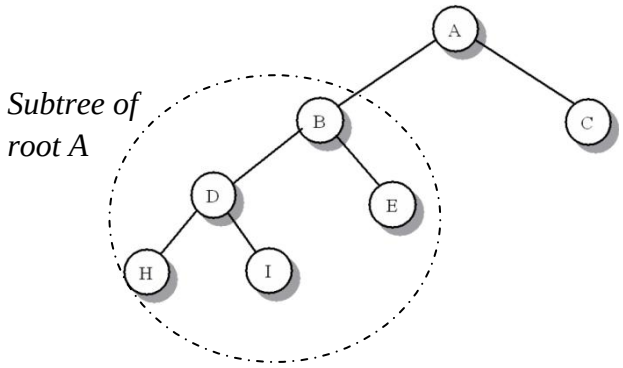
Tree Terminology cont... :

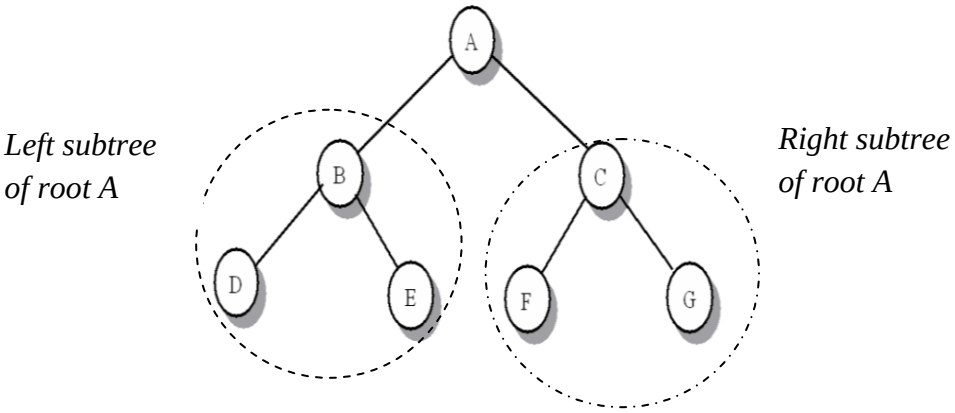
Path:

A *path* is a sequence of edges between nodes.

Subtrees of node n*:*

Subtrees of node *n* are the trees whose roots are the children of *n*.





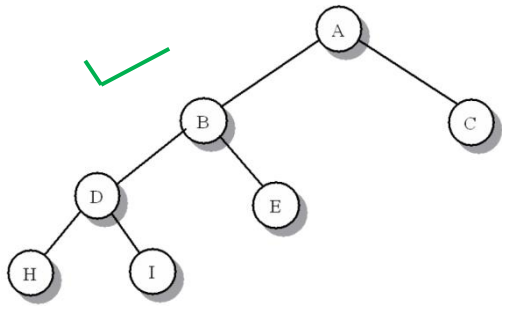
Binary Tree:

A *binary tree* is a tree in which each node has maximum two children, named as the *left child* and the *right child.*

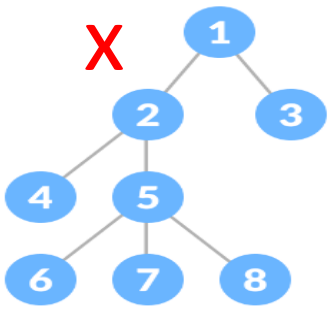
Any node in a binary tree has either 0, 1 or 2 child nodes.

Note: If a binary tree contains *m* nodes at level *l*, it contains at most *2m* nodes at level *l*+1

Example:



[A binary tree]

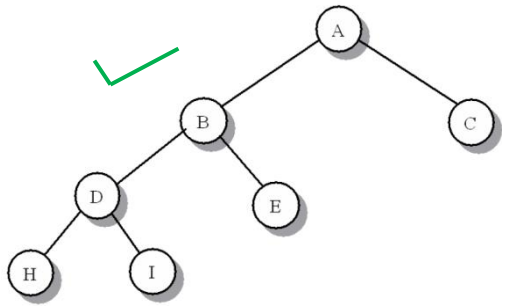


[Not a binary tree]

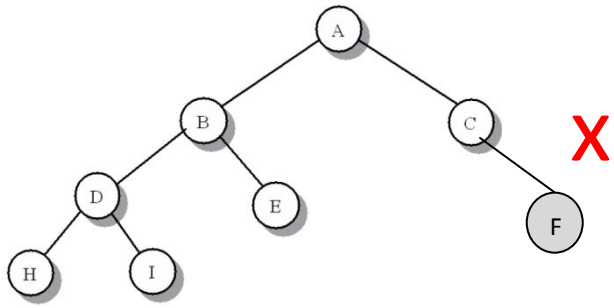
Strictly binary tree:

A strictly binary tree is a binary tree where each node has either 0 or 2 child nodes.

