C.Sc 253 Programming Assignment 4 Phase I & II

Fall 2012 - Phase I due 11/20/2013 at the start of class, Phase II due 12/4/2013 at the start of class.

Be sure to read the Programming Style document when turning in your assignment. This assignment will give you experience in the data structures, algorithms, and invariants having to do with graph algorithms.

Phase I due 11/20/2013

Problem setup: It's 1953 and President Eisenhower has just taken office. He's concerned about the ability to move military equipment across the US, quickly. After seeing the autobahn in Germany during the war, he proposes creating a system of highways spanning the country. To save money, he wants to use the minimum amount of concrete in constructing these highways. Thus, beginning in Washington, he wants you to plan a network of roads to reach all major US cities**.**

To receive full credit for Phase I, in addition to all Programming Style requirements, you must

- Generate graph classes for adjacency list and adjacency matrix data structures
- Using the latitude and longitudes of the cities in (http://www.artscipub.com/info/latlonofmajorcities.asp) create a minimal spanning tree rooted at Washington, DC.
- Compare your results with the expected theoretical results and display the resulting network of roads and give their total cost.
- Justify your choice of MST algorithm and data structures, keeping in mind that you will need to re-use them for Phase II.

Note that you should make some simplifying assumptions in this (i.e. it makes more sense to consider cities closer together than farther apart in the MST)

Phase II - Due 12/4

You've delivered your report to the white house, but it's obvious that this solution doesn't make a lot of sense. One cannot easily travel from point A to point B without going through Washington. Additionally, the MST doesn't necessarily contain the shortest path from Washington to every other point on the graph (nor should it). From a defense perspective, though, the road system is vulnerable to attack, destruction of just one road will disconnect part of the country's reachability. In graph theoretic terms, the edge connectivity of the MST is 1. We would like to improve this. Your task for Phase II is to go back to your original potential

network of roads, and figure out the edge connectivity between the critical cities of Los Angeles/Washington, Washington/Denver, and New York/Seattle.

You must use the Edmonds-Karp max flow algorithm for this and justify your choice of data structure and shortest path algorithm in addition to the requirements of Phase I and, of course, satisfy all Programming Style requirements.

You must work on your own and this must be your own work