Math 1450 - Calculus 1

Mon, Sept. 29

Announcements:

* Homework 5 due Thursday night, covers 2.3, 2.4, 2.5, 2.6
* Quiz 4 in discussion on Thursday, covers sugg. HW from last Fri, today, and Wed
* Don't forget about the tutoring center!

marquette.edu/tutoring

Today:

→ 2.5: The Second Derivative

→ 2.6: Differentiability

Office Hours

Mondays, 12-1

Wednesdays, 2-3

+ Help Desk!

Section 2.5: The Second Derivative

The derivative of $f(x)$ is $f'(x)$.

$f'(x)$ is itself a function

So, we can take the derivative of $f'(x)$.

We call this $f''(x)$, "f double prime"

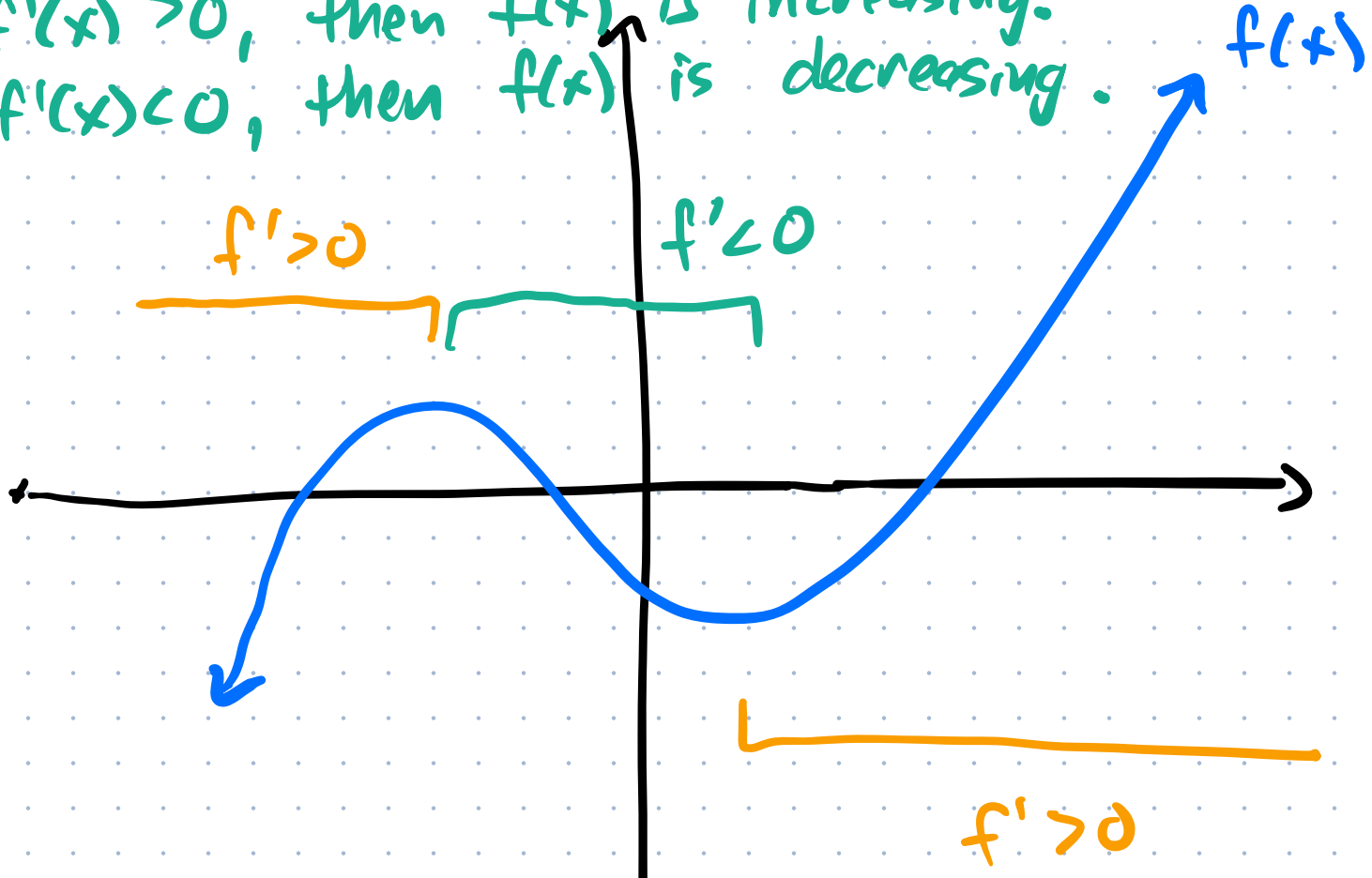
and it's the "second derivative of $f(x)$"

