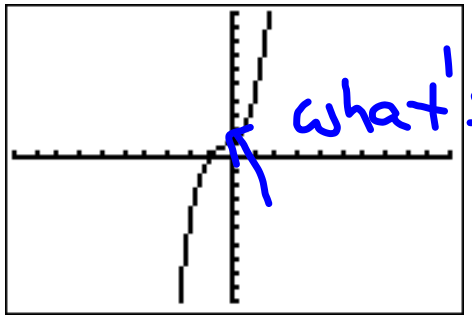
Limits

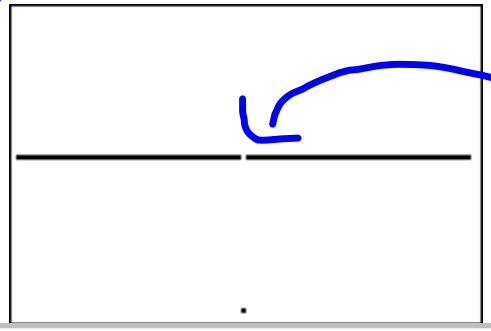
$$f(x) = \frac{(x^4 - 1)}{(x - 1)}$$

$$\lim_{x \to 1} \frac{(x^4 - 1)}{(x - 1)}$$

x	y
.9	3.439
.99	3.94
.999	3.994
.9999	3.9994
1	undefined
1.00001	4.0001
1.0001	4.0006
1.001	4.0060
1.01	4.0604
1.1	4.641



what's happening here?



note the discontinuity when x = 1

Why we have Limits

Avg Speed $= \frac{\Delta d}{\Delta t}$

$= \frac{200 \text{ miles}}{4 \text{ hrs}} = 50 \text{ mph}$

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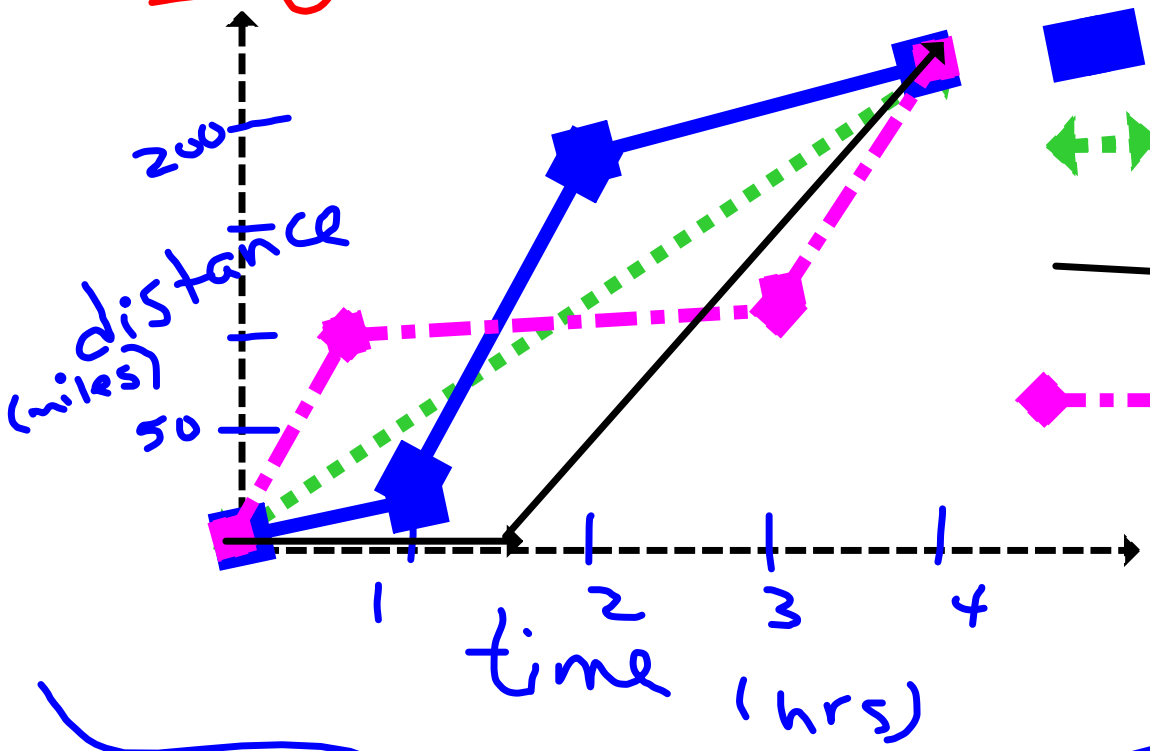
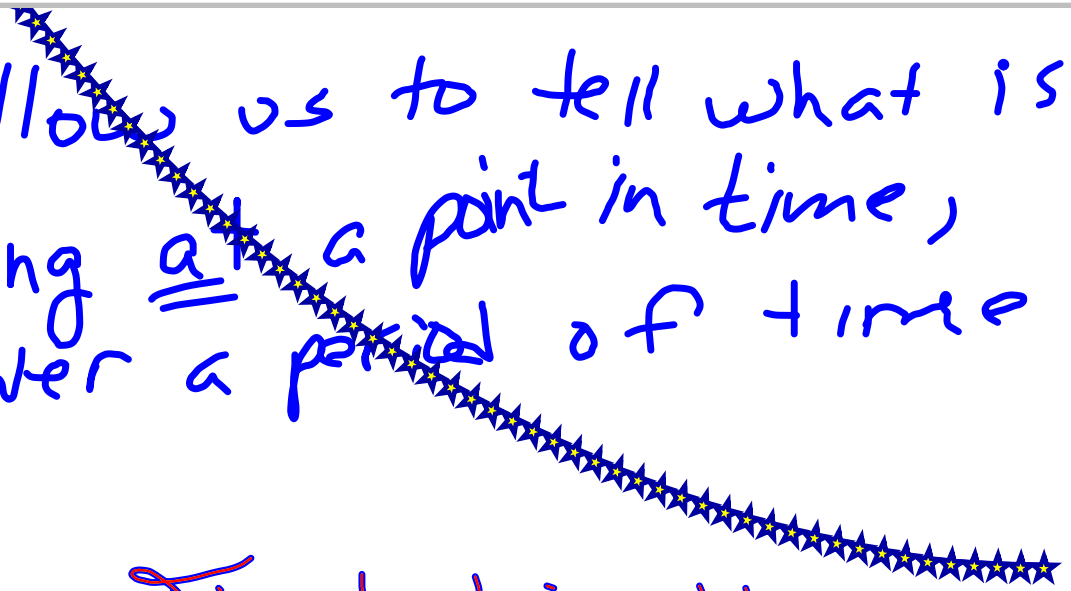


