

1. Design

- a. The problem that I attempted to solve was to find the shortest path from Sweet Home Oregon to 6 other points in Oregon Brownsville, Lebanon, I-5, Tangent, Albany, and Corvallis. The PDF that I turned in to GitHub has the remainder of my drawn-out Design I provide a design for Dijkstra's algorithm and for Prim's Algorithm

2. Test

- a. In my design write up, I have provided 5 visual tests for the `shortestPath()` function and `minimumSpanningTree()` by drawing the graphs and outlining the outputs for the shortest paths and all the minimum spanning trees to demonstrate that the output of the program is what is expected.
- b. In Function Tests() in file Graph.cpp lines 266 -> 277 tests the `addNode()` Function
- c. In Function Tests() in file Graph.cpp line 272 is a visual test for the `display()` Function
- d. In Function Tests() in file Graph.cpp lines 279 -> 303 tests the `connectNodes()` function
- e. In Function Tests() in file Graph.cpp lines 305 -> 312 tests the `getSize()` function

3. Implementation

- a. Function `addNode()` in file Graph.cpp lines 34 -> 38 adds nodes to the graph
- b. Function `connectNodes()` in file Graph.cpp lines 40 -> 63 connects the nodes in the graph
- c. Function `shortestPath()` in file Graph.cpp lines 79 -> 152 finds the shortest path from a given node to all other nodes in the graph
- d. Function `minimumSpanningTree()` in Graph.cpp lines 165 -> 251 find the shortest path to reach all other nodes in the graph

4. Complexity

- a. For my `shortestPath()` Function ideally using Dijkstra's Algorithm my O value would be $O(E + V \log(V))$ but mine is far from ideal and its big O value is $O(V^2)$ due to the nested for loop in my while loop
- b. For my `minimumSpanningTree()` the worst case scenario would be $O(V^2)$ due to my nested for loop in a for loop in a while loop
- c. `addNode()` functions time complexity is $O(1)$ because you only ever add one node at a time
- d. `connectNodes()` time complexity is $O(V)$ because of the one for loop to find the source and destination node
- e. `getSize()` is $O(1)$ because it returns one node at a time
- f. `display()` is $O(V)$ because of the for loop to display the node values
- g. `printPath()` is also $O(V)$ because while it does not have a loop in it, it is recursively called by a for loop
- h. Lastly `printSlash()` has one for loop making it $O(n)$