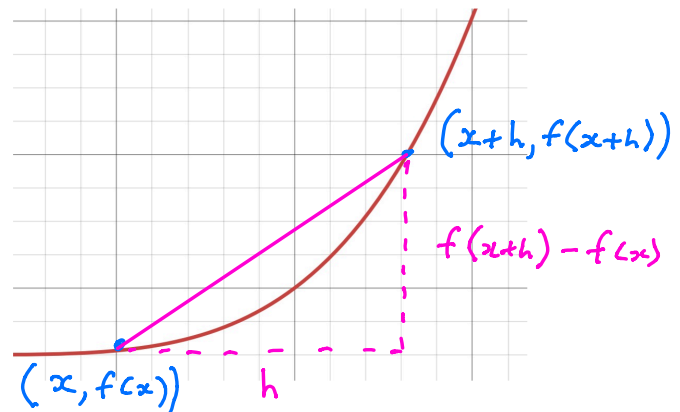


Differentiation From First Principles

The derivative of $f(x)$ written as $f'(x)$ is defined to be:

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$



Example

Let $f(x) = x^4$

then $f(x+h) = (x+h)^4 = x^4 + 4x^3h + 6x^2h^2 + 4xh^3 + h^4$

$$f'(x) = \lim_{h \rightarrow 0} \left[\frac{\cancel{x^4} + 4x^3h + 6x^2h^2 + 4xh^3 + h^4 - \cancel{x^4}}{h} \right]$$

$$f'(x) = \lim_{h \rightarrow 0} [4x^3 + 6x^2h + 4xh^2 + h^3]$$

$$f'(x) = [4x^3 + 0 + 0 + 0]$$

$$f'(x) = 4x^3$$
