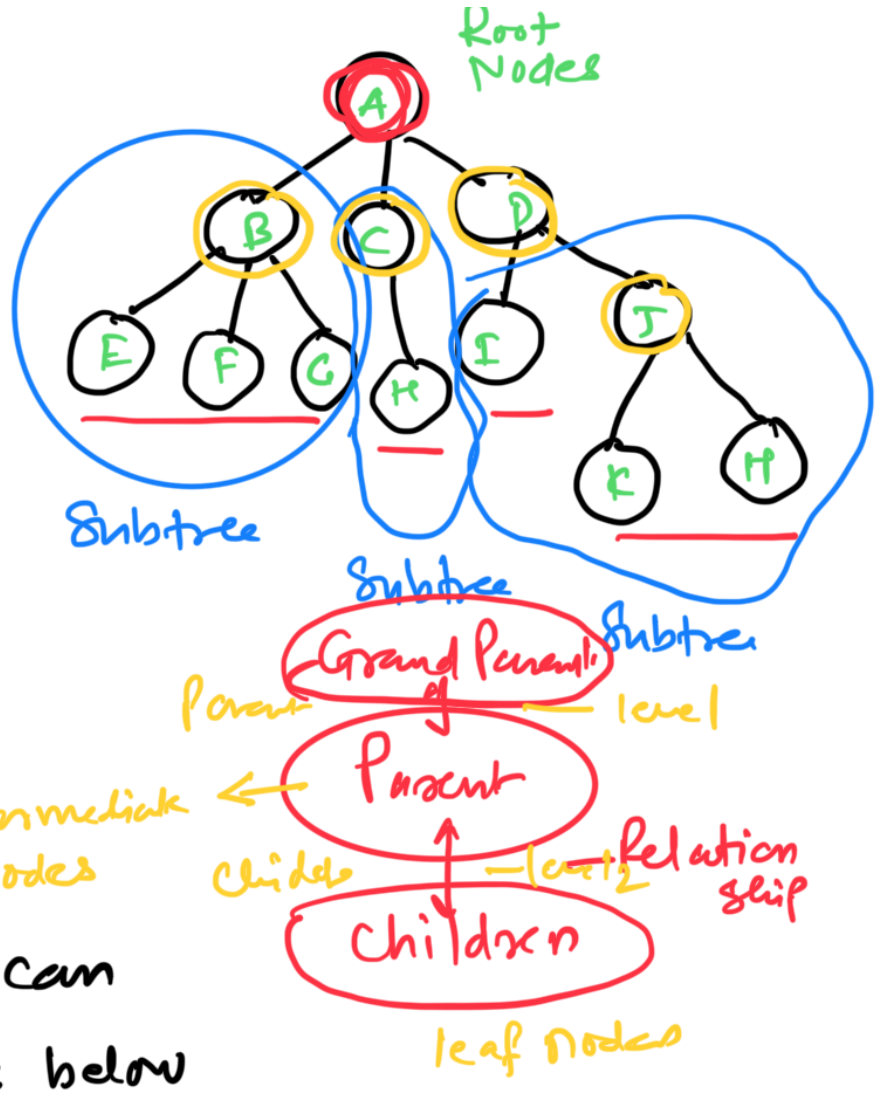
Trees



Root Node - A

Leaf Node - E, F, G, H, I, K, H

Intermediate Nodes - B, C, D, J

Tree -

- Each node in the tree can further have subtree below its hierarchy.
- A tree is a non linear data structure that represents a hierarchical relationship among the various data elements.
- Node - each element in a tree is referred as node
- Top most element → Root node

Terminologies

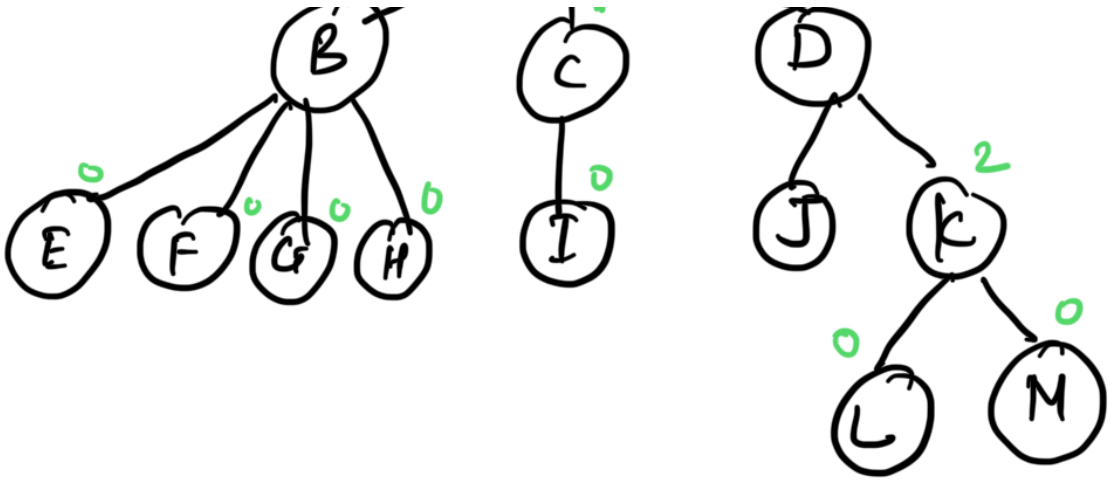
Leaf node - If refers to node with no children

