If $\varepsilon \approx 0$ and $\varepsilon \neq 0$

$st(7 - \varepsilon) = 7$

$st(7\varepsilon) = 0$

$st(5/\varepsilon)$ = undefined because $5/\varepsilon$ is infinite

Suppose H is negative infinite

$$st\left(\frac{4H - 1}{H^2 + 7}\right) = st\left(\frac{4H-1}{H^2+7} \cdot \frac{1/H^2}{1/H^2}\right) = st\left(\frac{4H/H^2 - 1/H^2}{H^2/H^2 + 7/H^2}\right)$$

Look @ biggest term

$$\boxed{st\left(\frac{4/H - 1/H^2}{1 + 7/H^2}\right)}$$

infinitesimal

$$\text{infinitesimal} = \frac{0 + 0}{1 + 0} = 0 = \frac{4H-1}{H^2+7} \approx 0$$

H is negative infinate

$|H| = (-H)$

$$st\left(\frac{H + 6}{|H| - 2}\right) = st\left(\frac{\frac{H}{|H|} + \frac{6}{|H|}}{\frac{|H|}{|H|} - \frac{2}{|H|}}\right) = st\left(\frac{-1 - \frac{6}{-H}}{1 + \frac{2}{-H}}\right) = \frac{-1-0}{1+0} = -1$$

Yesterday we computed things ~~that give~~ like the slope of $y=x^2$ at $x=3$. Now we're finding general slope formulas for the whole line.

slope of $f(x)$ at $x=a$: $st\left(\frac{f(a+\Delta)-f(a)}{\Delta x}\right)$ for $\Delta x \approx 0$, $\Delta x \neq 0$

General formula for slope: $f'(x) = st\left(\frac{f(x+\Delta x)-f(x)}{\Delta x}\right)$
called Derivative

ex. 1
$f(x) = x^2$

$$f'(x) = st\left(\frac{(x+\Delta x)^2 - x^2}{\Delta x}\right) \quad \Delta x \approx 0, \ \Delta x \neq 0$$

$$\downarrow$$

$$st\left(\frac{x^2 + 2x\Delta x + \Delta x^2 - x^2}{\Delta x}\right)$$

$$st\left(\frac{2x\Delta x + \Delta x^2}{\Delta x}\right) = st\left(\frac{\Delta x(2x+\Delta x)}{\Delta x}\right) = st(2x+\Delta x)$$
$$2x + 0 = 2x$$

slope of $y=x^2$ @ $x=-7$ is $\underline{-14}$

$2x$
$2(-7) = -14$

Pattern if $n = 2, 3, 4, 5, 6 \ldots$, then $(x+\Delta x)^n = x^n + nx^{n-1}\Delta x + \Delta x^2($something finite$)$

ex. 2

$$f(x) = x^n$$

$$f'(x) = st\left(\frac{(x+\Delta x)^n - x^n}{\Delta x}\right)$$

$$\downarrow$$

$$st\left(\frac{x^n + nx^{n-1}\Delta x + \Delta x^2(\text{finite}) - x^n}{\Delta x}\right)$$

$$\downarrow$$

$$st\left(\frac{nx^{n-1}\Delta x + \Delta x^2(\text{finite})}{\Delta x}\right)$$

$$\downarrow$$

$$st\left(\frac{\Delta x\,(nx^{n-1} + \Delta x(\text{finite}))}{\Delta x}\right)$$

$$\downarrow$$

$$st\left(nx^{n-1} + \Delta x(\text{finite})\right)$$

$$nx^{n-1} + 0(\text{finite})$$

$$\underline{nx^{n-1}}$$

The slope of $y = x^6$ @ $x = 2$ is $\underline{192}$

$$f'(x) = 6x^5 = \underset{(2)}{}$$

ex. 3

If $f(x) = \frac{1}{x}$, find $f'(x)$ $\quad 0 \neq \Delta x \approx 0$

$$f'(x) = st\left(\frac{\frac{1}{x+\Delta x} - \frac{1}{x}}{\Delta x}\right)$$

$$\downarrow$$

$$f'(x) = st\left(\frac{\frac{1}{x+\Delta x}\cdot\frac{x}{x} - \frac{1}{x}\cdot\frac{x+\Delta x}{x+\Delta x}}{\Delta x}\right)$$

$$\downarrow$$

$$st\left(\frac{\frac{x}{(x+\Delta x)x} - \frac{x+\Delta x}{(x+\Delta x)x}}{\Delta x}\right) = st\left(\frac{\frac{-\Delta x}{(x+\Delta x)x}}{\Delta x}\right)$$

$$st\left(\frac{-\Delta x}{(x+\Delta x)x\Delta x}\right) \overset{st}{=} \left(\frac{-1}{(x+\Delta x)x}\right) = \frac{-1}{(x+0)x} = \frac{-1}{x^2}$$

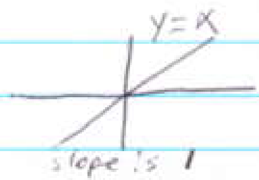
The slope of $y=\frac{1}{x}$ @ $x=-3$ is $-\frac{1}{9}$

$y'=\frac{-1}{x^2}$

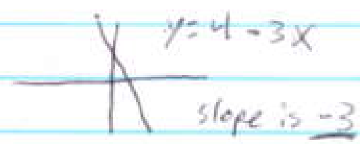
$\frac{-1}{3^2}=-\frac{1}{9}$

ex. 4

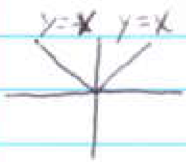
What is $(x)'$? $\underline{1}$



$(4-3x)'=\underline{-3}$



$$|x|'=\begin{cases}-1 & x<0\\ 1 & x>0\\ \text{undefined @ } 0\end{cases}$$



$(8)'=\underline{0}$