Computer Science 221

Practice Questions - Set 5

Here are some more sample questions to help you prepare for the final exam.

1. Suppose you have a stack ADT (i.e., an abstract data type that contains operations to maintain a stack).

   a) Describe how you could implement a queue using two stacks. For the enqueue and dequeue operations for this implementation, provide the Big-O complexity figures.
   b) Using this implementation, describe a linear time algorithm for reversing a queue.

2. If 5 points are placed in a 6 cm by 8 cm rectangle, argue that there are two points that are not more than 5 cm apart. (You may use the fact that 2 points in a 3 cm by 4 cm rectangle are not more than 5 cm apart.)

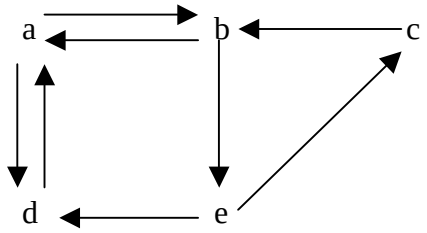
3. Suppose we want to sort an array of size *n* that contains items that are either 0 or 1.

   a) Give Big-Theta notation to describe the asymptotic worst-case number of comparisons made by InsertionSort to sort such an array. (No proof is necessary.)
   b) Describe a worst-case input for (a), in terms of the number of entries *n*.
   c) Give Big-Theta notation to describe the asymptotic worst-case scenario for the number of comparisons made by QuickSort to sort such an array. (Again, no proof is necessary.)
   d) Describe a worst-case input for (c), in terms of the number of entries *n*.

4. Show by giving a **proof by contradiction** that if 100 balls are placed into 9 boxes, then some box must contain 12 or more balls.

5. Given a graph for a tree (with no designated root), describe how a root can be chosen so that the tree has *maximum* height. Similarly, describe how a root can be chosen so that the tree has *minimum* height. (Note that path length is described as the number of edges that need to be traversed between two vertices.)

6. Consider the following graph. Indicate which of (a), (b), (c), and (d):
   - i) form a path in the graph
   - ii) are simple paths
   - iii) are cycles



a) a,b,e,c,b
b) a,d,a,d,a
c) a,d,b,e,a
d) a,b,e,c,b,d,a

7. Given the following adjacency matrix, draw the corresponding directed multigraph. Label your nodes: **1**, **2**, **3**, and **4**.

0 2 3 0
1 2 2 1
2 1 1 0
1 0 0 2

8. Draw a binary expression tree that corresponds to the following expression:

(a+b)/(c-d) + e + g * h / a

9. What is the output value of the following code as a function of *n* (exactly)?

```
int i, j, count;

count = 0;
for (i=0; i < n; i++)
   for (j=0; j < (i+1)/2; j++)
      count++;
cout << count << endl;
```

Hint: Consider the cases: *n* odd, and *n* even, separately.