Subtree - A portion of a tree, which can be viewed as a separate tree in itself.

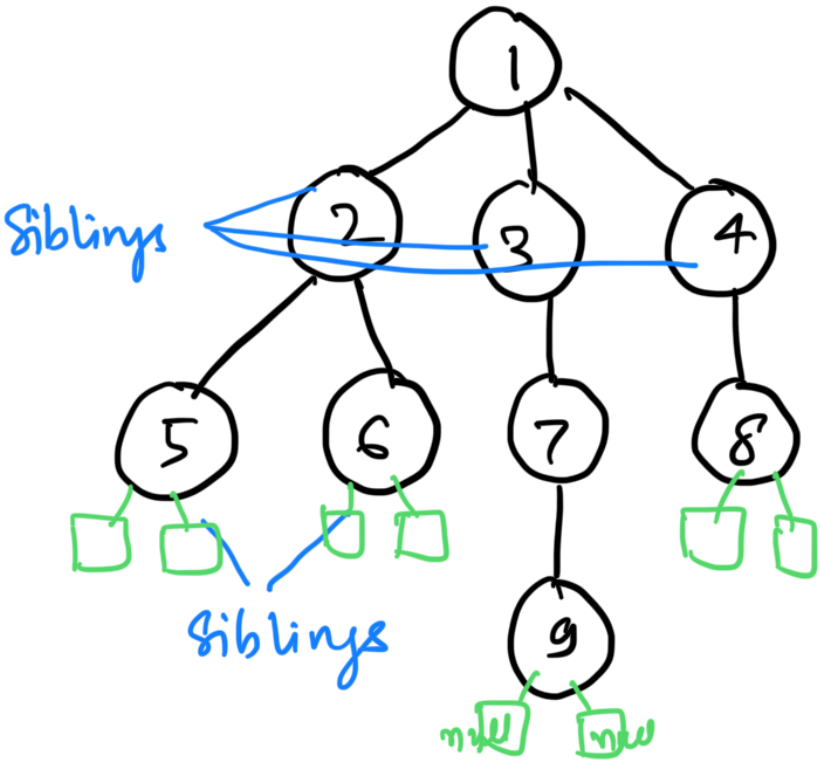
Children of a node - roots of the subtree of a node are called Childrens of the node

Edge - link from parent to child.