Third deriv: $f'''(x)$

Fourth deriv: $f^{(4)}(x)$ and so on

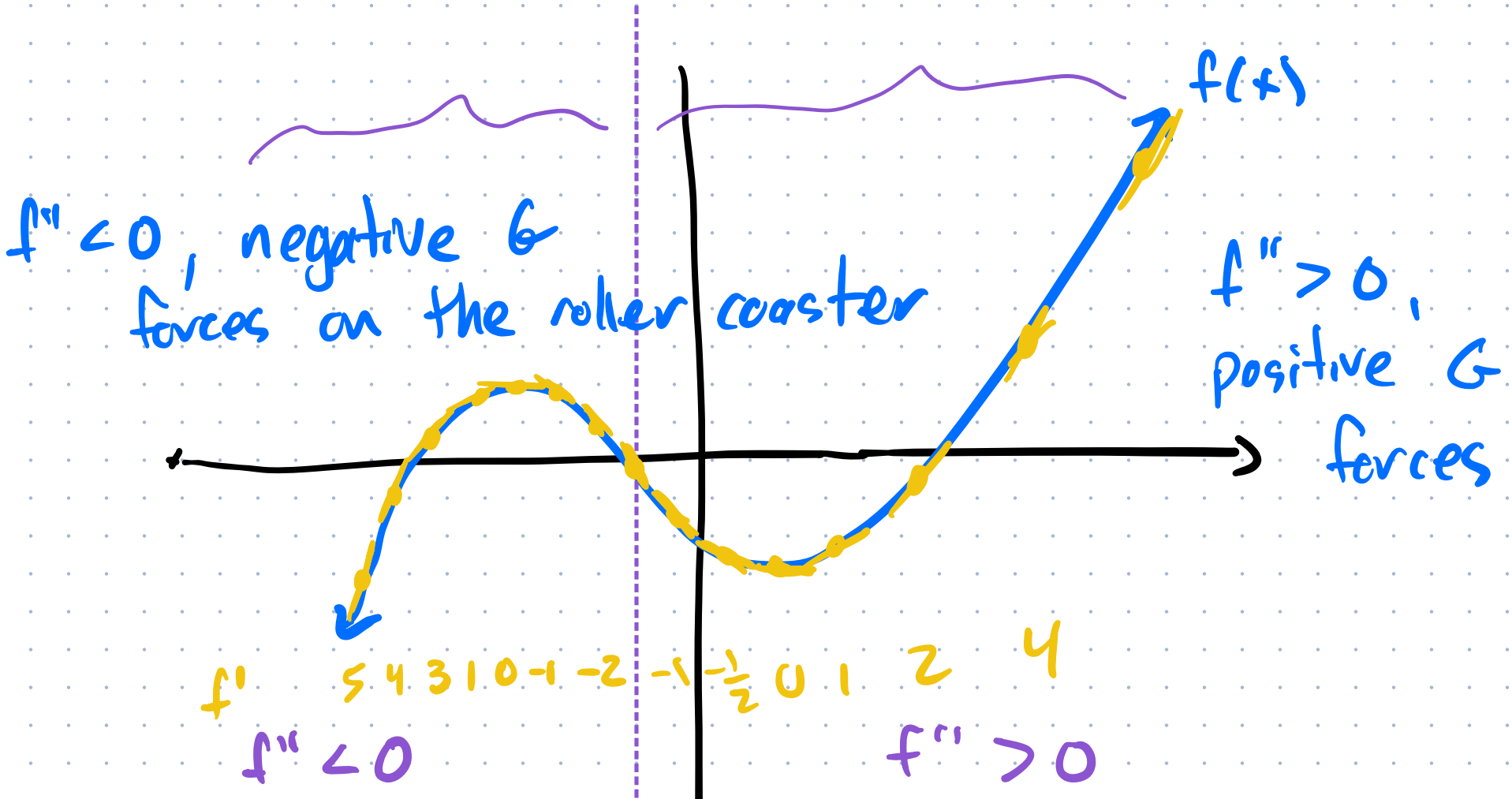
What does the second derivative mean?

