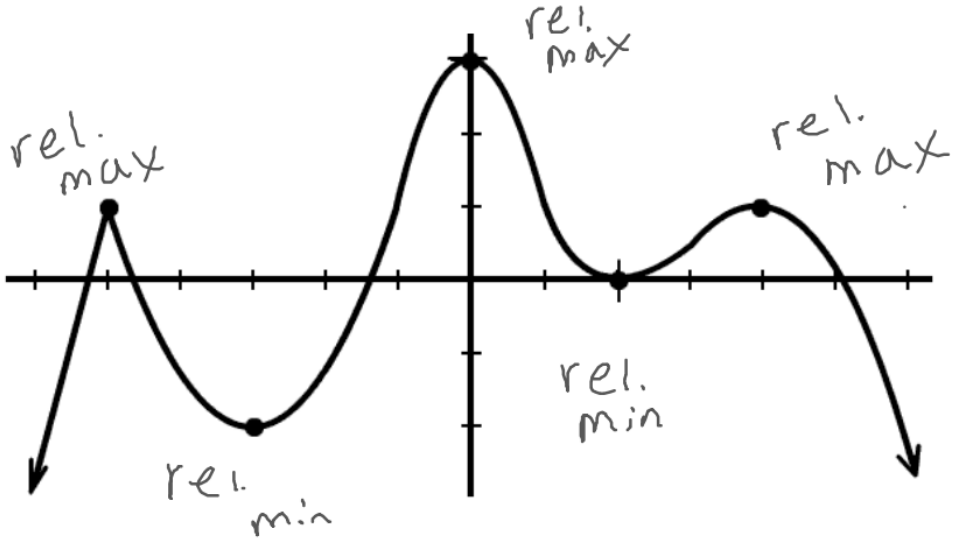
Where are the relative extrema of this function?



Relative Maximum:
- slope at point? 0 or undef.
- slope before point? pos
- slope after point? neg.

Relative Minimum:
- slope at point? 0 or undef
- slope before point? neg
- slope after point? pos

[redacted]

[redacted]

How to find relative extrema: First Derivative Test

- Find critical numbers of the function.
- Use the "interval method"/number line to find a sign change
- Use common sense/intuition to classify which C.N.'s are maxima and minima

(Also called the "First Derivative Test")

Example: Find and classify all relative extrema of the function.Justify your answer.

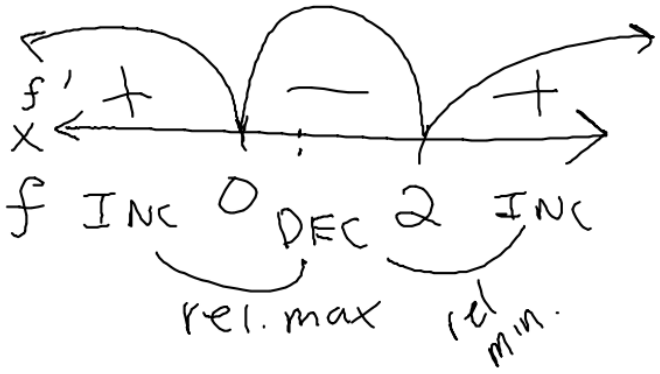
$f(x) = x^3-3x^2+5$

$f'(x) = 3x^2 - 6x = 0$

$3x(x-2) = 0$

$x=0 \quad x=2$

C.N.



f has a rel. max @ x=0
b/c. f' changed from pos → neg.

f has a rel. min @ x=2
b/c ... f' changes sign from neg → pos.

