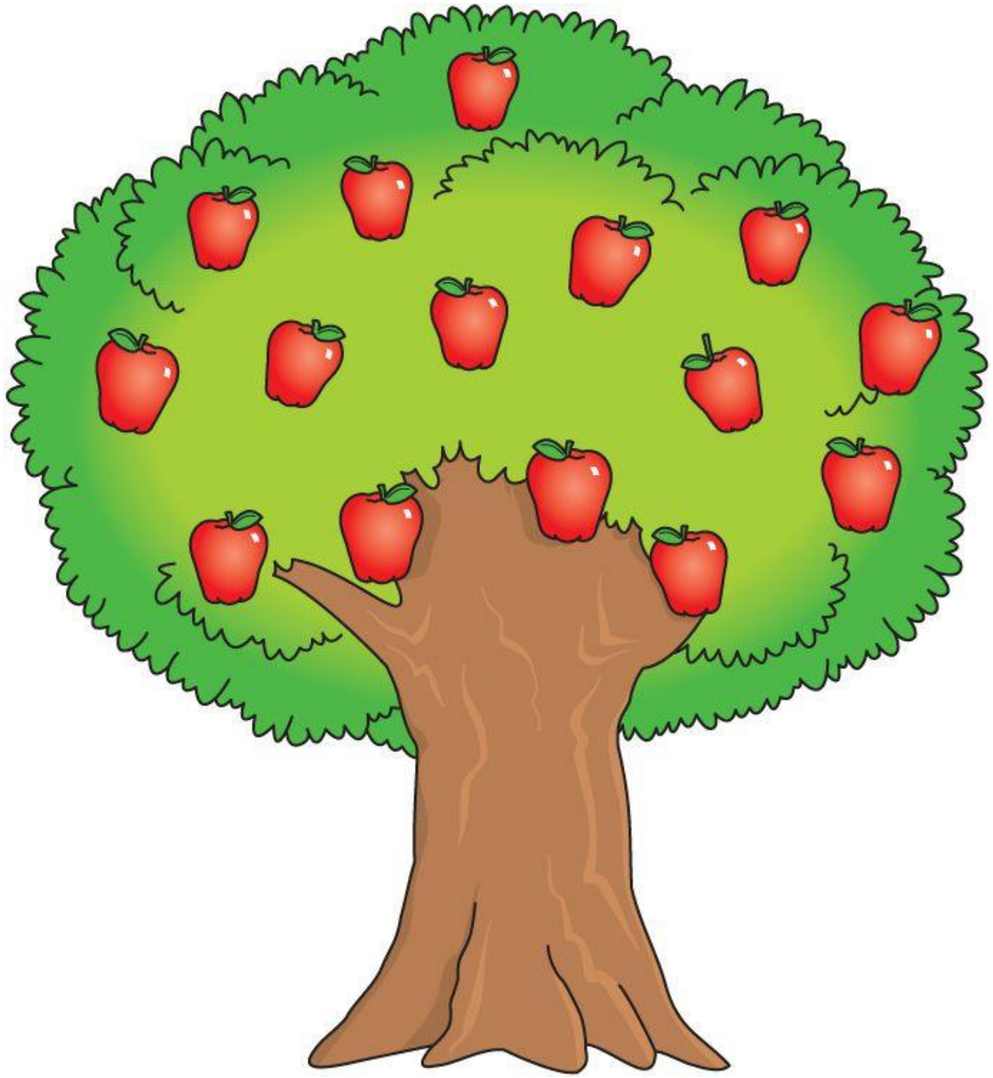
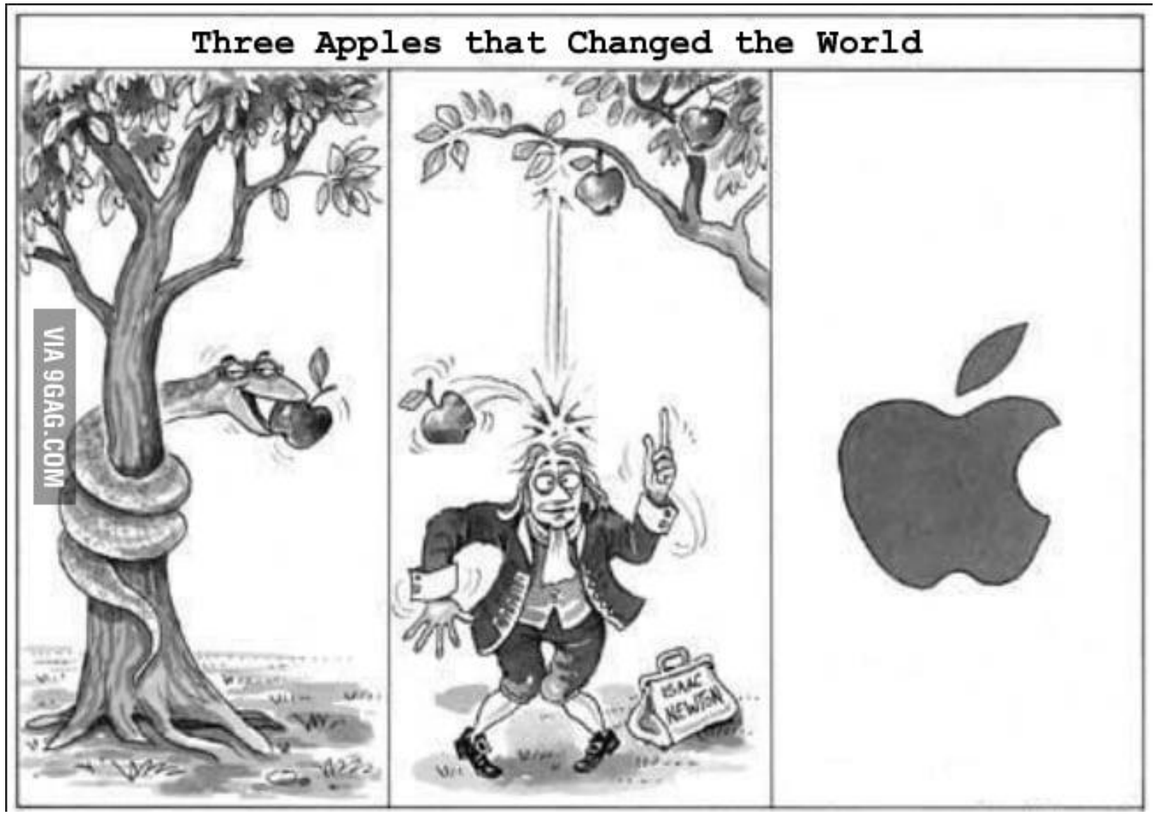
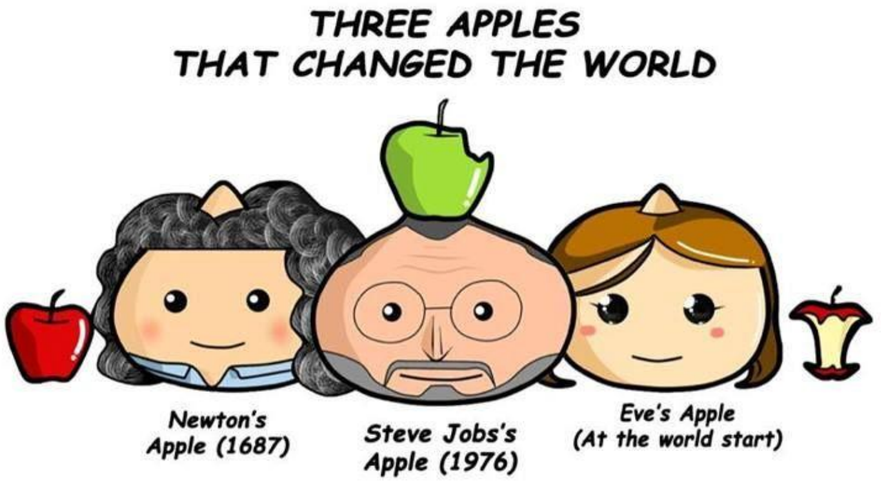
Lab 11

