CSE 373: Practice Midterm

1 Short Answer

a) Let $f(n) = 5n^3 + 6n^2 - 4n$ and let $g(n) = 6n^3 - 9n^2 + 16$.
Show that $f(n) = O(g(n))$ or $g(n) = O(f(n))$ or both, if applicable.

b) Suppose a heap is full and has n elements. What is the big time asymptotic runtime of an insert? Explain your answer

c) Write pseudocode, or explain briefly in paragraph form, an algorithm that will find the largest element in a BST. Include the worst-case runtime of this algorithm.

d) What is the best-case and worst-case bigO complexities for `find(key k, value v)` in a half-full hash table implemented using linear probing. Briefly explain these best and worst case scenarios.

2 Big O notation

For the following functions, determine the tightest bigO upper bound in terms of n. Write your answers on the line provided.

a)
```
void silly(int n) {
    for (int i = 0; i < n; ++i) {
        j = n;
        while (j > 0) {
            System.out.println(j =  + j);
            j = j - 2;
        }
    }
}

O(______)
```

b)
```
void f2(int n) {
    for(int i=0; i < n; i++) {
        for(int j=0; j < 10; j++) {
            for(int k=0; k < n; k++) {
                for(int m=0; m < 10; m++) {
                    System.out.println("!");
    }   }   }   }
}



O(______)
```

c)
```
int f3(int n){
    if (n < 10) return n;
    else if(n < 1000) return f3(n-2);
    else return f3(n/2);
}

O(______)
```

3 Heaps

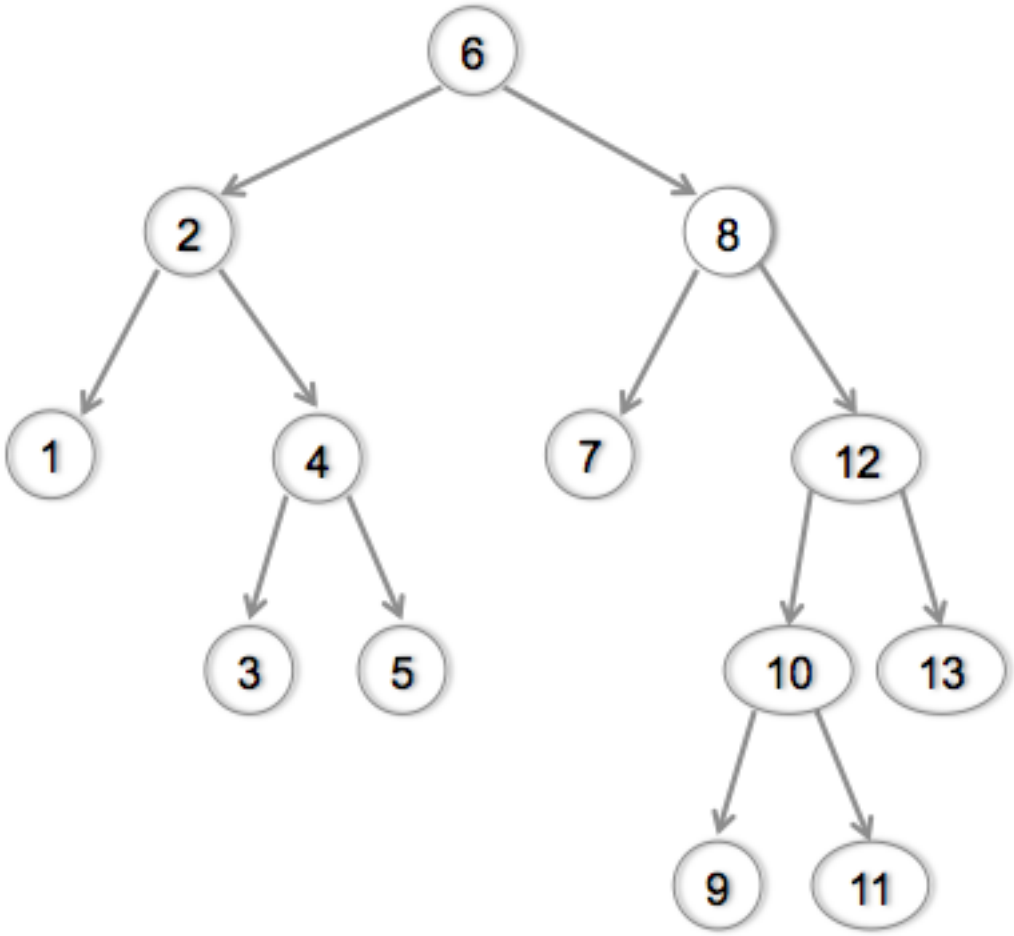
Show a min-heap after performing the following inserts:

$$[1, 9, 16, 4, -3, 19, 5, 0]$$

You only need to show the final result, but showing intermediate steps may earn you partial credit if a mistake is made. You may show either the tree or the array in your result.

4 Traversals

Provide the pre-order, in-order, post-order and BFS traversal of the following Binary Search Tree.



Pre-order:

In-order:

Post-order:

Breadth-first Search:

5 AVL insertions

Show an AVL tree after performing the following inserts:

$$[5, 8, 6, 10, 18, 9, 0, 11, 12]$$

You only need to show the final result, but showing intermediate steps may earn you partial credit if a mistake is made.

6 Design Decision

A client is trying to provide a data structure which logs the locations of process jobs on a small server farm. There are 64 servers at the farm and there is no limit to the number of jobs that should be assigned to each server. For each process job, there are four pieces of information which need to be tracked:

- An int ID number which is unique to each job
- An int which indicates to which server the job has been assigned
- A long which is the time that the process was assigned to the server
- A String which identifies the owner of the job

Because this is a log, the client will only delete records when they were created in error. Because of this, fast delete times are not important. Additionally, the client will be calling find much more frequently than insert, so any speed benefits should prioritize speeding up find, if possible.

Provide a data structure and implementation that would meet the clients demands. Explain what data will be stored where and how it will be accessed. Then, justify any decisions you made using material from the course. This includes, but is not limited to: asymptotic runtimes, memory usage, experimental results and data structure properties.

Continue your solution here, if necessary: