

SymPy Cheatsheet (<https://sympy.org>)

Basics

SymPy help: `help(function)`
Declare symbol: `x = Symbol('x')`
Substitution: `expr.subs(old, new)`
Numerical evaluation: `expr.evalf()`
Expanding: `expr.expand()`
Common denominator: `ratsimp(expr)`
Simplify expression: `simplify(expr)`

Constants

π : `pi`
 e : `E`
 ∞ : `oo`
 i : `I`

Numbers types

Integers (\mathbb{Z}): `Integer(x)`
Rationals (\mathbb{Q}): `Rational(p, q)`
Reals (\mathbb{R}): `Float(x)`

Basic functions

Trigonometric: `sin cos tan cot`
Cyclometric: `asin acos atan acot`
Hyperbolic: `sinh cosh tanh coth`
Area hyperbolic: `asinh acosh atanh acoth`
Exponential: `exp(x)`
Square root: `sqrt(x)`
Logarithm ($\log_b a$): `log(a, b)`
Natural logarithm: `log(a)`
Gamma ($\Gamma(x)$): `gamma(x)`
Absolute value: `abs(x)`

Calculus

$\lim_{x \rightarrow a} f(x)$: `limit(f, x, a)`
 $\lim_{x \rightarrow a-} f(x)$: `limit(f, x, a, dir='-')`
 $\lim_{x \rightarrow a+} f(x)$: `limit(f, x, a, dir='+')`
 $\frac{d}{dx} f(x)$: `diff(f, x)`
 $\frac{\partial}{\partial x} f(x, y)$: `diff(f, x)`
 $\int f(x) dx$: `integrate(f, x)`
 $\int_a^b f(x) dx$: `integrate(f, (x, a, b))`
Taylor series (at a , deg n): `f.series(x, a, n)`

Equations

Equation $f(x) = 0$: `solve(f, x)`
System of equations: `solve([f, g], [x, y])`
Differential equation: `dsolve(equation, f(x))`

Geometry

Points: `a = Point(xcoord, ycoord)`
Lines: `l = Line(pointA, pointB)`
Circles: `c = Circle(center, radius)`
Triangles: `t = Triangle(a, b, c)`
Area: `object.area`
Intersection: `intersection(a, b)`
Checking tangency: `c.is_tangent(l)`

Plotting

Plot: `Plot(f, [a, b])`
Zoom: `+/-`: `R/F` or `PgUp/PgDn` or `Numpad +/-`
Rotate X,Y axis: `Arrow Keys` or `WASD`
Rotate Z axis: `Q` and `E` or `Numpad 7` and `9`
View XY: `F1`
View XZ: `F2`
View YZ: `F3`
View Perspective: `F4`
Axes Visibility: `F5`
Axes Colors: `F6`
Screenshot: `F8`
Exit plot: `ESC`

Discrete math

Factorial ($n!$): `factorial(n)`
Binomial coefficient $\binom{n}{k}$: `binomial(n, k)`
Sum ($\sum_{n=a}^b expr$): `summation(expr, (n, a, b))`
Product ($\prod_{n=a}^b expr$): `product(expr, (n, a, b))`

Linear algebra

Matrix definition: `m = Matrix([[a, b], [c, d]])`
Determinant: `m.det()`
Inverse: `m.inv()`
Identity matrix $n \times n$: `eye(n)`
Zero matrix $n \times n$: `zeros(n)`
Ones matrix $n \times n$: `ones(n)`

Printing

L^AT_EX print: `print(latex())`
Python print: `print(python())`
Pretty print: `pprint()`

Examples

Find 100 digits of π^e :
`(pi**E).n(100)`

Expand $(x+y)^2(x-y)(x^2+y)$:
`((x + y)**2 * (x - y) * (x**2 + y)).expand()`

Simplify $\frac{1}{x} + \frac{x \sin x - 1}{x^2 - 1}$:
`simplify((1/x) + (x * sin(x) - 1)/(x**2 - 1))`

Check if line passing through points (0,1) and (1,1) is tangent to circle with center at (5,5) and radius 3:
`Circle(Point(5,5), 3).is_tangent(Line(Point(0,1), Point(1,1)))`

Find roots of $x^4 - 4x^3 + 2x^2 - x = 0$:
`solve(x**4 - 4*x**3 + 2*x**2 - x, x)`

Solve the equations system: $x + y = 4$, $xy = 3$:
`solve([x + y - 4, x*y - 3], [x, y])`

Calculate limit of the sequence $\sqrt[n]{n}$:
`limit(n**(1/n), n, oo)`

Calculate left-sided limit of the function $\frac{|x|}{x}$ in 0:
`limit(abs(x)/x, x, 0, dir='-')`

Calculate the sum $\sum_{n=0}^{100} n^2$:
`summation(n**2, (n, 0, 100))`

Calculate the sum $\sum_{n=0}^{\infty} \frac{1}{n^2}$:
`summation(1/n**2, (n, 0, oo))`

Calculate the integral $\int \cos^3 x dx$:
`integrate(cos(x)**3, x)`

Calculate the integral $\int_1^{\infty} \frac{dx}{x^2}$:
`integrate(1/x**2, (x, 1, oo))`

Find 10 terms of series expansion of $\frac{1}{1-2x}$ at 0:
`(1/(1 - 2*x)).series(x, 0, 10)`

Solve the differential equation $f''(x) + 9f(x) = 1$:
`dsolve(f(x).diff(x, x) + 9*f(x) - 1, f(x))`