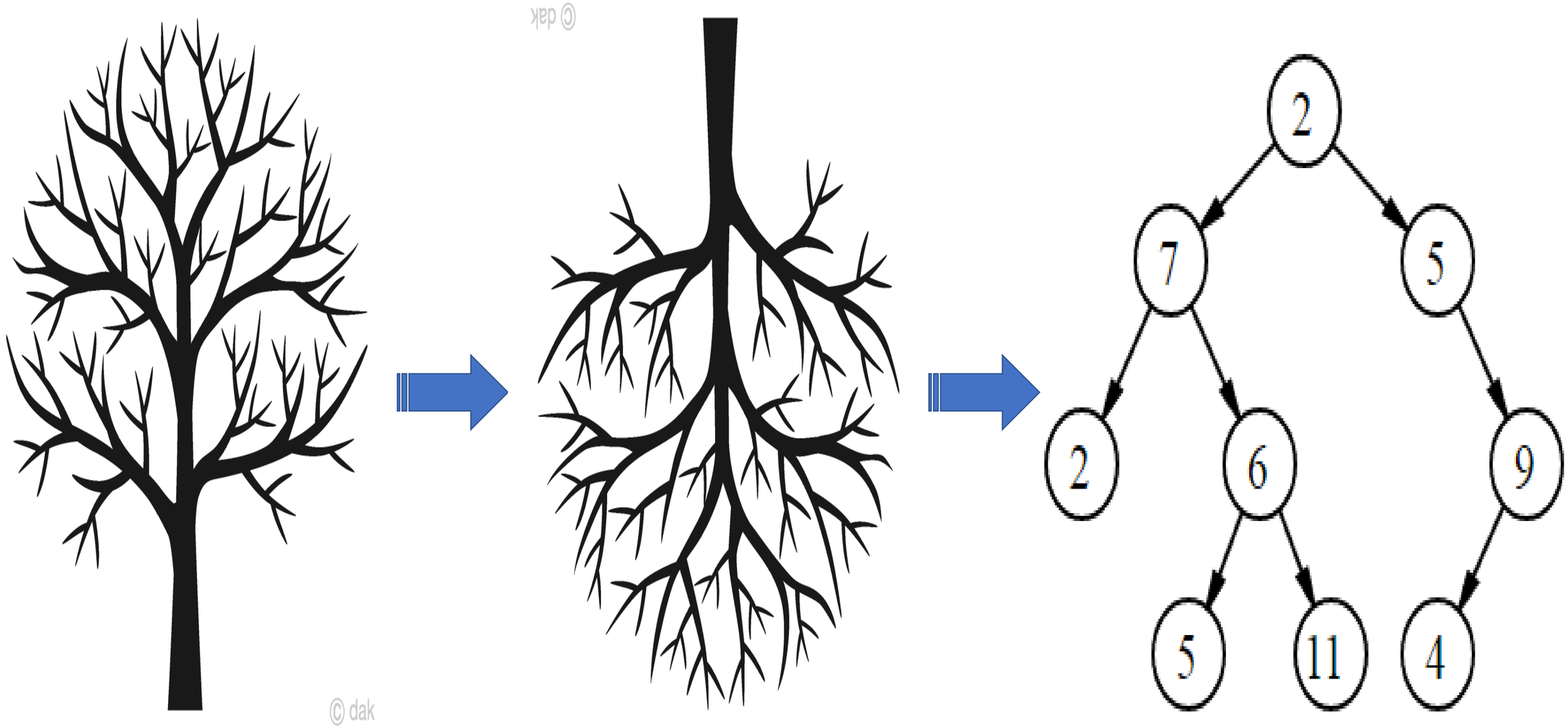
Tree




Three Apples that Changed the World
VIA 9GAG.COM
ISAAC NEWTON


3 Apples changed the world!
ADAM'S
ISAAC'S
STEVE'S


THREE APPLES
THAT CHANGED THE WORLD
Newton's Apple (1687)
Steve Jobs's Apple (1976)
Eve's Apple (At the world start)


© dak
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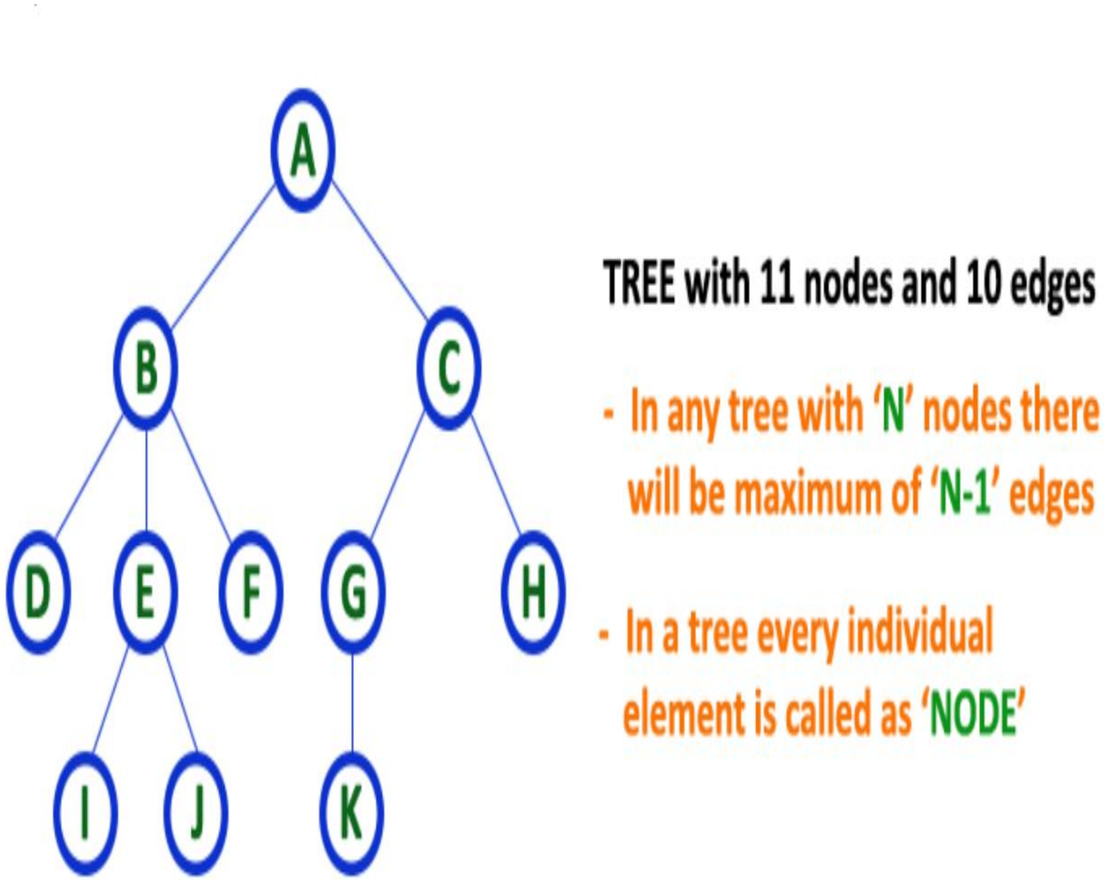
Tree

- **Tree is a non-linear data structure which organizes data in hierarchical structure and this is a recursive definition.**
- **Tree data structure is a collection of data (Node) which is organized in hierarchical structure recursively**

