# Tutorial-6

Akinjay Aggarwal I, 35

Qn1→ What do you mean by Minimum spanning Tree? What is the application of MST.

A minimum spanning tree or minimum weight spanning tree is a subset of the edges of a connected, edge-weighted undirected graph that connects all the vertices together, without any cycle and with minimum possible total edge weight.

Applications

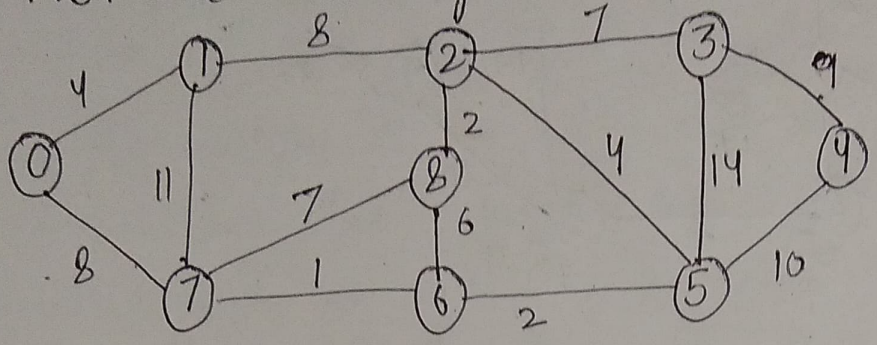
- Designing local area network.
- Laying pipelines connecting offshore drilling sites, refineries and consumer markets.
- Suppose you want to construct highways or roadways spanning several cities, there we use the concept of MST.
- To reduce cost, you use the concept of MST to connect the houses.

Qn2→ Please analyze the time and space complexity of Prim's, Kruskal, dijkstra's and Bellman Ford Algorithm.

Soln⇒

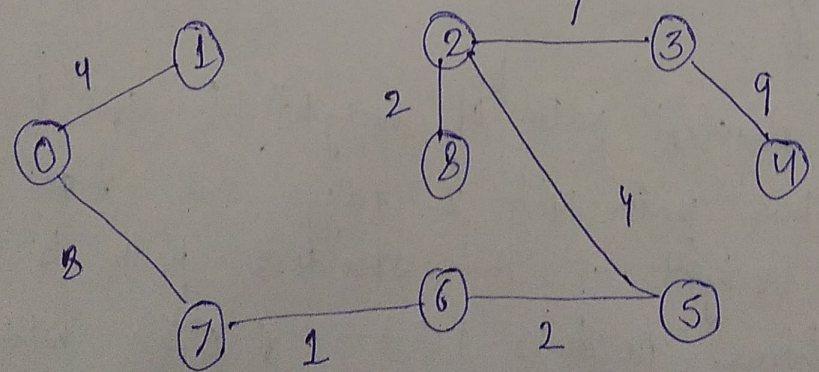
| Algorithms | Time Complexity | Space Complexity |
|---|---|---|
| Prim's | $O(V^2)$ | $O(V+E)$ |
| Kruskal | $O(E \log V)$ | $O(\log E)$ |
| Dijkstra | $O(V+E)$ | $O(V+E)$ |
| Bellman | $O(VE)$ | $O(V)$ |

Q3. Apply Prims and Kruskal algo on the graph to compute MST and its weight.

