- If a function f(x) is differentiable @ point *a*, then f(x) is continuous @ *a*
- If f(x) is not continuous @ point *a*, then f(x) is not differentiable @ *a*

- $\lim_{x\to 0} \frac{\sin(x)}{x} = 1$
- $\lim_{x\to 0} \frac{1-\cos(x)}{x} = 0$
- $\lim_{x\to 0} \frac{\tan(x)}{x} = 1$

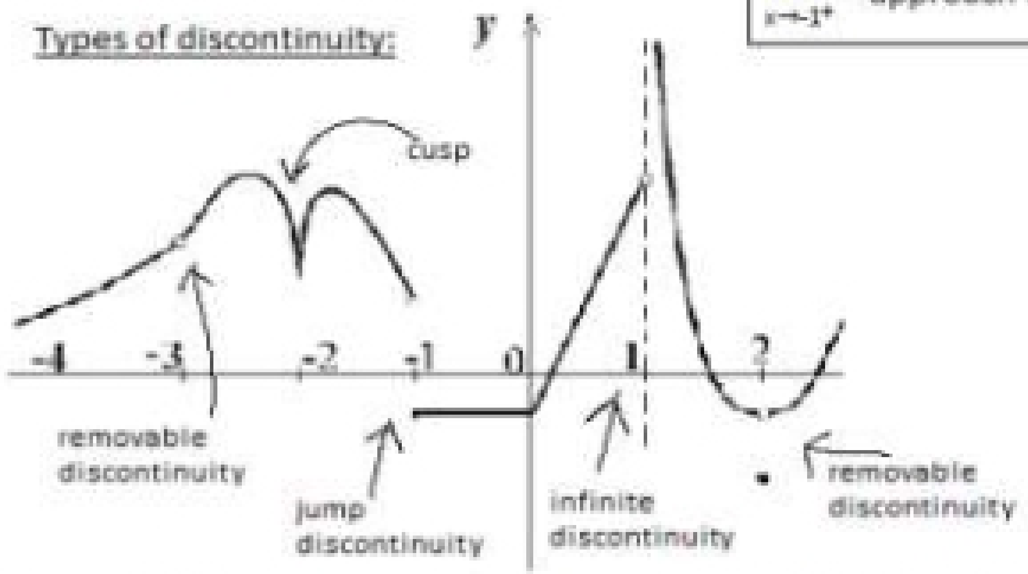
Derivative:
- aka instantaneous rate of change
- aka slope of tangent line

$\lim_{x\to -1^-}$ = approach from left

$\lim_{x\to -1^+}$ = approach from right

Limit Laws:
- $\lim_{x\to a} [f(x) + g(x)] = \lim_{x\to a} f(x) + \lim_{x\to a} g(x)$
- $\lim_{x\to a} [f(x) - g(x)] = \lim_{x\to a} f(x) - \lim_{x\to a} g(x)$
- $\lim_{x\to a} [cf(x)] = c \lim_{x\to a} f(x)$
- $\lim_{x\to a} [f(x)g(x)] = \lim_{x\to a} f(x) \bullet \lim_{x\to a} g(x)$
- $\lim_{x\to a} \frac{f(x)}{g(x)} = \frac{\lim_{x\to a} f(x)}{\lim_{x\to a} g(x)}$ if $\lim_{x\to a} g(x) \neq 0$

Types of discontinuity:



The limit of f(x) does NOT exist at -1 and 1
The function f(x) is NOT continuous at -3, -1, 1, & 2
The function f(x) is NOT differentiable at -2, -1, & 1

Finding continuity of piecewise functions:
- $f(x) = \begin{cases} x-2 & \text{if } x < 0 \\ x^2-2 & \text{if } x \geq 0 \end{cases}$

f(x) = x-2	$f(x) = x^2-2$
f(0) = 0 -2 = -2	$f(0) = 0^2-2 = -2$

-2 = -2 , therefore it is continuous at x=0

Derivatives of Trig Functions:
- sin x = cos x
- tan x = $\sec^2$ x
- sec x = sec x tan x
- cos x = -sin x
- cotan x = $-\text{cosec}^2$ x
- cosec x = -cosec x cotan x

Finding Limit of an Absolute Value:

$\lim_{x\to -1} \frac{|x+1|}{x+1}$; $|x+1| = \begin{cases} x+1 & \text{if } x \geq -1 \\ -(x+1) & \text{if } x < -1 \end{cases}$

$\lim_{x\to -1^-} \frac{|x+1|}{x+1} = \lim_{x\to -1^-} \frac{x+1}{x+1}$

&

$\lim_{x\to -1^+} \frac{|x+1|}{x+1} = \lim_{x\to -1^+} \frac{-(x+1)}{x+1}$

Finding differentiability of piecewise functions:
- $f(x) = \begin{cases} 2x & \text{if } x < 1 \\ x^2-2 & \text{if } x \geq 1 \end{cases}$

f(x) = 2x	$f(x) = x^2-2$
f'(x) = 2	f'(x) = 2x
f'(1) = 2	f'(1) = 2

2 = 2 , therefore it is differentiable at x=1

Differentiation Rules:
- $\frac{d}{dx}(x^n) = nx^{n-1}$
- $\frac{d}{dx}(c) = 0$
- $\frac{d}{dx}(x) = 1$
- $[f(x)g(x)] = f'(x)g(x) + f(x)g'(x)$
- $\frac{f(x)}{g(x)} = \frac{f'(x)\,g(x) - f(x)g'(x)}{g(x)^2}$
- $f(g(x)) = f'(g(x)) \bullet g'(x) \bullet x'$
- $\frac{d}{dx}[f(x) + g(x)] = \frac{d}{dx}f(x) + \frac{d}{dx}g(x)$
- $\frac{d}{dx}[f(x) - g(x)] = \frac{d}{dx}f(x) - \frac{d}{dx}g(x)$
- $\frac{d}{dx}[cf(x)] = c\frac{d}{dx}f(x)$