A strictly binary tree with *n* levels always contain *2n-1* nodes.



[A strictly binary tree]

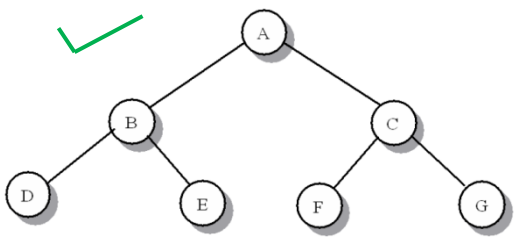


[A binary tree but not a strictly binary tree]

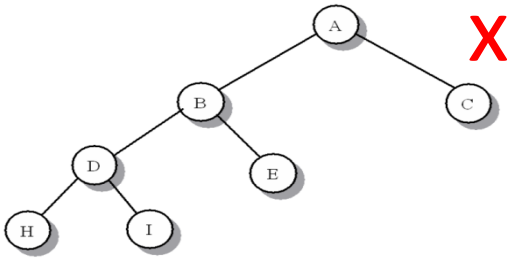
Complete binary tree:

A complete binary tree of depth *d* is the strictly binary tree all of whose leaf nodes are at level *d*.

A complete binary tree of depth *d* contains exactly 2^l nodes at each level.



[complete binary tree of depth 2]

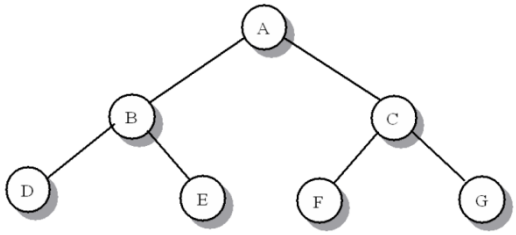


[not a complete binary tree, its a strict binary tree]

Some properties:

1. A complete binary tree of depth d contains exactly 2^l nodes at each level
2. In a complete binary tree, the number of nodes at depth d is $2^{d.}$
3. In a complete binary tree the height of the tree is $\log_2(n+1)-1$.

Explanations on properties:



[A complete binary tree of depth 2]

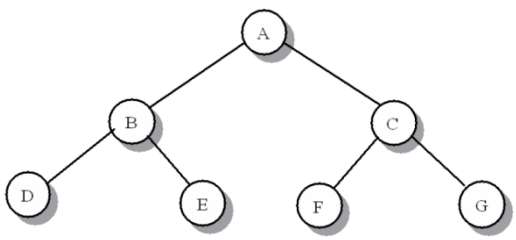
1. A complete binary tree of depth d contains exactly 2^l nodes at each level
   Example: depth of the tree=2
   At level 0, 2^0 nodes will be present. i.e. 1 nodes // node A
   At level 1, 2^1 nodes will be present. i.e. 2 nodes //node B, C
   At level 2, 2^2 nodes will be present. i.e. 4 nodes //node D, E, F, G

2. In a complete binary tree, the number of nodes at depth d is $2^{d.}$

   Example:
   Number of nodes at depth 0= 20 = 1. //node A
   Number of nodes at depth 1= 21 = 2. //node B, C
   Number of nodes at depth 2= 22 = 4. //Node D, E,F,G

3. In a complete binary tree the height of the tree is $\log_2(n+1)-1$, where n is the number of nodes.

   Example-1: If number of nodes in a tree=7
   So height of the tree= $\log_2(7+1)-1$
   $= \log_2(8)-1$
   $=3-1$
   $=2$
   height of the tree (with 7 nodes)=2



Example-2:

If number of nodes in tree = 15

So height of the tree= $\mathbf{\log_2(15+1)-1}$

$$= \log_2(16)-1$$
$$=4-1$$
$$=3$$

Example: height of the tree (with 15 nodes)=3