Example

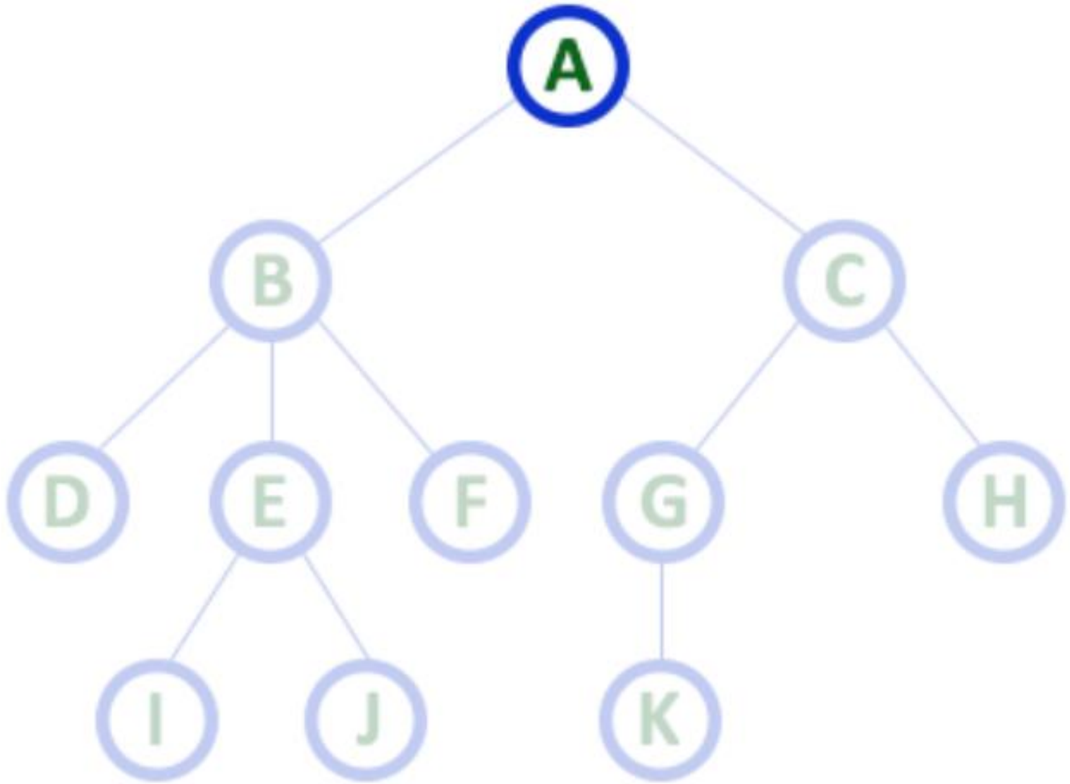
- In tree data structure, every individual element is called as **Node**.
- Node stores the actual data of a particular element and link to next element in hierarchical structure.
- In a tree data structure, if we have **N** number of nodes then we can have a maximum of **N-1** number of links.



Terminology

1. Root

In a tree data structure, the first node is called as **Root Node**. Every tree must have a root node. We can say that the root node is the origin of the tree data structure. In any tree, there must be only one root node. We never have multiple root nodes in a tree.



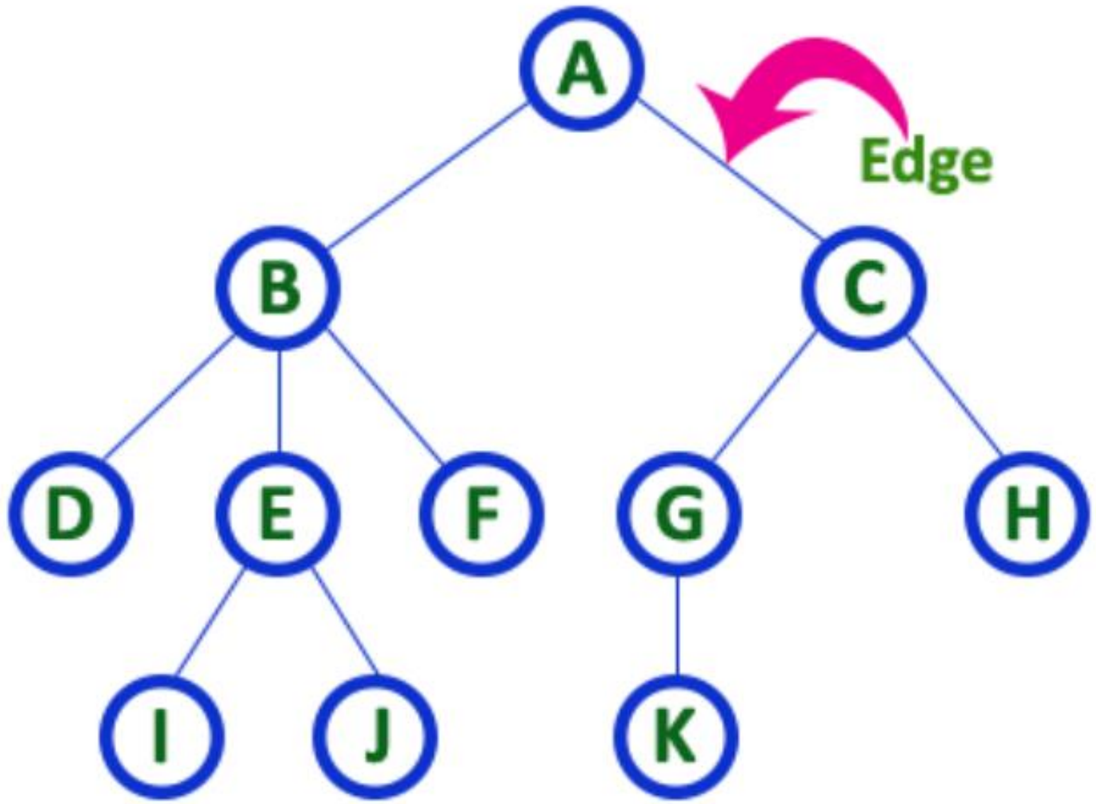
Here ‘A’ is the ‘root’ node

- In any tree the first node is called as ROOT node

Terminology (Cont...)

2. Edge

In a tree data structure, the connecting link between any two nodes is called as **EDGE**. In a tree with '**N**' number of nodes there will be a maximum of '**N-1**' number of edges.

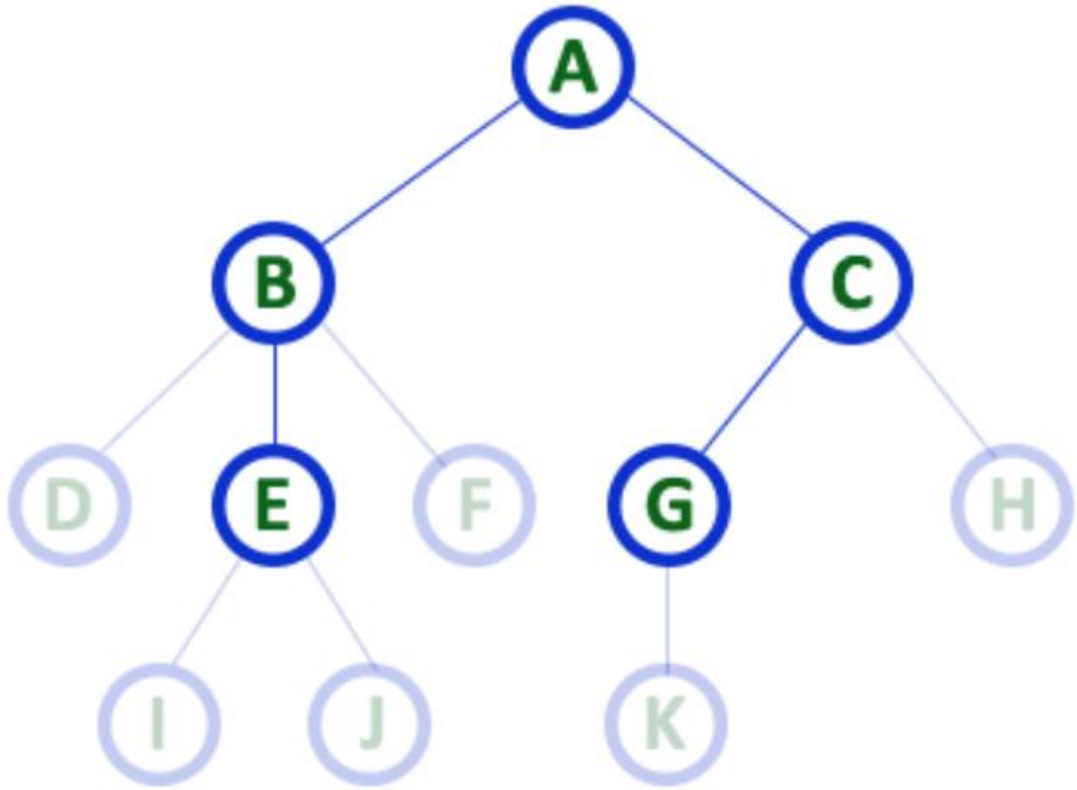


- In any tree, 'Edge' is a connecting link between two nodes.

