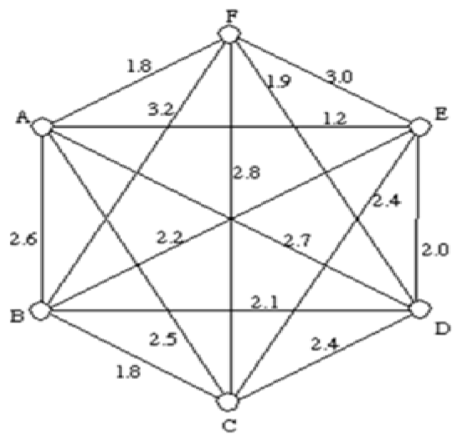
CS 5114 Theory of Algorithms, Spring 2020
Homework 5: Due on 20 April 2020, 11:59pm

I pledge that this test/assignment has been completed in compliance with the Graduate Honor Code and that I have neither given nor received any unauthorized aid on this test/assignment.

Name (Print): ______________________________

Signed: ______________________________



1. (5%) Use Kruskal's algorithm to find a minimum spanning tree and indicate the edges in the graph shown left. Indicate on the edges that are selected the order of their selection.

2. (5%) Use Prim's algorithm to find the minimum spanning tree and indicate the edges in the graph shown left. Indicate on the edges that are selected the order of their selection.

3. (20%) The transpose of a directed graph $G = (V, E)$ is the graph $G^T = (V, E^T)$, where $E^T = \{(v, u) \in V \times V : (u, v) \in E\}$. Thus, G^T is G with all its edges reversed. In the algorithms that compute G^T from G for both the adjacency list and adjacency-matrix representations of G, discuss the running times of the algorithms. (Give a simple description of your algorithms and give the running times of the algorithms in O notation).

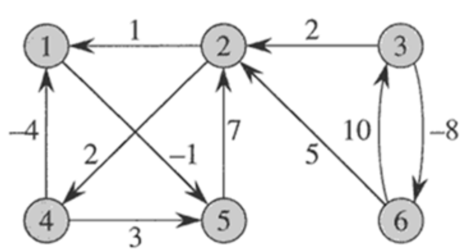
4. (20%) Make a 3-by-3 chart with row and column labels WHITE, GRAY, and BLACK. In each cell (i, j), indicate whether, at any point during a depth-first search of a directed graph, there can be an edge from a vertex of color i to a vertex of color j. For each possible edge, indicate what edge types it can be. Make a second such chart for depth-first search of an undirected graph. (Hint: Use 4 types of edges: T, B, F, and/or C. Fill the following table for directed and undirected graphs. You should show two tables for both cases).

edge (i, j)	White	Gray	Black
White			
Gray			
Black			

Table 1: Directed graph

edge (i, j)	White	Gray	Black
White			
Gray			
Black			

Table 2: Undirected graph



5. (25%) Run SLOW-ALL-PAIRS-SHORTEST-PATHS on the weighted, directed graph of the left figure, showing the matrices that result for each iteration of the loop.

6. (25%) Run the Floyd-Warshall algorithm on the weighted, directed graph of the left figure. Show the matrix $D^{(k)}$ that results for each iteration of the outer loop.