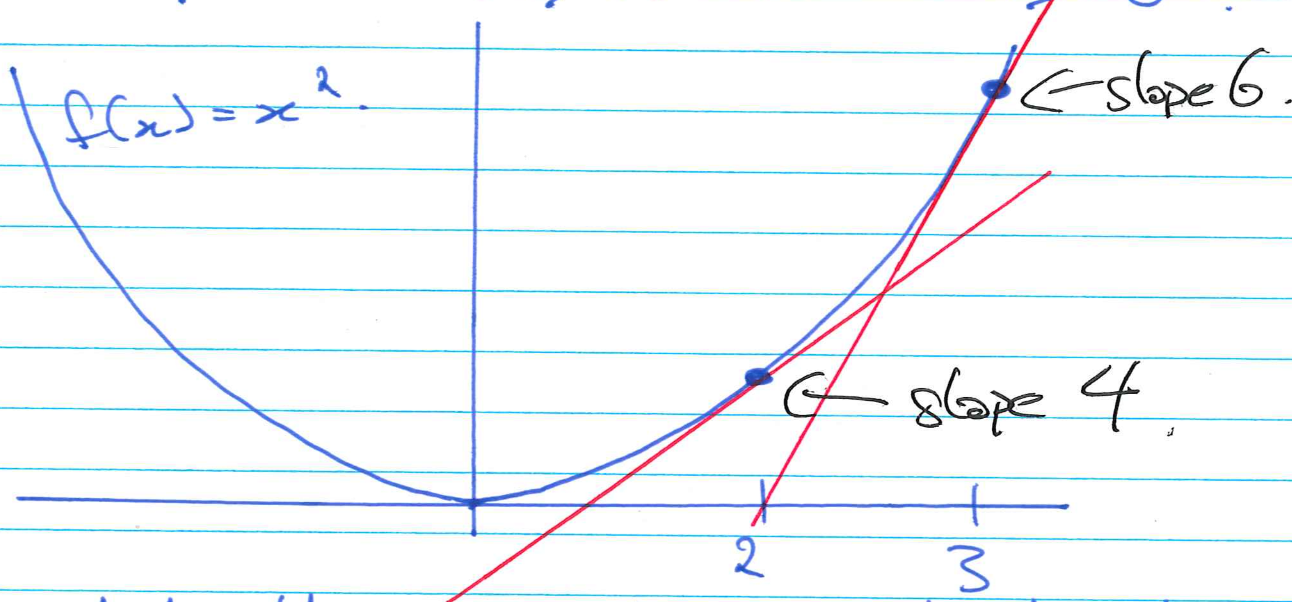
Oct 7

- HW4 Due Wed.
- HW5 Due Next Mon.
- Labs as usual next week.

(§2.1 of text)

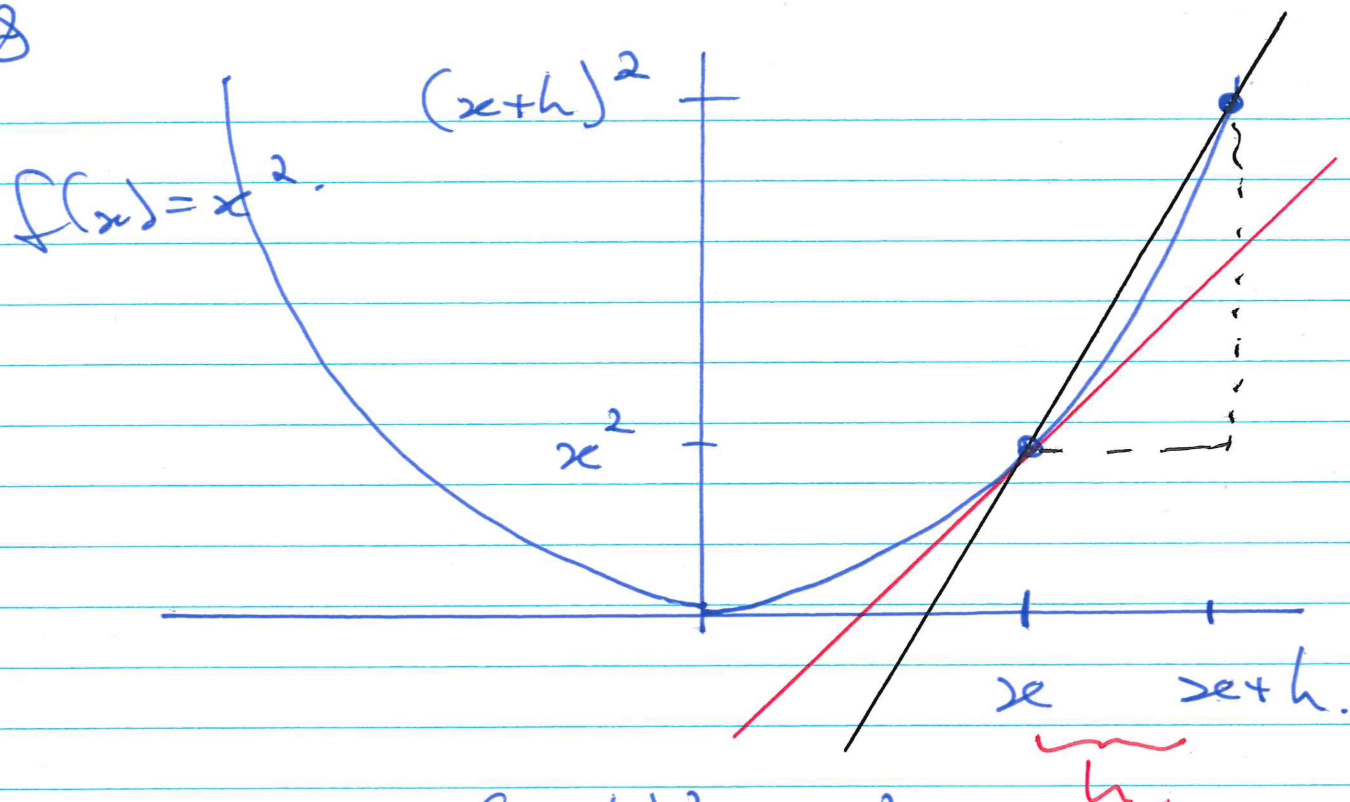
Last class we found the slope of the tangent lines to $f(x) = x^2$ at points $(2,4)$ and $(3,9)$.



