DAA TUTORIAL - 6

Name - Samaridhi
Section - F
Roll no. - 24
University Roll no - 2016985.

Que> What do you mean by minimum spanning tree? What are the applications of MST?

Ans 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:

1) 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.

ii> Designing LAN.

iii> Suppose you want to construct high ways or railroads spanning several cities, then we can use concept of MST.

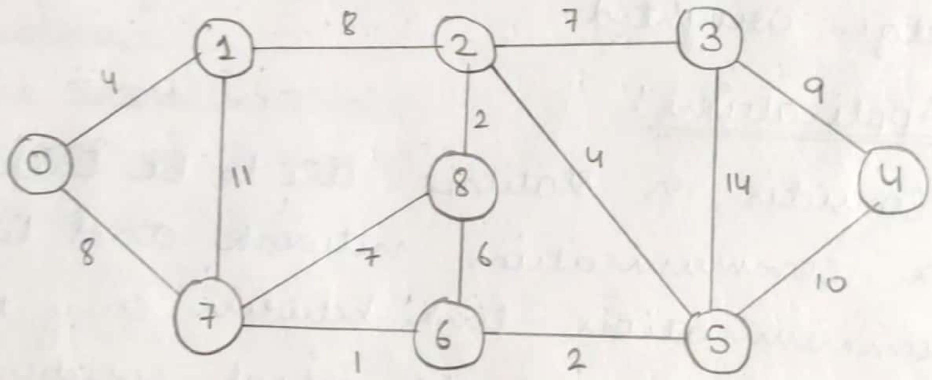
iv> Laying pipeline connecting off shore drilling site, refineries & consumer markets.

Que 2) Analyze time & space complexity of Prism, Kruskal, Dijkstra & Bellman Ford Algorithm.

Ans

	Time complexity	Space complexity
Prism's Algorithm	$O(\|E\| \log \|V\|)$	$O(V)$
Kruskal's Algorithm	$O(\|E\| \log \|E\|)$	$O\|V\|$
Dijkstra's Algorithm	$O(V^2)$	$O(V^2)$
Bellman ford Algorithm.	$O(VE)$	$O(E)$

Que 3) Apply Kruskal & Prism's Algorithm on given graph to compute MST & its weight.



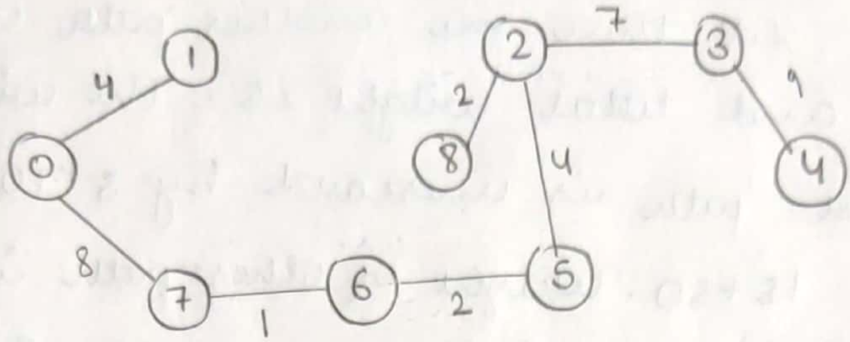
Ans Kruskal's Algorithm

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	✗

Prim's Algorithm

Weight = 4+8+2+4+2
+7+9+3
= 37 Ans

O	V	W	
4 >	3	9	✓
4	5	10	✗
1	7	11	✗
3	5	14	✗

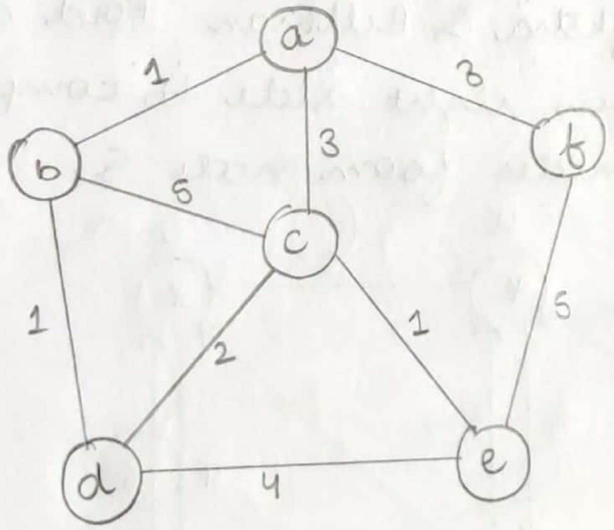


$$\text{Weight} = 1+2+2+4+4+7+8+9$$
$$= 37$$

<u>Que</u> 4> Given a directed weighted graph. You are also given the shortest path from a source vertex 's' to a destination vertex 't'. Does the shortest path remain same in following cases:

i> If weight of every edge is increased by 10 units

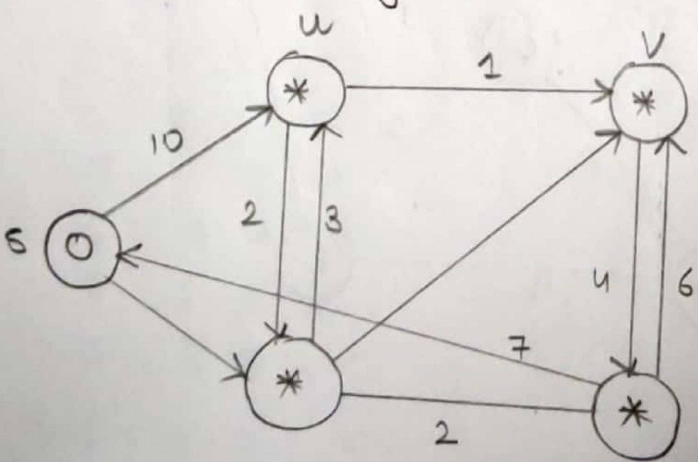
ii> If weight of every edge is multiplied by 10 units.



