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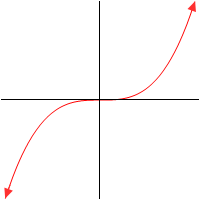
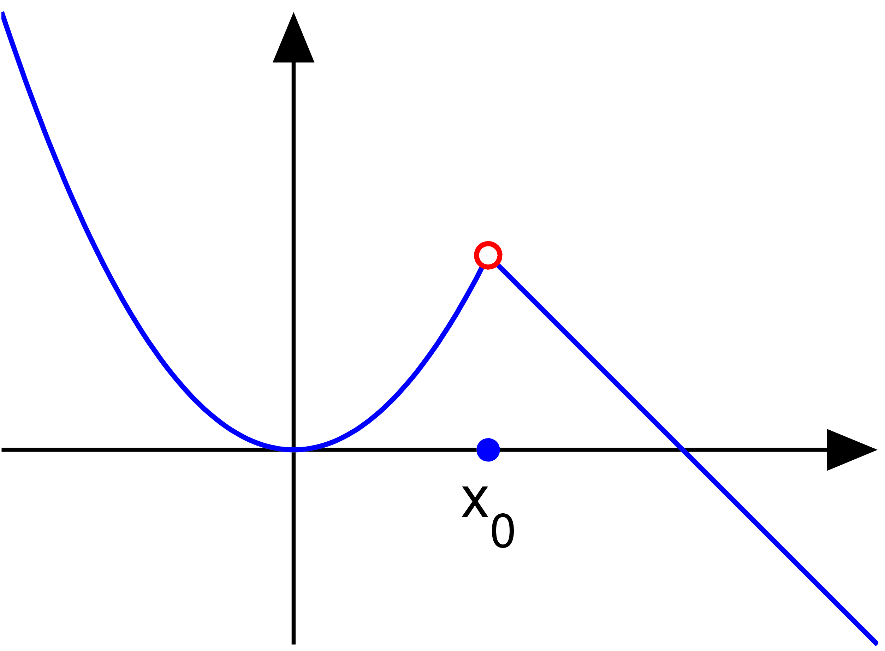
Math 31A Lecture Notes: Extreme Values

Definition; *Extrema*: maximum or minimum

Definition; *Extreme Values*: Let f be a function on an interval I and a ϵ I. We say d is the:

* Absolute maximum of f on I if for all
* Absolute minimum of f on I if for all

Counter Examples:

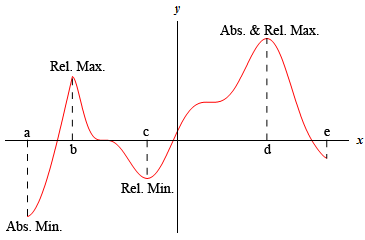
 

Has no abs. max. on (a, b) Has no abs. max on [a, b]

Theorem: A continuous function defined in a closed interval has both absolute min and max.

Definition; *Local Extrema*: We say f(c) is a:

* Local max of f at x = c if f(c) is the abs. max of f in some open interval containing c.
* Local min of f at x = c if f(c) is the abs. min of f in some open interval containing c.



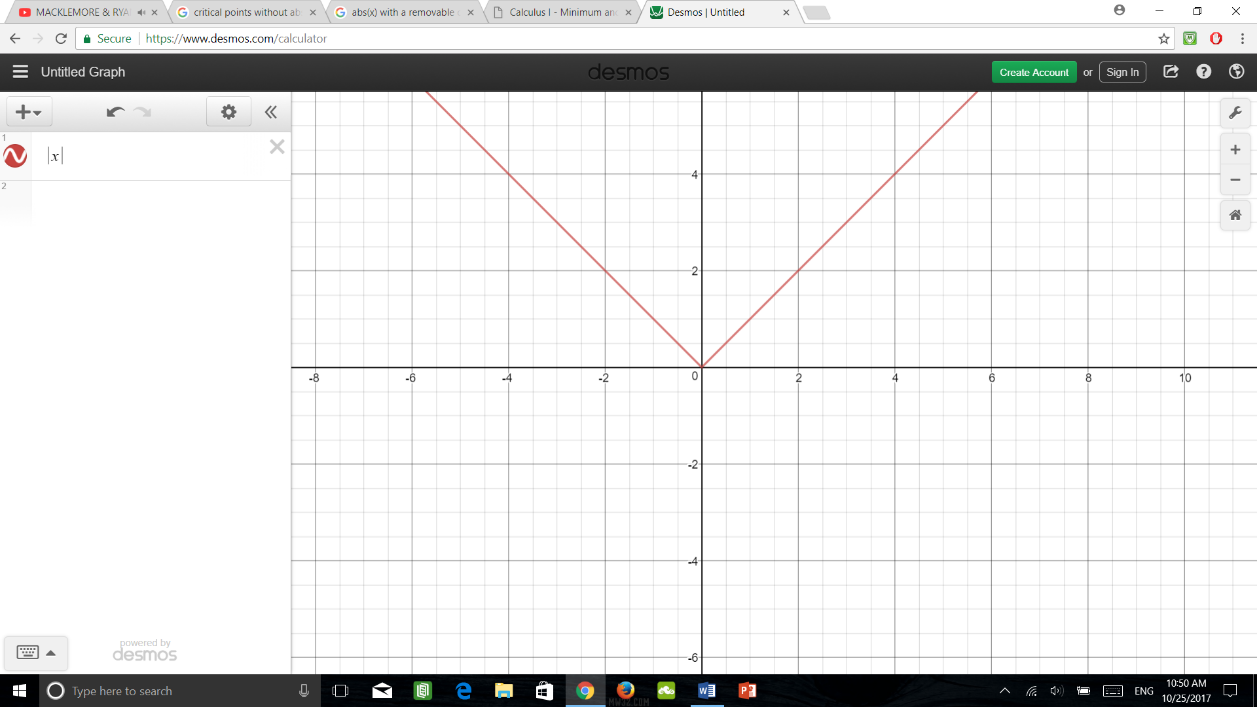
Definition; *Critical Point*: A number c in the domain of f is called critical point if either

OR

Example 1: Find critical points of the function

f is differentiable everywhere, hence the critical points c are solutions to

Hence, f has critical points c = 2, c = 4.