The avg speed tells us nothing

Limits allow us to tell what is happening at a point in time, not over a period of time.



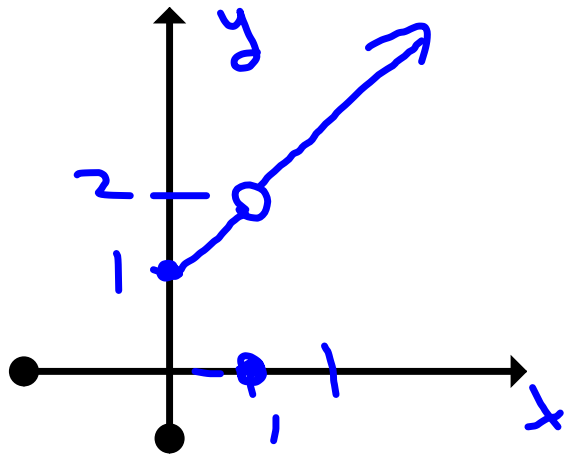
Ways to find Limits

1. Chart (POD)
   suggests what the limit might be and is a back up, but after other methods are learned, it can only be used as a secondary method. (See POD)

2) Graphically - look at the graph
or use a calculator and graph →
use calculus to confirm analytically

* Watch for "glitches" (holes + asymptotes)

$$f(x) = \begin{cases} x+1 & x \neq 1 \\ 0 & x = 1 \end{cases}$$



3. Substitution - direct substitution, put the number in + see if it works

Ex: $\lim_{x \to 3} \frac{x+2}{x+3} = \frac{5}{6}$

* Don't Quit if it doesn't work!

4. Algebraically Factor Reduce - Simplify

$\lim_{x \to 3} \frac{x^2-9}{x-3} = \frac{9-9}{3-3} = \frac{0}{0}$ ~~DNE~~ don't stop!

$\lim_{x \to 3} \frac{(x+3)(x-3)}{(x-3)} = \lim_{x \to 3}(x+3) = (6)$ factor!

Lauren - we miss you. Feel better.