Degree of a node - If refers to the number of Subtrees of a node in a tree



Degree of a Tree = 4 { highest degree of a node in a tree }

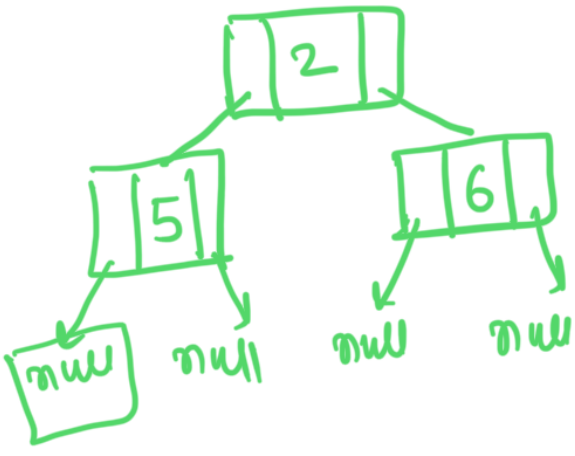


Root - 1

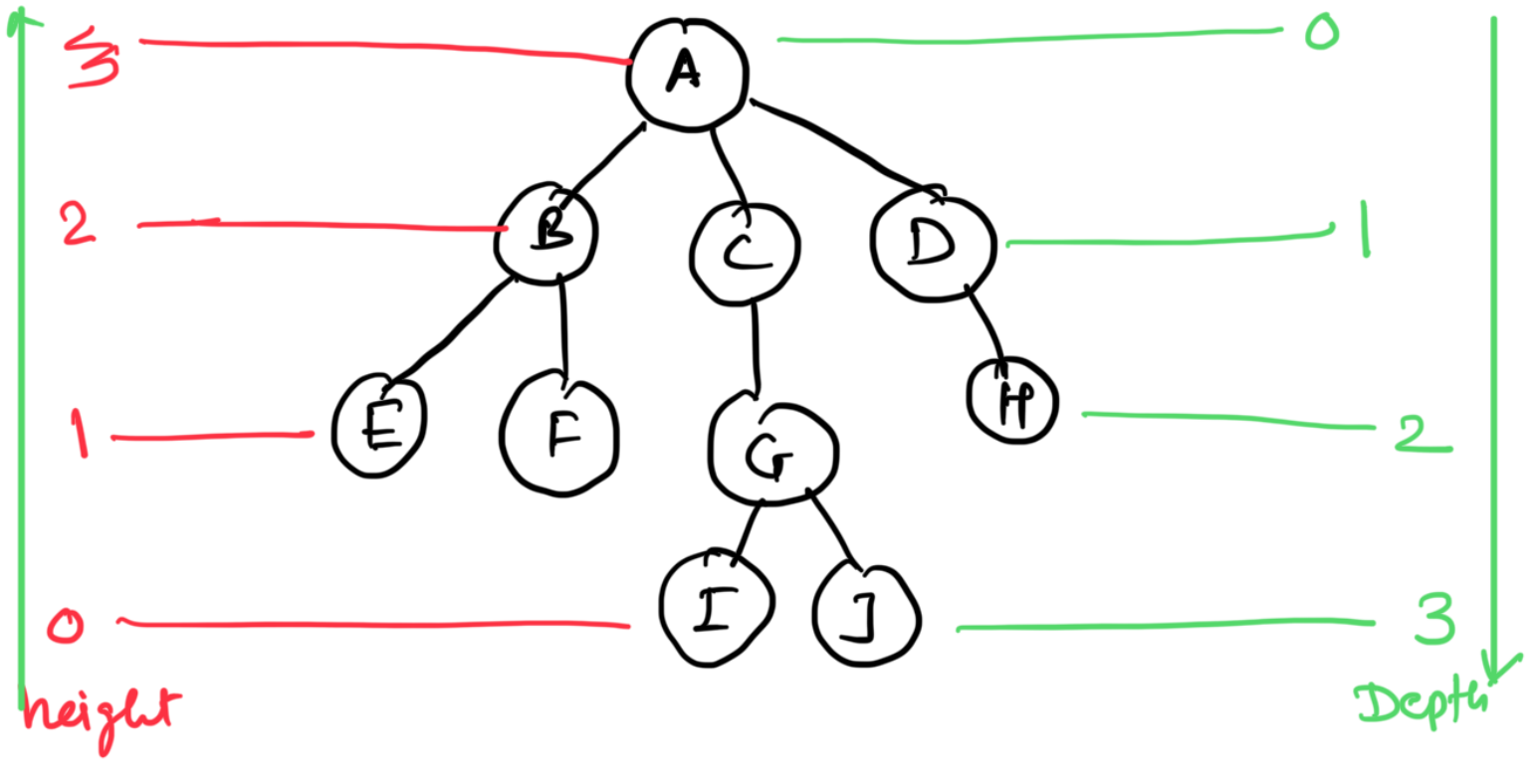
Child - 2, 3, 4, 5, 6, 7, 8, 9

Parent - 1, 2, 3, 4, 7

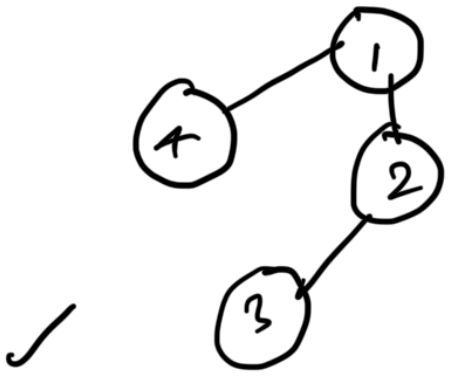
Siblings - Nodes with same parent



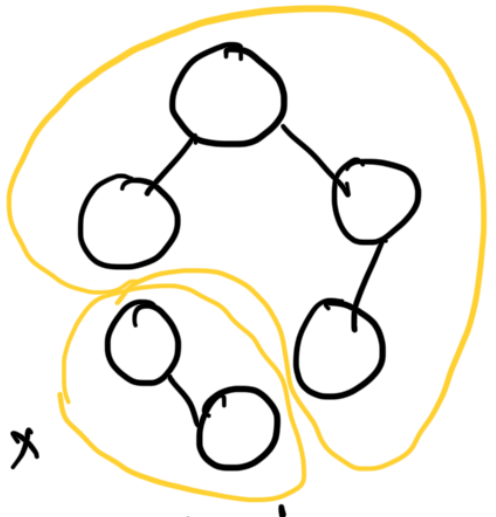
Depth of a tree : Total number of levels = 0 - 3
= 4 levels



