

Basic differentiation in Maple

Defining a function f by $f(x) = x^n$:

$$f := x \rightarrow x^n; \quad x \rightarrow x^n \quad (1)$$

Calculating the function f' in two different ways,
using the definition and by means of the command **diff** :

$$\text{limit}\left(\frac{f(x+h) - f(x)}{h}, h=0\right); \quad \frac{x^n n}{x} \quad (2)$$

$$\text{diff}(f(x), x); \quad \frac{x^n n}{x} \quad (3)$$

The command **simplify** can be used to simplify any expression
in Maple (the % sign refers to the latest output) :

$$\text{simplify}(\%); \quad x^{-1+n} n \quad (4)$$

Another example using the **diff** command :

$$\text{diff}(\sin(x)^{\cos(x)}, x); \quad \sin(x)^{\cos(x)} \left(-\sin(x) \ln(\sin(x)) + \frac{\cos(x)^2}{\sin(x)} \right) \quad (5)$$

To see the *chain rule* in action, define two functions l and m ,
and differentiate $l(m(x))$ with respect to x :

$$l := x \rightarrow \exp(x); \quad x \rightarrow e^x \quad (6)$$

$$m := x \rightarrow -x^2; \quad x \rightarrow -x^2 \quad (7)$$

$$\text{diff}(l(m(x)), x); \quad -2x e^{-x^2} \quad (8)$$

$$-2x \quad (9)$$

Derivatives of higher order can be directly obtained using the dollar

sign, telling maple to differentiate n\$ times with respect to x (in the example, one, two and three times, respectively) :

$$s := x \rightarrow \begin{cases} -(a \cdot x)^2 & x < 0 \\ (b \cdot x)^2 & x \geq 0 \end{cases};$$

$$x \rightarrow \text{piecewise}(x < 0, -a^2 x^2, 0 \leq x, b^2 x^2) \tag{10}$$

diff(s(x), x); *diff*(s(x), x\$2); *diff*(s(x), x\$3);

$$\begin{cases} -2 a^2 x & x \leq 0 \\ 2 b^2 x & 0 < x \end{cases}$$

$$\begin{cases} -2 a^2 & x < 0 \\ \text{undefined} & x = 0 \\ 2 b^2 & 0 < x \end{cases}$$

$$\begin{cases} \text{undefined} & x = 0 \\ 0 & \text{otherwise} \end{cases} \tag{11}$$