Hana Park CS 470 Exam 4 Analysis

Question 2: MST-PRIM: Please implement the source code of MST-PRIM algorithm. The pseudocode is in the textbook (Cormen's version), page 634.

1. **Implementation Explanation:**

Prim's MST takes a 2D array with integers. The indexes of the vector of vectors/2D arrays represent the lines that connect to each other if there is a array value greater than 0. In order to implement Prim's algorithm in which we connect all vertices, we will create s set of vertices that are already connected. To do this, we will do the following. After assigning a key value to all vertices in the original graph, the keys will all initially be set to negative infinity. Then the key value will be assigned as 0 for the first vertex. After this initialization PRIMS function will continue to pick a vertex that has not been added and include it to the set until they have all been seen. Every time the vertex is picked and has a minimum key value, the function will iterate through each adjacent vertices' and update key values. This is done by comparing whether the weight of the edge is less than the previous key value.

2. **Time and Space Complexity Analysis**

The overall time complexity of the algorithm will take vertex V^2 time (O(V^2)). This is because the nested for loop within the Prims function has to check and see if the connection exist between two vertices and the printing function prints out all the final connections. This can be done more efficiently with adjacency lists. The space complexity is also V^2 for the 2D array that holds the final connection graph (O(V^2)).

3. **The screenshots of your algorithms' outputs**

```
Test Case 1 with V=9
0 4 0 0 0 0 0 0 0
4 0 8 0 0 0 0 0 0
0 8 0 7 0 4 0 0 2
0 0 7 0 9 0 0 0 0
0 0 0 9 0 0 0 0 0
0 0 4 0 0 0 2 0 0
0 0 0 0 0 2 0 1 0
0 0 0 0 0 0 1 0 0
0 0 2 0 0 0 0 0 0

Test Case 2 with V=9
0 4 0 0 0 0 0 0 0
4 0 8 0 0 0 0 0 0
0 8 0 7 0 0 0 0 2
0 0 7 0 9 0 0 0 0
0 0 0 9 0 0 0 0 0
0 0 0 0 0 0 2 0 0
0 0 0 0 0 2 0 1 3
0 0 0 0 0 0 1 0 0
0 0 2 0 0 0 3 0 0

Test Case 3 with V=9
0 4 0 0 0 0 0 5 0
4 0 0 0 0 0 0 0 0
0 0 0 7 0 0 0 0 2
0 0 7 0 0 0 0 0 0
0 0 0 0 0 5 0 0 0
0 0 0 0 5 0 2 0 0
0 0 0 0 0 2 0 0 3
5 0 0 0 0 0 0 0 7
0 0 2 0 0 0 3 7 0
PS C:\Users\Hana Park\CS4
```