Terminology (Cont…)

3. Parent

In a tree data structure, the node which is a predecessor of any node is called as **PARENT NODE**. In simple words, the node which has a branch from it to any other node is called a parent node. Parent node can also be defined as "**The node which has child / children**".



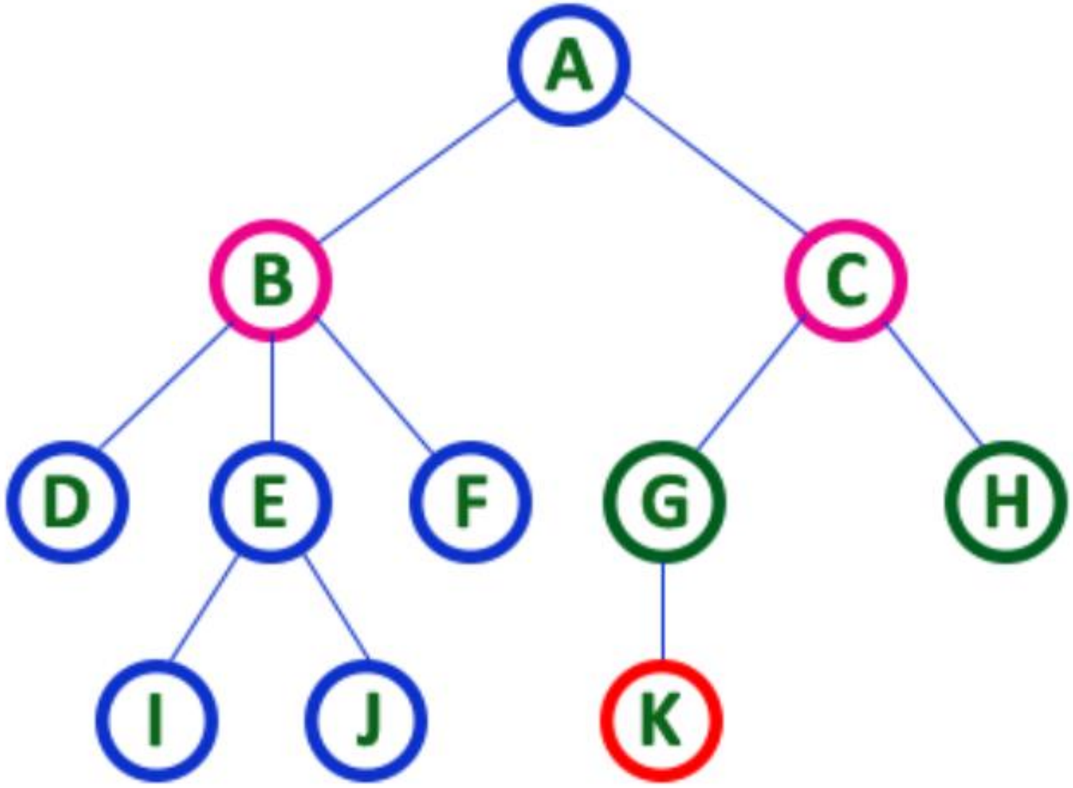
Here A, B, C, E & G are Parent nodes

- **In any tree the node which has child / children is called 'Parent'**
- **A node which is predecessor of any other node is called 'Parent'**

Terminology (Cont…)

4. Child

In a tree data structure, the node which is descendant of any node is called as **CHILD Node**. In simple words, the node which has a link from its parent node is called as child node. In a tree, any parent node can have any number of child nodes. In a tree, all the nodes except root are child nodes.



Here B & C are Children of A

Here G & H are Children of C

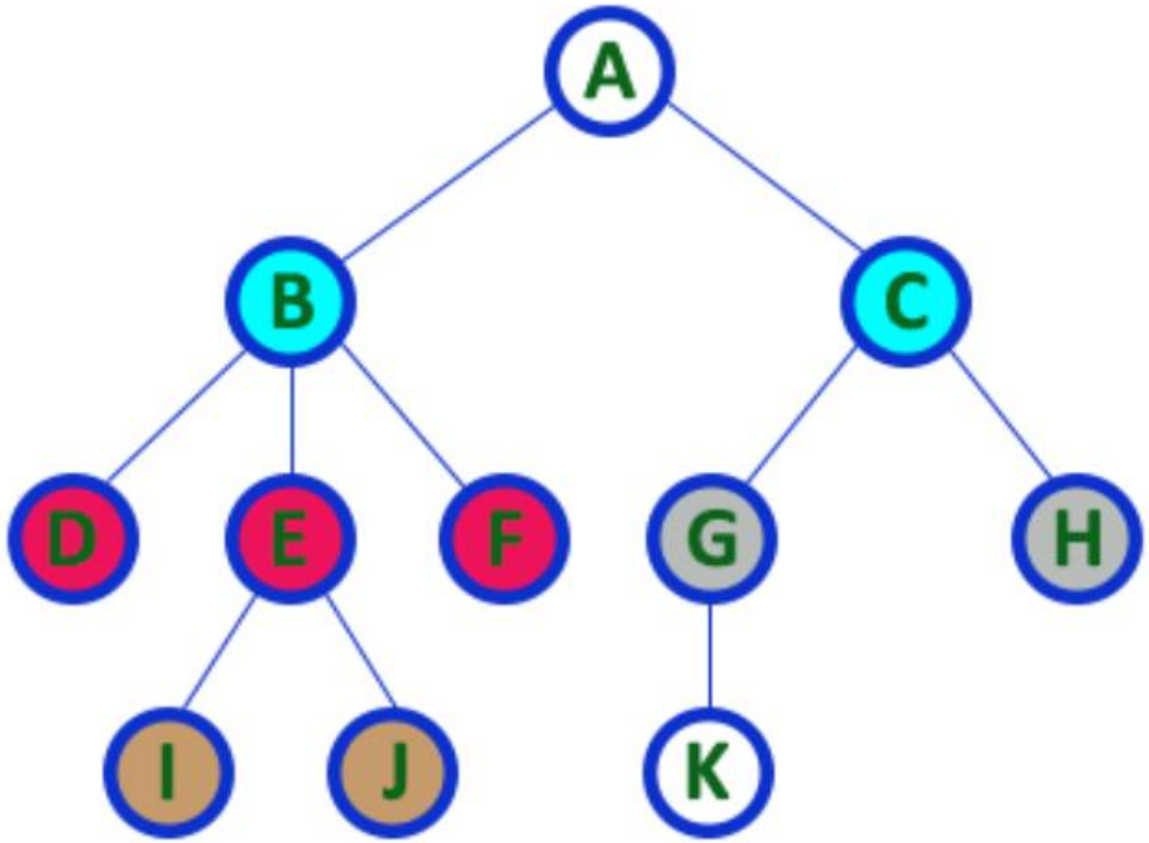
Here K is Child of G

- descendant of any node is called as CHILD Node

Terminology (Cont…)

5. Siblings

In a tree data structure, nodes which belong to same Parent are called as **SIBLINGS**. In simple words, the nodes with the same parent are called Sibling nodes.