Ans i> The shortest path may change. The reason is that there may be different no. of edges in different paths from 's' to 't'. For ex:- 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 other 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 doesn't change. The reason is that weights of all path from 's' to 't' gets multiplied by same unit. The number of edges or path doesn't matter.

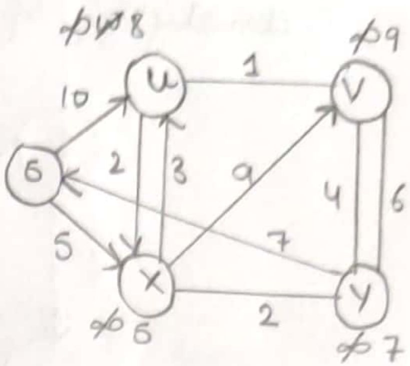
Que 5> Apply Dijkstra & Bellman Ford algorithm on graph given right side to compute shortest path to all nodes from node S.



Ans

Dijkstra's Algorithm :

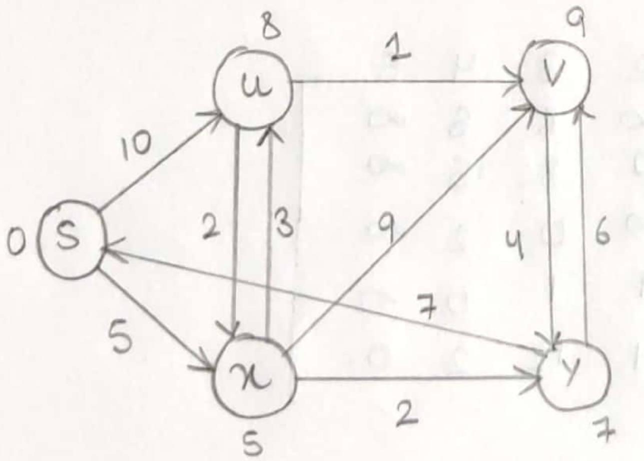
NODE	Shortest Dist from source node.
u	8
x	5
v	9
y	7



Bellman Ford 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

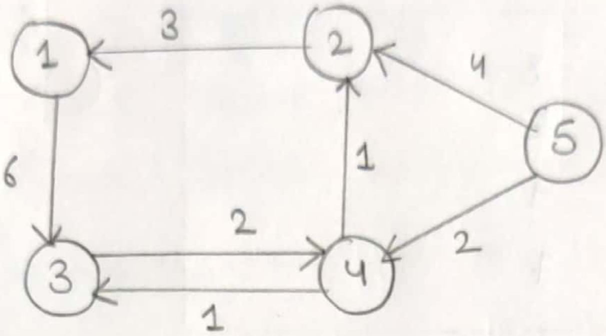
graph does not have negative cycle.



→ Final Graph.

Scanned by CamScanner

Que 6) Apply all pair shortest path algorithm. Floyd Warshall on below mentioned graph. Also analyze space & time complexity of it.



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

$$
\begin{array}{c|ccccc|}
 & 1 & 2 & 3 & 4 & 5 \\
\hline
1 & 0 & \infty & 6 & 3 & \infty \\
2 & 2 & 0 & 8 & 5 & \infty \\
3 & \infty & \infty & 0 & 2 & \infty \\
4 & \infty & 1 & 1 & 0 & \infty \\
5 & \infty & 4 & \infty & 2 & 0
\end{array}
$$

$$
\begin{array}{c|ccccc|}
 & 1 & 2 & 3 & 4 & 5 \\
\hline
1 & 0 & \infty & 6 & 3 & \infty \\
2 & 2 & 0 & 8 & 5 & \infty \\
3 & \infty & \infty & 0 & 2 & \infty \\
4 & 3 & 1 & 1 & 0 & \infty \\
5 & 6 & 4 & 12 & 2 & 0.
\end{array}
$$

$$
\begin{array}{c|c}
 & \begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \end{array} \\
\begin{array}{c} 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{array} &
\begin{bmatrix}
0 & \infty & 6 & 3 & \infty \\
2 & 0 & 8 & 5 & \infty \\
\infty & \infty & 0 & 2 & \infty \\
3 & 1 & 1 & 0 & \infty \\
6 & 4 & 12 & 2 & 0
\end{bmatrix}
\end{array}
$$

$$
\left.\begin{array}{l}
\text{Time complexity} : O(|V|^3) \\
\text{space Complexity} : O(|V|^3)
\end{array}\right\} \underline{\underline{\text{Ans}}}
$$