Welcome to Math 1910!

Math 1910: Calculus for Engineers

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Last Time	**Today**	**Upcoming**
Nothing	Introductions	HW Due 1 Sep.
	Derivatives Review	Quiz on 1 Sep.

Administrative

- All course information can be found on https://blackboard.cornell.edu/
- Section is review, practice problems, homework questions, etc.
- Occasionally there will be workshops with engineering applications
- Homework is due on Thursdays and graded for completion.
- Quizzes **every Thursday** with questions straight from homework.

Derivatives Review

- Given a function f, the **derivative** of f at the point a is defined by

$$f'(a) := \lim_{h \to 0} \frac{f(a+h) - f(a)}{h} = \lim_{x \to a} \frac{f(x) - f(a)}{x - a}$$

- The line tangent to $(a, f(a))$ is $y - f(a) = f'(a)(x - a)$.

  - $(cf)' = cf'$ if c is a constant.
  - $(f+g)' = f' + g'$
  - **Product rule**: $(fg)' = f'g + fg'$.
  - **Quotient rule**: $\left(\frac{f}{g}\right)' = \frac{gf' - fg'}{g^2}$.
  - **Chain rule**: $(f(g(x)))' = f'(g(x))g'(x)$.

*rhymes with "early"

- **Implicit differentiation** is used to compute $\frac{dy}{dx}$ when the variables x and y are related by an equation, such as $x^3 - y^3 = 4$.
- **The first derivative test:** If f is differentiable and c is a critical point, then the type of critical point can be found in the table.

Sign Change	**Type of Critical Point**
From $+$ to $-$	Local max
From $-$ to $+$	Local min

- A function f is **concave up** on (a, b) if f' is increasing, and **concave down** if f is decreasing. A **point of inflection** is a point $(c, f(c))$ where the concavity changes. We can use the first derivative test on f' to find the inflection points.

Problems

(1) Compute $\frac{dy}{dx}$.

(a) $y = 3x^5 - 7x^2 + 4$
(b) $y = \frac{x}{x^2+1}$
(c) $y = (x^4 - 9x)^6$
(d) $y = \sqrt{x + \sqrt{x}}$
(e) $y = \tan(x)$
(f) $y = \sin(2x)\cos^2(x)$
(g) $y = \tan(\sqrt{1 + \csc x})$
(h) $x^3 - y^3 = 4$
(i) $y = xy^2 + 2x^2$
(j) $y = \sin(x + y)$

(2) Find the points on the graph of $f(x) = x^3 - 3x^2 + x + 4$ where the tangent line has slope 10.

(3) Find the critical points of f and determine if they are minima or maxima.

(a) $f(x) = x^3 - 4x^2 + 4x$
(b) $f(x) = x^2(x + 2)^3$
(c) $f(x) = x^{2/3}(1 - x)$

(4) Find the points of inflection of the function f

(a) $f(x) = x^3 - 4x^2 + 4x$
(b) $f(x) = x - 2\cos x$
(c) $f(x) = \frac{x^2}{x^2+4}$

(5) Find conditions on a and b that ensure $f(x) = x^3 + ax + b$ is increasing on $(-\infty, \infty)$.