TUTORIAL - 6

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1) Minimum Spanning Tree is a subset of edges of a connected edge-weighted undirected graph that connects all the vertices together without any cycles & with minimum possible edge weighted.

Applications :-

- Consider n stations are to be linked using a communication network and lying of communication link between any two stations involves a cost. The ideal solution would be to extract a subgraph termed as minimum cost spanning tree.
- Designing LAN.
- Suppose you want to construct highways or railroads spanning several cities, then we can use concept of MST.
- Laying pipelines connecting offshore drilling sites, refineries & consumer markets.

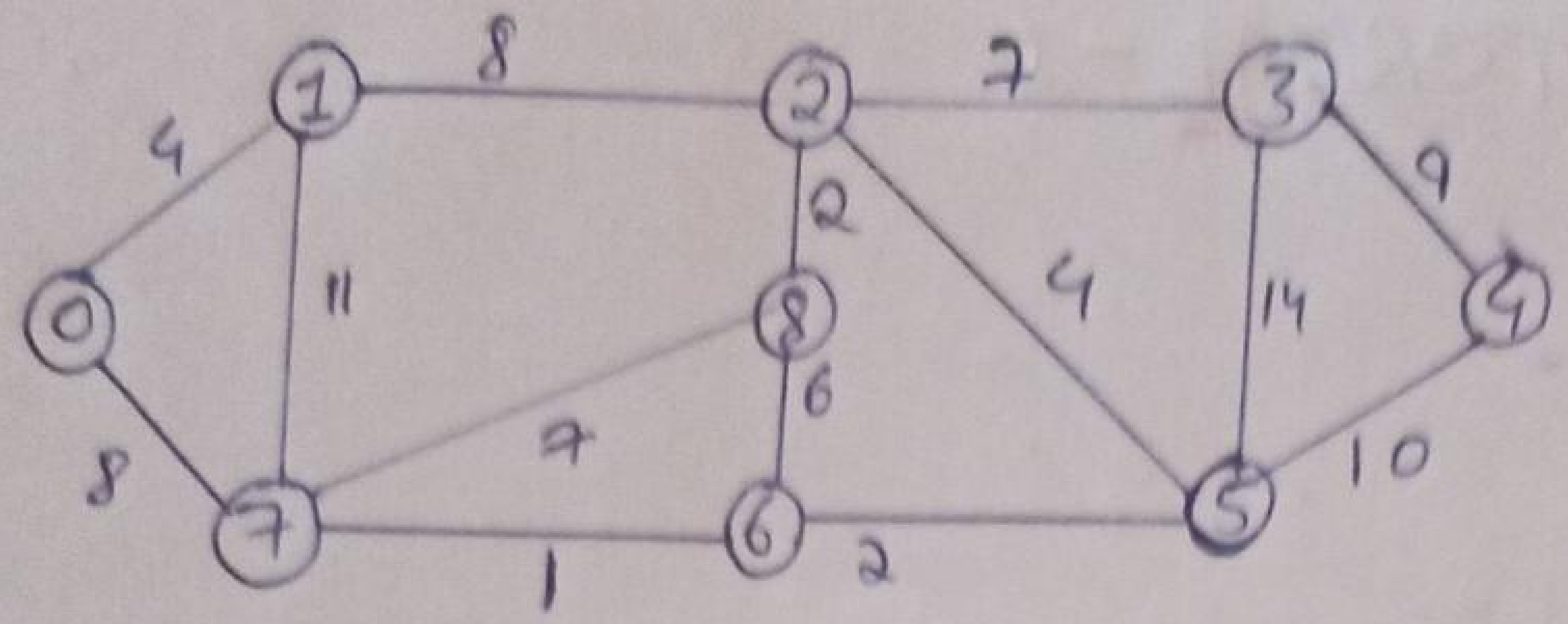
2) • Time complexity of Prim's algorithm : $O(|E|\log|V|)$
Space complexity of Prim's algorithm : $O|V|$

• Time complexity of Kruskal's algorithm : $O|E|\log|E|$
Space complexity of Kruskal's algorithm : $O|V|$

