CSE 311: Foundations of Computing I
Assignment #3
April 14, 2014
due: Wednesday, April 23, 1:30 p.m., *before lecture begins*

Bundles: The problems in each homework assignment will be divided into 2 groups (to facilitate distribution to grading TAs). You will turn in 2 corresponding bundles. Write your name in the *upper left corner* of each bundle's top page, with your last name printed clearly in CAPITAL LETTERS. Each bundle should be stapled separately. We don't supply the stapler.

This week's turnin bundles: (A) problems 1–3, (B) problems 4–6.

Textbook numbering labeled "6th edition" refers to the textbook's Sixth Edition. Numbering that is unlabeled refers to the Seventh Edition.

1. For each of the following functions, state whether or not it is injective, and whether or not it is surjective. Justify your answers.
   (a) $f : \mathbf{N} \to \mathbf{N}$, where $f(n) = n^2$.
   (b) $f : \mathbf{Z} \to \mathbf{N}$, where $f(n) = n^2$.
   (c) $f : \mathbf{R} \to \mathbf{R}$, where $f(n) = 3n + 7$.
   (d) $f : \mathbf{N} \to \mathbf{N}$, where $f(n) = \lceil n/3 \rceil$.
   (e) $f : \mathbf{N} \to \mathbf{N}$, where $f(n) = 3 \lceil n/3 \rceil$.
   (f) $f : \mathbf{N} \to \mathbf{N}$, where $f(n) = \begin{cases} n+1, & \text{if } n \text{ is even} \\ n-1, & \text{if } n \text{ is odd} \end{cases}$.

2. Let $f : \mathbf{N} \to \mathbf{N}$ and $g : \mathbf{N} \to \mathbf{N}$, where $f(x) = x \bmod 28$ and $g(x) = x + 1$. What are each of the functions $f \circ g$ and $g \circ f$? Either prove that these two functions are equal, or give a counterexample proving that they are unequal.

3. Section 4.3 [6th edition: Section 3.5], exercise 6. Justify your answer. The function $n!$ is defined on page 151 [6th edition: page 145]. (Hint: Think about the unique factorization of 100! into primes. What about this factorization determines the number of zeros at the end of the decimal representation of 100! ?)

4. Suppose you graph a function $f : \mathbf{R} \to \mathbf{R}$. The fact that f is a function means that any straight vertical line will intersect the graph of f at exactly one point. What similar statement can you make about the graph of f if f is
   (a) injective?
   (b) surjective?
   (c) bijective?

5. Draw the graph of the function $f : \mathbf{R} \to \mathbf{R}$, where $f(x) = \lfloor x/4 \rfloor$. Show the graph for the interval $-12 \leq x \leq 12$.

6. Section 4.1 [6th edition: Section 3.4], exercise 4. Give a careful proof.