

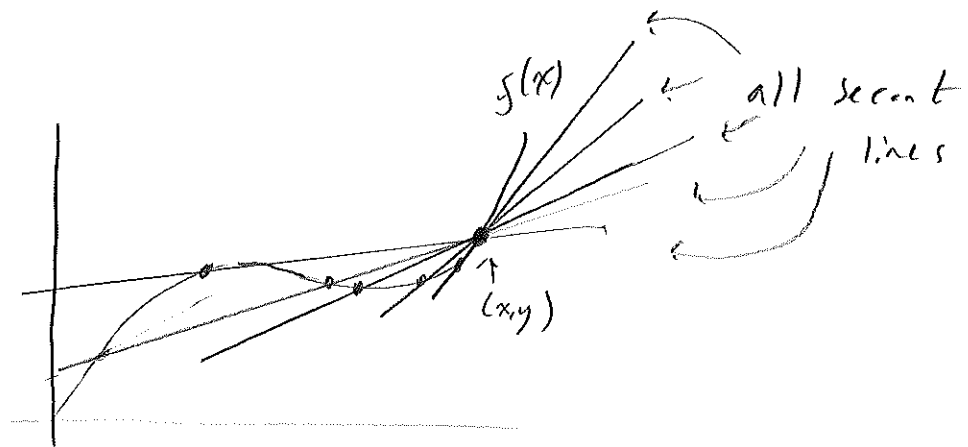
# 1.3 Graphs and Rates of Change

1.3

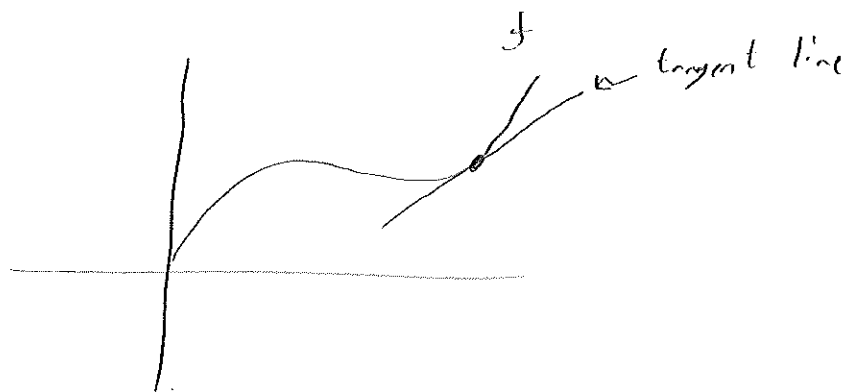
Q:

What happens when we shrink the interval

for ARC?

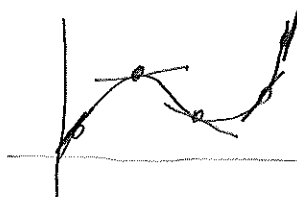


As the interval shrinks, we start getting a line that is tangent to just one point, whose slope matches the slope of  $f$  at this point.



Def] The slope of this line is called the (instantaneous) rate of change

Ex

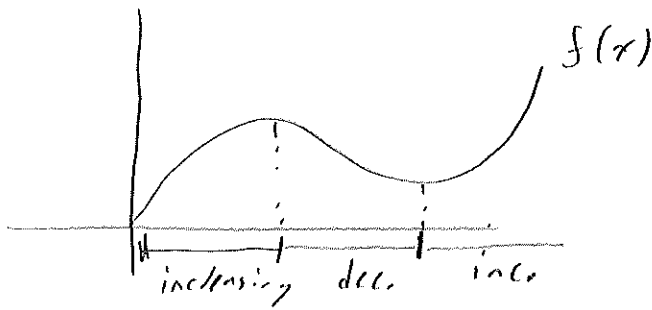


Q: What are ROC's used for?

Def] An increasing function on an interval  $I$  is a function  $f$  such that  $f(x) < f(y)$  for  $x < y$  and both  $x, y$  are in  $I$

Def] A decreasing function  $\text{---||---}$  such that  $f(x) > f(y)$  for  $x > y$ .

Ex



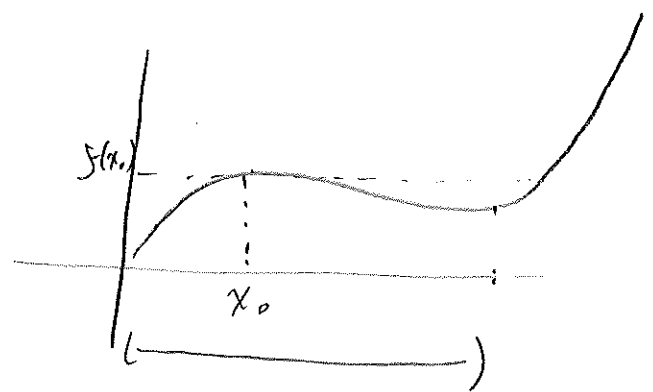
Notice that the slope of the tangent line (ROC) is positive for increasing functions and negative for dec. functions.