Properties of a Tree



✓



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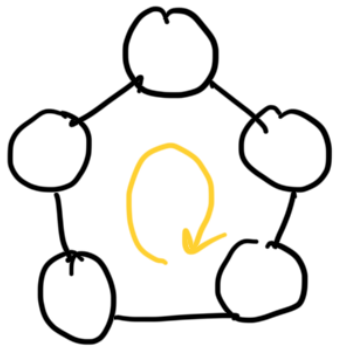


nodes = finite
= non empty

Tree

Not a tree

not connected

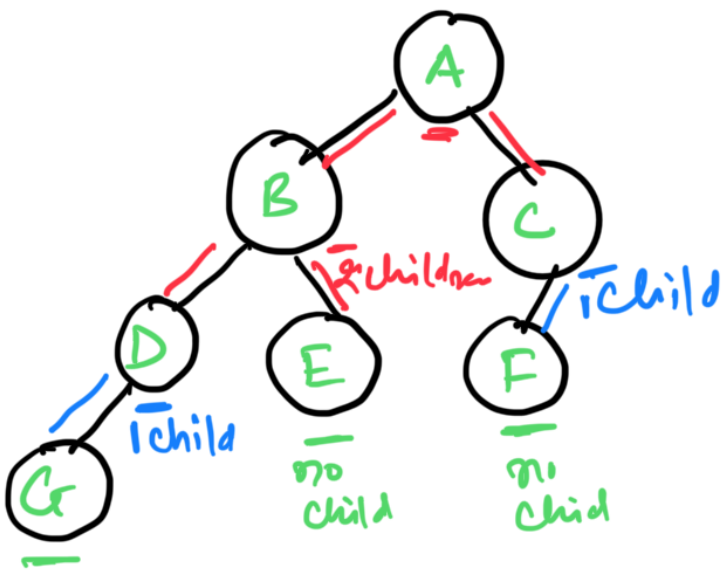
Not a tree

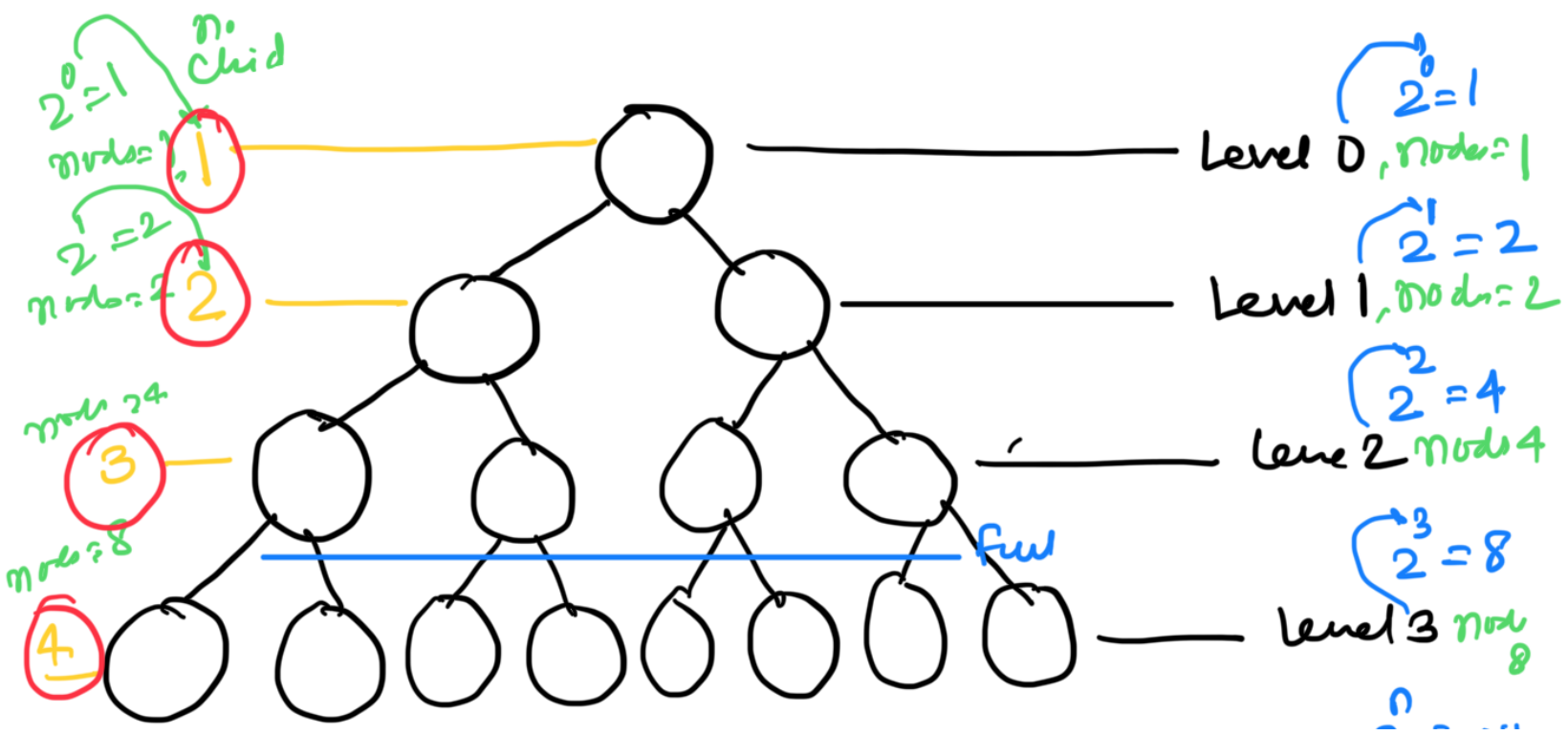
no cycle

1. The number of nodes in a tree must be a finite and non-empty set.
2. There must exist a path to every node of a tree.
3. There must not be any cycle in the tree

Binary Tree: tree in which every node has at most two children (0 – 2)

no. of children (0, 1, 2)





fwd

The maximum number of nodes on level i of a binary tree is 2^i, $i \geq 0$

The maximum number of nodes on level i of a binary tree is 2^{i-1}, $i \geq 1$

Eg ⇒ levels = 4 $2^{4-1} = 2^3 = 8$ $i \geq 1$

$2^4 = 16$ ✗ $2^{4-1} = 2^3 = 8$ max of nodes

Q = level = 3, max no of nodes in BT

0-3 | 1-3

4 level → 16 max

3 level → 8 max

