Name - Dhruv Saini

Section - ML

Roll NO - 2015241, 24

Subject - Design & Analysis of Algo.

TCS 505

Tutorial

1

Minimum spanning tree is a spanning tree where the cost is minimum amoung all the spanning trees. There can be multiple minimum spanning trees also.

Minimum spanning tree has direct application in the design of networks. It is used in algorithms approximating the travelling salesman problem, multi-terminal minimum cut problem and minimum-cost weighted perfect matching

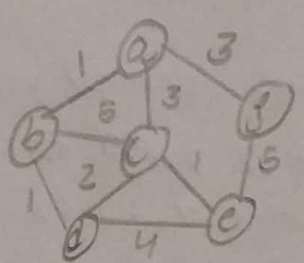
Its other practical applications are -

1. Image segmentation
2. Handwriting recognition
3. Cluster analysis

2

Algorithm	Time complexity	Space complexity
Prim's Algo.	$O(V^2)$ $O(E\log V)$	$O(\|V\|)$
Kruskal's Algo.	$O(E\log E) \equiv O(E\log V)$	$O(\|V\|)$
Dijkstra's Algo.	$O(E\log V)$	$O(\|V\| + \|E\|)$
Bellman Ford's Algo	$O(V \cdot E)$	$O(V)$

3.

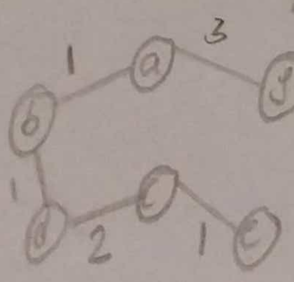


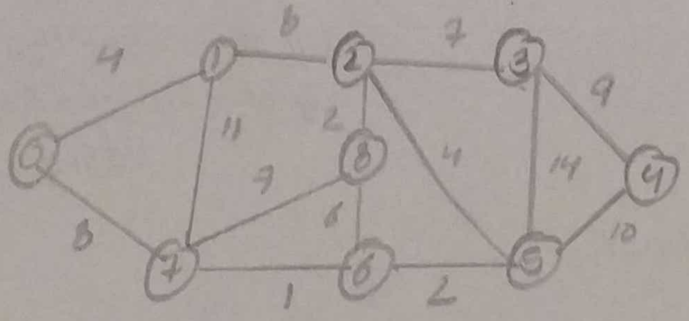
Using Kruskal's Algorithm

U	V	W	
a	b	1	✓
b	d	1	✓
c	e	1	✓
c	d	2	✓
a	c	3	
a	f	3	✓
d	e	4	
b	c	5	
e	f	5	

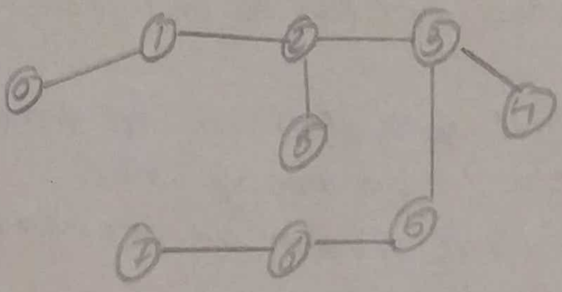
MST

Min wt = 8





MST



Min wt = 37

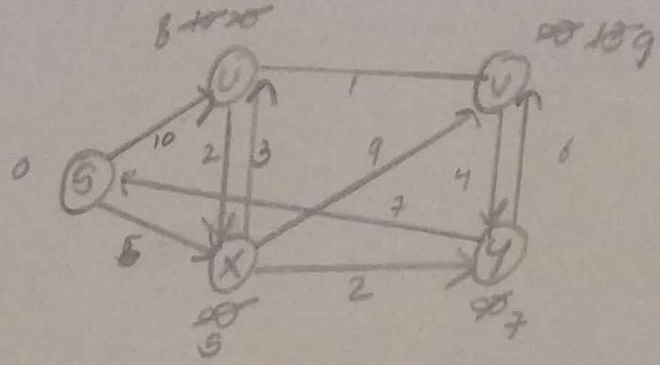
G	w	
0,1	4	✓
0,7	8	
1,7	11	
1,2	8	✓
2,3	7	✓
2,8	2	✓
2,5	4	✓
8,7	7	
8,6	6	
5,6	2	✓
5,3	14	
5,4	10	
6,7	1	✓
3,4	9	✓

4

- The shortest path may change. The reason is, there may be a different no of edges in different paths from 'S' to 'T' eg. let shortest path be of weight 15 and has 5 edges. let there be another path where 2 edges & total weight 25. The weight of the shortest path is increased by 5 * 10 and become 15+50.
  weight of other path is increased by 2 * 10 & becomes 25+20. So, the shortest path changes to the other path with weight as 45.

- If we multiply all edge weights by 10, shortest path doesn't change. The no. of edges on a path doesn't change. The no. of edges on a path doesn't matter

5



Dijkstra Algorithm

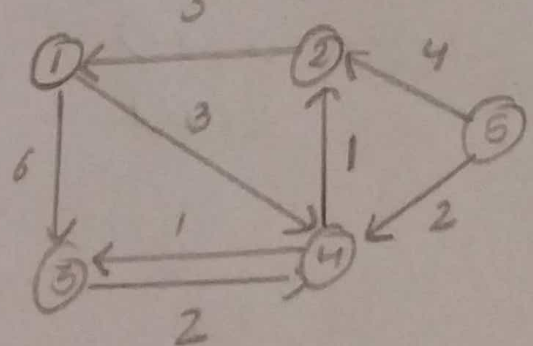
Node	Shortest dist. from source
u	8
v	9
x	5
y	7

Bellman Ford's Algorithm

s	u	v	x	y
0	~~∞~~	~~∞~~	~~∞~~	~~∞~~
	~~10~~ 8	9	5	7

s	u	v	x	y
0	8	9	5	7

6



D =

	1	2	3	4	5
1	0	∞	6	3	∞
2	3	0	∞	∞	∞
3	∞	∞	0	2	∞
4	∞	1	1	0	∞
5	∞	4	∞	2	0

D1 =

	1	2	3	4	5
1	0	∞	6	3	∞
2	3	0	9	6	∞
3	∞	∞	0	2	∞
4	∞	1	1	0	∞
5	∞	4	∞	2	0

D2 =

	1	2	3	4	5
1	0	∞	6	3	∞
2	3	0	9	6	∞
3	∞	∞	0	2	∞
4	4	1	1	0	∞
5	7	4	13	2	0

D3 =

	1	2	3	4	5
1	0	∞	6	3	∞
2	3	0	9	6	∞
3	∞	∞	0	2	∞
4	4	1	1	0	∞
5	7	4	13	2	0

D4 =

	1	2	3	4	5
1	0	4	4	3	∞
2	3	0	7	6	∞
3	6	3	0	2	∞
4	4	1	1	0	∞
5	6	3	3	2	0

D5 =

	1	2	3	4	5
1	0	4	4	3	∞
2	3	0	7	6	∞
3	6	3	0	2	∞
4	4	1	1	0	∞
5	6	3	3	2	0

TC = $O(V^3)$

SC = $O(V^2)$