**Algorithms (CSCI 323 & 700)**

**Spring 2016 - Homework #2**

**(Due at the beginning of class on 2/17/2016)\***

The first three questions pertain to the recurrence g(0) = 2, g(1) = 1, g(n) = g(n-1) + 2g(n-2)

1. Using the method of characteristic equations presented in class, derive the closed-form formula g(n) = 2n + (-1)n.
2. Using mathematical induction, prove that the formula g(n) = 2n + (-1)n works for all cases n ≥ 0.
3. Using the logarithm-based approximation method discussed in class, estimate how many digits are in g(1000). Then use an on-line calculator to find out the actual number of digits in g(n).

The next four questions relate to using basic data structures for sorting.

(Do not use an array or other data structure besides the one indicated.)

1. Suppose n unsorted elements are in a stack. Describe how to sort the data, using auxiliary stacks as necessary. What is the time complexity of your algorithm?
2. Suppose n unsorted elements are in a queue. Describe how to sort the data, using auxiliary queues as necessary. What is the time complexity of your algorithm?
3. Suppose n unsorted elements are in a “binary search tree”, defined as a binary tree in which the keys in the left and right children are respectively smaller and larger than the key in their parent node. Describe how to sort the data, using auxiliary BSTs as necessary. What is the time complexity of your algorithm?
4. Suppose n unsorted elements are in a “heap”, defined as a binary tree in which the keys in the left and right children are *both* larger than the key in their parent node. Describe how to sort the data, using auxiliary heaps as necessary. What is the time complexity of your algorithm?
5. Given the various possible shapes of a binary tree, what are the best, average and worst case number of operations for “preorder” traversal? Why?

\* Only if you will not be able to attend class on the due date, submit your solutions - *before 6:00 p.m. on the due date* - to the instructor at LT.CS320@yahoo.com