If $f'(x) > 0$, then $f(x)$ is increasing.
If $f'(x) < 0$, then $f(x)$ is decreasing.



If $f'' > 0$, then f' is increasing, so f is getting steeper and steeper.

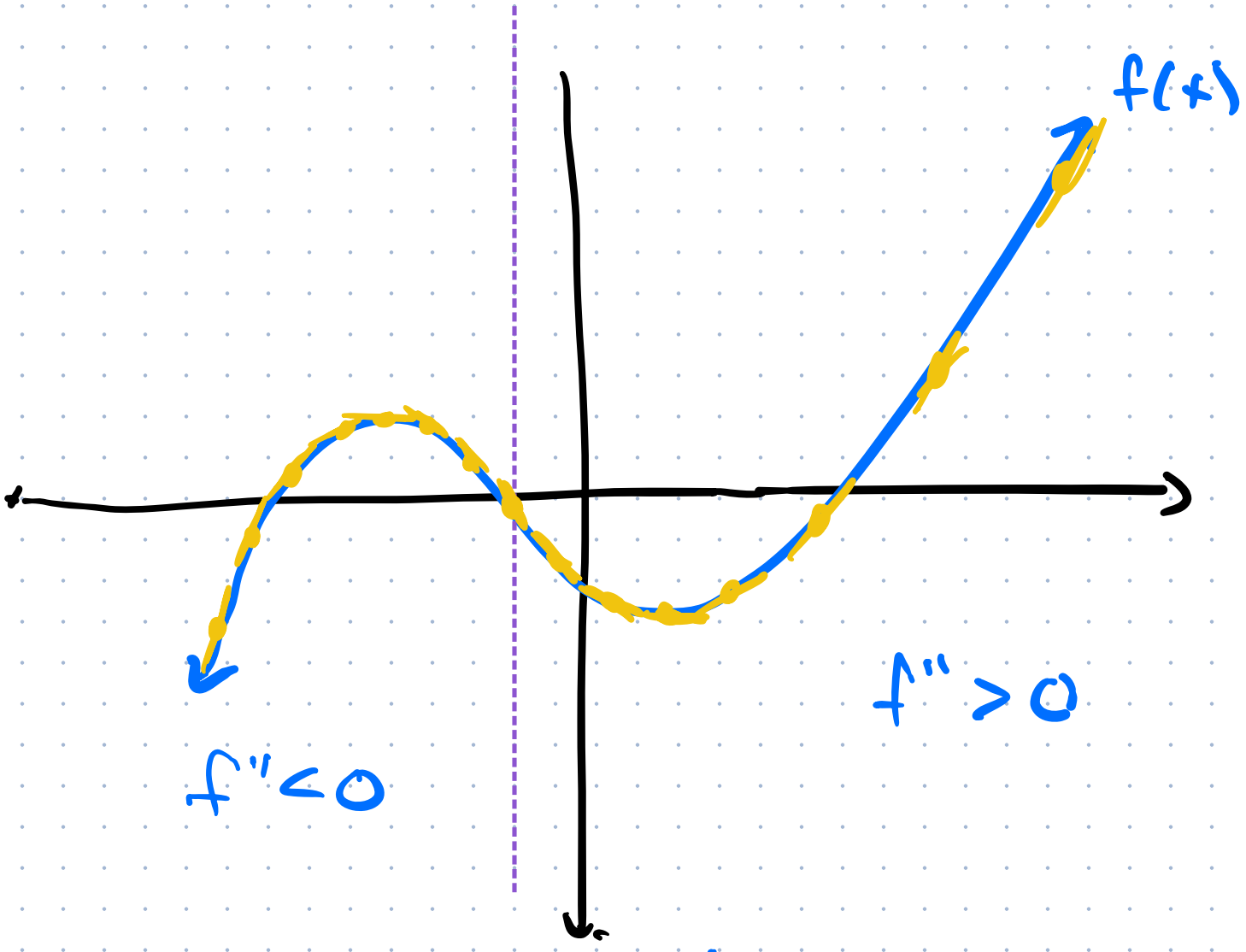
What does the second derivative mean?



