* Graph:

Graph is a non-linear data structure in which Graph G is composed of a finite set of vertices and edges.

Represent as: G = (V, E)

⇒ Graph Representation:

There are two type of Graph Representation.

1) Adjancency Matrix Representation.
2) Adjacency Linked List Representation.

1 Adjacency Matrix Representation:

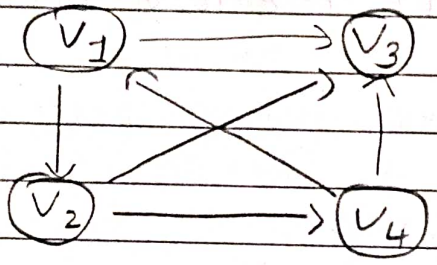
In this matrix representation, we have to use 2 dimensional array.

This representation is also called Sequential representation.

If edge from
V_i to V_j then $A[i, j] = 1$

If edges are not
from V_i to V_j then $A[i, j] = 0$

Ex.



	V_1	V_2	V_3	V_4
V_1	0	1	1	0
V_2	0	0	1	1
V_3	1	0	0	0
V_4	1	0	1	0

2 Adjacency Linked list Representation

In this representation, vertices are represent by ~~three~~ Two part,

1) Data
2) 2 link part.

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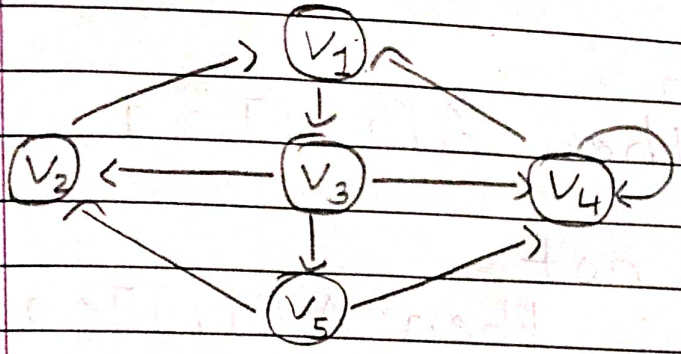
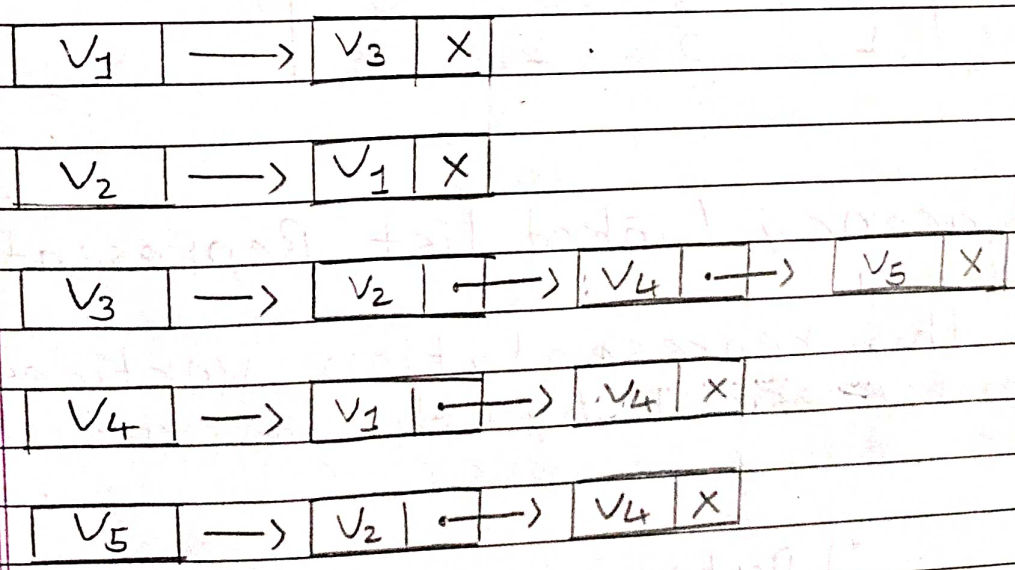
Ex.