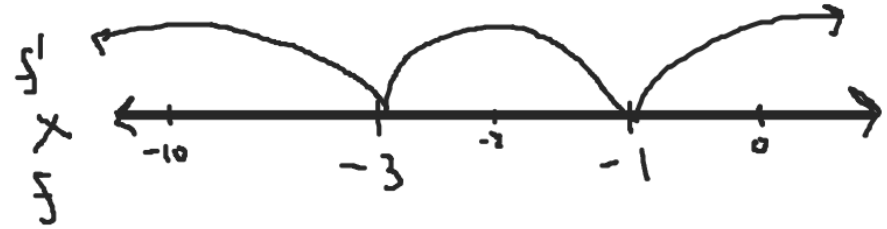
Using a Number Line
- place C.N. on there
- Bunny Hops
- Test values between hops
  (plug into f '(x))

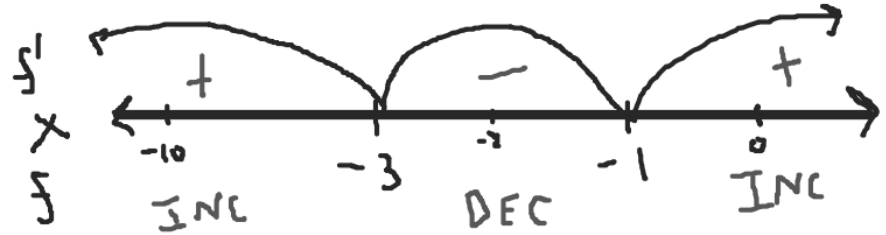
A Number Line Is NOT sufficient Justification on AP test. Need to use English

Your turn: Find and classify all relative extrema. Justify.

$f(x) = x^3+6x^2+9x+6$

$f'(x) = 3(x+3)(x+1)$
CN: $x = -3, x = -1$

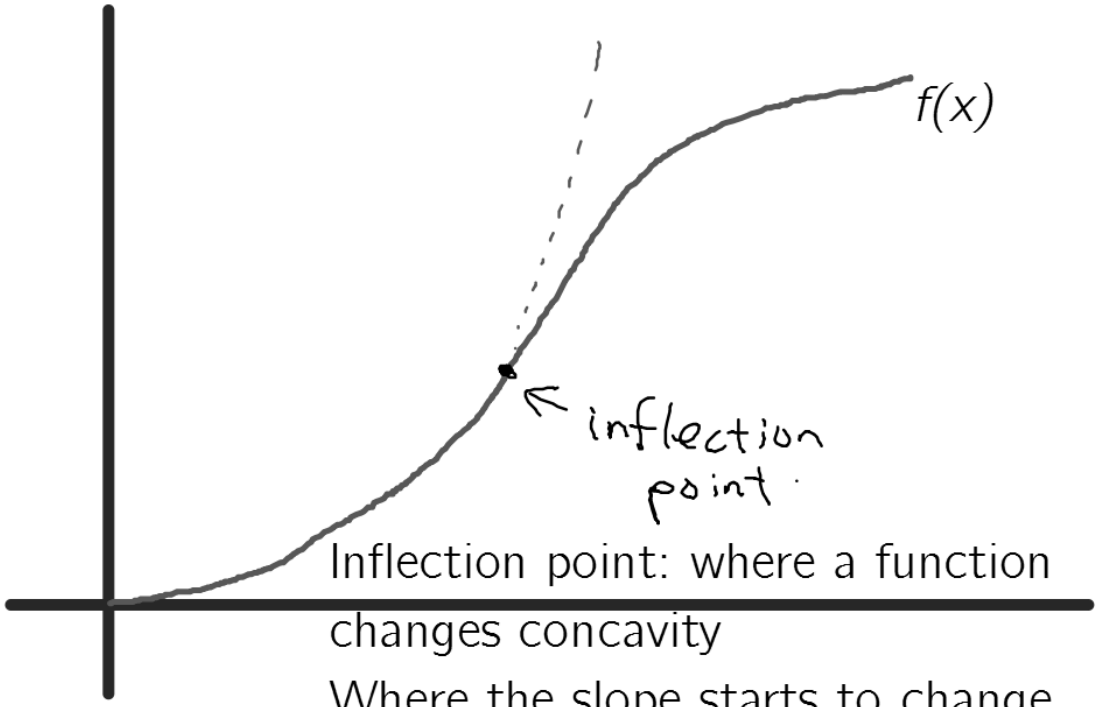




Justification:
f has a rel. max at
x=-3 because f' changes
from positive to negative there.

f has a rel. min at x = -1
because f' changes from
negative to positive there.

