CS 5343: HW #4. Do circled Problems

R-13.16 Show how to modify the pseudo-code for Dijkstra's algorithm for the case when the graph is directed and we we want to compute shortest directed paths from the source vertex to all the other vertices.

R-13.17 Show how to modify Dijkstra's algorithm to not only output the distance from v to each vertex in G, but also to output a tree T rooted at v such that the path in T from v to a vertex u is a shortest path in G from v to u.

R-13.18 There are eight small islands in a lake, and the state wants to build seven bridges to connect them so that each island can be reached from any other one via one or more bridges. The cost of constructing a bridge is proportional to its length. The distances between pairs of islands are given in the following table.

	1	2	3	4	5	6	7	8
1	-	240	210	340	280	200	345	120
2	-	-	265	175	215	180	185	155
3	-	-	-	260	115	350	435	195
4	-	-	-	-	160	330	295	230
5	-	-	-	-	-	360	400	170
6	-	-	-	-	-	-	175	205
7	-	-	-	-	-	-	-	305
8	-	-	-	-	-	-	-	-

Find which bridges to build to minimize the total construction cost.

R-13.19 Draw a simple, connected, undirected, weighted graph with 8 vertices and 16 edges, each with unique edge weights. Illustrate the execution of Kruskal's algorithm on this graph. (Note that there is only one minimum spanning tree for this graph.)

R-13.20 Repeat the previous problem for the Prim-Jarník algorithm.

R-13.28 Repeat Exercise R-13.22 for Figures 13.18 and 13.20 illustrating Kruskal's algorithm.

R-13.29 Repeat Exercise R-13.22 for Figures 13.21 and 13.22 illustrating the Prim-Jarník algorithm.

R-13.30 How many edges are in the transitive closure of a graph that consists of a simple directed path of n vertices?

R-13.31 Given a complete binary tree T with n nodes, consider a directed graph $\vec{G}$ having the nodes of T as its vertices. For each parent-child pair in T, create a directed edge in $\vec{G}$ from the parent to the child. Show that the transitive closure of $\vec{G}$ has $O(n \log n)$ edges.

R-13.32 A simple undirected graph is ***complete*** if it contains an edge between every pair of distinct vertices. What does a depth-first search tree of a complete graph look like?

R-13.33 Recalling the definition of a complete graph from Exercise R-13.32, what does a breadth-first search tree of a complete graph look like?

C-13.8 The time delay of a long-distance call can be determined by multiplying a small fixed constant by the number of communication links on the telephone network between the caller and callee. Suppose the telephone network of a company named RT&T is a free tree. The engineers of RT&T want to compute the maximum possible time delay that may be experienced in a long-distance call. Given a free tree T, the *diameter* of T is the length of a longest path between two nodes of T. Give an efficient algorithm for computing the diameter of T.

C-13.9 A company named RT&T has a network of n switching stations connected by m high-speed communication links. Each customer's phone is directly connected to one station in his or her area. The engineers of RT&T have developed a prototype video-phone system that allows two customers to see each other during a phone call. In order to have acceptable image quality, however, the number of links used to transmit video signals between the two parties cannot exceed 4. Suppose that RT&T's network is represented by a graph. Design an efficient algorithm that computes, for each station, the set of stations it can reach using no more than 4 links.