Vertex with adjacency list,

$V_1 \rightarrow V_3$
$V_2 \rightarrow V_1$
$V_3 \rightarrow V_2, V_4, V_5$
$V_4 \rightarrow V_1, V_4$
$V_5 \rightarrow V_2, V_4$



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=> Basic Terminology of Graph:

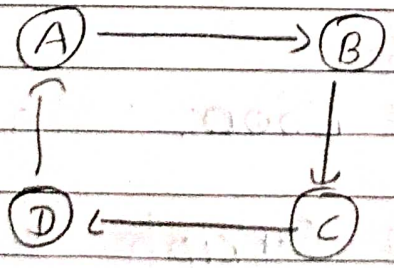
1 Directed Graph: A Graph is called directed Graph, if every ~~ve~~ edges of graph has direction.

2 Undirected Graph: A Graph is called undirected Graph, if edges does not have any direction.

3 Null Graph: A Graph is called null graph, if graph does not contain any edges.

4 Path: A path in a graph is a finite sequence of edges which joins a sequence of vertices.

Ex.



Path → A - B - C - D

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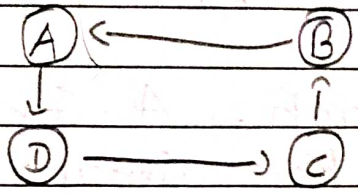
5 Cycle: A cycle is a path in which first and last vertices are same.

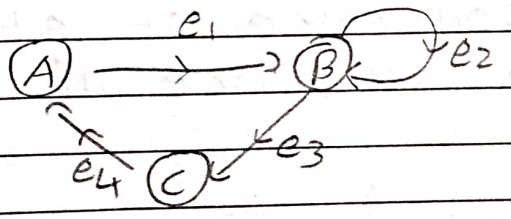
Ex.



Cycle → A - D - C - B - A

6 Loop: An edge will called Loop, if edges starting and ending point are same.

Ex.



e_2 is called Loop.

7 Cyclic Graph: Graph is called Cyclic Graph, if graph contain cycle.

8 Acyclic Graph: Graph does not contain cycle.

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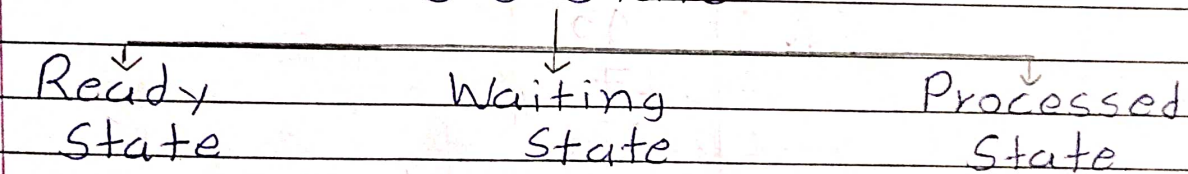
* BFS (Breath First Search):

Breath First Search method is use for searching in a graph.

For BFS searching, we have to use Queue for tracking graph.

In BFS, For tracking the graph we have to start from Root vertex.

In BFS there are three state.

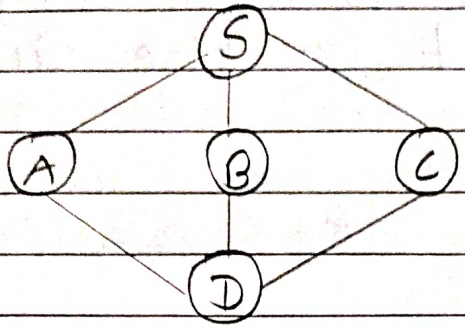


-> Ready State: Element is not in Queue and Processed not start.

