomery< T > >, [518](#)
- ModeTraits< Givaro::ZRing< double > >, [519](#)
- ModeTraits< Givaro::ZRing< float > >, [519](#)
- ModeTraits< Givaro::ZRing< Givaro::Integer > >, [519](#)
- need_field_characteristic< Field >, [520](#)
- need_field_characteristic< Givaro::Modular< Field > >, [520](#)
- need_field_characteristic< Givaro::ModularBalanced< Field > >, [521](#)
- SimdChooser< T, false, b >, [727](#)
- SimdChooser< T, true, false >, [727](#)
- SimdChooser< T, true, true >, [728](#)
- vand
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, [557](#)
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [561](#)
 - Simd128_impl< true, true, false, 2 >, [575](#)
 - Simd128_impl< true, true, false, 4 >, [584](#)
 - Simd128_impl< true, true, false, 8 >, [593](#)
 - Simd128_impl< true, true, true, 2 >, [602](#)
 - Simd128_impl< true, true, true, 4 >, [610](#)
 - Simd128_impl< true, true, true, 8 >, [619](#)
 - Simd128i_base, [622](#)
 - Simd256_impl< true, false, true, 8 >, [628](#)
 - Simd256_impl< true, true, false, 4 >, [654](#)
 - Simd256_impl< true, true, true, 4 >, [688](#)
 - Simd512_impl< true, true, false, 8 >, [715](#)
 - Simd512_impl< true, true, true, 8 >, [724](#)
 - Simd512i_base, [726](#)
- vandnot
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, [558](#)
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [562](#)
 - Simd128_impl< true, true, false, 2 >, [576](#)
 - Simd128_impl< true, true, false, 4 >, [584](#)
 - Simd128_impl< true, true, false, 8 >, [593](#)
 - Simd128_impl< true, true, true, 2 >, [602](#)
 - Simd128_impl< true, true, true, 4 >, [611](#)
- Simd128_impl< true, true, true, 8 >, [620](#)
- Simd128i_base, [622](#)
- Simd256_impl< true, false, true, 8 >, [628](#)
- Simd256_impl< true, true, false, 4 >, [654](#)
- Simd256_impl< true, true, true, 4 >, [688](#)
- Simd512_impl< true, true, false, 8 >, [715](#)
- Simd512_impl< true, true, true, 8 >, [724](#)
- Simd512i_base, [726](#)
- VEC_ADD
 - FFLAS::vectorised, [288](#)
- VEC_SUB
 - FFLAS::vectorised, [288](#)
- vect_size
 - FieldSimd< _Field >, [450](#)
 - NoSimd< T >, [522](#)
 - Simd128_impl< true, true, false, 2 >, [576](#)
 - Simd128_impl< true, true, false, 4 >, [584](#)
 - Simd128_impl< true, true, false, 8 >, [594](#)
 - Simd128_impl< true, true, true, 2 >, [602](#)
 - Simd128_impl< true, true, true, 4 >, [611](#)
 - Simd128_impl< true, true, true, 8 >, [620](#)
 - Simd256_impl< true, false, true, 8 >, [629](#)
 - Simd256_impl< true, true, false, 2 >, [638](#)
 - Simd256_impl< true, true, false, 4 >, [655](#)
 - Simd256_impl< true, true, false, 8 >, [663](#)
 - Simd256_impl< true, true, true, 2 >, [672](#)
 - Simd256_impl< true, true, true, 4 >, [688](#)
 - Simd256_impl< true, true, true, 8 >, [697](#)
 - Simd512_impl< true, false, true, 8 >, [705](#)
 - Simd512_impl< true, true, false, 8 >, [715](#)
 - Simd512_impl< true, true, true, 8 >, [725](#)
- vect_t
 - FieldSimd< _Field >, [445](#)
 - NoSimd< T >, [521](#)
 - Simd128_impl< true, true, false, 2 >, [569](#)
 - Simd128_impl< true, true, false, 4 >, [578](#)
 - Simd128_impl< true, true, false, 8 >, [587](#)
 - Simd128_impl< true, true, true, 2 >, [595](#)
 - Simd128_impl< true, true, true, 4 >, [604](#)
 - Simd128_impl< true, true, true, 8 >, [613](#)
 - simd128_int64.inl, [869](#)
 - Simd128i_base, [621](#)
 - Simd256_impl< true, false, true, 8 >, [624](#)
 - Simd256_impl< true, true, false, 2 >, [631](#)
 - Simd256_impl< true, true, false, 4 >, [641](#), [642](#)
 - Simd256_impl< true, true, false, 8 >, [657](#)
 - Simd256_impl< true, true, true, 2 >, [665](#)
 - Simd256_impl< true, true, true, 4 >, [675](#)
 - Simd256_impl< true, true, true, 8 >, [690](#)
 - simd256_int64.inl, [872](#)
 - Simd256i_base, [698](#)
 - Simd512_impl< true, false, true, 8 >, [700](#)
 - Simd512_impl< true, true, false, 8 >, [708](#)
 - Simd512_impl< true, true, true, 8 >, [717](#)
 - simd512_int64.inl, [874](#)
 - Simd512i_base, [726](#)
- verification_PLUQ
 - benchmark-pluq.C, [794](#)

- verifPLUQ
 - test-lu.C, [1095](#)
