§1.4 – Pick some graphing calculator stuff up as we go. In the meantime, use the solutions to help you. And maybe we'll work a problem or two in class, on demand.

Beth

§1.4 #22 $\cos x = x$ has 1 solutions.

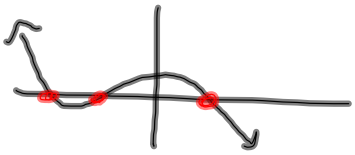
(a) Show that $\cos x = .3x$ has 3 sol'ns.

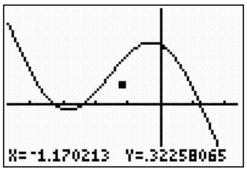
Two ways

① I showed that $\cos x - .3x$ has 3 x-intercepts

$\cos x = .3x \implies \cos x - .3x = 0$

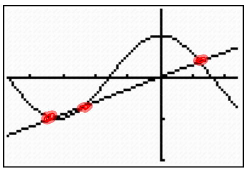
Graph of $\cos x - .3x$





A graph of $\cos x$ & $.3x$ on same axes

Visual question.



By guess and check, I thought $y = .35x$ was pretty good for part (b). Good enough.

Find $m \ni \cos x = mx$ has 2 sol'ns.

such that.

§1.4 Collect on Thursday, 1/27

Graphers will be needed, in spots, on homework.

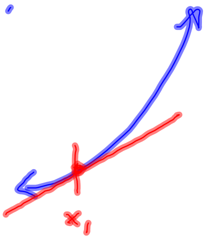
§2.1 – Tangent and Velocity

$\frac{\Delta y}{\Delta x} \to \frac{dy}{dx}$ $\qquad$ $\frac{\Delta \text{distance}}{\Delta \text{time}}$ = Average Velocity.

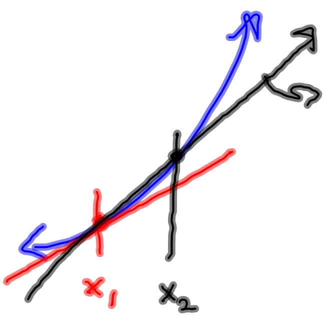
$m_{sec} \to m_{tan}$

Know $\to$ Don't Know yet

Recall day 1 in lecture (and day 2) when I tried to speak about the tangent line problem?



Want steepness at x_1



Secant line

Its slope is close to the slope of the tangent line.

$m_{sec} \approx m_{tan}$

Graphers can help §2.1, which is a numerical approach to the tangent line question.

We'll take x_2 closer & closer to x_1 & guess what m_{tan} is.

$\boxed{E}$ Let $f(x) = x^2 - 2x + 1$

We estimate m_{tan} at the point

$P = (2,1) = (x_1, y_1)$

	(x_2, y_2)	m_{sec}
①	$(2.5, 2.25)$	
②	$(2.01, 1.0201)$	
③	$(2.0001, 1.00002)$	

$$m_{sec} = \frac{f(x_2) - f(x_1)}{x_2 - x_1}$$

$P = (2,1)$

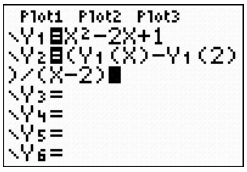
$$\frac{f(x) - f(2)}{x - 2} = \frac{Y(x) - Y(2)}{x - 2}$$

① $m_{sec} = \dfrac{2.25 - 1}{2.5 - 2} = 2.5$

$= (Y_1(x) - Y_1(2)) / (x-2)$ is the m_{sec} I will use in my grapher.

② $m_{sec} = \dfrac{1.0201 - 1}{2.01 - 2} = 2.01$

③ $m_{sec} = \dfrac{1.00002 - 1}{2.0001 - 2} \approx 2$



Grapher Window

For m_{sec} from $(2,1)$ to $(x, f(x))$

where $f(x) = Y_1 = x^2 - 2x + 1$.

My Y_2 is the function that spits out the m_{sec}.

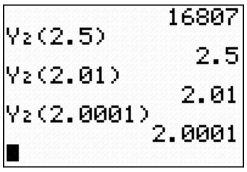


Table works good.

Sometimes its precision is lacking.