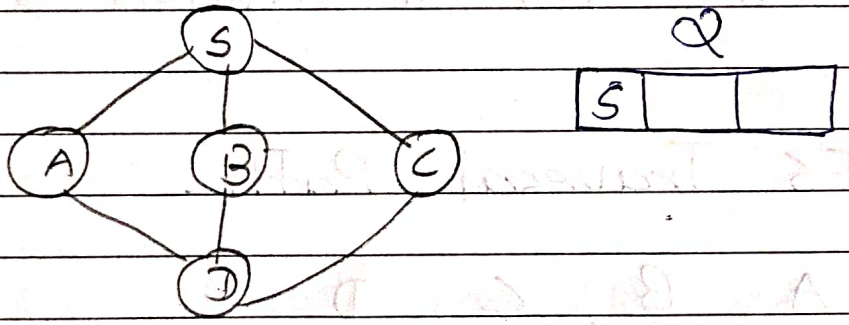
-> Waiting State: Element is in Queue, but Processed not start.

-> Processed State: Processed is start and element is out in the Queue.

Ex. Track the Graph:

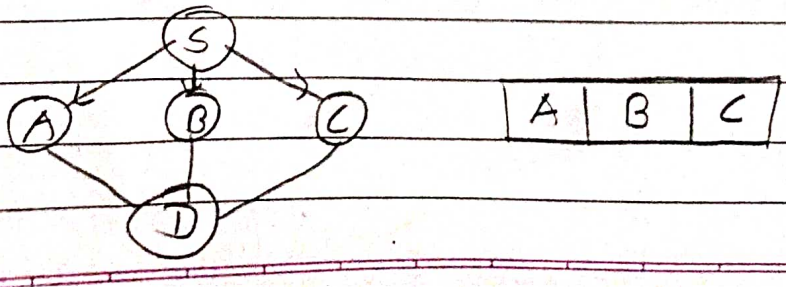


- Step-1 - In BFS, First we have to select Root vertex and insert root element in the Queue.

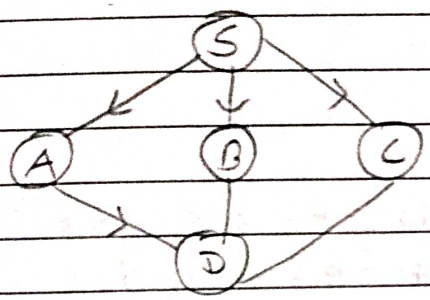


- Step-2 - After the root element we have to select adjcest nodes in the graph.

In this graph A, B and C are adjsent node and insert into Queue and delete root element



- Step - 3 - After that select First element and insert adjsent node element in the Queue



B	C	D

- Step - 4 - After the D element there are no a unwisited node.

So, BFS Travesal Path:

S, A, B, C, D

- Algorithm:

1 Initialize all nodes to ready state.

2 Insert the starting node in queue and change its state to waiting state.

3 ~~dete~~ Repeat the 4 and 5 step untill Queue is empty.

4 Delete the front node n of queue. Process and change to state to Processed state.

5 Insert n in the queue, all the adjesent node are in ready state and change this state to waiting state.

6 Exit.

* DFS:

Depth First Search method is use for searching in a graph.

For DFS, we have to use stack for tracking the path.

In DFS we have to start from the root node.

First we have to insert root element in root.

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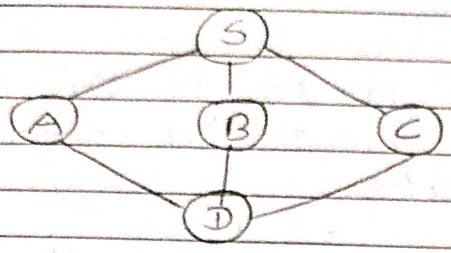
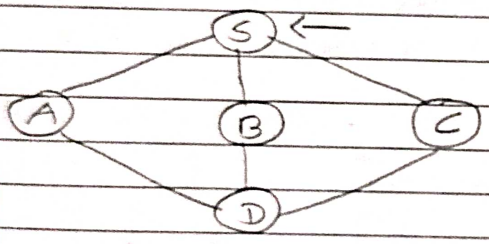
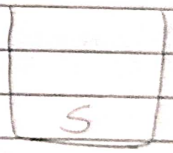
Ex. Track the Grap :



- Step-1 - In DFS, First we have to select root element and push root element in the stack.