We did this by taking the limit of secant lines.
(One computation for each)

Let's find the slopes of all tangent lines in one go.

2



$$m_{sec} = \frac{(x+h)^2 - x^2}{x+h-x}$$

$$= \frac{(x+h)^2 - x^2}{h}$$

$$\boxed{\begin{array}{c} (x+h)(x+h) \\ h \\ x^2 + xh + xh + h^2 \end{array}}$$

$$m_{tan} = \lim_{h \to 0} m_{sec}$$

$$= \lim_{h \to 0} \frac{(x+h)^2 - x^2}{h}$$

$$= \lim_{h \to 0} \frac{\cancel{x^2} + 2xh + h^2 - \cancel{x^2}}{h}$$

$$= \lim_{h \to 0} \frac{2xh + h^2}{h}$$

③

$$= \lim_{h \to 0} \frac{\cancel{h}(2x+h)}{\cancel{h}}$$

$$= \lim_{h \to 0} (2x + h)$$

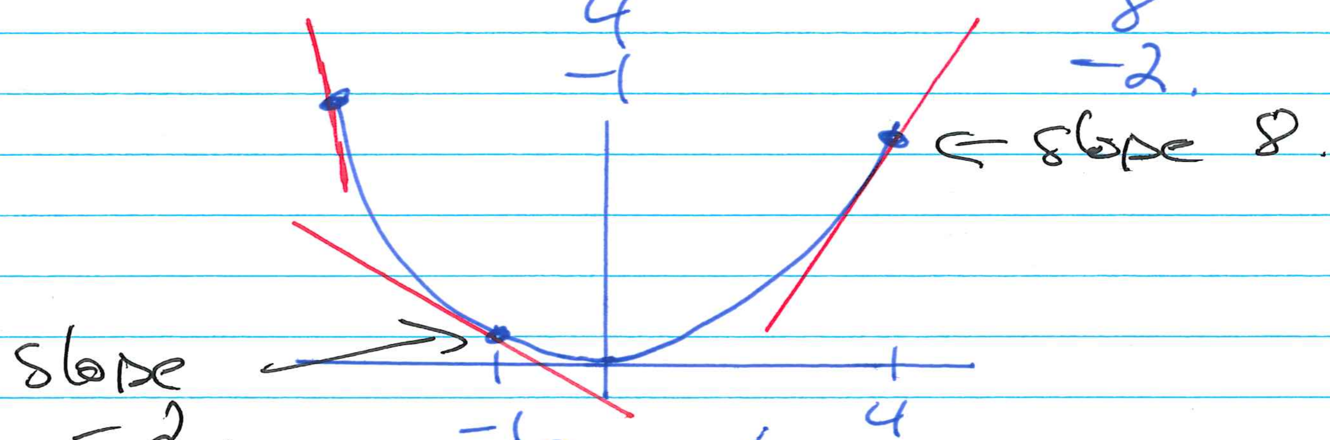
$$= 2x + 0$$

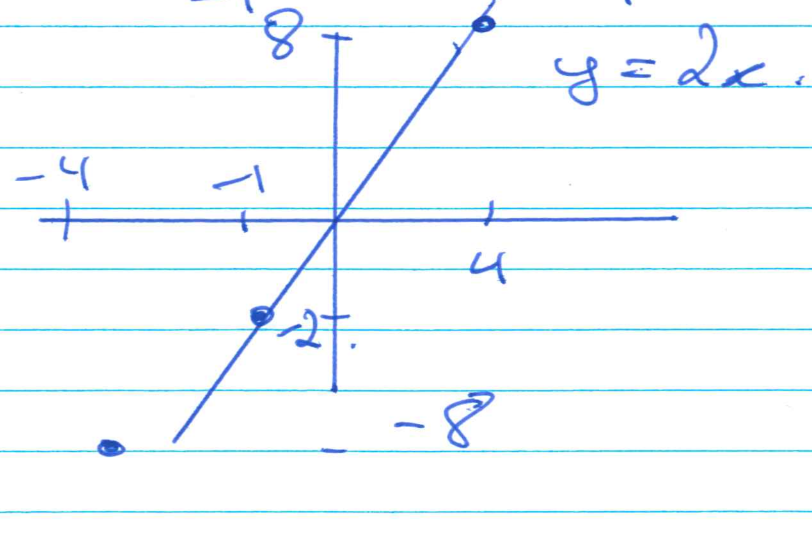
$$= 2x$$

