① According to the definition of the derivative, compute $f'(5)$ for $f(x) = x^2$

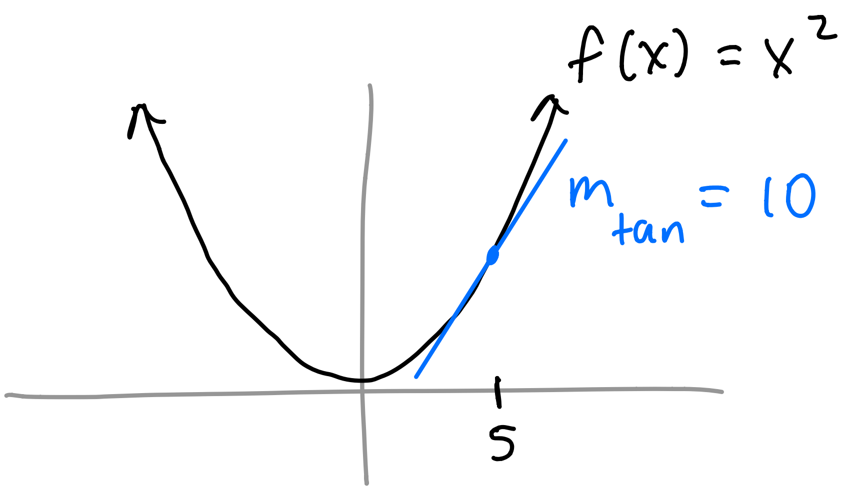
$$f(x) = x^2$$

$$f'(5) = \lim_{x \to 5} \frac{f(x) - f(5)}{x - 5}$$

$$= \lim_{x \to 5} \frac{x^2 - 25}{x - 5}$$

$$= \lim_{x \to 5} \frac{\cancel{(x-5)}(x+5)}{\cancel{x-5}}$$

$$= \lim_{x \to 5} x + 5 = 10$$



② What is the equation of the tangent line for $f(x) = x^2$ at $x = 5$ (problem 1)?

$$y - f(a) = f'(a)(x - a)$$

$$y - 25 = 10(x - 5)$$

$$y - 25 = 10x - 50$$

$$y = 10x - 25$$

③ According to the definition of the derivative, compute $f'(3)$ for $f(x) = x^2 - 8x$

$$f'(a) = \lim_{x \to a} \frac{f(x) - f(a)}{x - a}$$

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

$$* \; h = x - a$$

$$\lim_{h \to 0} \frac{f(3+h) - f(3)}{h}$$

$$= \lim_{h \to 0} \frac{((3+h)^2 - 8(3+h) - (3^2 - 8(3))}{h}$$

$$= \lim_{h \to 0} \frac{((9 + 6h + h^2) - (24 + 8h)) - (9 - 24)}{h}$$

$$= \lim_{h \to 0} \frac{h^2 - 2h}{h} = \frac{\cancel{h}(h-2)}{\cancel{h}}$$

$$= \lim_{h \to 0} h - 2 = \boxed{-2}$$

④ Use the Sum and difference, constant multiple, and power rules to compute the derivative for the function $f(x) = x^3 - 12x + 8$