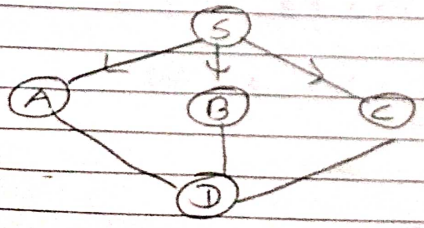




push S

- Step-2 - After the root element, we have to select root element adjesent node.

and pop the A and push A, B and C



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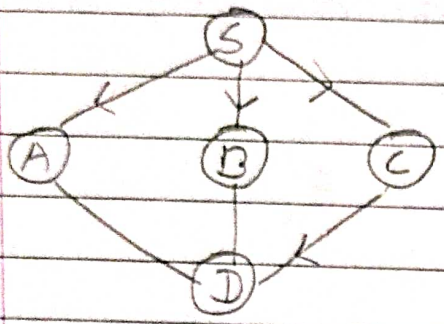
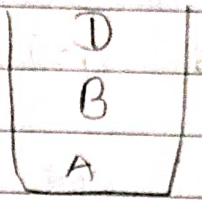
- step - 3 - After that take C element and push adjesent element of the C. and pop C.





- step - 4 - After that pop D, pop B and pop A.

So, DFS Travesal Path.

S C D B A

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* Minimum Spanning Tree:

=> Spanning Tree:

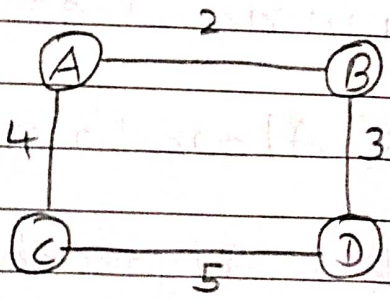
A spanning tree of a connected graph G contain all the nodes and has the edges which connects all the nodes.

In a spanning tree, there are no cycle in the graph.

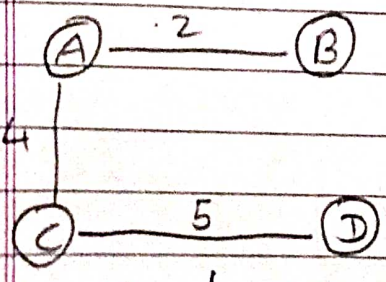
=> Minimum Spanning Tree:

A minimum spanning tree is founed when the edges are picked to minimize the total cost.

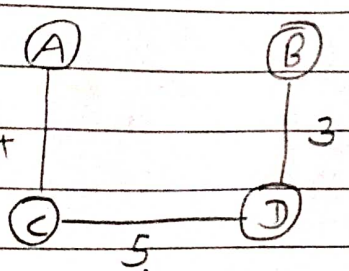
Ex.



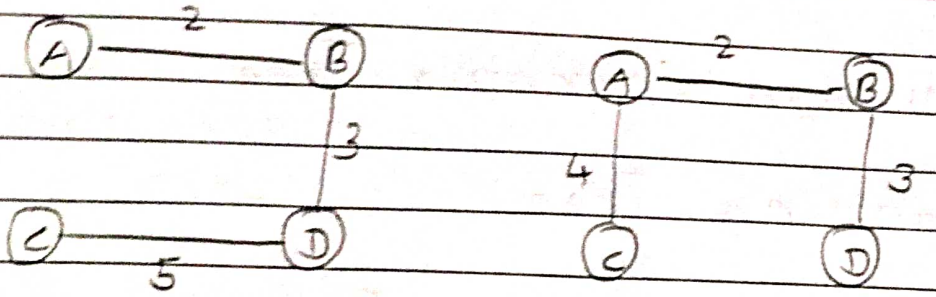
-> Spanning Tree:



Cost = 11



Cost = 12



Cost = 10 Cost = 9

- This four are possible spanning tree.
- Cost = 9 is a minimum spanning tree.

