# 15-211: Assignment 5 Theory Questions

## Due: August 3, 2009 in class

Name: _____

Andrew ID: _____

These questions count for 15% of the homework grade. Please hand in your answers, written or typeset, in lecture on Friday.

1. **DFAs**

(2) (a) Draw the DFA with both *goto* and *fail* arrows for {said, sad, add, dad}. Please designate which are *goto* and which are *fail* transitions.

(1) (b) What is the worst-case runtime complexity of building a DFA for a pattern of length $n$ over the alphabet of $m$? Explain your answer.

(2) (c) Draw a DFA that accepts binary strings with 1 as the second to last letter.

(2) (d) Draw a DFA that accepts strings that look like 1*0*1*, where the *s are repetitions of the letter before it. It must have at least 101 but may have infinitely many more 1's after the first or last 1 and infinitely many 0s after the first 0. Example: 111011 is acceptable, 111111 is not acceptable, 1110011100 is not acceptable.

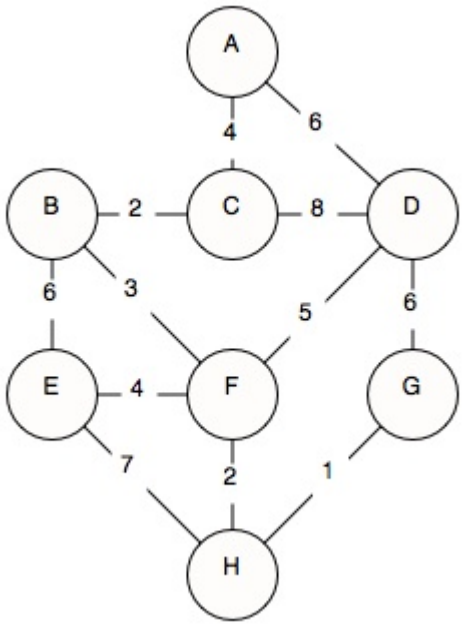
2. Each of these problems can be solved easily by a graph algorithm. Indicate, for each problem, which of the following algorithms you would use: Dijkstra's Algorithm, Prim's Algorithm, Topological Sorting, Breadth-First Search, Depth-First Search. Give a one-sentence explanation for each of your choices.

(1) (a) A student needs to take a certain number of courses to graduate, and these courses have prerequisites that must be followed. Assume that ALL courses are offered every semester and that the student can take ONE course each semester. How can she find an appropriate sequence to take?

(1) (b) A word can be changed to another word of the same length by a series of single-character substitutions (with no additions or deletions). Given two words of the same length, how could we find out if we could change one into the other so that all of the intermediate strings are valid words? For example, bleed converts to blood by the sequence bleed, blend, blond, blood.

(1) (c) Suppose you are working at a cable TV company. How could you design an optimal cable wire plan such that all the customers are connected and the total length of the cable is as small as possible?

3. **Graph Algorithms**




(1) (a) For the graph above, list in order the edges that are added to the MST using Prim's Algorithm starting at $A$.

(1) (b) For the graph above, list in order the edges that are added to the MST using Kruskal's Algorithm.

(1) (c) Does this graph have multiple MSTs? When will a graph have multiple MSTs?

4. Suppose we use BFS and DFS to find a path from some starting vertex to an ending vertex in a graph.

(1) (a) Will BFS and DFS always return the same path between a pair of vertices in a tree? Give a explanation about why or why not.

(1) (b) In general, will DFS and BFS always return the same path between two vertices in any graph? Give a brief explanation about why or why not.