Here B & C are Siblings

Here D E & F are Siblings

Here G & H are Siblings

Here I & J are Siblings

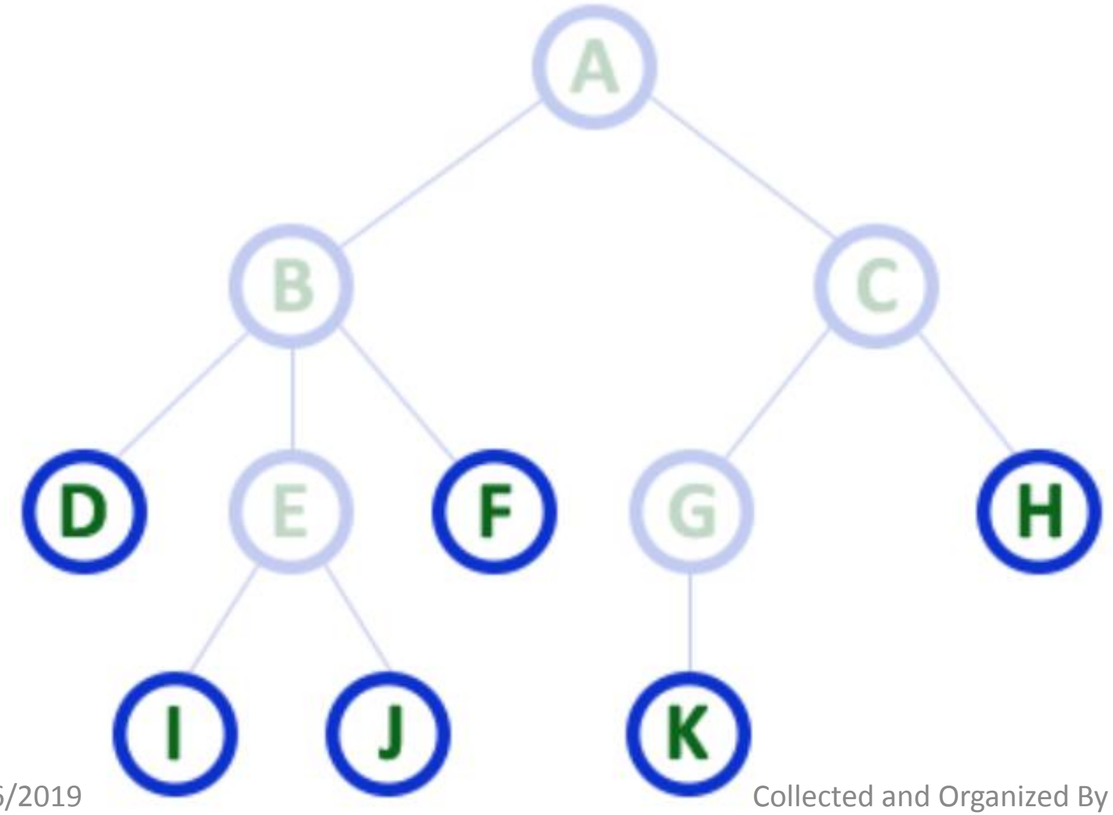
- **In any tree the nodes which has same Parent are called 'Siblings'**
- **The children of a Parent are called 'Siblings'**

Terminology (Cont…)

6. Leaf

In a tree data structure, the node which does not have a child is called as **LEAF Node**. In simple words, a leaf is a node with no child.

In a tree data structure, the leaf nodes are also called as **External Nodes**. External node is also a node with no child. In a tree, leaf node is also called as '**Terminal**' node.



Here D, I, J, F, K & H are Leaf nodes

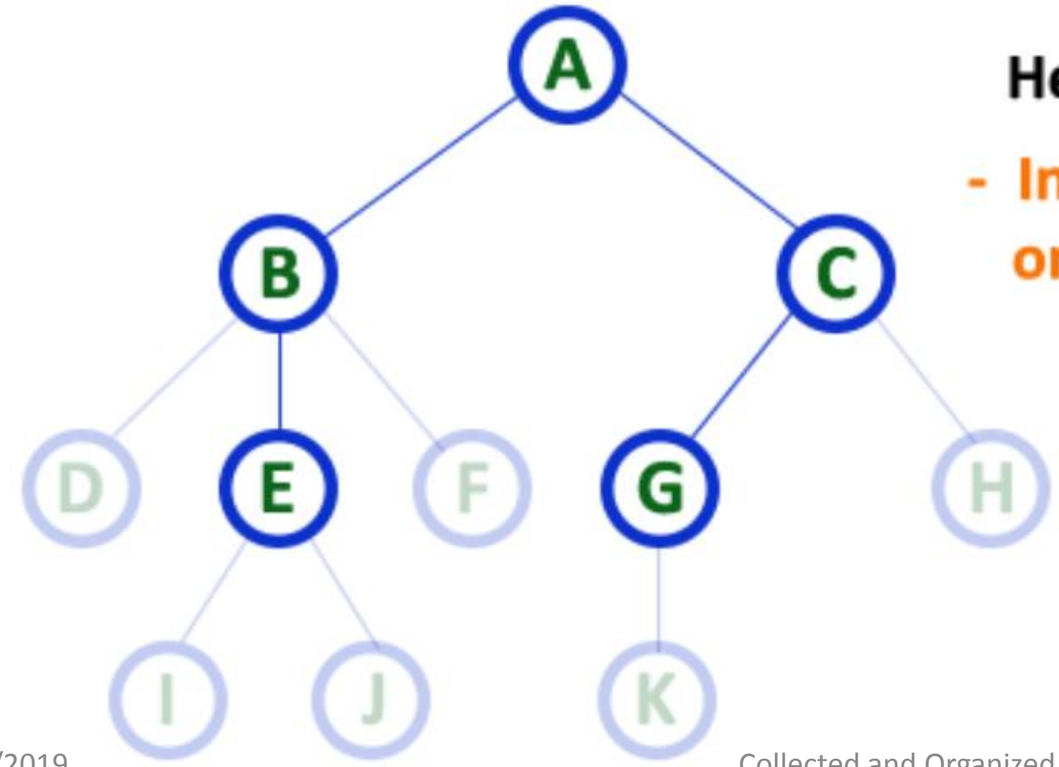
- **In any tree the node which does not have children is called 'Leaf'**
- **A node without successors is called a 'leaf' node**

Terminology (Cont…)

7. Internal Nodes

In a tree data structure, the node which has atleast one child is called as **INTERNAL Node**. In simple words, an internal node is a node with atleast one child.

In a tree data structure, nodes other than leaf nodes are called as **Internal Nodes**. The root node is also said to be Internal Node if the tree has more than one node. Internal nodes are also called as '**Non-Terminal**' nodes.



