CS 146 Midterm Exam 10/8/15

Name:

There are X questions worth a total of 100 points. Please use your time wisely so you get to all of the questions. Keep your answers clear.

You may use notes, books, but no electronics.

Please wait to turn the page until everyone is told to begin.

1	/ 10
2	/ 10
3	/ 15
4	/ 15
5	/ 10
6	/ 10
7	/ 20
8	/ 10

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100

Complexity

Question 1.

Indicate for each of the statements below whether the statement is true or false. You do not need to show work. (Each worth 2 points.)

a) $3n\log_{13}n$ is in $O(n^2)$

b) n is in $O(\log_3 n)$

c) n^3 is in $\Omega(n^4)$

d) $2n^3 + n^2$ is in $\theta(n^3)$

e) 10^n is in $\Omega(n^2)$

Question 2.

Give the running time (complexity) of the statements as a function of the value of the variable `n`. (Each worth 5 points.)

(a)
```
sum = 0;
i = 0;
j = 7n;
while(i < j) {
   sum++; i++; j--;
}
```

(b)
```
x = n;
while (x > 0) {
    y = n;
    while (y > 0) {
        sum++;
        y = y / 2;
    }
    x = x / 2;
}
```

Binary Heap Operations

Question 3.

a. Draw the binary min heap represented by the following array: (5 points)

Index	0	1	2	3	4	5	6	7
Value		4	9	12	29	17	14	16

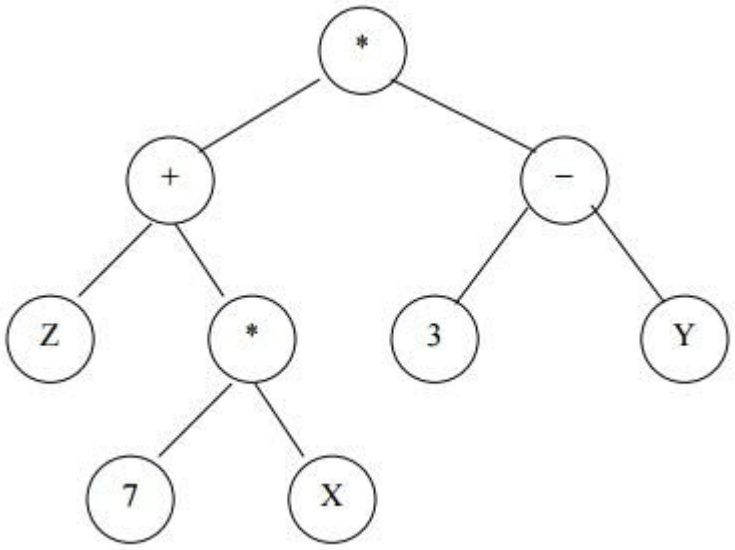
b. Show the result of calling deleteMin twice on the heap you drew in part (a). Show the heap after each deleteMin, and circle the final heap. (5 points)

c. Starting with the heap you ended up with in part (b), insert values 11 & 2 in that order. Draw the heap after each insertion, and circle the final heap. (5 points)

Binary Tree

Question 4.

The following is a binary tree.



a) Write down the nodes of this tree during an inorder traversal. (5 points)

b) Write down the nodes of this tree during a postorder traversal. (5 points)

c) Write down the nodes of this tree during a preorder traversal. (5 points)

Binary Search Trees

Question 5.

Write pseudo-code for a method in the BinarySearchTree class to count the number of node balances (according to the AVL definition of balance) in the BinarySearchTree. Basically you are checking each node if it is balanced, incrementing a counter if it is balanced.

Assume that the tree is a BinarySearchTree. It should return an int, be inside the BinarySearchTree class, and take no arguments. You can use any helper methods, class variables, as needed. (Worth 10 points)

AVL Trees

Question 6.

Show the AVL tree that results after each of the integer keys 9, 22, 14, 15, 50, 51, and 33 are inserted, in that order, into an initially empty AVL tree. Clearly show the tree that results after each insertion, and make clear any rotations that must be performed. (10 points)

HashTable

Question 7.

Consider inserting data with integer keys 22, 14, 12, 48, 36, 12 in that order into a hash table of size 11 where the hashing function is h(key) % 11.

a) Show a chaining hash table after doing the insertions. (5 points)

b) Show an open addressing with linear probing hash table after doing the insertions. (5 points)

c) Show an open addressing with quadratic probing hash table after doing the insertions. (5 points)

d) What is the difference between primary and secondary clustering? (5 points)

B Trees

Question 8.

a) Given a B-Tree with M = 40 and L = 12, how many children must an internal node have? How many children must a leaf node have? (5 points)

b) Draw a valid B-Tree with M = 5, L = 4, which has one internal node and three leaf nodes. (5 points)