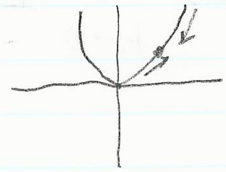
Keanu Vestil
Mr. Fox
PreCalculus H

Limit: as a function approaches an x-value, what y-value is it approaching

$\lim_{x \to b} f(x)$ read as "limit of f(x) as x approaches b"

Solve $\lim_{x \to 2} x^2$

- Graphically



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- Numerically

x	1.5	1.9	2.1	2.5
y	2.25	3.61	4.41	6.25

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- Plug it in
(if it is continuous at given point) $\lim_{x \to 2} x^2 = 2^2 = 4$

$\lim_{x \to b^+}$: limit approaching from the right
$\lim_{x \to b^-}$: limit approaching from the left

A limit does not exist if...

- $\lim_{x \to b^+} \neq \lim_{x \to b^-}$ i.e. $\lim_{x \to 0} \frac{1}{x}$ dne
- Oscillates between two fixed values
- The limit is not approaching a specific value i.e. $\lim_{x \to 0} \frac{|x|}{x}$ dne

Reduce when possible:

$\lim_{x \to 0} \frac{x^2}{x} = \lim_{x \to 0} x$ (even if there is a hole, the limit exists)

Rational-Polynomial functions: Horizontal Asymptote

$\lim_{x \to \infty} \frac{x-3}{2x+1} = \frac{1}{2}$ (ratio of lead coefficients)

$\lim_{x \to \infty} \frac{x+1}{x^2-1} = 0$ (degree of top < degree of bottom

$\lim_{x \to \infty} \frac{x^2-3}{x+4} = \text{dne}$ (approaching infinity)

(c is a constant) $\lim_{x \to a} c = c$

$\lim_{x \to 0} \cos\left(\frac{1}{x}\right) = \text{dne}$

$\lim_{x \to 0} \frac{\sin x}{x} = 1$

$\lim_{x \to \infty} \cos(x) = \text{dne}$

$\lim_{x \to 0} \frac{1-\cos x}{x} =$

Derivative: the slope of a line tangent to a function at a given point

Written as:

- $f'(x)$ "f prime of x" $f'(a) = \lim_{h \to 0} \frac{f(a+h) - f(a)}{h}$
- $\frac{dy}{dx} f(x)$
- $\frac{d}{dx} f(x)$
- $D_x(f(x))$

Rules:

- Addition/Subtraction: $(f(x) \pm g(x))' = f(x)' \pm g(x)'$
- Quotient: $\left(\frac{f}{g}\right)' = \frac{gf' - fg'}{g^2}$
- Product: $(fg)' = f'g + fg'$
- Power Rule: $(x^n)' = n(x^{n-1})$
- $(\sin(x))' = \cos(x)$
- $(\cos(x))' = -\sin(x)$
- $(e^x)' = e^x$
- $(\tan(x))' = \sec^2(x)$
- $(\ln(x))' = \frac{1}{x}$
- $(\text{constant})' = 0$
- $([\text{constant}]f(x))' = [\text{constant}](f'(x))$
- Chain Rule: $(f(u)) = f'(u) \cdot u'$

Normal lines are perpendicular to the ~~Tangent Line~~

$m_{normal} \cdot m_{tangent} = -1$

Normal Line is the negative reciprical of Tangent Line