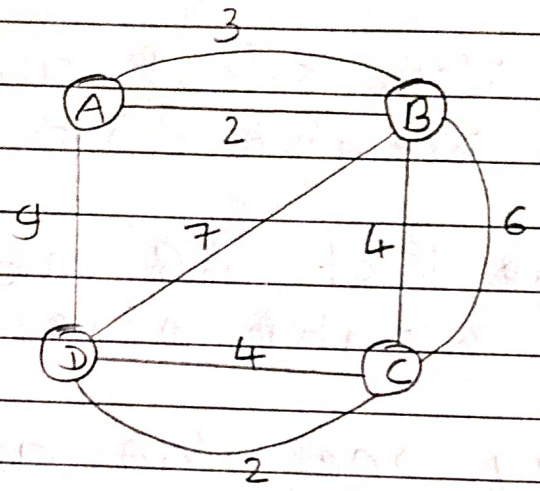
* 2 Method of Finding Minimum Spanning Tree.

There are two method of Finding Minimum Spanning Tree.

1) Prim's Algorithm
2) Kruskal's Algorithm.

1 Prim's Algorithm :

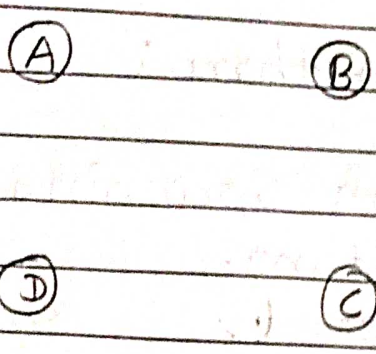
Ex. Find Minimum Spanning Tree using Prim's Algorithm:



- Step - 1 - Create edge list of this given graph.

Edge	Weight
AB	2
AB	3
AD	9
BC	4
BC	6
BD	7
CD	4
CD	2

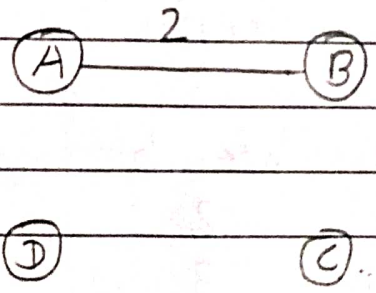
- Step - 2 - Create skeleton for Spanning tree.



- Step - 3 - Now select any edge with minimum weight from edge list.

In the edge list, AB and CD are minimum weight edge.

Select any one edge and delete from the list.

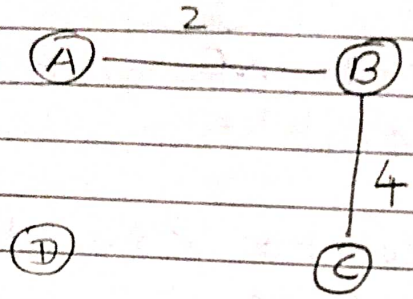


- Step-4 - After that select one end point from AB edge.

This are the edges: AB(3), AD(9), BC(6), BD(7), BC(4).

After that select minimum weight list.

In this list, BC edge is minimum weight edge.



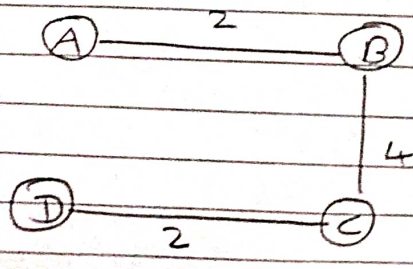
- step - 5 - After that select any one end from A, B and C.

This are the edges: AB(3), AD(9), BC(6), BD(7), CD(4), CD(2).

AB(3) and BC(6) are cycle. So, this edges are remove from list.

After that select minimum weight list.

In this list, CD edge is minimum weight edge in the list.