this function tells us the slope of the tangent line to x^2 at any point

For example:

at	$x =$		slope is
	2		4
	3		6
	4		8
	-1		-2.



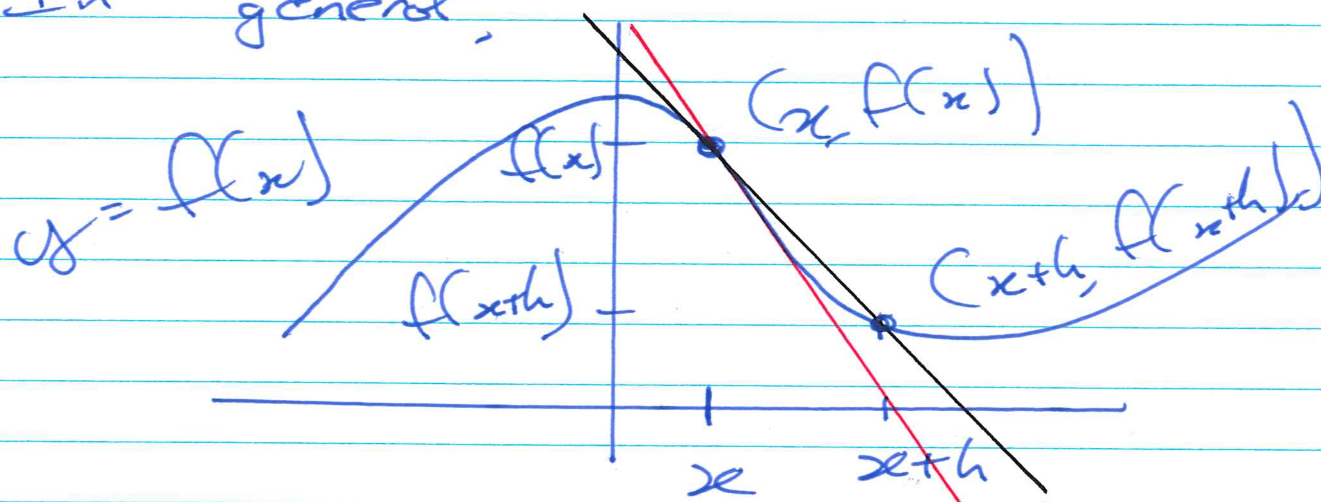


If $f(x) = x^2$ we write

$$\frac{df}{dx} = f'(x) = 2x.$$

different notations for the derivative.

In general,



$$m_{sec} = \frac{f(x+h) - f(x)}{x+h-x}.$$

difference quotient.

$$= \frac{f(x+h) - f(x)}{h}.$$

$$\boxed{f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}}$$

deffinition of the derivative.

Example: Find the derivative of $f(x) = x^3$.

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}.$$

$$= \lim_{h \to 0} \frac{(x+h)^3 - x^3}{h}.$$

$$= \quad \vdots$$

bunch of algebra.

$$= 3x^2.$$