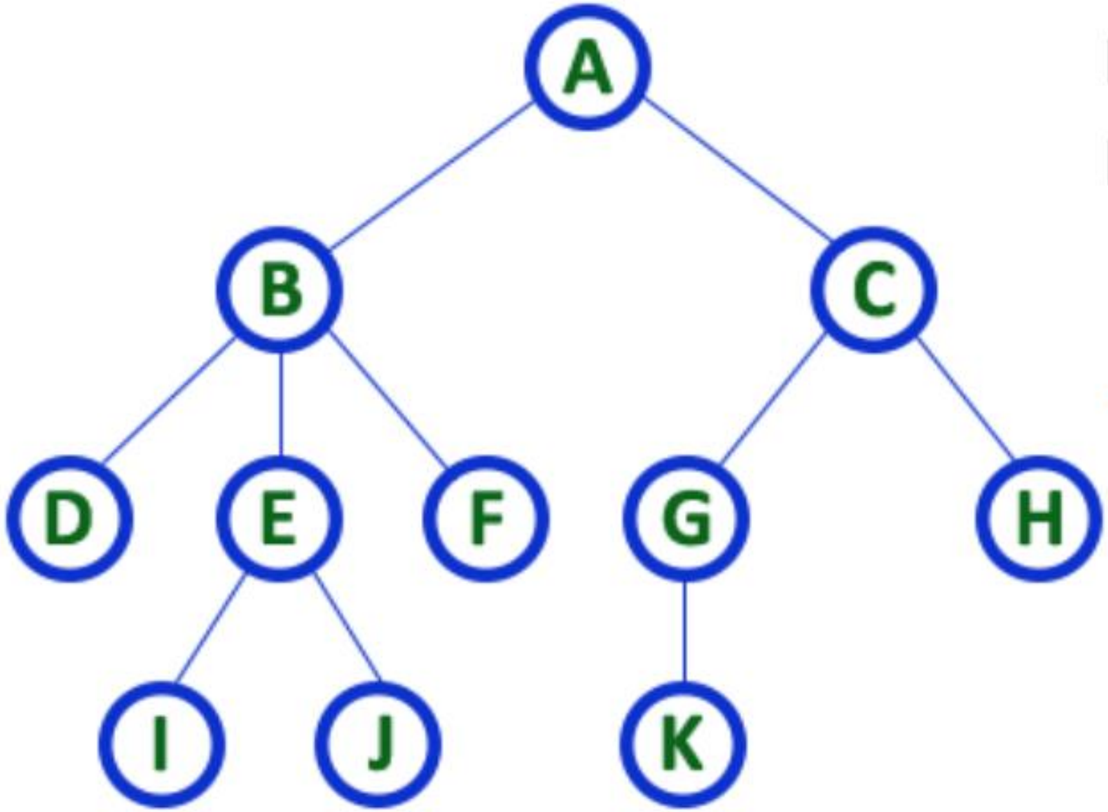
Here A, B, C, E & G are Internal nodes

- **In any tree the node which has atleast one child is called 'Internal' node**
- **Every non-leaf node is called as 'Internal' node**

Terminology (Cont…)

8. Degree

In a tree data structure, the total number of children of a node is called as **DEGREE** of that Node. In simple words, the Degree of a node is total number of children it has. The highest degree of a node among all the nodes in a tree is called as '**Degree of Tree**'



Here Degree of B is 3

Here Degree of A is 2

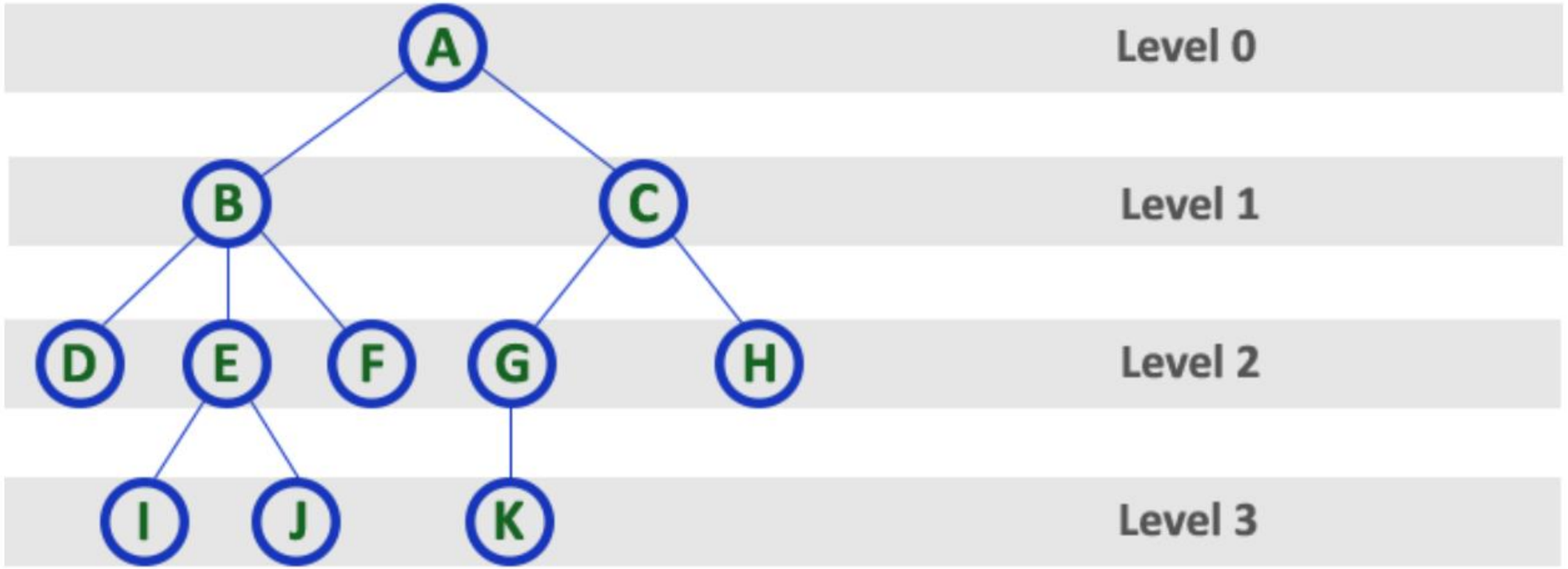
Here Degree of F is 0

- In any tree, 'Degree' of a node is total number of children it has.

Terminology (Cont…)

9. Level

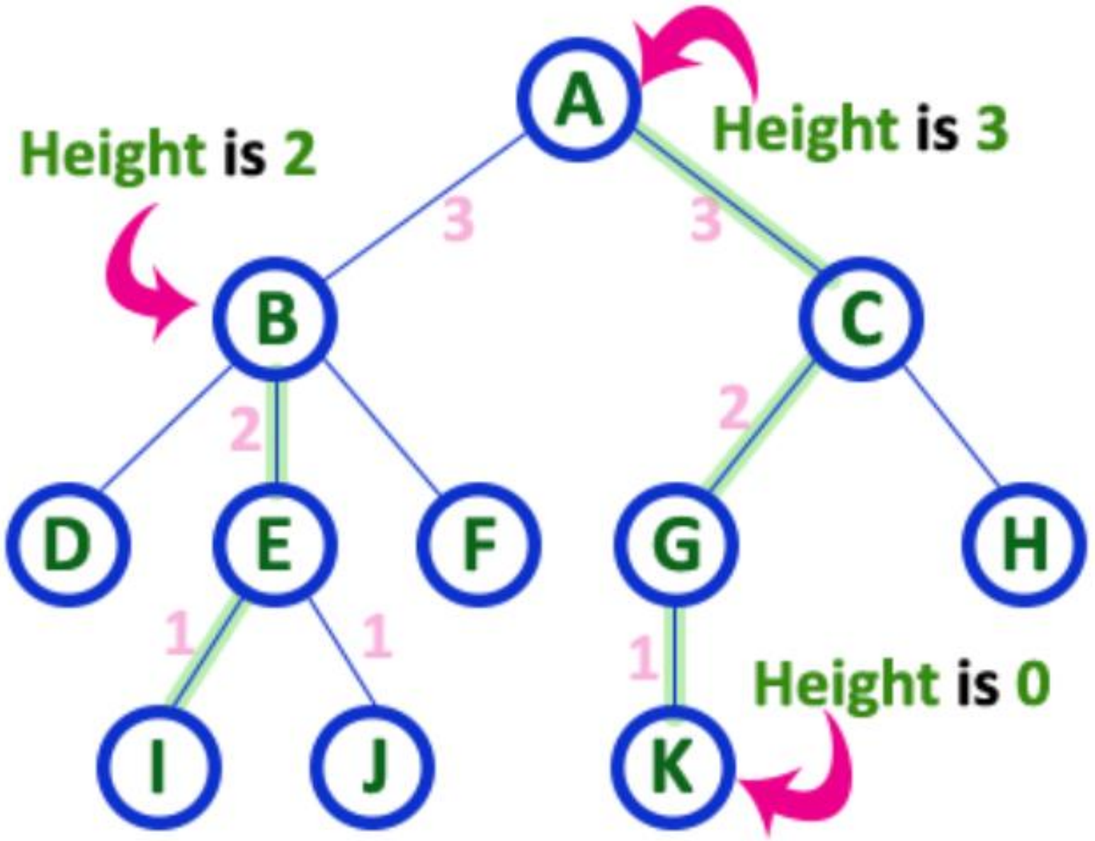
In a tree data structure, the root node is said to be at Level 0 and the children of root node are at Level 1 and the children of the nodes which are at Level 1 will be at Level 2 and so on… In simple words, in a tree each step from top to bottom is called as a Level and the Level count starts with '0' and incremented by one at each level (Step).



