Derivative Notation

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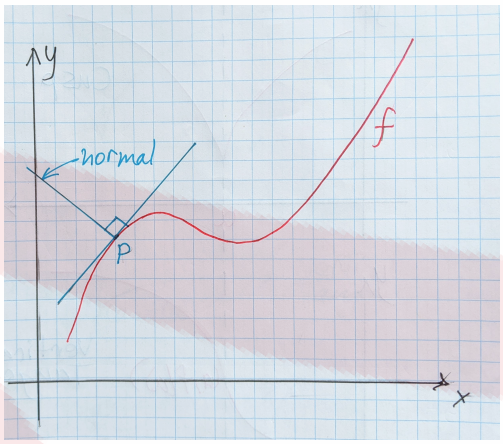
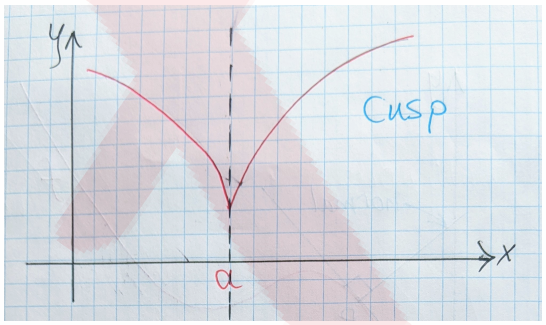
Terms

The **normal** to the graph of f at the point P is the line that is perpendicular to the tangent at P.

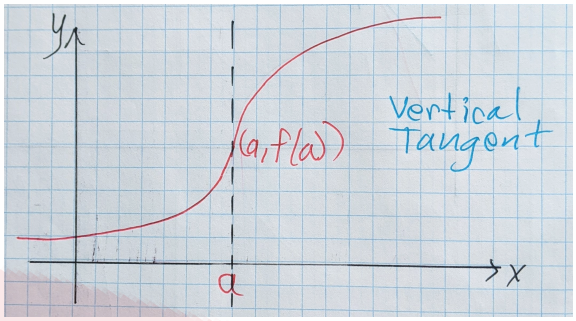


A function is said to be **differentiable** at a if the derivative $f'(a)$ exists.
A point where f is **not differentiable**, the derivative is said to not exist. Three common ways for a derivative not to exist are:

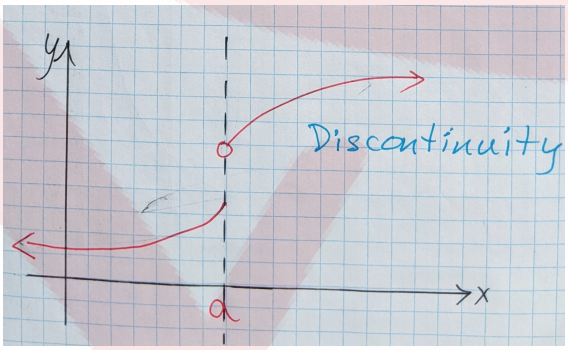
Cusp



Vertical Tangent



Discontinuity



Derivative Notation

There are different notations for the derivative of a function. Two of the more common notations for derivative are,

$$\boxed{f'(x) \text{ and } \frac{dy}{dx}}$$

It is possible for a function to be continuous at a point but not differentiable. The absolute function $f(x) = |x|$ is such a function.

Example

Let's consider the derivative of a polynomial function. If we consider the simplest polynomial, $f(x) = x + c$, a line. Let's calculate the derivative of f.

$$\begin{aligned} f'(x) &= \lim_{h\to 0} \frac{(x+h) - f(x)}{h} \\ &= \lim_{h\to 0} \frac{x + h + c - (x + c)}{h} \\ &= \lim_{h\to 0} \frac{h}{h} = 1 \end{aligned}$$

Exercises

1. Use the definition of the derivative to determine the derivative.

   a) $f(x) = x^2 + 3x$

   b) $f(x) = \frac{3}{x+2}$

   c) $f(x) = \sqrt{3x + 2}$

   d) $f(x) = \frac{1}{x^2}$

   e) $y = c$

   f) $y = x$

   g) $y = mx + b$, where m and b are constants

   h) $y = ax^2 + bx + c$, where a, b and c are constants.

2. Use the definition of the derivate to find the value of the derivative $f'(x)$ at the point $x = a$.

   a) $f(x) = x^2,\ a = 2$

   b) $f(x) = x^2 + 3,\ a = -1$

   c) $f(x) = \sqrt{x+1},\ a = 3$

   d) $f(x) = x + 4,\ a = -2$

   e) $f(x) = \frac{2}{x-3},\ a = 4$