Example 2:

if x < 0

if x > 0

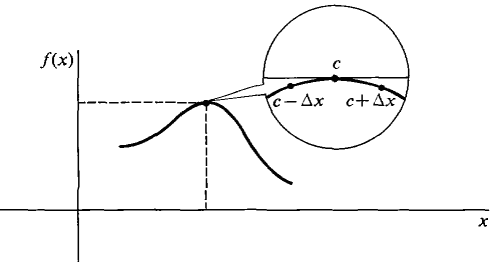
But does not exist.

Hence, f has critical points c = 0.

Theorem: If f(c) is a local min or max then c is a critical point of f.

Proof: Assume f(c) is a local min.

Case 1: does not exist. Then, c is the critical point by definition of a critical point.

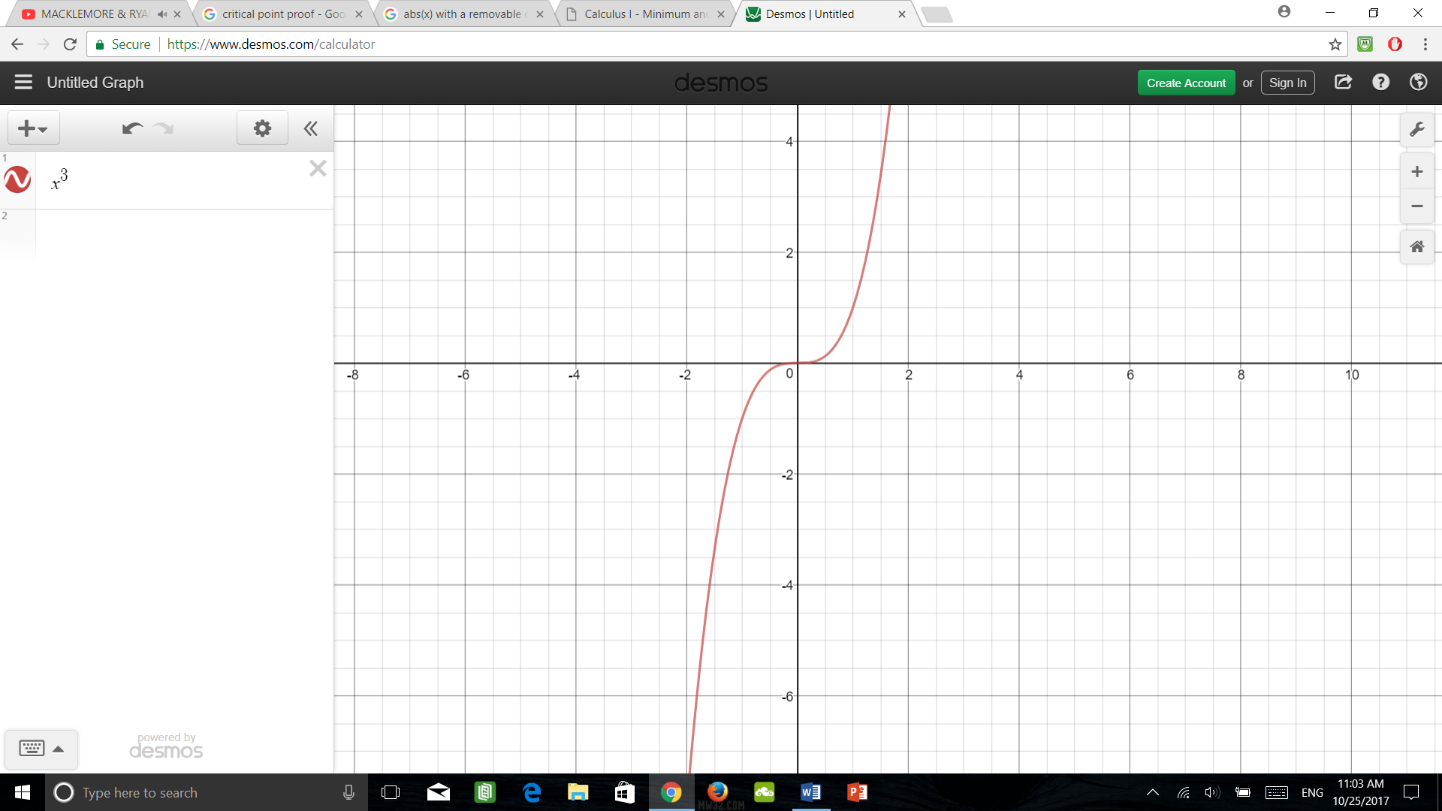
Case 2: exists. We have to show . Since f(c) is a local min, we have for h sufficiently small. Hence:

if h > 0

if h < 0

Hence:

Hence, and c is a critical point.

Warning: Not all critical points yield a local min or max.

Example 3:

Hence, and c is a critical point.