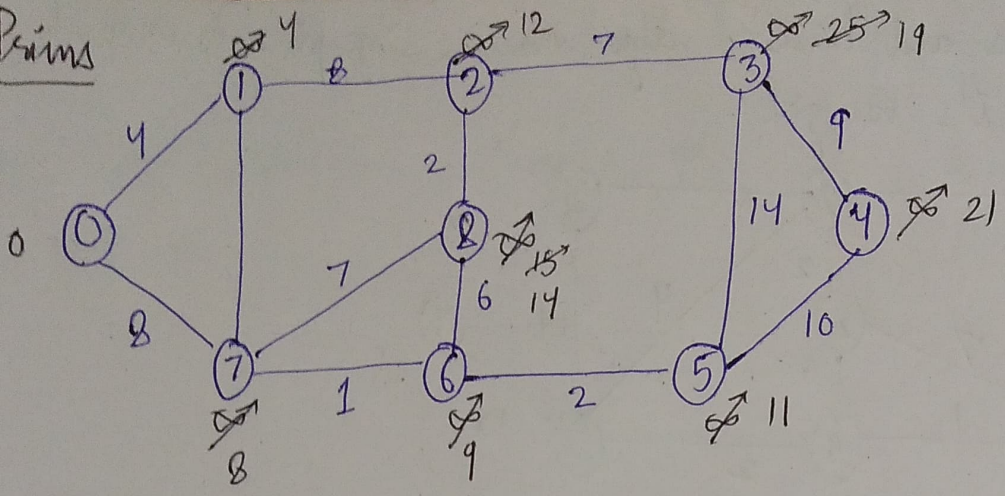


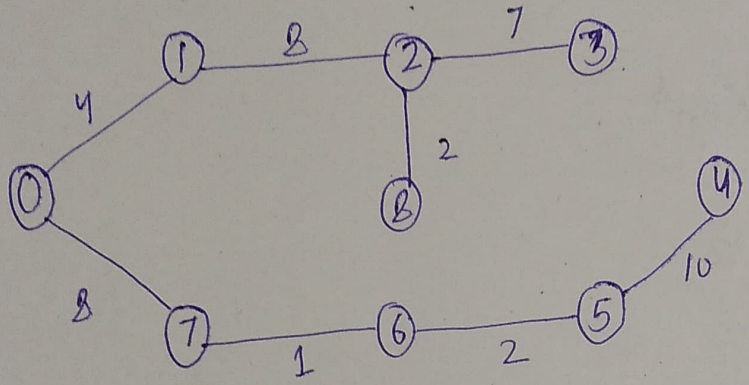

Soln ⇒ Kruskal

| Path | Weight |
|---|---|
| 7→6 | 1 |
| 6→5 | 2 |
| 2→8 | 2 |
| 0→1 | 4 |
| 2→5 | 4 |
| 8→6 | 6 |
| 2→3 | 7 |
| 7→8 | 7 |
| 0→7 | 8 |
| 1→2 | 8 |
| 3→4 | 9 |
| 5→4 | 10 |
| 1→7 | 11 |
| 3→5 | 14 |



Prims




MST

Qn:- Given a weighted graph. You are also given the shortest path from a source vertex 's' to a given destination vertex 't'. Does the shortest path remains same in the modified graph in the following case.

- If the weight of every edge is ~~red~~ by 10 units
- If the weight of every edge is multiplied by 10 units.

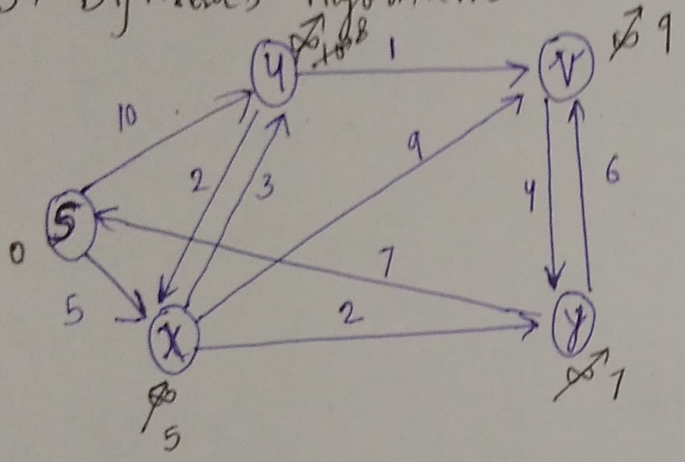
Soln:- The shortest path may change. The reason is that there may be different number of edges in different paths from 's' to 't'.

For example → Let shortest path be of weight 15 and has 5 edges Let there be another path with 2 edges and total weight is 25. The weight of the shortest path is increased by 5*10 and hence becomes 15+50 (65), while the

Weight of other path is increased by $2^* 10$, it becomes 25+20 (45), so shortest has changed to other path whose weight is 45.

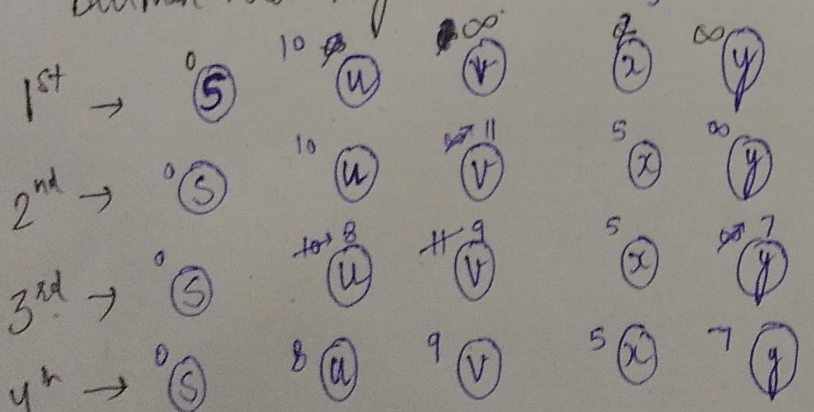
(iii) If we multiply all the edges with 10, the shortest path does not change. The reason is ~~same~~ that weight of all ~~pat~~ paths from 's' to 't' is multiplied by some amount. The number of edges on a path does not matter.

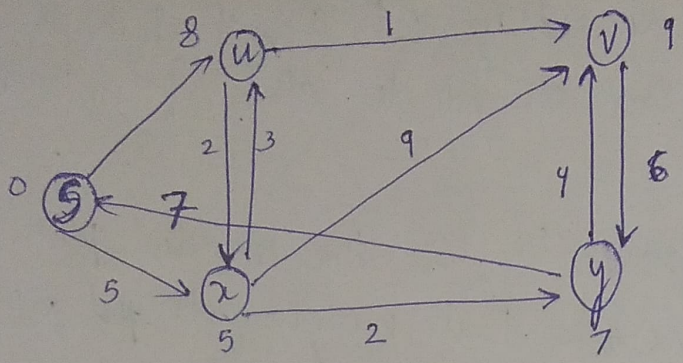
Q5- Dijkstra's Algorithm




| Node | Shortest distance from source node |
|---|---|
| u | 8 |
| x | 5 |
| v | 7 |
| y | 9 |

Bellman Ford Algorithm




s
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