- VERSION
 - config.h, [799](#)
- vor
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, [557](#)
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [561](#)
 - Simd128_impl< true, true, false, 2 >, [575](#)
 - Simd128_impl< true, true, false, 4 >, [584](#)
 - Simd128_impl< true, true, false, 8 >, [593](#)
 - Simd128_impl< true, true, true, 2 >, [602](#)
 - Simd128_impl< true, true, true, 4 >, [610](#)
 - Simd128_impl< true, true, true, 8 >, [619](#)
 - Simd128i_base, [622](#)
 - Simd256_impl< true, false, true, 8 >, [628](#)
 - Simd256_impl< true, true, false, 4 >, [654](#)
 - Simd256_impl< true, true, true, 4 >, [688](#)
 - Simd512_impl< true, true, false, 8 >, [714](#)
 - Simd512_impl< true, true, true, 8 >, [724](#)
 - Simd512i_base, [726](#)
- vxor
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, [557](#)
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [562](#)
 - Simd128_impl< true, true, false, 2 >, [576](#)
 - Simd128_impl< true, true, false, 4 >, [584](#)
 - Simd128_impl< true, true, false, 8 >, [593](#)
 - Simd128_impl< true, true, true, 2 >, [602](#)
 - Simd128_impl< true, true, true, 4 >, [611](#)
 - Simd128_impl< true, true, true, 8 >, [620](#)
 - Simd128i_base, [622](#)
 - Simd256_impl< true, false, true, 8 >, [628](#)
 - Simd256_impl< true, true, false, 4 >, [654](#)
 - Simd256_impl< true, true, true, 4 >, [688](#)
 - Simd512_impl< true, true, false, 8 >, [715](#)
 - Simd512_impl< true, true, true, 8 >, [724](#)
 - Simd512i_base, [726](#)
- WAIT
 - parallel.h, [1032](#)
- Winograd, [760](#)
 - FFLAS::BLAS3, [201](#)
- winograd.C, [768](#)
 - balanced, [769](#)
 - DOUBLE_TO_FLOAT_CROSSOVER, [768](#)
 - GFOPS, [768](#)
 - main, [769](#)
 - TTimer, [768](#)
- Winograd_L_S
 - FFLAS::BLAS3, [204](#)
- Winograd_LR_S
 - FFLAS::BLAS3, [204](#)
- Winograd_R_S
 - FFLAS::BLAS3, [205](#)
- WinogradAcc_2_24
 - FFLAS::BLAS3, [202](#)
- WinogradAcc_2_27
 - FFLAS::BLAS3, [202](#)
- WinogradAcc_3_21
 - FFLAS::BLAS3, [202](#)
- WinogradAcc_3_23
 - FFLAS::BLAS3, [201](#)
- WinogradAcc_L_S
 - FFLAS::BLAS3, [204](#)
- WinogradAcc_LR
 - FFLAS::BLAS3, [203](#)
- WinogradAcc_R_S
 - FFLAS::BLAS3, [203](#)
- WinogradCalc
 - FFLAS::Protected, [225](#)
- WinogradPar, [760](#)
- WinogradSteps
 - FFLAS::Protected, [224](#)
- WinogradThreshold
 - FFLAS::Protected, [223](#), [224](#)
- WinoPar
 - FFLAS::BLAS3, [200](#)
- WINOTHRESHOLD
 - fflas.h, [821](#)
- WRITE
 - parallel.h, [1033](#)
- write
 - RNSInteger< RNS >, [548](#)
 - RNSIntegerMod< RNS >, [553](#)
- write_field
 - Matio.h, [1048](#)
- write_matrix
 - benchmark-fgemv-mp.C, [783](#)
 - RNSIntegerMod< RNS >, [553](#)
- write_matrix_long
 - RNSIntegerMod< RNS >, [554](#)
- writeCommandString
 - FFLAS, [194](#)
- writeDnsFormat
 - FFLAS, [158](#)
- WriteMatrix
 - FFLAS, [194](#), [196](#)
- WritePermutation
 - FFLAS, [196](#)
- zero
 - FFLAS, [83](#)
 - FieldSimd< _Field >, [447](#), [448](#)
 - RNSInteger< RNS >, [548](#)
 - RNSIntegerMod< RNS >, [555](#)
 - ScalFunctions< Element, typename enable_if< is_floating_point< Element >::value >::type >, [557](#)
 - ScalFunctions< Element, typename enable_if< is_integral< Element >::value >::type >, [561](#)
 - Simd128_impl< true, true, false, 2 >, [575](#)
 - Simd128_impl< true, true, false, 4 >, [584](#)
 - Simd128_impl< true, true, false, 8 >, [593](#)

Simd128_impl< true, true, true, 2 >, [601](#)
Simd128_impl< true, true, true, 4 >, [610](#)
Simd128_impl< true, true, true, 8 >, [619](#)
Simd128i_base, [621](#)
Simd256_impl< true, false, true, 8 >, [624](#)
Simd256_impl< true, true, false, 2 >, [638](#)
Simd256_impl< true, true, false, 4 >, [654](#)
Simd256_impl< true, true, false, 8 >, [663](#)
Simd256_impl< true, true, true, 2 >, [672](#)
Simd256_impl< true, true, true, 4 >, [687](#), [688](#)
Simd256_impl< true, true, true, 8 >, [697](#)
Simd256i_base, [698](#)
Simd512_impl< true, false, true, 8 >, [701](#)
Simd512_impl< true, true, false, 8 >, [714](#)
Simd512_impl< true, true, true, 8 >, [724](#)
Simd512i_base, [726](#)
ZOSparseMatrix
 FFLAS, [79](#)