MATH 352: TAKE-HOME EXAM 1
DUE TUESDAY MARCH 1 BY MIDNIGHT
(THAT'S THE MIDNIGHT BETWEEN MONDAY AND TUESDAY)

Instructions Your exam should be LaTeXed and emailed (.pdf, .tex and any figures) to me before midnight. Use a file name that has your name as part of it. I will award 10 points as long as the exam will compile for me without any adjustments. You may use **your** book, **your** notes, and you may ask me (Heather) questions.
You may use no other resources on this exam. Your work should be sufficient to convince any of your classmates. Be sure to cite any results you use in your work. **If you need a homework result, you must provide the proof of this result as well.** The exam is due by midnight between Monday February 29 and Tuesday March 1. Late exams will be accepted with penalty: **5 points for every minute your exam is late**.
Your email must include the statement:

"I did not use any resource other than my book, my notes, and/or Heather."

You should type your name as an electronic signature to this statement.
Prove or disprove the following statements.

(1) Suppose $f \in C(\mathbb{R})$ and (x_n) is a Cauchy sequence, then $(f(x_n))$ is also a Cauchy sequence.
(2) If $f'(x) \geq 0$ on the interval (a, b), then f is monotone increasing on (a, b).
(3) Define the function

$$f(x) = \begin{cases} x + x^2 \sin(1/x) & \text{if } x \neq 0 \\ 0 & \text{if } x = 0 \end{cases}.$$

Then f satisfies $f'(0) > 0$, but is not monotone increasing on any open interval containing 0.
(4) The set of functions $\{f_n : \mathbb{R} \to \mathbb{R} \mid n \in \mathbb{N} \text{ and } f_n(x) = n + \frac{\sqrt{x}}{n}\}$ is equicontinuous.