If $f'' > 0$, then f' is increasing, so f is getting steeper and steeper upward.

If $f'' < 0$, then f' is decreasing, so f is getting steeper downward

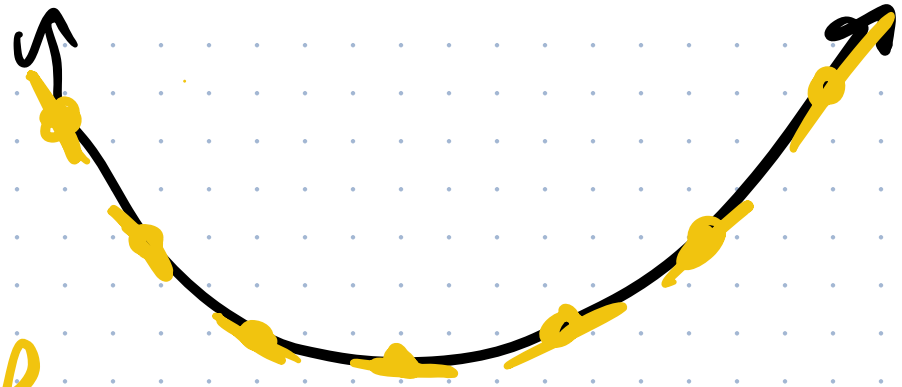
What does the second derivative mean?



f''>0 = "concave up" = bending upward

f''<0 = "concave down" = bending downward

Concave up:

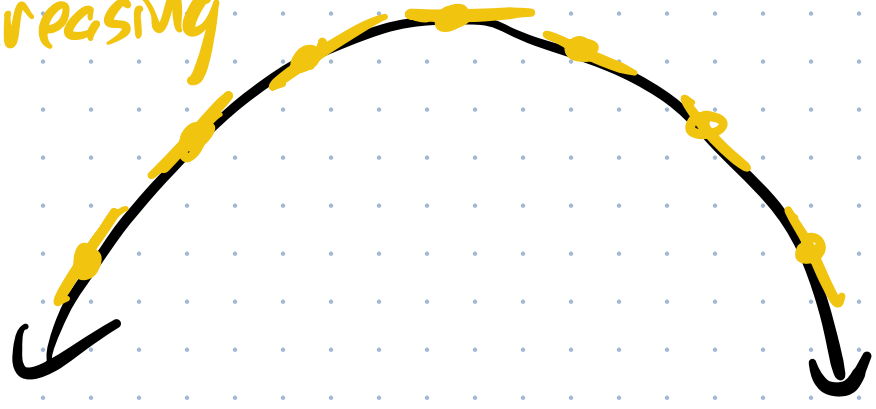


f' increasing

f'' > 0

f is concave up

Concave down:

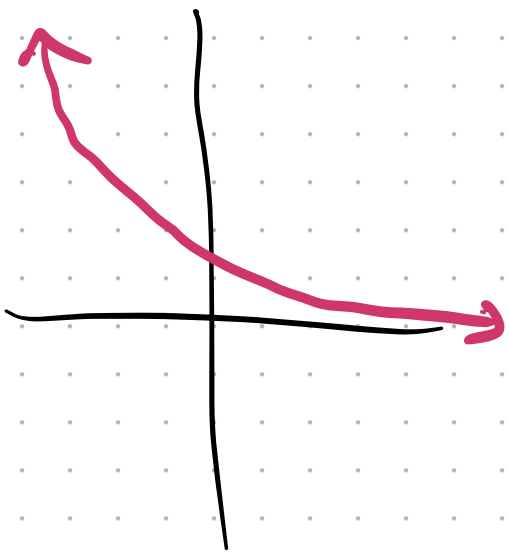


f' decreasing

f'' < 0

f is concave down

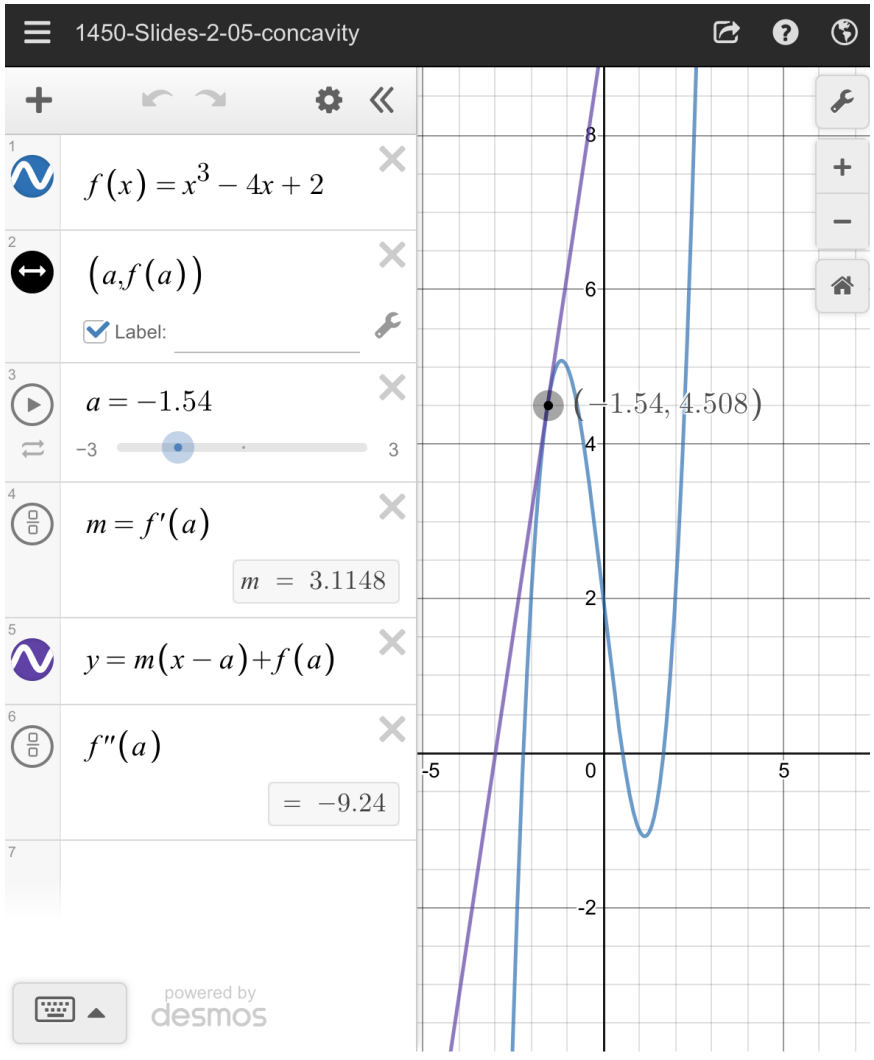
$g(x) = \left(\frac{1}{2}\right)^x$



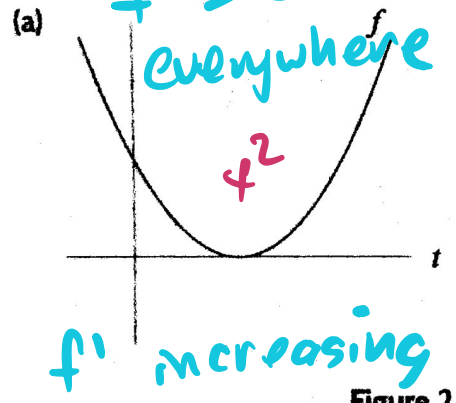
g > 0 everywhere

g' < 0 everywhere

g'' > 0 everywhere


1450-Slides-2-05-concavity
$f(x) = x^3 - 4x + 2$
$(a, f(a))$
Label:
$a = -1.54$
−3
3
$m = f'(a)$
$m = 3.1148$
$y = m(x - a) + f(a)$
$f''(a)$
$= -9.24$
$(-1.54, 4.508)$
8
6
4
2
-2
-5
0
5
powered by
desmos

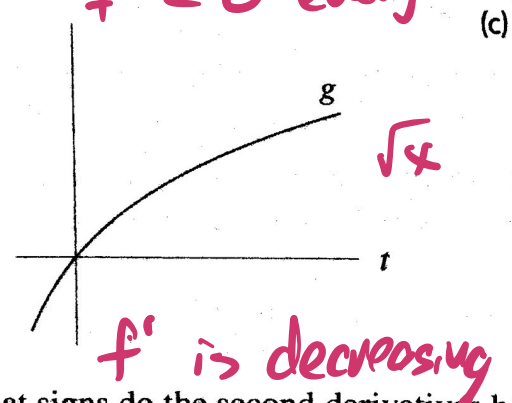
Example 1 For the functions graphed in Figure 2.46, what can be said about the sign of the second derivative?



