Concavity

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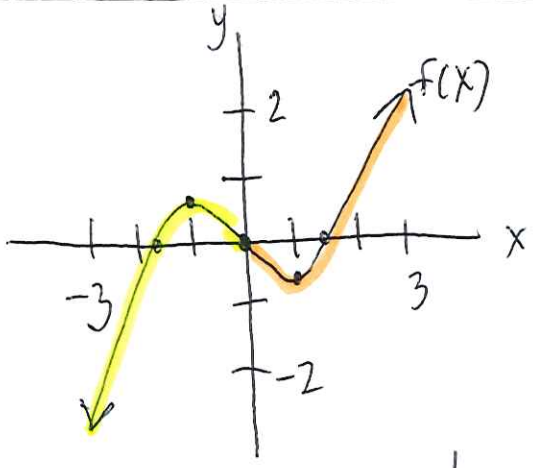
ES: How to determine intervals where $f(x)$ is concave upward or concave downward?

Graph $f(x) = \frac{1}{3}x^3 - x$



where are the intervals for:

Concave downward
$(-\infty, 0)$

Concave upward
$(0, \infty)$

Test for Concavity

① If $f''(x) > 0$ for all x in (a,b) then the graph of $f(x)$ is concave upward on (a,b).

② If $f''(x) < 0$ for all x in (a,b) then the graph of $f(x)$ is concave downward on (a,b).

ex $f(x) = \frac{1}{3}x^3 - x$

Step1 find $f''(x)$

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

$f''(x) = 2x$

Step2 Set $f''(x) = 0$ and solve for x.

$0 = 2x$

$0 = x$

Step 3 make table

Interval	$(-\infty, 0)$	$(0, \infty)$
test value	$x = -1$	$x = 1$
Sign of $f''(x)$	$f''(-1) = -2$ neg.	$f''(1) = 2$ pos.
Conclusion	concave downward	concave upward

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