

1 LIMITS AND CONTINUITY

Find $\lim_{x \rightarrow 0} f(x) = \frac{\cos(x)}{x}$

```
1 from sympy import *
2
3 x = symbols('x')
4 f = cos(x)/x
5 lm = limit(f, x, 0)
6 print('The limit of f(x) at x =
    0: {}'.format(lm))
```

Find $\lim_{x \rightarrow 0^-} f(x) = \frac{\cos(x)}{x}$

```
1 from sympy import *
2
3 x = symbols('x')
4 f = cos(x)/x
5 lml = limit(f, x, 0, '-')
6 print('The left limit of f(x) at
    x = 0: {}'.format(lml))
```

Find $\lim_{x \rightarrow 0^+} f(x) = \frac{\cos(x)}{x}$

```
1 from sympy import *
2
3 x = symbols('x')
4 f = cos(x)/x
5 lmr = limit(f, x, 0, '+')
6 print('The right limit of f(x)
    at x = 0: {}'.format(lmr))
```

2 DERIVATIVES

Find the first order of derivative of $f(x) = 5x - 3x^2$

```
1 from sympy import *
2
3 x = symbols('x')
4 f = 5*x - 3*x**2
5 df = diff(f, x, 1)
6 print('The first order of
    derivative of f(x) = {}'.
    format(df))
```

Find the second order of derivative of $f(x) = 5x - 3x^2$

```
1 from sympy import *
2
3 x = symbols('x')
4 f = 5*x - 3*x**2
5 df = diff(f, x, 2)
6 print('The second order of
    derivative of f(x) = {}'.
    format(df))
```

Find the first order of derivative of $f(x) = 5x - 3x^2$ at $x = 2$

```
1 from sympy import *
2
3 x = symbols('x')
4 f = 5*x - 3*x**2
5 dfa = diff(f, x, 1).subs(x, 2)
6 print(' df(2) : {}'.format(dfa))
```

3 SEQUENCES AND SERIES

Find the Taylor polynomial generated by $f(x) = \sin(x)$ at $x = 1$ and order 3

```
1 from sympy import *
2
3 x = symbols('x')
4 expr = sin(x)
5 taylor_poly = expr.series(x, 1,
    3)
6 print('Taylor polynomial {}'.
    format(taylor_poly))
```

Find the Maclaurin polynomial generated by $f(x) = \sin(x)$ at $x = 0$ and order 3

```
1 from sympy import *
2
3 x = symbols('x')
4 expr = cos(x)
5 maclaurin_poly = expr.series(x,
    0, 3)
6 print('Maclaurin polynomial {}'.
    format(maclaurin_poly))
```

4 PARTIAL DERIVATIVES

$f(x, y) = x^2 + 3xy + y - 1$ find the first-order derivative $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$

```
1 from sympy import *
2
3 x, y = symbols('x, y')
4 f = x**2 + 3*x*y + y - 1
5 dfx = diff(f, x, 1)
6 dfy = diff(f, y, 1)
7 print('The first order of
  partial derivative of f(x, y)
  w.r.t x = {}'.format(dfx))
8
9 print('The first order of
  partial derivative of f(x, y)
  w.r.t y = {}'.format(dfy))
```

```
1 from sympy import *
2 from sympy import oo
3
4 x = symbols('x')
5 f = x**2 + x + 1
6 fin = integrate(f, x)
7 print('The integrate of f(x) =
  {}'.format(fin))
```

Find the integrate of $f(x, c) = \int_0^2 \frac{1}{x^3 - 2x - c}$

```
1 from sympy import *
2 from sympy import oo
3
4 x = symbols('x')
5 f = lambda x, c: 1/(x**3 - 2*x -
  c)
6 fin = integrate(f(x, 5), (x, 0,
  2))
7 print('The integrate of f(x) =
  {}'.format(fin.evalf()))
```

5 EXTREME VALUES AND SADDLE POINTS

Find the critical value of $f(x) = x^3 - 2x + 1$

```
1 from sympy import *
2
3 x = symbols('x')
4 f = x**3 - 2*x + 1
5 df = diff(f, x)
6 cvals = solveset(df, x)
7 print('Critical values:', [i for
  i in cvals.evalf()])
```

Find the absolute maximum and minimim values of $f(x) = x^2$ on $[-2, 1]$

```
1 from sympy import *
2
3 x = symbols('x')
4 f = x**2
5 x_c = solve(diff(f), x)
6 candidates = [-2, 1] + x_c
7 yvals = [f.subs(x, v).evalf()
  for v in candidates]
8 print('The absolute maximum is
  ', max(yvals))
9 print('The absolute minimum is
  ', min(yvals))
```

6 INTEGRALS

Find the integrate of $f(x) = \int x^2 + x + 1$