$i \geq 0 \rightarrow 2^i$ — (*)

$i \geq 1 \rightarrow 2^{i-1}$

The maximum number of nodes in a binary tree of depth k is $2^{k+1} - 1$ where $k >= 0$

eg. $k = 3$

$2^{3+1} - 1 = 2^4 - 1 = 16 - 1 = 15$

The maximum number of nodes in a binary tree of depth k is $2^k - 1$ where $k \geq 1$

eg $k = 4$

$2^4 - 1 = 16 - 1 = 15$

Def^n: Binary Tree is a specific type of tree in which

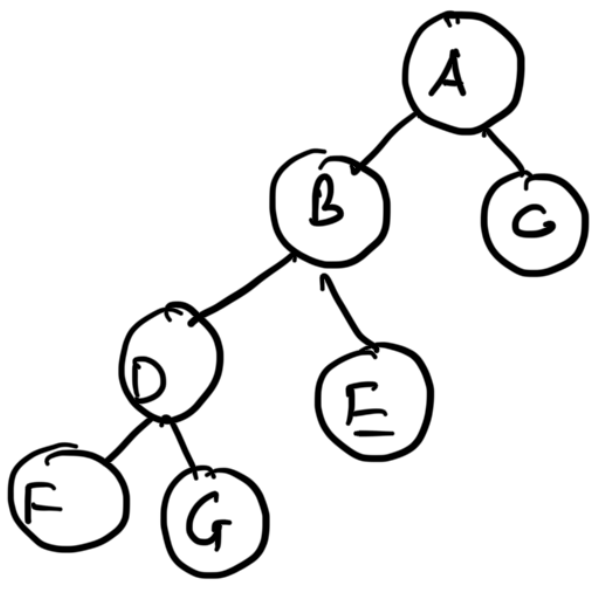
— each node can have at most two children namely left child and right child.

Eg

1. Strictly Binary Tree
2. full Binary Tree
3. Comple Binary Tree
4. In Complete Binary Tree
5. ACBT : Almost Complete Binary Tree
6. Perfect Binary Tree

1. Strictly Binary Tree

— A binary tree in which every node, except for the leaf node has non-empty left and right children.



2. full Binary :

A binary tree is a full binary tree if every node has 0 or 2 childrens (0 or 2)

Depth ⇒ 2 (d>1)