Data Structures Final Exam
Due: 11:59 pm November 20, 2011

Name : _____ id#:_____

Answer ALL the following Questions
Please *type* your answer.

1. (10 pts)

Given the following code :

```
sum = 0 ;

for ( i = 0 ; i < n ; i++ )
  for ( j = 0 ; j <  i * i ; j++ )
      if ( j % i == 0 )
          for(k = 0 ; k < j ; k++)
              sum++ ;
```

What is the time complexity (in Θ –notation) in terms of n ?

2.(10 pts)

Suppose we have a collection of two million (2×10^6) records . What are the possible maximum and possible minimum heights if the following data structure is use and Explain how you get your answer.

a) **Binary Search Tree**
b) **AVL Tree**

3. ***(20 pts)***

For a binary tree (not necessary a BST), we are given the following information
preorder traversal sequence : W D B X T F A D E
postorder traversal sequence : X B D A F E D T W

Can you construct and draw the tree from the given ? If so, draw the tree. Is the tree unique? If the tree is not unique, how many possible binary tree with the given pair of traversal sequences?

4. (10 pts)

Design an algorithm that find the largest three integers from any given array of n Integers. You must guarantee that the number of comparisons is no greater than 2n in the worst case. Justify your claim.

5. (20 pts) Base on programming assignment #3

A)

Filling the complexity for each case using $\Theta(1)$, $\Theta(\log n)$, $\Theta(n)$, $\Theta(n\log n)$, $\Theta(n^2)$, $\Theta(n^3)$

	sort method		random order	already sorted	reverse-sorted	all data are the same	
1	bubblesort						
2	selectionSort						
3	insertionSort						
4	heapsort						
5	mergesort						
6	mergesort switch to insertionsort						
7	quicksort recursive, left-most pivot element						
8	quicksort recursive, left-most pivot element switch to insertionsort when size is < cutoff size						
9	quicksort recursive, median of three pivot element and switch to insertionsort when size is < cutoff size						
10	quicksort non-recursive, median of three pivot element and switch to insertionsort when size is < cutoff size						

B) If linkedlists are used instead of arrays, for each case will the performance be improved or be worsen ? justify your answer.

6. ***(20 pts)***

Suppose the following hashtable of size N = 13 is given, with hash function
$h(x) = (x+1)^2 + 1 \bmod N$.
a) Assume the open-address linear probe method is used for collision resolution.
b) Assume double hashing with $d(k) = 7 - k \bmod 7$ is used for collision resolution.
What the table would look like after the following insertion sequence of records with key 1997, 2011, 1698, 2270, 2012, 1776 , 1997, 16910, 2613 , 17069 , 2017.

c) Repeat b) if last entry is 2016 instead of 2017. What will happen? Please explain why.

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(a)

0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

(b)

0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

(c)

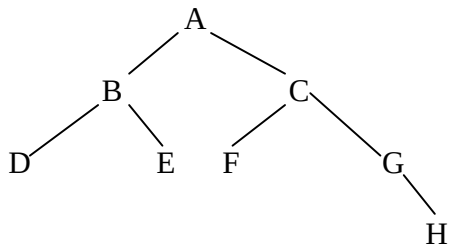
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

7. (10 pts)

Assume that all of the requirements on hw4 are implemented. Implement the following method that takes a binary tree object as a parameter and return a mirror image of the tree. The image retains all of its nodes with its left child and right child switched. Nodes at every level must have their left child and right child switched.

For example :

INPUT TREE



RETURN TREE