What happens when the ROC changes from positive to negative (or vice-versa)?

Def] A function  $f$  reaches a local maximum of  $f(x_0)$  at  $x = x_0$  if there is some interval around  $x_0$  such that  $f(x_0) \geq f(x)$  for any other  $x$  in this interval.

Def] —||— local minimum —||—  
such that  $f(x_0) \leq f(x)$  —||—

$f = x$



in this interval,  $f(x_0)$  is the maximal value of  $f$ . So,  $x_0$  is a local max.

Q: Why local?

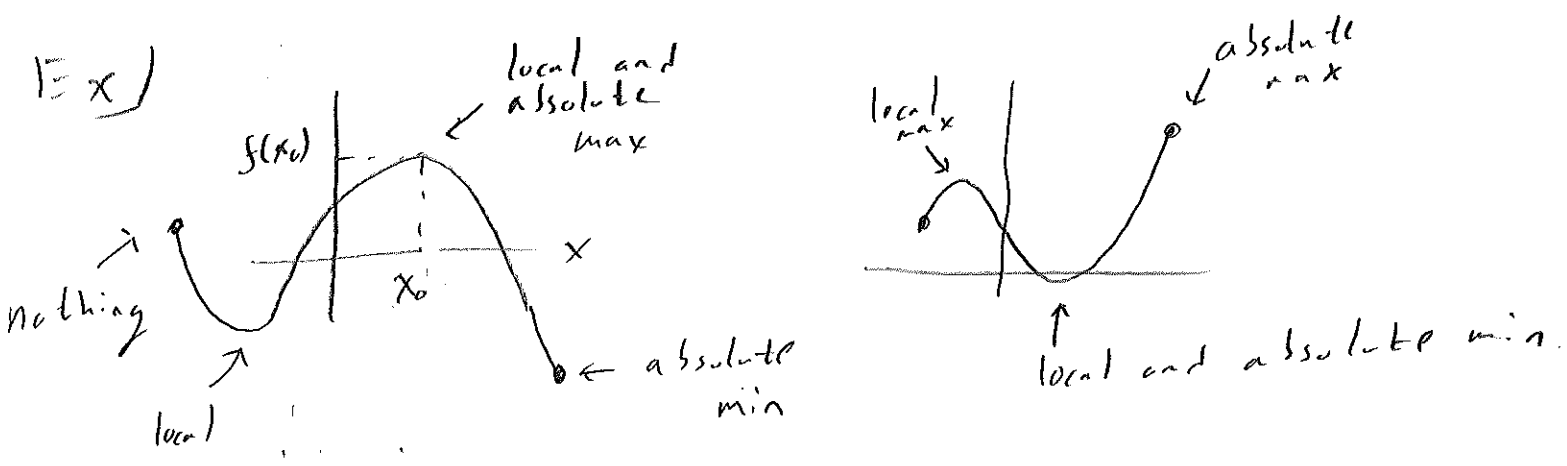
A: There may be other points where  $f$  is larger/smaller

Def]  $x_0$  is an absolute max if  $f(x_0)$  is the highest point on the graph.

Def] —||— absolute min —||— lowest —||—

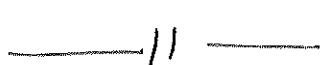
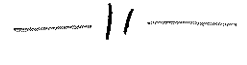
1.3

Note! Absolute min/max could occur at local min/max,  
or at the endpoints.



Group work (see handout)

Def] A function is concave up if it looks like it is bending upwards

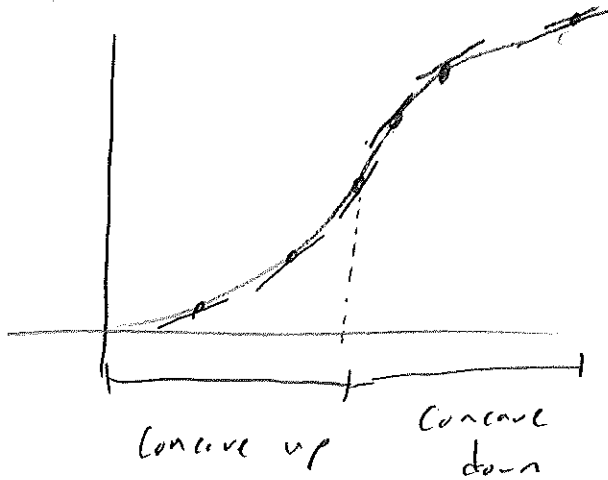
Def]  concave down  downwards

Def] A point where the concavity changes is called an inflection point.

Precise definitions will come later!

Q: When a function is concave up/down what is happening with its rate of change?

EX)



~ notice that the tangent lines are all positive here!

BUT, the slope is increasing until we change concavity, and then it decreases.

The function is increasing at an increasing rate

The function is increasing at a decreasing rate.

Group work / Desmos.