Limits :

Calculate the limiting value of an expression: ((Type -> for the → symbol.)

In[101]:=
```
Limit[(x^3 - 1) / (x - 1), x → 1]
```
Out[101]= 3

In[104]:= $\text{Limit}\left[\frac{(2\,x^3 - 1)}{5\,x^3 + x - 1}, x \to \infty\right]$

Out[104]= $\frac{2}{5}$

To write a fraction, use (ctrl + /).

Derivatives

In[105]:= $D\left[x^6, x\right]$

Out[105]= $6\,x^5$

D function gives the derivative. You can also use prime to denote derivative.

In[106]:=
```
Sin'[x]
```
Out[106]= Cos[x]

In[107]:=
```
Cos'[x]
```
Out[107]= -Sin[x]

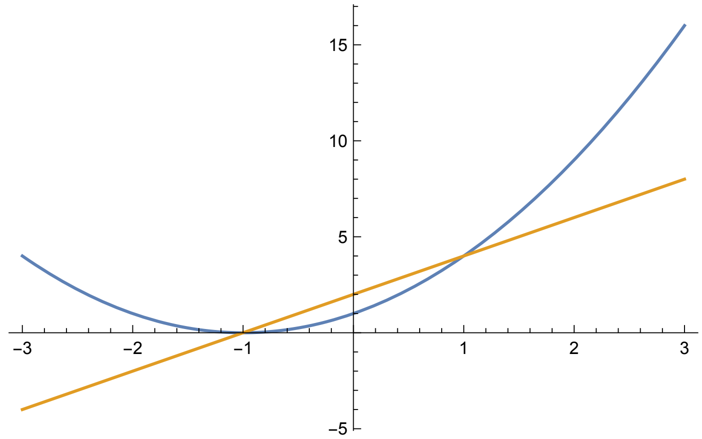
You can define a function and calculate the derivative:

In[108]:= $f[x\_] = x^2 + 2\,x + 1;$
```
f'[x]
```
Out[109]= $2 + 2\,x$

You can pass derivative directly into plot:

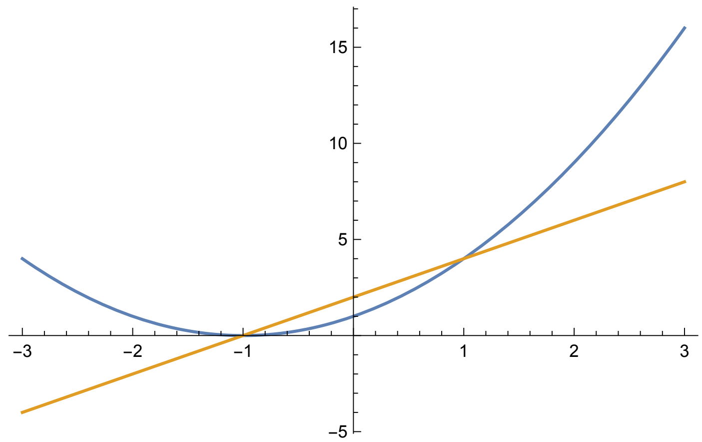
In[110]:=
```
Plot[{f[x], f'[x]}, {x, -3, 3}]
```

Out[110]=



In[112]:=
```
Plot[{f[x], f'[x]}, {x, -3, 3}, PlotLegends → "Expressions"]
```

Out[112]=



You can also take multiple derivatives: For example {x,3} represents the derivatives third times.

In[113]:= D$[x^6$, {x, 3}$]$

Out[113]= $120\, x^3$

In[114]:=
```
Sin''[x]
```

Out[114]= -Sin[x]

Integrals

Compute integrals with integrate function:

In[115]:= Integrate$[8\, x^4$, x$]$

Out[115]= $\frac{8\, x^5}{5}$

You can use integration sign to integrate. For thsi use esc intt esc and variable in which the integration is to be carried out.

In[116]:= $\int 8\,x^4\,dx$

Out[116]= $\frac{8\,x^5}{5}$

For definite integral, use esc dintt esc and specify upper and lower limits:

In[117]:= $\int_0^{\pi} \text{Sin}[x]\,dx$

Out[117]= 2

You can use NIntegrate for a numeric approximation:

In[118]:= `NIntegrate[x^3 Sin[x] + 2 Log[3 x^3], {x, 0, Pi}]`

Out[118]= 21.7876

Sequences, Sums and Series

In Mathematica, sequences are represented by lists. We use Table to define a simple sequences:

In[119]:= `Table[x^2, {x, 1, 7}]`

Out[119]= {1, 4, 9, 16, 25, 36, 49}

Some well-known sequences are built in:

In[120]:= `Table[Fibonacci[x], {x, 1, 7}]`

Out[120]= {1, 1, 2, 3, 5, 8, 13}

Recursive sequence using RecurrenceTable:

In[121]:= `RecurrenceTable[{a[x] == 2 a[x - 1], a[1] == 1}, a, {x, 1, 8}]`

Out[121]= {1, 2, 4, 8, 16, 32, 64, 128}

To compute the total sum of the sequence:

In[122]:= `Total[%]`

Out[122]= 255

In[123]:= `Sum[i (i + 1), {i, 1, 10}]`

Out[123]= 440

In[124]:= $\sum_{i=1}^{10} i\,(i+1)$

Out[124]= 440

You can do indefinite and multiple sums:

In[126]:= $\sum_{i=1}^{n} \sum_{j=1}^{n} i\, j$

Out[126]= $\frac{1}{4} n^2 (1+n)^2$

Calculating a generating function for a sequence:

In[127]:=
```
FindSequenceFunction[{2, 4, 6, 8}, n]
```

Out[127]= $2\, n$

You can generate power series expansion:

In[128]:=
```
Series[Exp[x^2], {x, 0, 8}]
```

Out[128]= $1 + x^2 + \frac{x^4}{2} + \frac{x^6}{6} + \frac{x^8}{24} + O[x]^9$

You can use Normal to truncate the higher order terms:

In[129]:=
```
Normal[%]
```

Out[129]= $1 + x^2 + \frac{x^4}{2} + \frac{x^6}{6} + \frac{x^8}{24}$

Power series in terms of derivatives

```
Series[2 f[x] - 3, {x, 0, 3}]
```

Out[132]= $-1 + 4\, x + 2\, x^2 + O[x]^4$

In[133]:=
```
Series[2 f[x] - 3, {x, 0, 3}]
```

Out[133]= $-1 + 4\, x + 2\, x^2 + O[x]^4$

Simplification of convergent series:

In[134]:= $\sum_{n=0}^{\infty} 0.5^n$

Out[134]= 2.