f'' > 0 everywhere

t^2

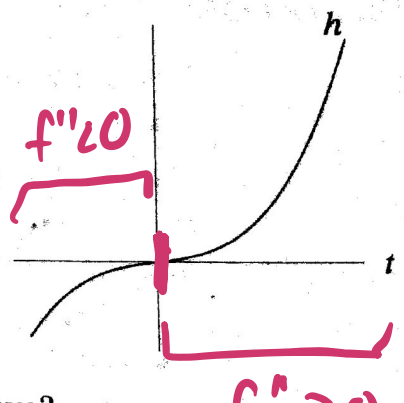
f' increasing



f'' < 0 everywhere

$\sqrt{x}$

f' is decreasing



f'' < 0

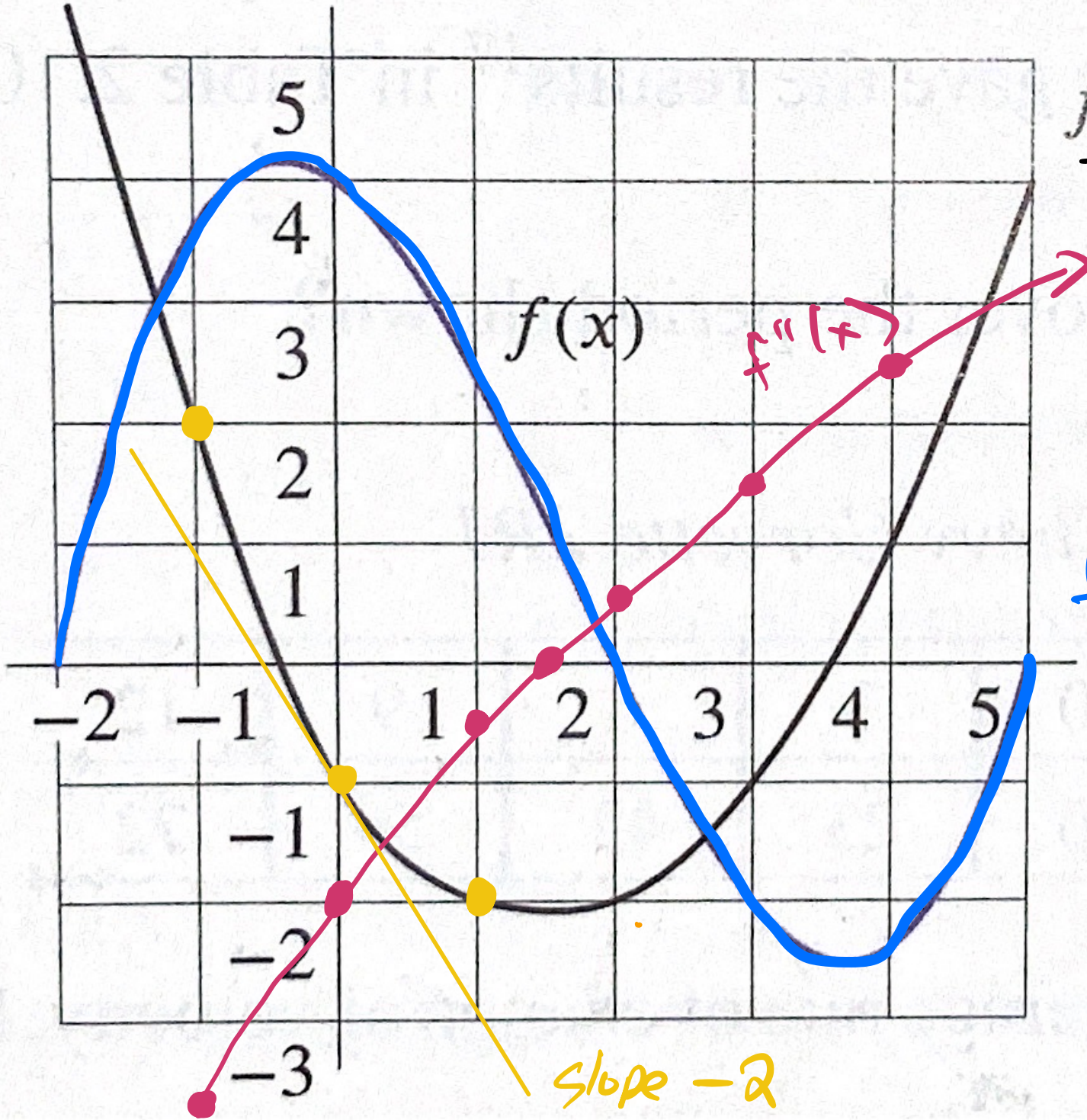
f'' > 0

Figure 2.46: What signs do the second derivatives have?

f' > 0

f' ≥ 0

Draw $f''(x)$. (the derivative of $f'(x)$)



$f''(-1) \approx -3.5$

$f''(0) \approx -2$

$f''(1) \approx -\frac{1}{2}$

f(x)

slope −2

Position – Velocity – Acceleration

Position: $s(t)$ s is the position of an object at time t

Velocity: $v(t) = s'(t)$ (speed but with a +/− sign)

Acceleration: $a(t) = v'(t) = s''(t)$

Suggested HW

2.5: 1, 2, 4–14, 18, 19, 20, 21, 23, 24, 25, 26, 28
39, 41, 42, 43