Announcements

- HW #3 reopened; due Fri 11pm
- HW #4 out, due Fri 11pm (Sec 2.1, 2.2)
- Quiz #4 at Thurs, due Mon Sept 20, 11pm
- In class Monday: Review for Test #1
- Test #1: Wed Sept 22, in class. See 1.1–1.9, 2.1, 2.2
  ⇒ Bring a non-CAS calculator ⇐

- $f'(a)$ = Derivative of f at a
  = Slope of the tangent line to f at a
  = Instaneous rate of change at a
  = Avg rate of change over smaller and smaller intervals containing a.

Last time: $f(x) = 2x^2$

- Avg rate of change of f over $[1, 1+h] = 4 + 2h$
- $f'(1) = 4$

- How do we find the derivative $f'(x)$?
- Avg rate of change of f over $[x, x+h]$?

$f(x)=2x^2$

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

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

$$= \frac{2[x^2+2xh+h^2] - 2x^2}{h}$$

$$= \frac{\cancel{2x^2} + 4xh + 2h^2 \cancel{-2x^2}}{h}$$

$$= \frac{\cancel{h}(4x+2h)}{\cancel{h}}$$

$$= \boxed{4x+2h}$$

- When h is close to zero, Avg rate of change is $4x$.
- $\boxed{f'(x) = 4x}$

Estimating a Derivative

x	2.7	2.8	2.9	3.0	3.1
$f(x)$	-0.993	-1.030	-1.065	-1.099	-1.131

- Estimate $f'(2.8)$.

(Right estimate) $\Rightarrow \dfrac{f(2.9)-f(2.8)}{2.9-2.8} = \dfrac{(-1.065)-(-1.030)}{0.1}$

$= \dfrac{-0.035 \cdot 10}{0.1 \quad 10} = \underline{-0.35}$

$\Rightarrow \dfrac{f(2.8)-f(2.7)}{2.8-2.7} = \dfrac{(-1.030)-(-0.993)}{0.1}$

$= -0.37$

Final Estimate $= \frac{1}{2}$(left Est + Right Est)

$= \frac{1}{2}((-0.37) + (-0.35)) = \boxed{-0.36}$

Derivatives from a graphical point of view

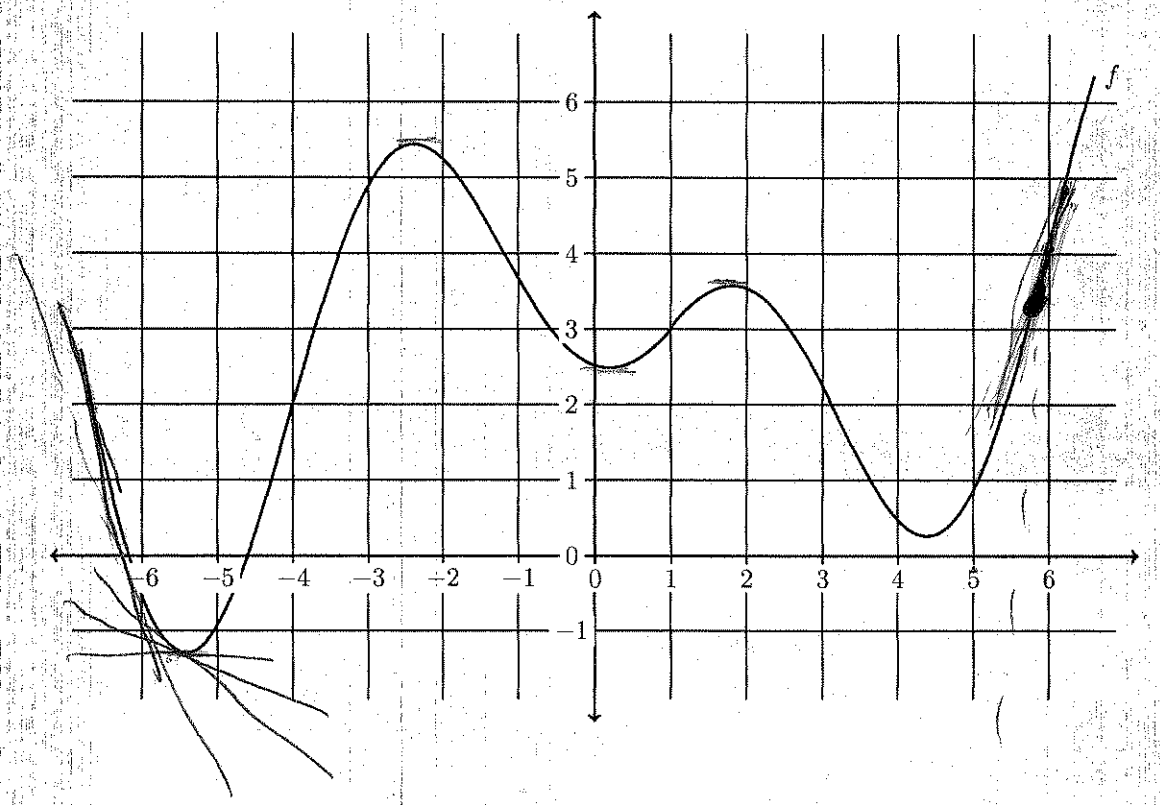
- $f'(x)$ = slope of tangent line to f at x

