we can compute the derivative at any generic point $x$:

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

We can also write:

$$f'(a) = \lim_{h \to 0} \frac{f(a+h) - f(a)}{h}$$

Notation:

$$f'(x) = \frac{dy}{dx} = \frac{d}{dx} f(x) = D_x f(x) = f_x(x) = \frac{df}{dx}$$

eg. $f'(1)$ does not exist.

$$f'(1) \neq \frac{3}{2}$$

but

$$f'(1) \approx 3.5$$

eg.

$$f(x) = x^3 - x^2$$

do some work to find that

$$f'(x) = 3x^2 - 2x$$

Can do it again...

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

3 work

$$f''(x) = 6x - 2$$

do it again

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

$\frac{\text{sum work}}{4}$

$$= 6$$

Slow that $f(a)$ does not exist at 0 if $f(0) = \lim_{x \to 0} f(x)$.

$$f(0) = \lim_{h \to 0} f(h)$$

but all $\lim_{h \to 0} f(h) \neq \lim_{h \to 0} f(h) - 1$

the limit from right at 0 from the left,
so the limit does not exist
so $f(0)$ does not exist.

call $f'(a) = 1$

$f'(0) = 1$