• Time complexity of Dijkstra's algorithm : $O(V^2)$
Space complexity of Dijkstra's algorithm : OV^2

• Time complexity of Bellman Ford's algorithm : $O(VE)$
Space complexity of Bellman Ford's algorithm : $O(E)$

3)

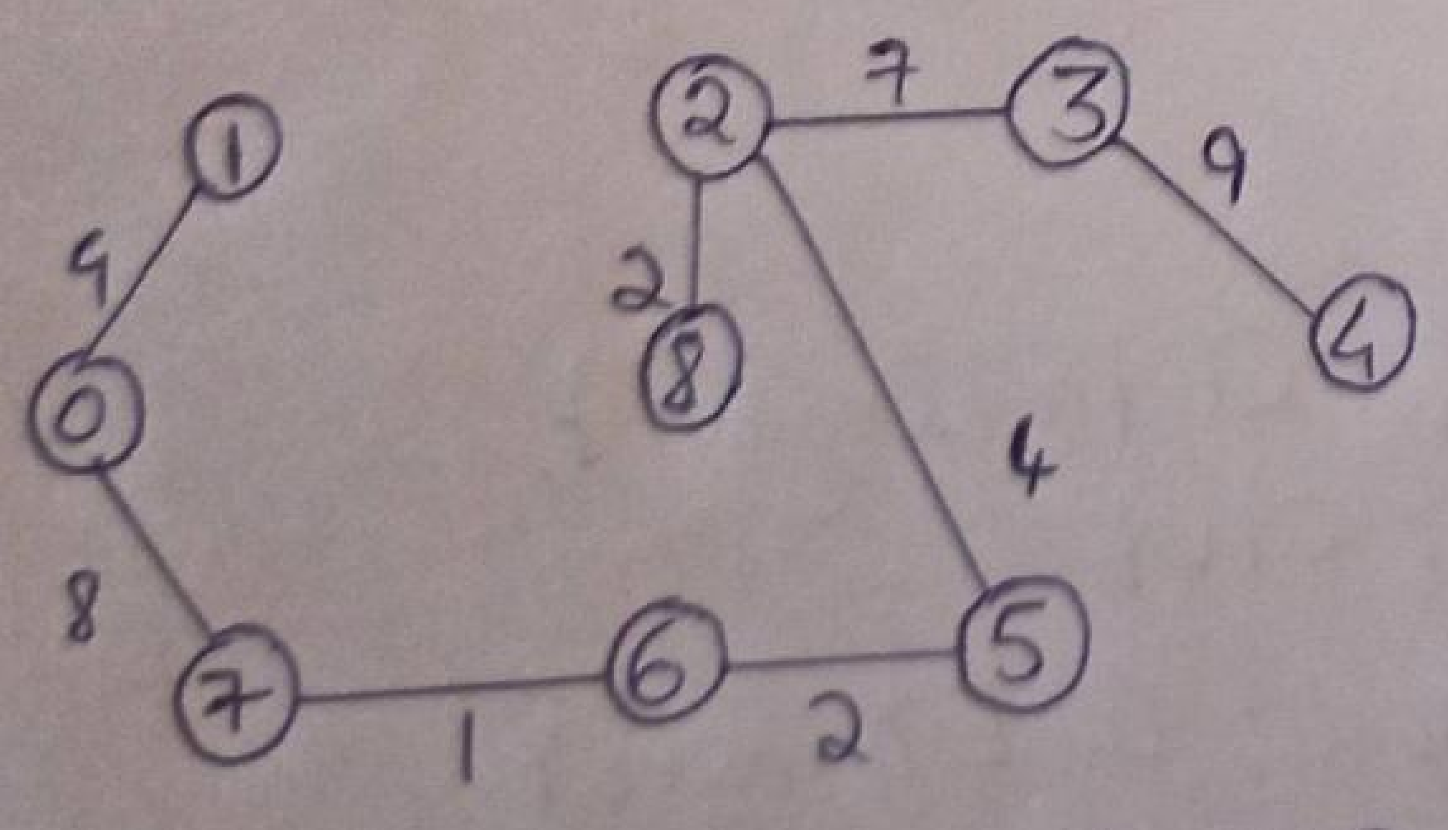


Kruskal's Algorithm

O	V	W
6	7	1
5	6	2
2	8	2
0	1	4
2	5	4
6	8	6
2	3	7
7	8	7
0	7	8
1	2	8
4	3	9
4	5	10
1	7	11
3	5	14

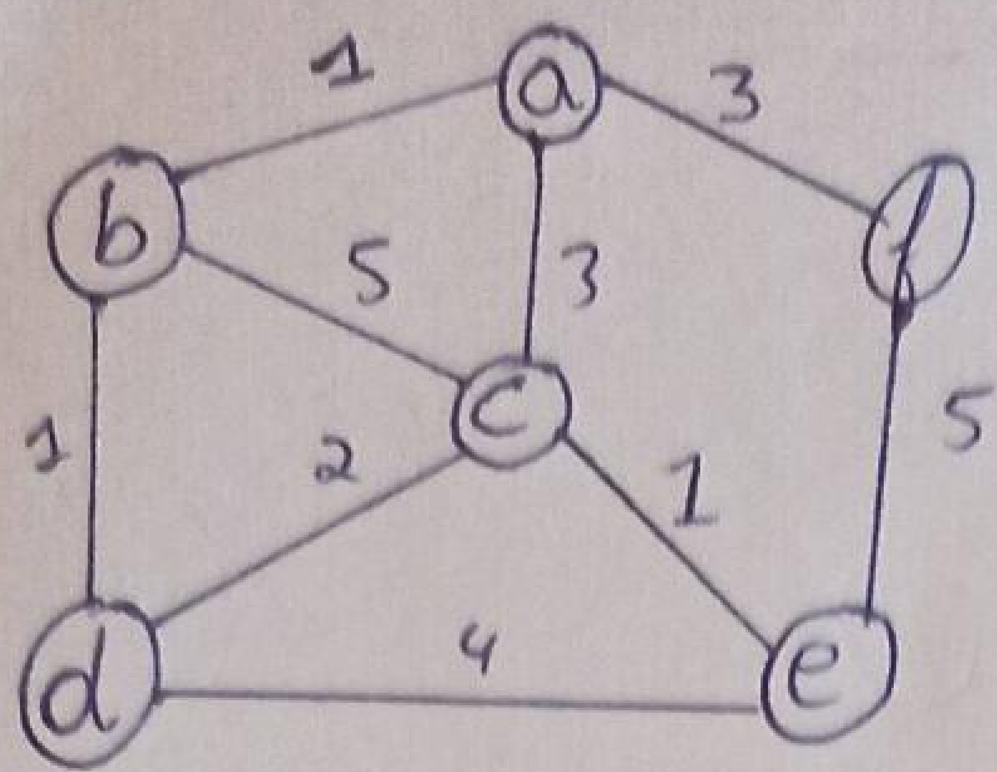
Prim's Algorithm

Weight $\Rightarrow 4+8+2+4+2+7+9+3$
$\Rightarrow 37$



Weight $\Rightarrow 1+2+2+4+4+7+8+9$
$\Rightarrow 37$

4)



(i) The shortest path may change. The reason is that there maybe different no. of edges in different paths from 's' to 't'.
Eg:- Let the shortest path of weight 15 and has edges 5.
Let there be another path with 2 edges and total weight 25.
The weight of shortest path is increased by 5*10 and becomes 15+50. Weight of shortest path is increased by 2*10 & becomes 25+20. So, the shortest path changes to other path with weight as 45.

(ii) If we multiply all edges weight by 10, the shortest path doesnot change. The reason is that weights of all path from 'S' to 't' gets multiplied by same unit. The numbers of edges or path doesn't matter.