- Algorithm:

1 Start

2 Create edge list of given graph with their weights.

3 Draw all nodes to create skeleton for spanning tree.

4 Select edge with lowest weight and add it to skeleton and delete from edge list.

5 Select one end from edge list, while adding edge take the one end from skeleton tree and its cost should be minimum.

6 Repeat step-5 until n-1 edges are added.

7 End.

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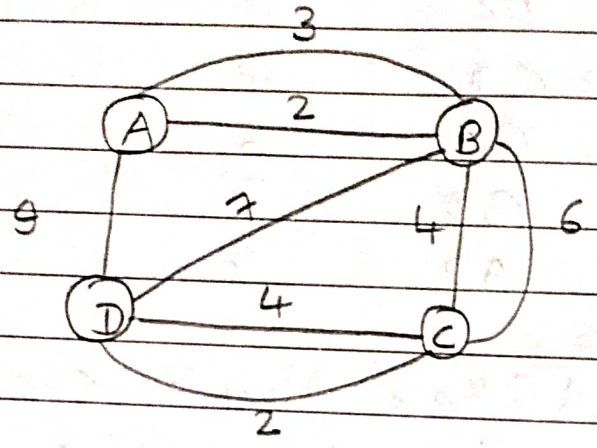
2 Kruskal's Algorithm:

Ex. Find the minimum spanning tree using Kruskal's Algorithm.



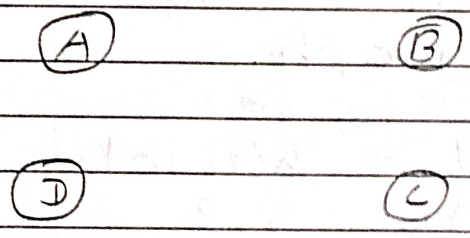
- Step-1- Create edge list of this given graph.

Edge	Weight
AB	2
AB	3
AD	9
BC	4
BC	6
BD	7
CD	4
CD	2

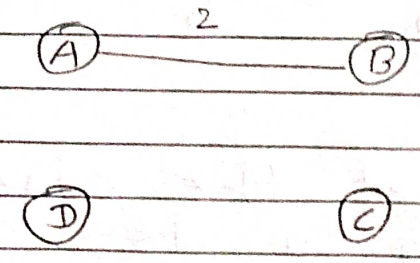
- Step-2 - Short the edges list according to its weight.

Edge	Weight
AB	2
CD	2
AB	3
BC	4
CD	4
BC	6
BD	7
AD	9

- step- 3 - After that, create skeleton for spanning list.

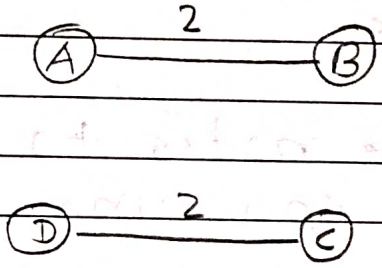


- step- 4 - After that, Now select first entry from the edge list and delete from the edge list.



- step-5 : Now select second entry from the list, but this entry does not create a cycle.

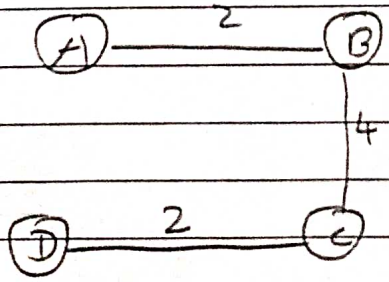
In this list, CD = 2 is a minimum edge in the list and remove from the list.



- step-6 - After that select next edge from the list. Here AB is create cycle.

So, we have to select next edge from the list.

In this list, BC = 4 is a minimum edge in the list.



- Algorithm:

1 Start

2 Create the edge list of given graph with its weight.

3 Sort the edge list according to their weights.

4 Draw all the nodes to create skeleton for spanning tree.

5 Pick up the edge at the top of the edge list and remove from the list.

6 Connect vertices in the skeleton until edges should be n-1.

7 Repeat this step 5 and 6.

8 End.