DERIVATIVES PART 1

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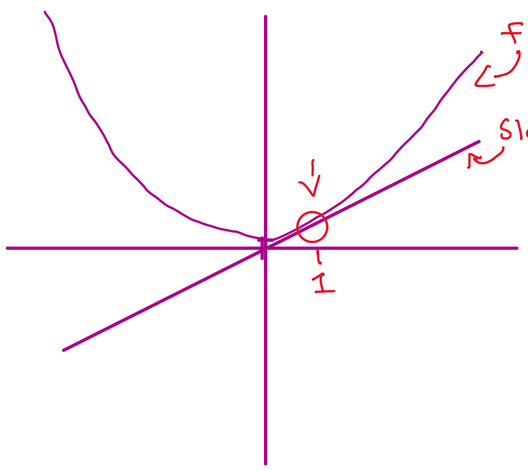
Concept:

—> Derivative of $f(x)$ is the rate of change of f with respect to x

—> Derivative is written as: $f'(x)$ or $\frac{df}{dx}$ ← find $f'(x)$ or find $\frac{dF}{dx}$

—> Represents slope of tangent line to curve of function at given point



Common Rules:

① power Rule: $f(x) = x^n \rightarrow f'(x) = nx^{n-1}$
↳ Example: $f(x) = x^3 \rightarrow n=3$ $f'(x) = 3x^2$ $f(x) = 3 \cdot x^{3-1}$ $3 \cdot 2x^{2-1}$ $6x$ $= 3x^2$

② Constant Rule: $f'(x)$ of $C=0$
↳ Example: $f(x) = 5x$ $f'(x) = 0$ $C=0$ $4=0$

③ Constant Multiple Rule: $f(x) = C \cdot g(x)$ $f'(x) = C \cdot g'(x)$
↳ Example: $f(x) = 5x^2$ $f'(x) = 5 \cdot 2x = 10x$ $5x^2$ $g(x)$ x^2 $2 \cdot x^{2-1}$ $2x$

④ Sum Rule: $f(x) = g(x) + h(x) \rightarrow f'(x) = g'(x) + h'(x)$
↳ Example: $f(x) = x^3 + 2x \rightarrow 2x$ $f'(x) = 3 \cdot x^{3-1} + 1 \cdot 2x^{1-1} + 2$ $g'(x) = 3x^2$ $2x^1$ $2 \cdot 1 x^{1-1}$ $2 \cdot 1 \cdot 1$ 2 $x^0 = 1$

⑤ Product Rule: $f(x) = g(x) \cdot h(x) \rightarrow f'(x) = g'(x)h(x) + g(x)h'(x)$
↳ Example: $f(x) = x^3 \cdot \sin(x)$ $f'(x) = 3x^2 \sin(x) + x^3 \cdot \cos(x)$ $g'(x)h(x)$ $g(x)h'(x)$ x^3 $3 \cdot x^{3-1}$ $3x^2$ $\sin(x) \rightarrow \cos(x) = h'(x)$

⑥ Quotient Rule: $f(x) = \frac{g(x)}{h(x)} \rightarrow f'(x) = \left[\frac{g'(x)h(x) - g(x)h'(x)}{h(x)^2}\right]$
↳ Example: $f(x) = \frac{x^2}{x+1}$ $g(x)$ $h(x)$ $f'(x) = \frac{2x(x+1) - x^2(1)}{(x+1)^2}$ x^2 $2 \cdot x^{2-1}$ $2x$ $h'(x)$ $g'(x)h(x)$ $g(x)h'(x)$ $h(x) = x+1$ $h(x) = 1+0$ $h'(x) = 1$ x^1 $1 \cdot x^{1-1}$ $1 \cdot 1$

⑦ Chain Rule: $f(x) = g(h(x)) \rightarrow f'(x) = g'(h(x)) \cdot h'(x)$
↳ Example: $f(x) = (2x+1)^3$ $f'(x) = 3 \cdot (2x+1)^{3-1} \cdot 2$ $= 6(2x+1)^2$ $g'(h(x))$ $h'(x)$ $h'(x) = 2x+1$ $= 2 \cdot 1 x^{1-1} + 0$ $= 2 \cdot 1 \cdot 1 + 0$ $= 2$
$f(x) = (x+1)^2$
$f'(x) = ?$

$f(x) = 4x^2$ 4 $g(x)$ c $g'(x)$

$f(x) = 6x^3$ 6 $g(x)$ c x^3 $3x^2$ $6 \cdot 3x^2$ $18x^2$

$f(x) = x^2 + x^4$ $2x + 4x^3$

$g(x)h(x) = g'(x)h(x) + g(x)h'(x)$

$f(x) = x \sin(x)$ $g(x)$ $h(x)$ $x = x^1$ x^1 $1x^0$ $1 \cdot 1$ 1 $\cos(x)$ $g'(x) = 1$ $h'(x) = \cos(x)$

$\sin x + x \cos x$