Terminology (Cont...)

10. Height

In a tree data structure, the total number of edges from leaf node to a particular node in the longest path is called as **HEIGHT** of that Node. In a tree, height of the root node is said to be **height of the tree**. In a tree, **height of all leaf nodes is '0'.**



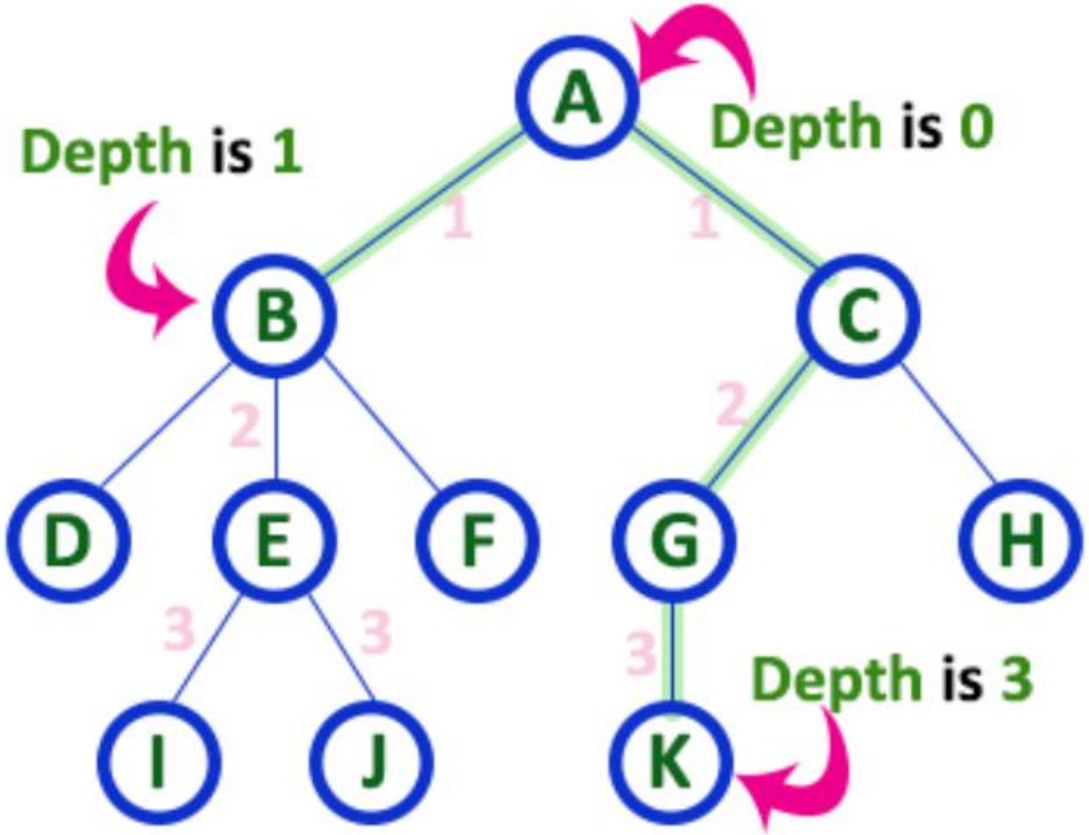
Here Height of tree is 3

- In any tree, 'Height of Node' is total number of Edges from leaf to that node in longest path.
- In any tree, 'Height of Tree' is the height of the root node.

Terminology (Cont...)

11. Depth

In a tree data structure, the total number of egdes from root node to a particular node is called as **DEPTH** of that Node. In a tree, the total number of edges from root node to a leaf node in the longest path is said to be **Depth of the tree**. In simple words, the highest depth of any leaf node in a tree is said to be depth of that tree. In a tree, **depth of the root node is '0'.**



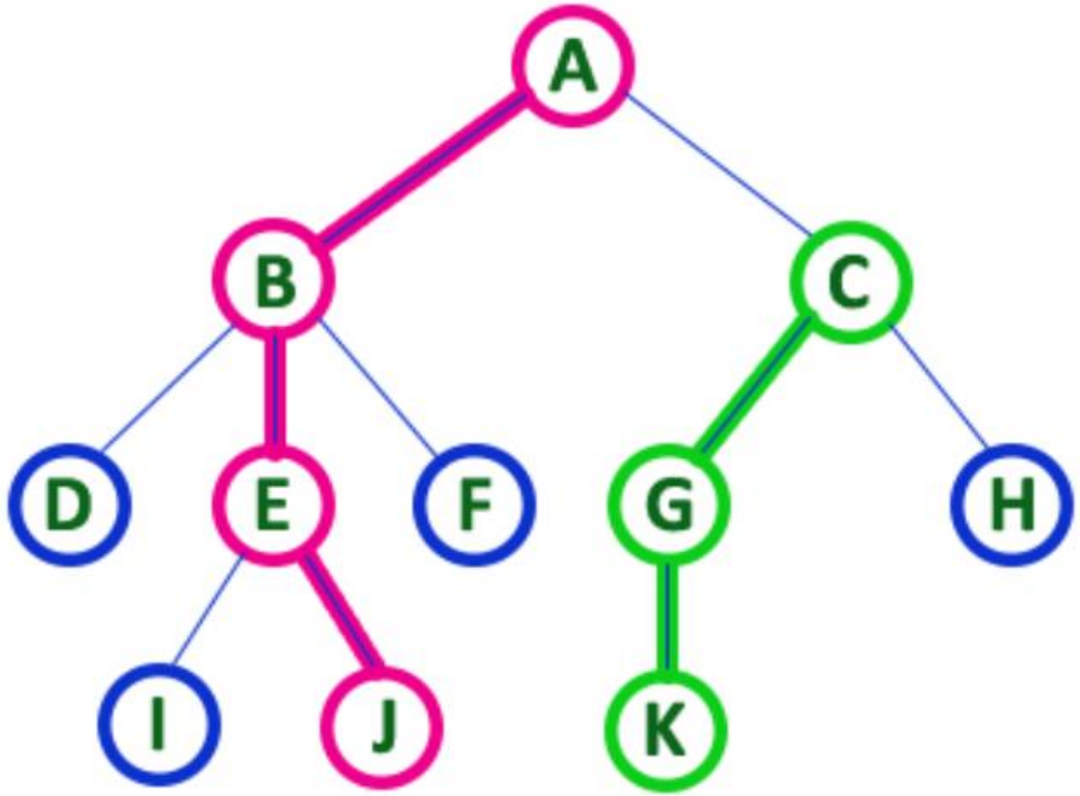
Here Depth of tree is 3

- **In any tree, 'Depth of Node' is total number of Edges from root to that node.**
- **In any tree, 'Depth of Tree' is total number of edges from root to leaf in the longest path.**

Terminology (Cont…)

12. Path

In a tree data structure, the sequence of Nodes and Edges from one node to another node is called as **PATH** between that two Nodes. **Length of a Path** is total number of nodes in that path. In below example **the path A - B - E - J has length 4**.