So VARS-YVARS-Y2 is handy.

① $m_{sec} = \dfrac{2.25-1}{2.5-2} = 2.5$

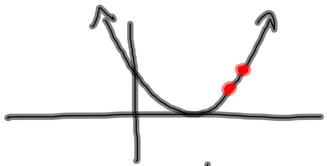
② $m_{sec} = \dfrac{1.0201-1}{2.01-2} = 2.01$

③ $m_{sec} = \dfrac{1.00002-1}{2.0001-2} \approx 2$

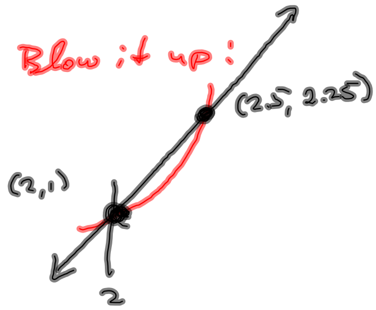
$y - y_1 = m(x-x_1) \Longrightarrow \underline{y = m(x-x_1) + y_1}$

Better!

① $m = 2.5$, $(x_1, y_1) = (2,1)$



Blow it up:



This line has equation

$y = 2.5(x-2)+1$

is the line between

$(2,1)$ & $(2.5, 2.25)$

From our work, what's the m_{tan} @ $(2,1)$?

Looks like $m_{tan} = 2$

Equation of tangent line is

$y = m(x-x_1) + y_1$

$\boxed{y = 2(x-2)+1}$

Line thru $(2,1)$ with slope $m=2$.

Sorry so fast!

You can enter this directly into your calculator w/o any more simplifying!

$Y_1 = 2(X-2)+1$

$Y_1 = 2(X-2)+1$

can be entered as-is into your Y= window. So the quickest way to build a line and play around with it is the point-slope version (needs only the slope and a point on the line) I gave you in lecture, today.

It's also a cool way to view ALL lines as transformations on the basic function f(x) = x.

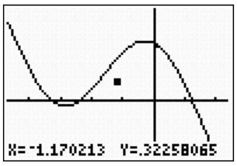
This one, for instance, is just f(x) = x,
stretched vertically by a factor of 2 (multiply y-values by 2),
shifted to the right 2
Shifted up 1

$Y_1 = 2(X-2)+1$

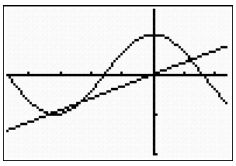
So you know everything about every (nonvertical) line, just by knowing $y = x$ and how to shift and stretch functions!

$Y_1 = 2f(x - 2) + 1$!

Screen captures from lecture that didn't make it into notes:

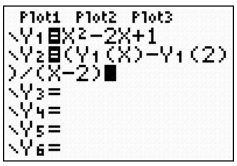


A graph of cos(x) - 0.3x



Graphs of cos(x)
and 0.3x, separately.

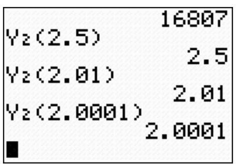
Either way, you can see that cos(x) and 0.3x intersect 3 times.



This is what I entered when I wanted to plug in different x-values into the slope between the point (2, 1) = (2, f(2)) on the graph of

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

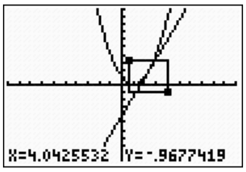
and any other point (x, f(x)) on the curve.

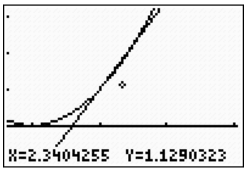


Tables are really quick for plugging in a whole bunch of different x-values, but this method, using the VARS key, isn't as limited in accuracy as the table, which doesn't display as many digits.

A not very good attempt at showing a secant line that WE built, the tangent line, and the function. I think I should've used a taller window, so you could see all three more clearly.

To capture a part of the screen: ZOOM-1 Then use arrow keys to anchor the corners of the zoom-box. Hit enter at each corner. My top left corner should've been farther up.





This is the result of the zoom. I should've made it taller and skinnier. That would have accentuated the key features I wanted to show. I will do another one like it next time we meet.