5) Dijkastra's Algorithm:-

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

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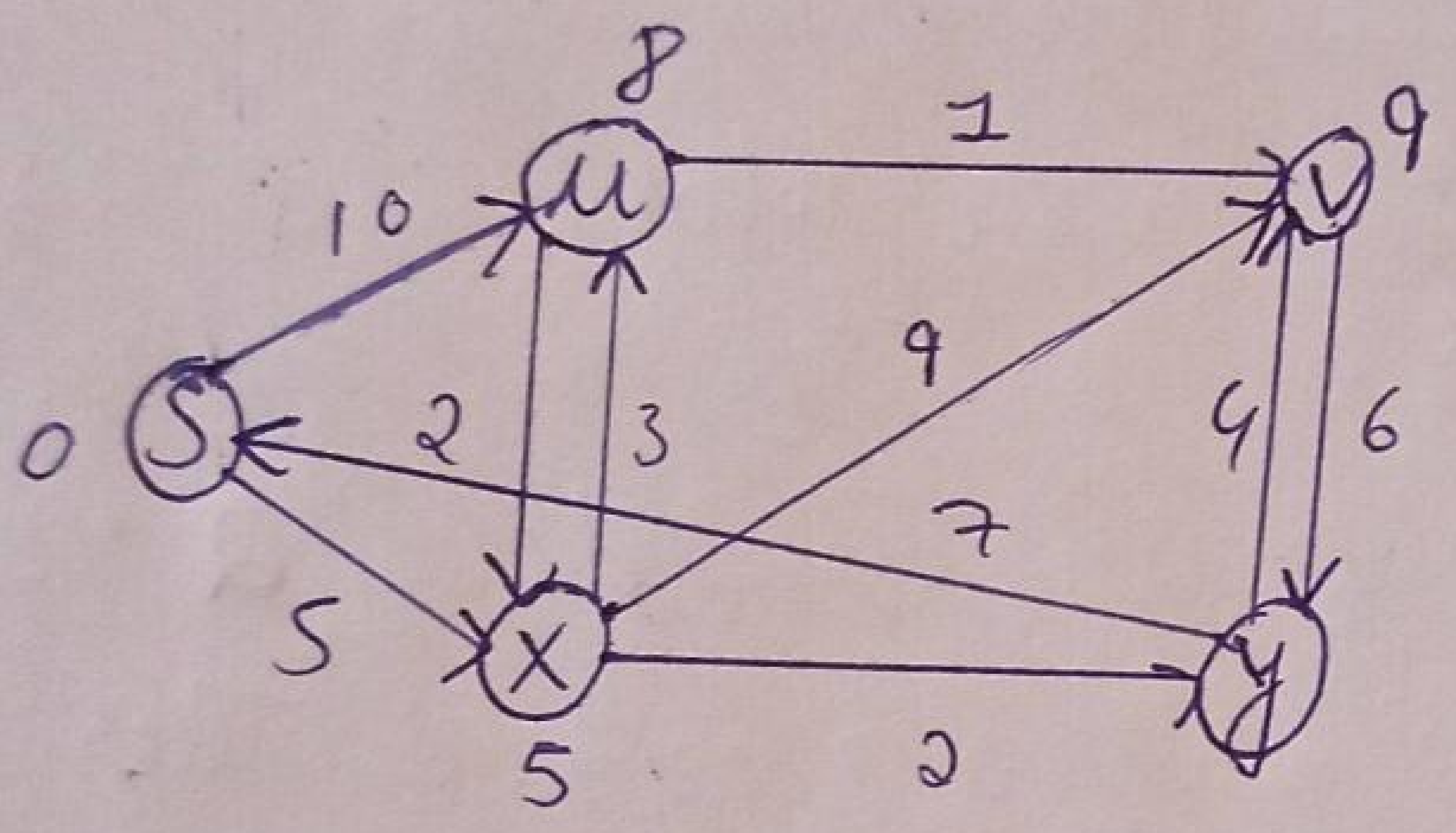
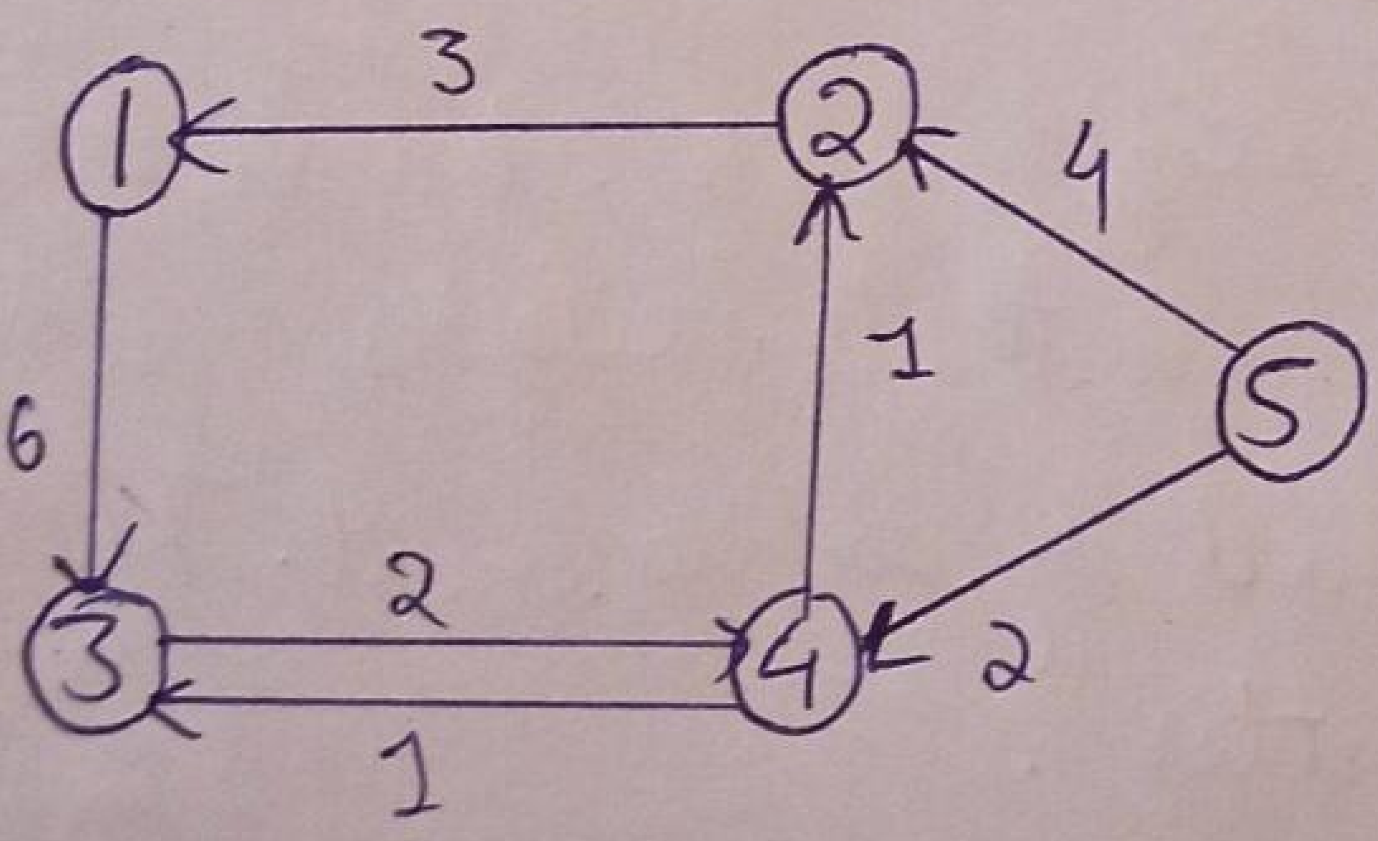
Bellman Ford's Algorithm →

	S	u	v	x	y
1st →	0	~~10~~ ∞	∞	~~∞~~ 5	∞
2nd →	0	10	~~∞~~ 11	5	∞
3rd →	0	~~10~~ 8	~~11~~ 9	5	~~∞~~ 7
4th →	0	8	9	5	7



← Final graph

6)



$$
\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{array}
\begin{array}{c}
\begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \end{array} \\
\begin{bmatrix}
0 & \infty & 6 & 3 & \infty \\
2 & 0 & \infty & \infty & \infty \\
\infty & \infty & 0 & 2 & \infty \\
\infty & 1 & 1 & 0 & \infty \\
\infty & 4 & \infty & 2 & 0
\end{bmatrix}
\end{array}
$$