HW 2: Sections 1.1 and 1.2

Due: Monday, September 9th in SQRC by 9pm

Learning Goals:

- Estimate the slope of a curve at a point using a graph.
- Evaluate limits using a graph.
- Explain the difference between limits, left limits, and right limits.
- Use numerical and graphical methods to estimate limits of functions.

A reminder about collaboration: Collaboration is an important part of learning mathematics and I strongly encourage you collaborate with your classmates on homework and studying for exams. With that said, there is a difference between working with someone else and copying down what they say or write without understanding it. I encourage you to write up final solutions on your own after you understand a problem, which might mean stepping away from your study group for 5 or 10 minutes.

Questions:

1. Problem 1.1.2. Sketch the graph of $f(x) = x^3 + 2$ and estimate the slope at $a = 1$ and $a = 2$. Feel free to use a computer or graphing calculator to help you sketch.

2. Problem 1.1.6. Sketch the graph of $f(x) = \ln(x)$ and estimate the slope at $a = 1$ and $a = 2$. Feel free to use a computer or graphing calculator to help you sketch.

3. Problem 1.2.8. Use the graph (in the textbook) to identify each limit or state that it does not exist.

4. Problem 1.2.10. Sketch the graph of

$$f(x) = \begin{cases} x^3 - 1 & \text{if } x < 0 \\ 0 & \text{if } x = 0 \\ \sqrt{x+1} - 2 & \text{if } x > 0 \end{cases}$$

   and identify each limit.

   a) $\lim\limits_{x \to 0^-} f(x)$
   b) $\lim\limits_{x \to 0^+} f(x)$
   c) $\lim\limits_{x \to 0} f(x)$
   d) $\lim\limits_{x \to -1} f(x)$
   e) $\lim\limits_{x \to 1^-} f(x)$

5. Problem 1.2.16. Use numerical and graphical (try `https://www.desmos.com`) evidence to conjecture whether

$$\lim_{x \to 1} \frac{x-1}{\ln(x)}$$

   exists. If not, describe what is happening at $x = a$ graphically.

6. Problem 1.2.22. Use numerical and graphical evidence to conjecture whether

$$\lim_{x \to -1} \frac{|x+1|}{x^2 - 1}$$

exists. If not, describe what is happening at $x = a$ graphically.