CSci 242. Algorithms and Data Structure **November 14th, 2017**

Instructor: Dr. M. E. Kim

Due: 5 PM, December 8th (Fri.)

Group Project (600 points)

Member: A Team of 3 People.

Write the programs that performs the given tasks of the graph below using a programming language of your preference. The graph model is an undirected graph of the US towns and roads whose weight is a distance between two towns, given in the data.

I. Data

A data of graph with the 113 US towns and 290 roads with the road distances are given in the excel sheet.

Task I. [100 pt.] Depth First Search

Starting from Grand Forks, traverse all of the towns by DFS.
1.1) List the towns in the order of traversal.
1.2) Give the total weight of your DFS tree of the traversed towns.
1.3) Give the map of your DFS tree of discovery edges.
1.4) Give the list of back edges.
1.5) Mark the DFS tree with the discovery edges in the given map.

> For a number of incident edges ($x \rightarrow y$) on a town x, choose an edge with the other end vertex y, ~~from the direction of North, NW, West, SW, South, SE, East, then NE, i.e. in the counter clockwise direction from the North.~~
>
> ~~e.g.) For Minneapolils, MN with its 9 incident edges,~~
> ~~1. MSP → Fargo@ND, 2. MSP → Pierre@SD, 3. MSP → Sioux Falls@SD,~~
> ~~4. MSP → Omaha@NE, 5. MSP → Des Moins@IA, 6. MSP → St. Louis@MO,~~
> ~~7. MSP → Madison@WI, 8. MSP → Duluth@MN~~

Task II. [100 pt.] Breadth First Search

Starting from Grand Forks, traverse all of the towns by BFS.
2.1.) List the towns in the order of traversal.
2.2) Give the total weight of your BFS tree of the traversed towns.
2.3) Give the map of your BFS tree of discovery edges.
2.4) Give the list of cross edges.
2.5) Mark the BFS tree with the discovery edges in the given map.

~~Similarly, choose an edge from a town in the North in the counter clockwise direction.~~

Task III. [150 pt.] Minimum Spanning Tree

Starting from Grand Forks, find the MST with the following information.
3.1) List the roads (i.e. edges) in your MST.
3.2) The total weight of your MST
3.3) The total number of edges (i.e. roads) in your MST
3.4) The map of your MST

Task IV. [150 pt.] SSSP (Single Source Shortest Path)

With the given data in I, find the shortest path from Grand Forks, through the following routes connecting the chosen 6 towns:

Grand Forks $\rightarrow^{\text{route 1}}$ Seattle (WA@NW) $\rightarrow^{\text{route 2}}$ Los Angeles(CA@SW) $\rightarrow^{\text{route 3}}$ Dallas (TX@SC) $\rightarrow^{\text{route 4}}$ Miami (FL@SE) $\rightarrow^{\text{route 5}}$ Boston(MA@NE) $\rightarrow^{\text{route 6}}$ Chicago (IL@NC) $\rightarrow^{\text{route 7}}$ Grand Forks.

For the final route of the Shortest path, give the following information.
4.1) A list of the towns on the shortest path b/t a pair of towns in each route
4.2) The subtotal distance of the shortest path in each route
4.3) The final total distance of the entire route of the shortest path.
4.4) The map of the final route.

Submission:

Preparation of document: **[100 pt.]**

- 4-6 pages, 1.5 space, 11 pt., single-column.
- Include 1) the title of your project, 2) Names of the Team Members, 3) a Role of each member and 4) the percentage of contribution of each member.
- For each task, describe the data structures and the algorithms that are used in your tasks, discussion of any issues and result, etc.. and/or answer the questions:
  e.g.) a data structure to represent the graph, a data structure for a Priority Queue to choose an edge with the minimum weight, a data structure for a set in Kruskal's algorithm for MST, etc.
- Include the images of outputs and the maps of routes.

Program + Output files:

- Source files, output file(s) and the image files of outputs in the map.
- Choose a programming language in your team's preference.

Submission to the blackboard:

- A .zip file of the written document + program file(s) + output files + maps.
- Name your zip file as Project-LastNamesOfMembers: e.g.) Project-Smith-Kim-Pandey.
- Upload the .zip file to the blackboard.