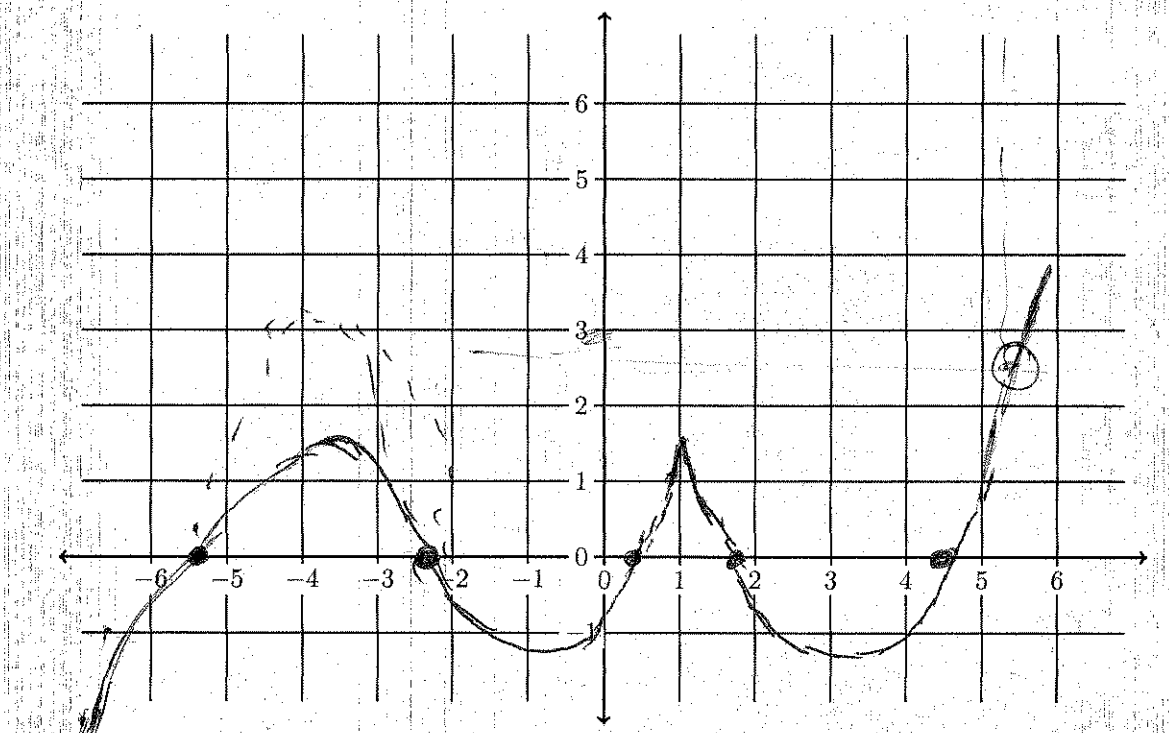
- $f'(x) > 0$ for each x in $[a,b]$?
  $\Rightarrow$ Slope of f at $x > 0$ for each x in $[a,b]$
  $\Rightarrow$ f is increasing on $[a,b]$

- $f'(x) < 0$ for each x in $[a,b]$?
  $\Rightarrow$ f is decreasing on $[a,b]$

- $f'(x) = 0$ for each x in $[a,b]$?
  $\Rightarrow$ f is constant on $[a,b]$

1. The graph of the function $f(x)$ appears below. Sketch the derivative $f'(x)$.





neg pos neg pos neg pos

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