This quiz is closed book and only one notes sheet. There are 75 points in ten questions and you must show your work to receive full credit. Put your name, the date, and “Exam 2” on each extra sheet of paper you turn in. Papers must be stapled.

1. Give and briefly explain an example of a solution that uses recursion. (5 points)

2. Define: (5 points each)
   (a) Tree
   (b) Interior node
   (c) Binary tree

3. For a given tree, what characteristic of the tree gives the maximum number of steps required to find any particular node? (5 points)

4. Given 5 unique items to store in a binary tree:
   (a) What is the worst case depth of the tree? (2 points)
(b) What is the best case depth of the tree? (2 points)

(c) With a plain BST and input in sorted order, what is the expected depth of the tree? (1 point)

5. What is the expected time complexity for a merge sort? (5 points)

6. Write the pseudo code to do a breadth-first traversal of a binary tree. (10 points)

7. Write the pseudo code to do an pre-order walk of a binary tree. (10 points)
8. Give an example, other than searching, of a use for a depth-first traversal of a binary tree. (5 points)

9. In class, we discussed a Red-Black tree to produce a balanced BST:
   (a) Does it always produce a perfectly balanced tree? (5 points)

   (b) What did the structure add to each node to aid in the balancing? (HINT: The name of the structure gives you the answer. 5 points)

10. What would you expect for the time complexity of a pre-order walk of a BST with $n$ nodes? (5 points)