

my sympy and python cheat sheet

Nasser M. Abbasi

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1 How to solve a first order ODE?

Solve $y'(x) = 1 + 2x$ for $y(x)$

```
from sympy import *
x = symbols('x')
y = Function('y')
ode = Eq(Derivative(y(x),x),1+2*x)
sol = dsolve(ode,y(x))
# Eq(y(x), C1 + x**2 + x)
checkodesol(ode,sol)
# (True, 0)
if checkodesol(ode,sol)[0]==True:
    print ('verified solution OK')
```

2 How to solve a first order ODE with initial condition?

Solve $y'(x) = 1 + 2x$ for $y(x)$ with $y(0) = 3$

```
import sympy
x = sympy.symbols('x')
y = sympy.Function('y')
ode = sympy.Eq(sympy.Derivative(y(x),x),1+2*x)
sol = sympy.dsolve(ode,y(x),ics={y(0):3})
# Eq(y(x), x**2 + x + 3)
sympy.checkodesol(ode,sol)
# (True, 0)
```

3 How to solve a second order ODE?

Solve $9y(x) + \frac{d^2}{dx^2}y(x) = 0$

```
from sympy import Function, dsolve, Derivative, Eq
x=sympy.symbols('x')
y=sympy.symbols('y', cls=Function)
ode=Eq(Derivative(y(x), x, x) + 9*y(x),0)
dsolve(ode, y(x))
```

gives

$$y(x) = C_1 \sin(3x) + C_2 \cos(3x)$$

4 How to solve and ODE and convert the result to latex string?

Solve $y'(x) = 1 + 2x$ for $y(x)$ with $y(0) = 3$

```
import sympy
x = sympy.symbols('x')
y = sympy.Function('y')
ode = sympy.Eq(sympy.Derivative(y(x), x), 1+2*x)
sol = sympy.dsolve(ode, y(x), ics={y(0):3})
# Eq(y(x), x**2 + x + 3)
sympy.latex(sol)
```

$$y(x) = x^2 + x + 3$$

5 How to solve a PDE in sympy?

PDE solving is still limited in sympy. Here is how to solve first order pde

Solve $u_t(x, t) = u_x(x, t)$

```
import sympy as sp
x,t = sp.symbols('x t')
u = sp.Function('u')
pde = sp.Eq( sp.diff(u(x,t),t) , sp.diff(u(x,t),x))
sol = sp.pdsolve(pde)
sp.latex(sol)
```

$$u(x, t) = F(t + x)$$

6 How to check if something is derivative?

```
import sympy
x = sympy.symbols('x')
y = sympy.Function('y')
expr = sympy.Derivative(y(x), x)
type(expr) is sympy.Derivative
    #True

if type(expr) is sympy.Derivative:
    print("yes")

    #yes
```

This also works, which seems to be the more preferred way

```
isinstance(expr, sympy.Derivative)
    #True
```

7 How to find function name and its arguments in a proc?

Suppose one passes $y(x)$ to a function, and the function wants to find the name of this function and its argument. Here is an example

```
def process(the_function):
    print("the function argument is ", the_function.args[0])
    print("the function name itself is ", the_function.name)
import sympy
x = sympy.symbols('x')
y = sympy.Function('y')
process(y(x))
```

This prints

```
the function argument is x
the function name itself is y
```