Consider the following differentiable curve: Concavity



What might this model?

Where is the "turning" point?

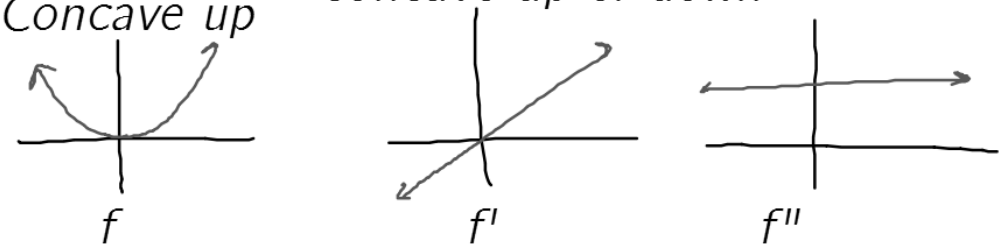
What changes here?

Inflection point: where a function changes concavity

Where the slope starts to change (Second derivative)

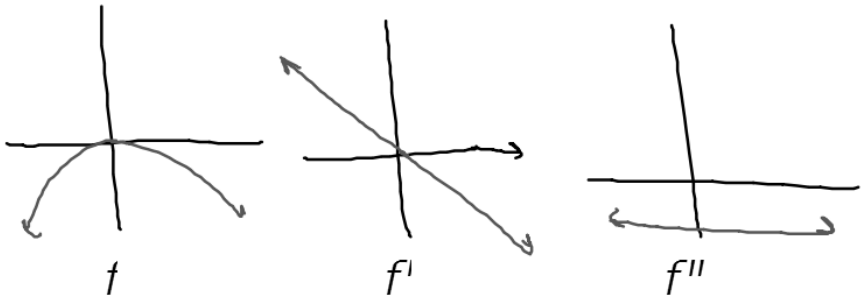
Concavity: *The sign of the second derivative tells you concave up or down*

