Homework Chapters 1-2 (10 points)
Due: Friday, September 8th, in class

Chapter 1:
1. Identify which type of algorithmic operation each one of the following steps belongs to:
   a. Get a value for x from the user.
   b. Test to determine if x is positive. If not, tell the user that he or she has made a mistake.
   c. Take the cube root of x.
   d. Do Steps 1.1, 1.2, and 1.3 x times.

2. The following is Euclid’s 2,300-year-old algorithm for finding the greatest common divisor (gcd) of two positive integers I and J.

   a. Go through this algorithm using the input values 20 and 32. After each step of the algorithm is completed, give the values of I, J, and R. Determine the final output of the algorithm.
   b. Does the algorithm work correctly when the two inputs are 0 and 32? Describe exactly what happens, and modify the algorithm so that it gives an appropriate error message.

3. A student was asked to develop an algorithm to find and output the largest of three numerical values x, y, and z that are provided as input. Here is what was produced:

   Is this a correct solution to the problem? Explain why or why not. If it is incorrect, fix the algorithm so that it is a correct solution.
4. Using only the sequential operations described in Section 2.2.2, write an algorithm that gets four numbers corresponding to scores received on three semester tests and a final examination. Your algorithm should compute and display the average of all four tests, weighting the final exam twice as heavily as a regular test.

5. Modify the test-averaging algorithm of Exercise 4 so that it reads in 15 test scores rather than 4. There are 14 regular tests and a final examination, which counts twice as much as a regular test. Use a loop to input and sum the scores. Feel free to use \( x_i \) to represent the \( i \)-th value in the list.

6. Design an algorithm that is given a positive integer \( N \) and determines whether \( N \) is a prime number, that is, not evenly divisible by any value other than 1 and itself. The output of your algorithm is either the message ‘not prime’, along with a factor of \( N \), or the message ‘prime’. You can use statements such as, “Set \( r \) to be the remainder upon computing \( x/y \)”.
7. Peanut Butter Jelly

Background:
As you have seen, algorithms play a vital role both in our daily lives and in the field of computer science. Our minds can effortlessly break down and process complex instructions, but this is usually because we have completed such a task before and understand what is implied by an ambiguous command. “Brush your teeth” seems simple enough, but “flantrix your squifflelizer” makes no sense unless you have previous experience with those words. In this problem, you take a fairly common task, creating a peanut butter and jelly sandwich (a PBJ if you will), and look at it from the point of view of somebody who doesn’t understand what a PBJ is.

Part 1:
Write an algorithm for creating a peanut butter and jelly sandwich. These directions will then be programmed into the Sandwich Bot 9000 (the SB9000), who will create delicious PBJs for you at your convenience. Note, however, that the SB9000 has little to no understanding of the basic human concepts needed to construct a PBJ, so you will have to explain everything it needs to do to accomplish this task.

The materials available to the SB9000 are:
- 1 loaf of bread, pre-sliced and sealed in a bag with a twist-tie
- 1 jar of peanut butter, lid closed but with the seal removed
- 1 jar of your favorite flavor of jelly, also unopened
- 1 plate, washed and sanitized
- 1 roll of paper towels or a stack of napkins
- 1 butter knife, not overly sharp

Create a step-by-step set of instructions for the SB9000 on the back side of this sheet. Be detailed and specific. Be sure to consider how your directions might be ambiguous or have multiple interpretations. While “place bread on the plate” may make sense to you, SB9000 may not understand or may interpret that in an unexpected way. Once you have finished the instructions, ask someone to check them by assuming the role of the SB9000. Have your SB9000 follow your directions, and ask it to do so as explicitly as possible.

Hints:
- While the SB9000 may have materials available to it, it does not know what they are. This could cause problems with your algorithm.