First Dertivative Test

Math165: Business Calculus

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Spring 2010, Week6 Lec1

- Assume $\mathbf{f(x)}$ is not a straight line and at some $\mathbf{x, f'(x) = 0}$, $\mathbf{x}$ is a critical number.
- What kind of point is the critical point $\mathbf{(x, f(x))}$?
- There are four possibilities:
  - Relative Minimum
  - Relative Maximum
  - one of two types of inflection points.

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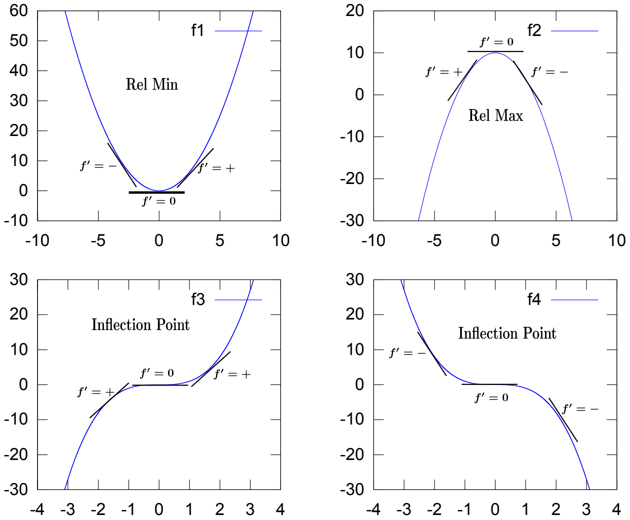
first derivative test

$\mathbf{f' = 0} \Rightarrow$ four posibilities



- The slope pattern across the critical point can be used to determine what kind of CP: Rel Min, REl Max or IP.
- This process is called The **First Derivative Test**.
- Slope pattern: $-, \mathbf{0}, + \Rightarrow$ Relative Minimum.
- Slope pattern: $+, \mathbf{0}, - \Rightarrow$ Relative Maximum.
- Slope pattern: $+, \mathbf{0}, + \Rightarrow$ Inflection Point.
- Slope pattern: $-, \mathbf{0}, - \Rightarrow$ Inflection Point.
- It is better to determine the shape of the graph using the signs of the slopes instead of trying to memorize the sign patterns.

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Typical exam problem:
$\mathbf{f(x) = (x-1)^3 + 1}$ Find the location of any critical points and use the first derivative test to determine what kind critial points.

- Find all critical points: set $f' = 0$ and solve for all $x = x_c$
- $f'(x) = \frac{d}{dx}[(x-1)^3 + 1] = \frac{d}{dx}(x-1)^3 + \frac{d}{dx}1 = 3(x-1)^{3-1}\frac{d}{dx}(x-1) + 0 = 3(x-1)^2$
- $f'(x) = 3(x-1)^2 = 0$ Gives $x_c = 1$ as the only critical number.
- Now use the first derivative test to determine what kind of CP at CN: $x_c = 1$
  - $f'(.9) = 3(.9-1)^2 = +$
  - $f'(1) = 0$
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first derivative test
example

$\mathbf{f(x) = (x - 1)^3 + 1}$

Use the first derivative test to determine what kind of CP at CN: $\mathbf{x_c = 1}$

$\mathbf{f'(.9) = 3(.9 - 1)^2 = +}$

$\mathbf{f'(1) = 0}$

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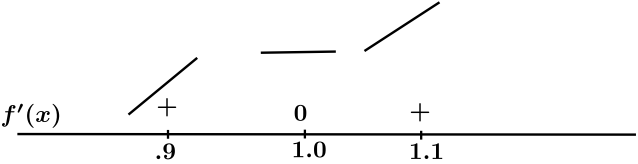
draw these lines based on the slope signs



This slope pattern can only match an infleciton point.

Here is the graph of **f(x)**