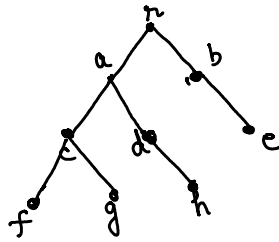**Binary Tree:** A tree whose elements have at most 2 children is called a binary tree. Since each element in a binary tree can have only 2 children, we typically name them the left and right child.
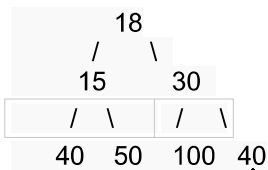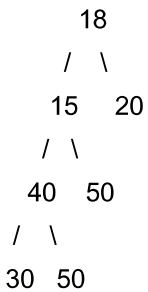

Types:

1) **Full Binary Tree** A Binary Tree is a full binary tree if every node has 0 or 2 children. The following are the examples of a full binary tree. We can also say a full binary tree is a binary tree in which all nodes except leaf nodes have two children.

  Example:

1)

```
        18
       /   \
     15     30
    /  \    /  \
  40   50 100  40
```

  2)

```
      18

     /  \

   15    20

  /  \

 40   50

/   \

30  50
```

In a Full Binary Tree, number of leaf nodes is the number of internal nodes plus 1

   L = I + 1

Where L = Number of leaf nodes, I = Number of internal nodes

(2) **Complete Binary Tree:** A Binary Tree is a complete Binary Tree if all the levels are completely filled except possibly the last level and the last level has all keys as left as possible
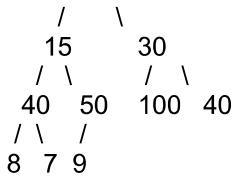The following are examples of Complete Binary Trees

1.
```
        18
       /   \
     15     30
    /  \    /  \
  40   50 100  40
```
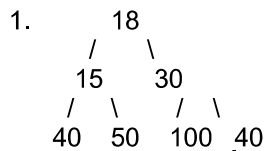
Full Binary Tree
⇒ Complete Binary Tree

2.

```
        18
```

```
      /  \
    15     30
   / \    /  \
  40  50 100  40
  / \  /
 8  7 9
```
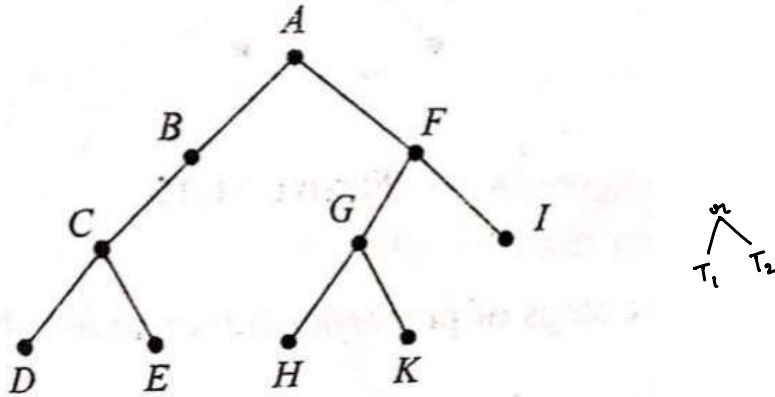
Complete Binary Tree
but not full Binary Tree

Note: <u>Every Full tree is Complete binary tree but converse is not true.</u>

Ques:1) Is the following is Binary Tree?   Yes
      2) Find pre-order, post-order and in-order traversal.

$$\overset{\text{or}}{\underset{T_1 \quad T_2}{\bigwedge}}$$

<u>Preorder</u> (or, T_1, T_2)

I) A, B, F II) A, B, C, F, G, I III) $A, B, C, D, E, F, G, H, K, I$

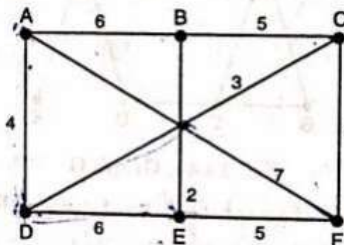<u>Inorder</u> (T_1, or, T_2)

(I) B, A, F (II) C, B, A, G, F, I (III) $D, C, E, B, A, H, G, K, F, I$

<u>Post Order</u> (T_1, T_2, or)

I) B, F, A (II) C, B, G, I, F, A IV) $D, E, C, B, H, K, G, I, F, A$

Ques: Find minimal spanning tree for the following weighted graph
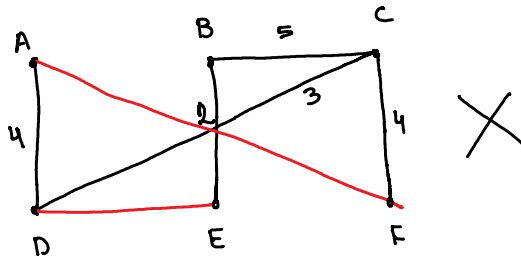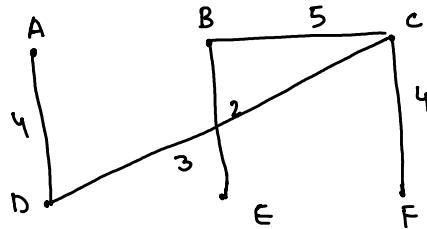
Sol:→ $|V| = 6$, For tree no. of edges are $6 - 1 = 5$
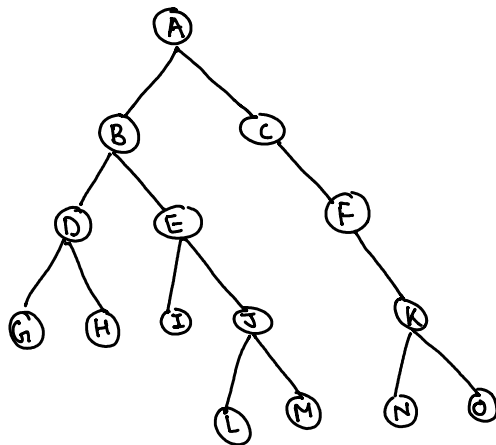
    Edge   Weight
```

| Edge | Weight |
|------|--------|
| 1 BE | 2 |
| 2 ED | 3 |
| 3 AD | 4 |
| 4 CF | 4 |
| BC | 5 |
| EF | 5 |
| DE | 6 |
| AF | 7 |



Minimal Spanning
tree is

Min wt = 2+3+4+4+5 = 18

Q:→



(i) What is the root node? → A

(ii) Depth of B and C → 1

(iii) Height of B and C → 3

(iv) Height of D, E and F → 1, 2, 2

Q:→ Find the minimal spanning tree

① 

②