CSci 242. Algorithms and Data Structure   **April 11th, 2017**

Instructor: Dr. M. E. Kim

Due: 5 PM, May 9th (Tue.)

Group Project

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.

~~**Task II. [200 pt.]   Biconnected Components**~~

~~From your DFS tree of discovery edges and the back edges,~~

~~2.1) Construct the auxiliary graph from the original graph of US map.~~
~~2.2) Find the connected components of the auxiliary graph in 2.1.~~
     ~~Print each connected components of their edges and vertices in the auxiliary graph.~~
     ~~Draw the connected components manually.~~
~~2.3) The connected components in 2.2) corresponds to the linked components of the graph.~~
     ~~Print each link components of their vertices and edges in the original graph,~~
         ~~i.e. the link components are the biconnected components of the original graph.~~
~~2.4) From the connected components in 2.3), list the separated edges and the separated vertices.~~

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. [250 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 $\rightarrow$route 1 Seattle (WA@NW) $\rightarrow$route 2 San Diego (CA@SW) $\rightarrow$route 3 Houston (TX@SC) $\rightarrow$route 4 Key West (FL@SE) $\rightarrow$route 5 New York City (NY@NE) $\rightarrow$route 6 Chicago (IL@NC) $\rightarrow$route 7 Grand Forks.

4.1) Your study on the chosen city such as history, climate including monthly average temperature, population, famous people in town, famous places, crucial industry, etc.

4.2) The final route of the Shortest Path:

   a)   a list of the towns on the shortest path b/t a pair of towns in each route
   b)   the subtotal distance of the shortest path b/t a pair of towns in each route
   c)   the final total distance of the entire route of the shortest path.
   d)   a map of the final route.

Task V. [150 pt. Optional]   SSLP (Single Source Longest Path)

Suppose that you earn the mileage reward that can be used for the purchase of air ticket from your travel club.   Thus, your goal is to visit the chosen 6 towns through the longest path.

With the given data in I, find the longest path from Grand Forks, through the same routes connecting the chosen 6 towns in Task IV:

5.1) Design the Single Source *Longest Path algorithm*.

5.2) Take a subgraph of the eight states in the Northwest: a subgraph of vertices and edges from WA, OR, ID, M, WY, NV, SD, ND.

 Find the route of the longest Path from Grand Forks, ND to Seattle in the route 1, printing

   a)   a list of the towns on the longest path,
   b)   the total distance of the longest path,
   c)   a map of the final route.
   d)   the difference of mileage between the shortest path in 4.2.b) and the longest path in 5.2.b).

Submission:

Preparation of document:

- 4-6 pages, 1.5 space, 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.
- Address any issues or the algorithms, etc. of the above 5 Tasks and/or answers of the questions.
- Include the images of outputs and the maps of routes.

Program files:

- Both source files, output file(s) and the images of outputs in the map.
- You can use any programming language of your preference.

Submission to eZ-LMS:

- A .zip file of the written document + program file(s).
- Name your zip file as Project-LastNamesOfMembers: e.g.) Project-Smith-Kim-Adhikari.
- Upload the .zip file to Submission section.