**Computer Science II Exam #1**

**Date: 2/14/2013**

**Last Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, First Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1) (9 pts) Solve the following recurrence relations using the Master Theorem:

a) T(n) = 4T(n/2) + O(n2)

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b) T(n) = 7T(n/3) + O(n2)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c) T(n) = 7T(n/2) + O(n)

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2) (10 pts) Order the following functions from smallest to largest based on big-theta notation. Assume that the base of all logarithms below is 2.



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3) (20 pts) Determine the value of the following sum: 

4) (20 pts) The code handout uses the backtracking technique to calculate the maximum number of knights that can be placed on a chess board with dimensions numRows x numCols such that no two knights can attack each other. Answer the following questions based on the code handout. (If you’ve never played chess, all you need to know is that a knight moves in an L-shape: two squares in one direction and one square in the perpendicular direction.)

a) (5 pts) On line 34, a recursive call is made to the method recSolve. In all, there are two lines with recursive calls in this function. Symbolically, what is the value of this recursive call? (Namely, what value is stored in the variable skipB when this line of code finishes.)

b) (5 pts) What is the size of the list returned by the function getPrevConflicts()? Will all ordered pairs stored in this list contain non-negative integers only? Why or why not?

c) (5 pts) What is the purpose of line 31? Would the code return the correct answer if we removed this line?

d) (5 pts) On line 14, why can we cut out of the recursion if the boolean condition tested is true?

5) (5 pts) Consider running a bucket sort on 3,000 real numbers values in the range [400, 1000). In which bucket number (with buckets starting at 0 and ending at 299,999) would the number 723.12 be placed?

6) (7 pts) What is the run-time (Big O) of the code segment below in terms of n?

while (n > 0) {

for (int i=0; i<n; i++)

sum++;

n = n/4;

}

7) (5 pts) Draw the result of inserting 31 into the AVL tree below:

40

/ \

20 50

/ \ \

10 30 60

/ / \

5 25 35

8) (5 pts) Draw the result of deleting 50 from the AVL tree below:

40

/ \

20 50

/ \ \

10 30 60

/

5

9) (10 pts) Determine a minimum spanning tree of the graph specified below using Kruskal's Algorithm. Please show each edge you consider to add to the tree. Indicate whether it gets added or not on the table provided. Note: You may not use each row of the table given. The graph is given below as a list of ordered pairs. The first item in the pair is the pair of vertices connected and the second item is the weight of their connection.

( (A, C), 8), ( (B, D), 3), ( (A, B), 4), ( (A, D), 5), ( (B, C), 4), ( (C, D), 6), ( (B, E), 7), ( (C, F), 5)

( (A, G), 4), ( (E, F), 5), ( (E, G), 3), ( (C, H), 7), ( (H, I), 2), ( (F, J), 6), ( (I, J), 5), ( (H, J), 6)

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| **Edge Considered** | **Added(Yes/No, why)** |
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10) (7 pts) What is the minimum number of comparisons necessary to sort an array of size 7? (Note: You will get 0 points for answering 7lg7. Rather, your answer must be an integer based on the proof shown in class. Note that 7! = 5040. And 210 = 1024.)

11) (2 pts) On what planet does the Mars Rover Curiosity reside currently? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_