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**PROJECT 4- Graph Algorithms” Minimum Spanning Tree**

**Objective:** The purpose of this project is to implement two algorithms to solve the minimum spanning tree of a graph. One algorithm we are using is Prim and the other one is a new algorithm to solve MST.

**Summary:**

In this project, we implemented Prim’s Algorithm to find the minimum spanning tree in our graph. Prim’s is a greedy type of algorithm that finds a subset of edges that contains every vertex to minimize the total weight of the tree. It works by starting with one vertex from a graph and then adding more vertices to it one at a time with the lowest possible weighted edge. The total running time for this algorithm is O(VlgV + ElgV) = O(E lgV) where E is the number of edges and V is the number of vertices. In the new minimum spanning tree algorithm we created, we sort each of the edges in order from heaviest to light weight. For each edge, if the edge is part of a cycle of the graph, we remove that edge from the graph. We used the DFS method to find the cycle of the graph. In the end, we should return the graph which gives us the minimum spanning tree.

**Data:**

Table 1. Running Time for each Edge Weighted Graph

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Algorithm | tinyEWG | mediumEWG | largeEWG | 1000EWG | 10000EWG |
| Prim’s | 1 ms | 2 ms | Not enough memory | 2 ms | 7 ms |
| New Algorithm | 2 ms | 32 ms | Not enough memory | 21 ms | 766 ms |

**Conclusion:**

From this project, we learned how to implement two types of algorithms for finding the minimum spanning tree. One is a well-known algorithm called Prim, and another is one we created ourselves. We also learned that the running time of Prim is O(E lg V) and that the running time of DFS takes O(V+E) time. After running each method and calculating the running time of each one for each of the edge weighted graph, we find that the Prim’s method is a lot more efficient compared to the new one we created. On the tinyEWG, the prim’s algorithm running time is 1 ms while the new algorithm’s time is 2 ms, and on the 10000EWG, the prims algorithm running time is 7ms and the new algorithm is 766 ms. We also fail to run the largeEWG because it contains too much memory. In the end, we find that prims has a much lower running time than the new algorithm.