CSCI 220 Data Structures and Algorithms, Fall 2015

Some Review Problems

I hope this provides some guidance. It is not a guarantee of anything! Although the exam is cumulative, at least 60% of it is likely to be on items since the last exam: Dijkstra's algorithm, the Bellman-Ford algorithm, binary search trees, and hashing. The problems are examples of the kinds of problems I think you should be able to solve.

And the good news: you may bring 1 page of notes (double-sided is fine) to the exam.

1. give the running time bounds on every algorithm and data structure operation you can think of. (Some I can think of: quicksort, mergesort, heapsort, heaps, stacks, queues, lists, hashtables, prim's algorithm, kruskal's algorithm, dijkstra's algorithm, bellman-ford algorithm.) Distinguish as much as possible O from Θ and worst-case from average.
2. Make up a list of numbers and show how quicksort sorts this list.
3. Make up a list of numbers and show how mergesort sorts this list.
4. Make up a list of numbers and show how heapsort sorts this list.
5. Make up a graph and show how prim's algorithm works on this graph, starting at a vertex you choose.
6. Make up a graph and show how kruskal's algorithm works on this graph.
7. Make up a graph and show how dijkstra's algorithm works on this graph, starting at a vertex you choose.
8. Make up a graph and show how bellman-ford works on the graph, starting at a vertex you choose.
9. Make up a list of values and show how a heap is built from them.
10. Make up a list of keys and a (simple) hash function and show how the keys get inserted into the hash table.
11. Make up a list of values and show how a BST is built from them.
12. Prove or disprove: Assuming it is unique, the lightest-weight edge in a graph *must* be in the minimum spanning tree of the graph.
13. An emergency room at a hospital does a triage on patients as they arrive and at any moment works on the patients with the greatest need. Explain which data structure you would use to implement a computer system to help them keep track of which patient should be examined next.
14. True or false (explain): the kth largest value in a max heap is always found within $\log k$ levels of the root.
15. Explain the difference between saying something is $O(n)$ and saying something is $\Omega(n)$.
16. You are building a game that involves a player wandering through a maze. You want to build a random maze each time the game is played. The maze is set on an n x n board; the player enters at cell (1,1) in the upper left hand corner and is trying to get out of the maze at the exit (n,n) at the bottom right corner.

    Give an algorithm that generates a random maze on the board. The initial configuration of the board is that every cell has four walls. Your algorithm determines which walls are torn out.