Review Questions for CS 10  (by Daisy Tam)

1. For the algorithm below, how many times will step 3 be executed? Given that 
   \( n=50 \). What will be the value printed in step 4?
   1. Get value of \( n \) from user.
   2. While \( n \leq 10,000 \)
   3. Set \( n \) to \( 3n+4 \).
   4. Print value of \( n \).
   5. Stop.

2. Rewrite above algorithm using repeat loop.

3. Write a Sequential Search algorithm that gets a list of names from the user, along 
   with a target name, and returns the position in the list where the target is located if 
   target is in the list, and returns zero of the target is not in the list.

4. Use Gauss’ technique to find a formula for the first \( n \) even positive integers.

5. Explain the difference between repeat loops and while loops in pseudo-code.

6. Compare Algorithm A, which does \( 10n \) basic operations, and Algorithm B, which 
   does \( (0.1)n^2 \) basic operations. Find the value of \( n \) which Algorithm B is more 
   efficient.
7. There are three different data clean up algorithms. Perform the Shuffle-Left, Copy Over, and the Converging Pointers method on the following set of numbers: 0 3 1 7 0 2 4 11 0

8. Given the list: 3 6 7 9 12 14 18 21 22 31 43 use binary search algorithm to decide whether 35 is in the list. Show steps.

9. Construct a binary search tree using the following numbers:
    2 3 7 9 10 13 15 18 21 28 30 32 36 39 41

10. Express the following numbers in base 10:
     a) [1011010111001]_2

     b) [237]_8

     c) [A17D]_{16}

11. Convert the following:
     a) [101100101]_2 to base 8

     b) [101100101]_2 to base 16
12. An instruction register for some processor has 4 bits for the op-code and 12 bits for a single address field. What is the maximum possible number of operations which can be performed by this processor? What is the maximum possible number of cells in memory (measured in KB)? Assuming that maximum memory size, what are the smallest and largest cell addresses?

13. What is the range of numbers which can be represented in sign/magnitude notation if 8 bits are available?

14. Perform the selection sort algorithm on the following set of number: 6 8 5 0 4 3

15. Suppose 10 bits are used to store signed integers in sign/magnitude representation. What bit string would be used to represent the number –27?

16. Assume that 16 bits are available for floating point representation of rational numbers with 10 bits for the signed mantissa and 6 bits for the signed exponent.

   a) What bit string would be used to represent 12.75?

   b) –20.25?
17. Design a four-input multiplexor circuit and label all parts pertaining to the circuit. Also, describe the range of input lines, output line(s), and selector lines.

18. Design a 3-to-8 decoder circuit and label all parts pertaining to the circuit. Also, describe the range of input lines, output line(s), and selector lines.

19. Given that a circuit has 3 inputs and 1 output: The condition that will produce an output of 1 is when two or more of its inputs are 0; otherwise, the output is 0. Draw a truth table, write a corresponding boolean expression in “sum-of-products” form, and draw a circuit diagram.

20. Write a complete assembly language problem (including all necessary pseudo-ops) that first compares the value of X and Y. If (X > Y), then output the value of X and then set the value of X to 2X+1; otherwise, output the value of Y and then set the value of Y to 2Y-3.

21. Using C++, write a program that will ask the user to input the subtotal cost of their purchase, which is then used to calculate the tax for that purchase, given that the tax is 8%. The program should output all relevant information, including subtotal, tax amount, and final cost of the purchase.