Spring 2019 CS 316
Data Structures Assignment 1 – 10 points
Due Date: Monday, Sept. 16th at the beginning of class (late assignments not accepted)

A hardcopy/paper copy of your answers must be submitted to me at the beginning of class. The point value for each answer is given in brackets [].

A reasonable level of professionalism on submitted homework assignments is expected. This includes:
1. Your name at the top of every page of the assignment.
2. Paper size should be on standard typewriter paper, 8.5 x 11 inches, or standard notebook size, approx. 8 x 10.5 inches. You are permitted to type some answers and handwrite others if you prefer but you are not required to type your answers.
3. All pages stapled (preferred) or paper clipped, not folded at the corner.
4. If handwriting your answers, the ink or pencil should be dark, legible and of a normal size print (please do not write very small).
5. Write legibly; if I cannot read your answer, your score for the answer is zero points.
6. The problems should appear in the order of the assignment and numbered accordingly. Grading your answers should not require leafing through pages or searching for your answers out of order.
7. Scribble is not professional; do not turn in papers with scribble. You may use pencil so that you can erase providing your print is dark.
8. The ratted edges of paper that remain after tearing paper from a spiral notebook is not acceptable.

A 5-point deduction for each violation will be taken. If an answer cannot be read, a score of zero is assigned.

1. [6 points] Consider the following unknown function:

   ```
   void unknown(int n)
   {
     cout << n % 10;
     if (n >= 10)
       unknown(n / 10);
   }
   ```

   a. Given the invocation “unknown (1234); “ what is output by this function?
   b. Show the state of the program stack for their code for the argument passed into unknown is 1234. We showed the state of the program stack in class, look at your notes and provide a similar answer for your code.
   c. Which line of code is the base case for this function?
   d. Give an English statement that summarizes what unknown does. This statement will become the verbiage for your theorem.
   e. Use induction to prove your theorem from part c. Recall, there are three parts to proving a theorem with induction. Write all three parts.

2. [2 points] An algorithm takes 0.5 ms for input size 100. How long will it take for input size 500 if the running time is the following (assume low-order terms are negligible)?
   a. Linear
   b. O(N logN)
   c. Quadratic
   d. Cubic
3. [2 points] What is the Big-Oh runtime for each of the following code segments?

   a.
   
   for( i = 0; i < n * n; ++i )
   for( j = 0; j < n * n; ++j )
       ++sum;

   b.
   
   for( i = 0; i < n; ++i ) {
       for( j = 0; j < n * n; ++j )
           ++sum;

       for( j = 0; j < n * n * n; ++j )
           ++sum;
   }