$$f(x) = x^3 - 12x + 8$$

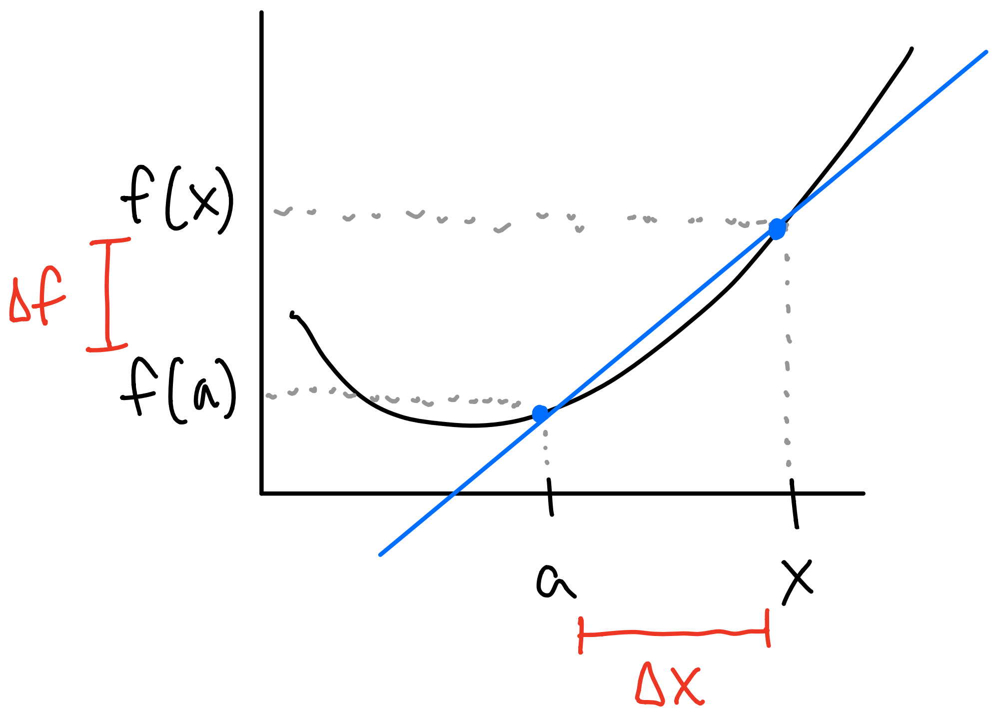
$$f'(x) = 3x^2 - 12$$

$f(x) = \text{final}$

$f(a) = \text{inital}$

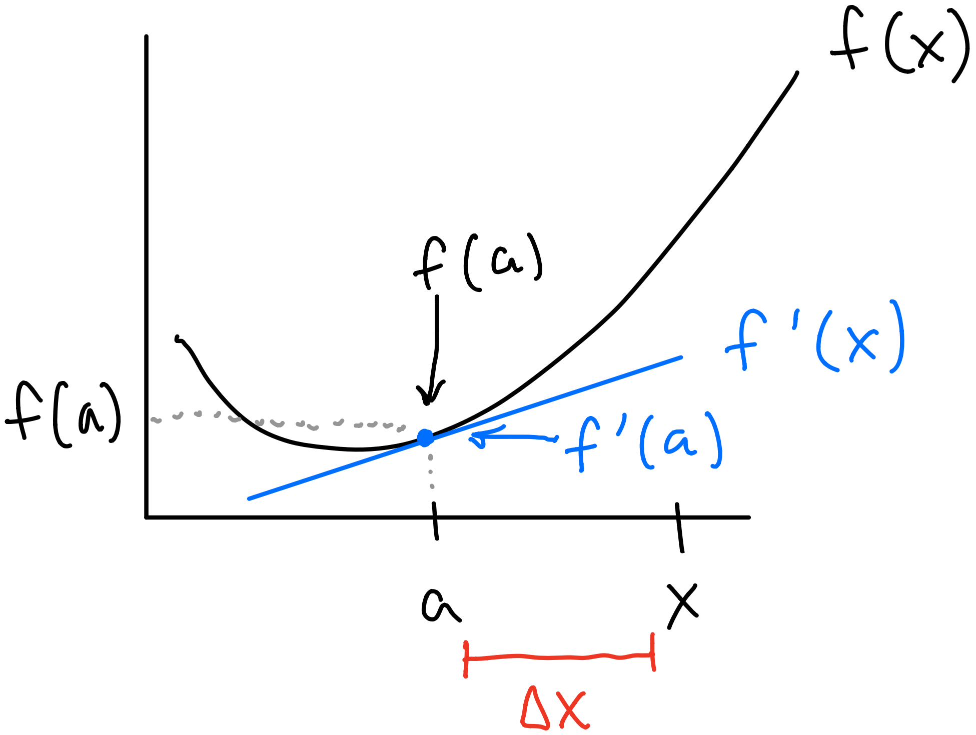
<u>Secant</u>

$$m_{sec} = \frac{\Delta f}{\Delta x} = \frac{f(x) - f(a)}{x - a}$$



## Derivative Equation

$$m_{tan} = f'(a) = \lim_{x \to a} \frac{f(x) - f(a)}{x - a}$$




## Formula for slope of tangent line

$$y - f(a) = f'(a)(x-a)$$

$$y = f'(a)(x-a) + f(a)$$

$$y = m \quad x \quad + \quad b$$

## Notation

$$f'(x) = \frac{df}{dx} = \frac{\Delta f}{\Delta x}$$

## Power Rule

$$\frac{d}{dx} x^n = n x^{n-1}$$

Ex: $f(x) = x^2$

$f'(x) = 2x$

Ex: $f(x) = 4x^3$

$f'(x) = 12x^2$

## Sum and Difference Rules

$f$ and $g$

$(f+g)' = f' + g'$

$(f-g)' = f' - g'$

Ex: $f(x) = 5x^4$

$g(x) = 8x$

$$Y = f(x) + g(x) = 5x^4 + 8x$$

$$y' = (f(x) + g(x))' = f'(x) + g'(x)$$

$$y' = 20x^3 + 8$$

Constant multiple rule

$$y = 5x^4 + 8x$$

$$y' = 20x^3 + 8$$

$$y'' = 60x^2$$

$\underline{e}$

$f(x) = e^x$

$f'(x) = e^x$