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Tutorial 6

Q1. Minimum spanning tree : A minimum spanning tree (MST) or minimum weight spanning tree is a subset of the edges of a connected, edge weighted undirected graph that connects all the minimum possible total edge weight.

Applications :

(i) It is used in computer networkes and Telecommunication network.

(ii) Suppose you want to construct highways or railroads spanning several cities then we can use the concept of minimum spanning tree.

(iii) Designing LAN

(iv) laying papilines connecting offshore drilling sites, refineries & consumer matrix

(v) suppose you meant to apply a set of houses with.
- Electric Power
- water
- Telephone line.
- sewage line.

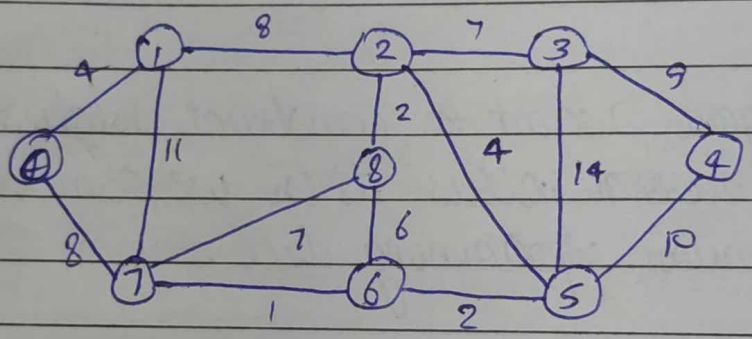
Sol 2. Time complexity of Prim's algorithm : $O(|E| \log |V|)$
space " " " " : $O(V)$.

Time complexity of Kruskal's algorithm : $O(|E| \log |E|)$
space " " " " : $O(|V|)$

Time complexity of Dijkstra's algorithm : $O(V^2)$
space " " " " : $O(V^2)$

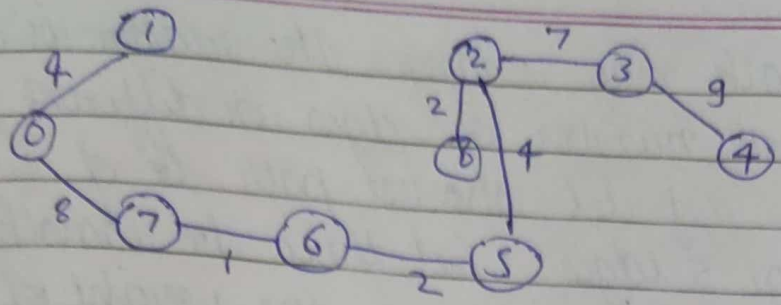
Time complexity of Bellmanford's algorithm : $O(VE)$
space " " " " : $O(E)$

Sol 3.



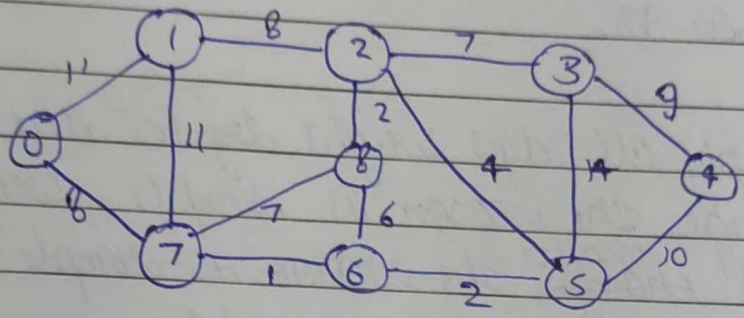
Kruskal's algorithm

U	V	W	
6	7	1	✓
5	5	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	✗



weight = 1+2+2+4+4+7+8+9 = 37

Prim's algorithm

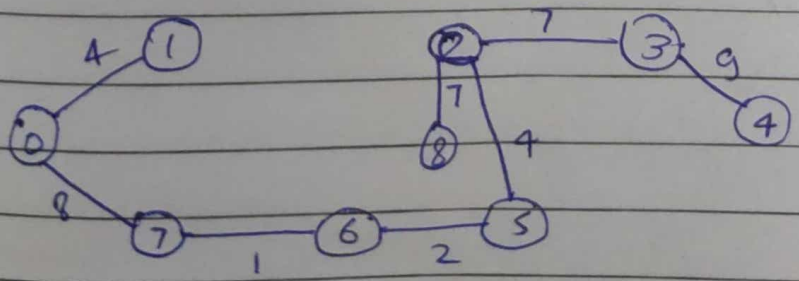


weight

0	1	2	3	4	5	6	7	8
0 ✓	∞	∞		∞			∞	
	4						8	
		8				1		7
	11		7		4			2
		4			2			6
			14	10				
			7	9				

Parent :

0	1	2	3	4	5	6	7	8
-1	$\times_0$	$\times_1$	-1	-1	-1	$\times_1$	$\times_0$	-1

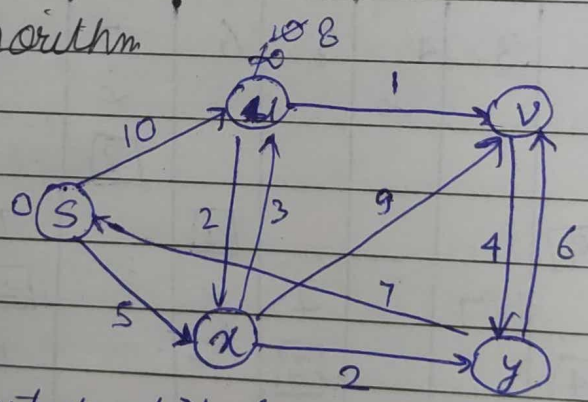


weight : 4+8+1+2+4+2+7+9 = 37

Sol 4 (i) The shortest path may change. The reason is there may be different number of edges in different paths from 's' to 't'. e.g. let shortest path be of weight 15 and has edge 5 edges. Let there be another path with 2 edges & total weight 25. The weight of the shortest path is increased by 5×10 & becomes $15 + 50$. Weight of the other path is increased by 2×10. & becomes $25 + 20$. So, the shortest path changes to the other path with weight as 45.

(ii) If we multiply all edges weight by 10, the shortest path doesn't change. The reason is simple, weights & of all path doesn't ~~change~~ matter, ~~The reason is simple, weight~~ It is like changing units of weights.

Sol 5 Dijkstra Algorithm



node	shortest dist. from source node
u	8
x	5
v	9
y	7

⇒ Bellman ford algorithm

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

(graph doesn't have -ve cycle)

final graph