Concave up



f con. up
f'' is positive

Concave down



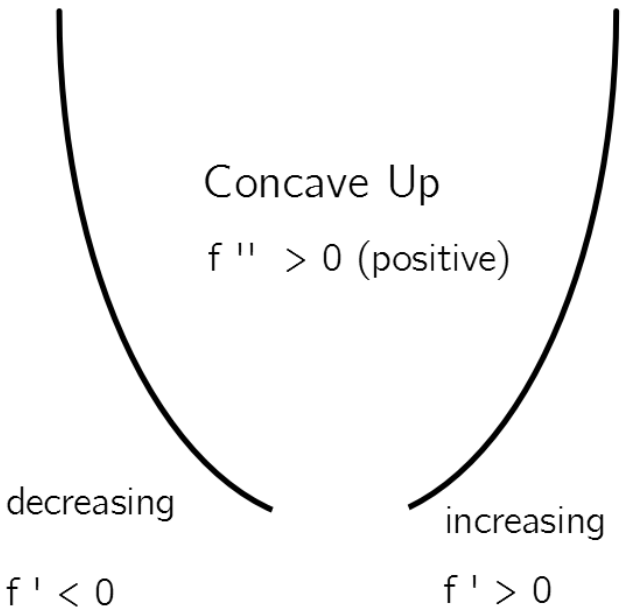
f is Conc. Down
f'' is negative

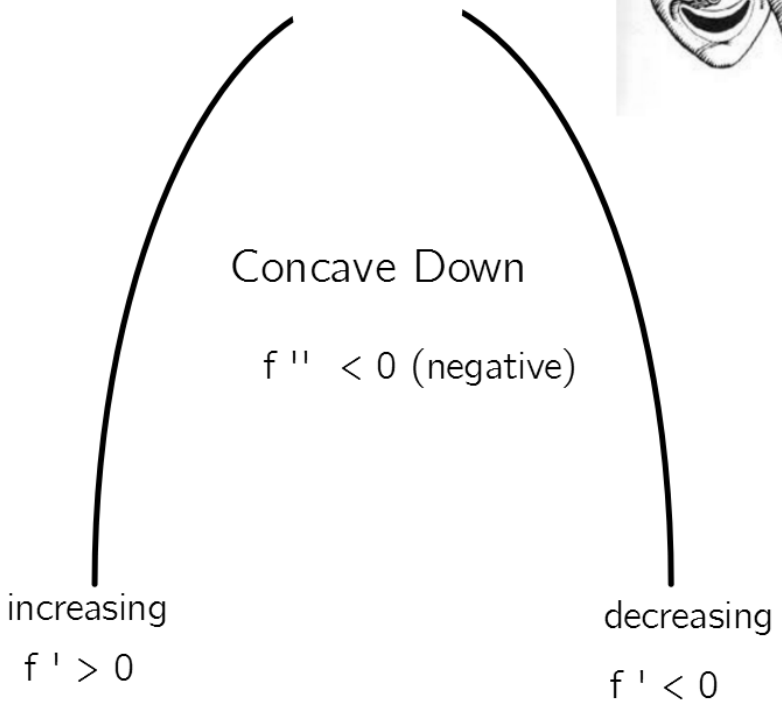
Terrace Points *(similar to critical points)*
where f " (x) = 0

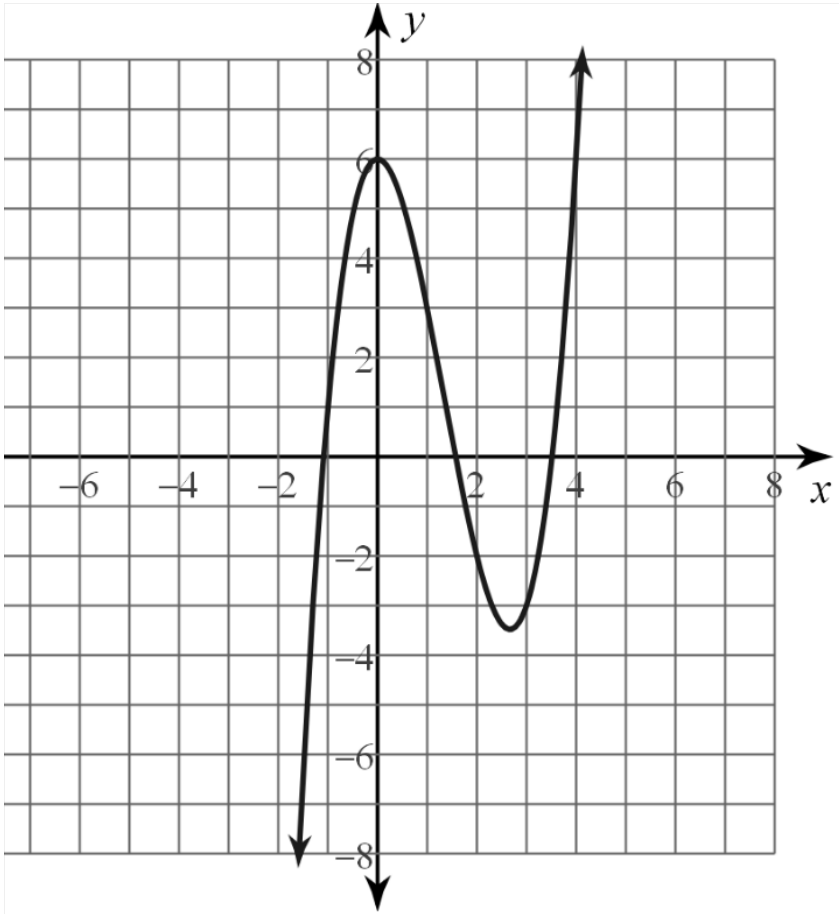
Inflection Points *(similar to relative extremes)*
where f"(x) changes sign
graphically: a change in concavity

All inflection points
are terrace points,
but not all terrace points
are inflection points

Four Types of Curvature







Example:

Here is the first derivative of f(x). Over what intervals is f concave up and concave down?

Find the location of all inflection points for $f(x) = x^3-x^2-1$

Just like finding
relative extrema..
except using f"