Calculus 1

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1 Derivatives

1.1 Derivative as a concept

The derivative of a line describes the rate of change of the vertical component with respect to the horizontal component. The derivative will allow us to calculate not the slope, but the instantaneous rate of change at a given point. The derivative will give us the rate of change at a given point that will be give us the slope of the tangent line at that point. The reverse is true as well.

1.2 Calculating the derivative

Considering that the Δy between two points is the result of subtracting the y component defined as $f(x)$ from the y component of a second point that can be written as $f(x + \Delta x)$, can be defined Δy as $f(x + \Delta x) - f(x)$. Thus, formula to find the derivative of a function $f(x)$ is

$$\frac{\Delta y}{\Delta x} = \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

Assuming a function $f(x) = x^2$ we can calculate the derivative as follows

$$\begin{aligned}
\frac{\Delta y}{\Delta x} &= \frac{f(x+\Delta x)-f(x)}{\Delta x} \\
&= \frac{x^2+2x\Delta x+(\Delta x)^2)-x^2}{\Delta x} \\
&= \frac{2x\Delta x+(\Delta x)^2}{\Delta x} \\
&= 2x+\Delta x
\end{aligned}$$

The equation $2x + \Delta x$ gives us the derivative of the function $f(x)$ when Δx heads towards zero, which would result in $2x + 0 = 2x$

In other words, the slope a x for $f(x) = x^2$ is $2x$

" heads towards 0" is written dx and "the derivative of" is commonly writtent $\frac{d}{dx}$. eg. $\frac{d}{dx}x^2 = 2x$