Just about any math equation !!!

- Derivative of one dimensional variable
- Derivative of multimensional variable

In [1]:
```
from sympy import *
init_printing()
```

In [2]:
```
x, y, z = symbols("x, y, z")
```

In [52]:
```
a, b,c,d = symbols ('a b c d')
f,g = symbols('f g', cls=Function)
```

Simple One Dimensional variable

In [6]:
```
diff(x**4, x)
```

Out[6]: $4x^3$

In [7]:
```
diff(x**4, x,x)
```

Out[7]: $12x^2$

In [9]:
```
diff(x**4, x,x,x)
```

Out[9]: $24x$

In [10]:
```
diff(x**4, x,x,x,x)
```

Out[10]: 24

In [15]:
```
# When would this be useful?
leeExpr.diff(x,y,z,1)
```

Out[15]: $(x^2y^2z^2 + 3xyz + 1)e^{xyz}$

More Complex Derivatives

In [18]:
```
leeExpr2 = x*(x+1)*(x+2)
leeExpr2
```

Out[18]: $x(x+1)(x+2)$

In [25]:
```
# First Derivative
leeFirstDeriv = leeExpr2.diff(x)
leeFirstDeriv
```

Out[25]: $x(x+1) + x(x+2) + (x+1)(x+2)$

In [27]:
```
# Second Derivative
leeSecondDeriv = diff(leeFirstDeriv, n=2)
leeSecondDeriv
```

Out[27]:

In [31]:
```
leeFunc_x_y = sin(y)*cos(x)**2
leeFunc_x_y
```

Out[31]:

In [33]:
```
# Differentiate with respect to x
deriv_leeFunc_x_y = diff(leeFunc_x_y,x)
deriv_leeFunc_x_y
```

Out[33]: $-2\sin(x)\sin(y)\cos(x)$

In [34]:
```
# Differentiate with respect to y
deriv_leeFunc_x_y = diff(leeFunc_x_y,y)
deriv_leeFunc_x_y
```

Out[34]: $\cos^2(x)\cos(y)$

In [43]:
```
# Differentiate with respect to x THEN differentiate with respect to y
# THEN differentiate with respect to x again
deriv_leeFunc_x_y = diff(leeFunc_x_y,x,y,x)
deriv_leeFunc_x_y
```

Out[43]: $2(\sin^2(x) - \cos^2(x))\cos(y)$

In [47]:
```
# Chain rule
f = x**2
g = sin(x)
chainDiff = diff((f*g, x))
chainDiff
```

Out[47]: $\frac{d}{dx}(x^2\sin(x), \quad x)$