- **In any tree, 'Path' is a sequence of nodes and edges between two nodes.**

Here, 'Path' between A & J is

A - B - E - J

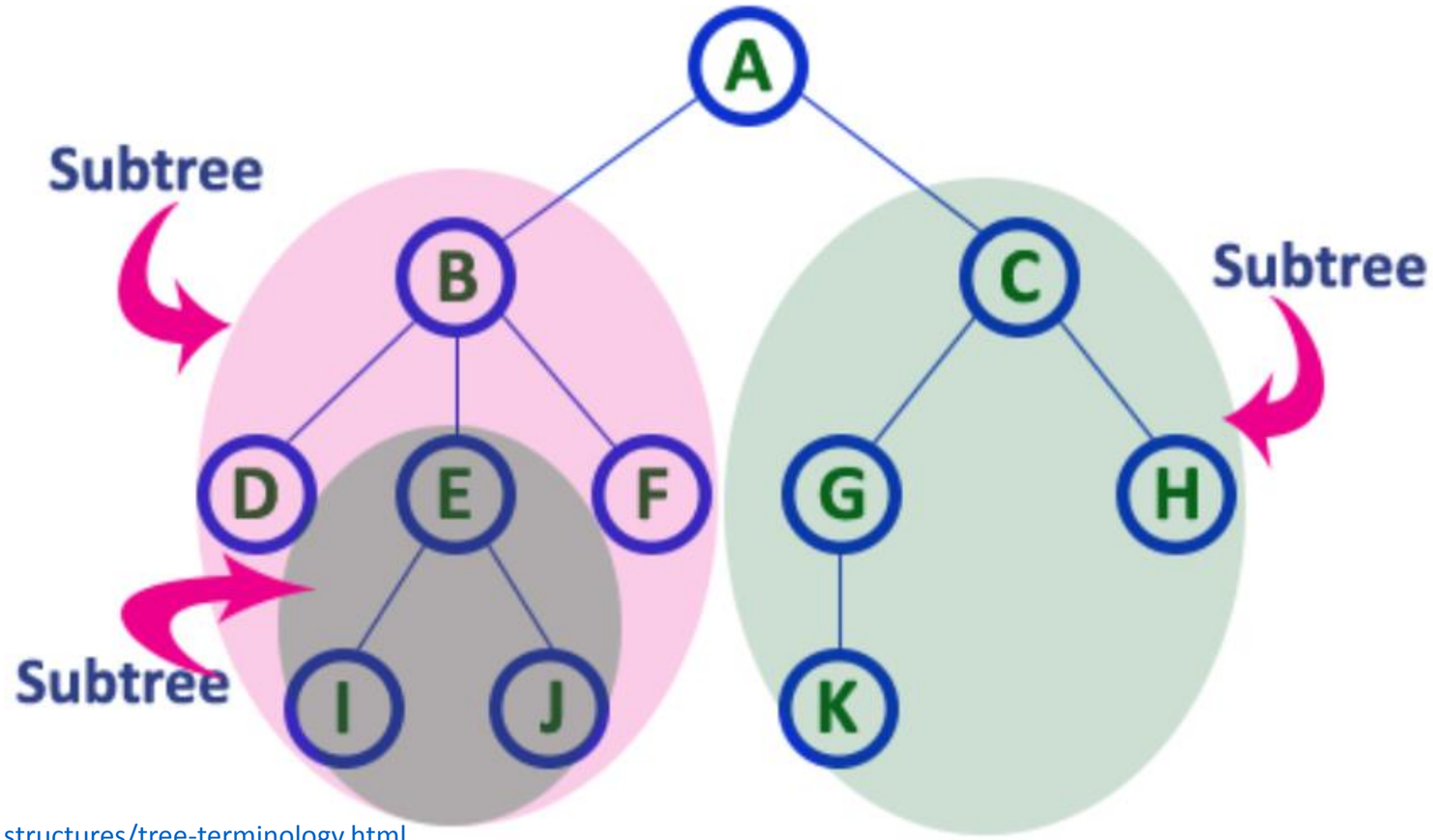
Here, 'Path' between C & K is

C - G - K

Terminology (Cont…)

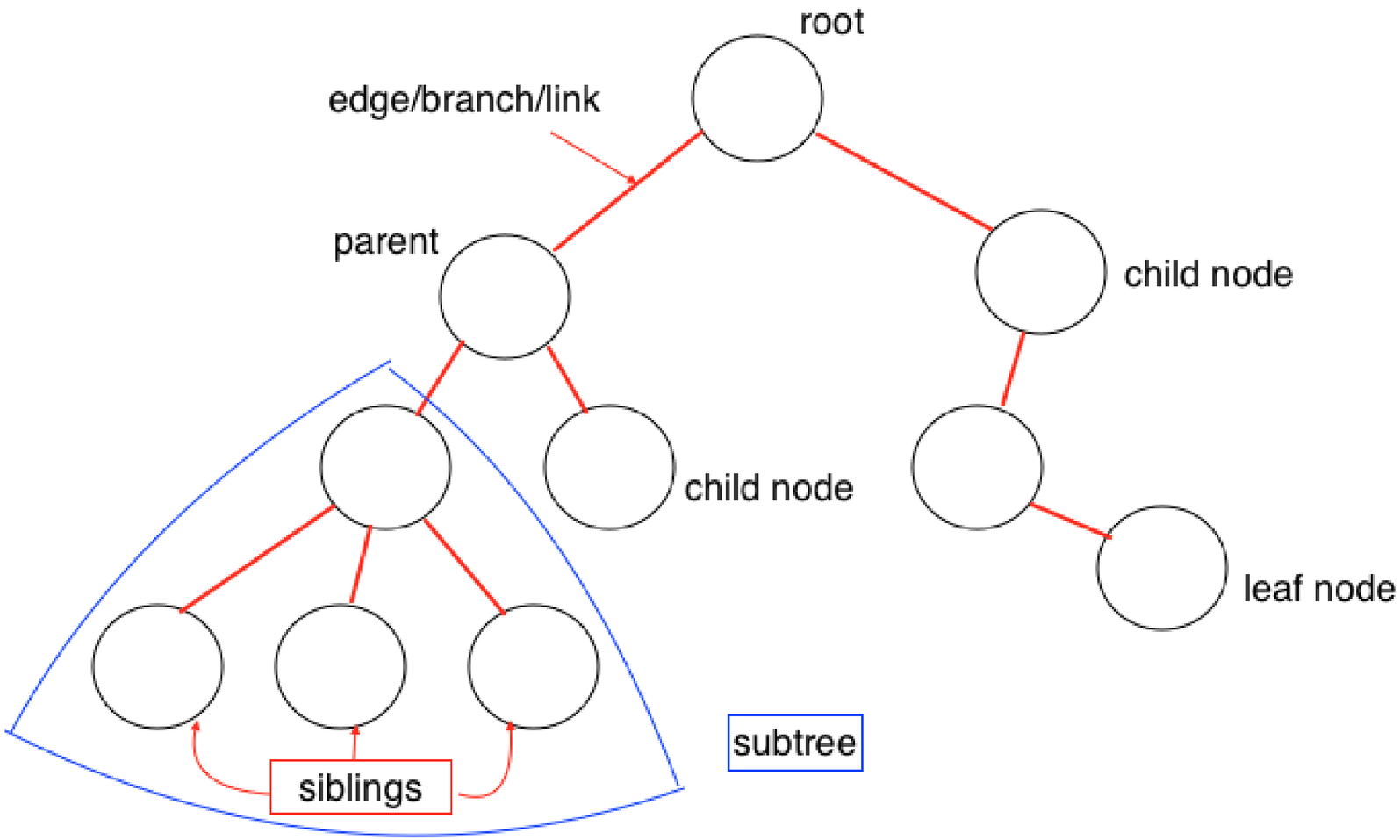
13. Sub Tree

In a tree data structure, each child from a node forms a subtree recursively. Every child node will form a subtree on its parent node.



Link: http://btechsmartclass.com/data_structures/tree-terminology.html

Terminology (Cont…)



***Trees vs. Graphs

- https://freefeast.info/difference-between/difference-between-trees-and-graphs-trees-vs-graphs/

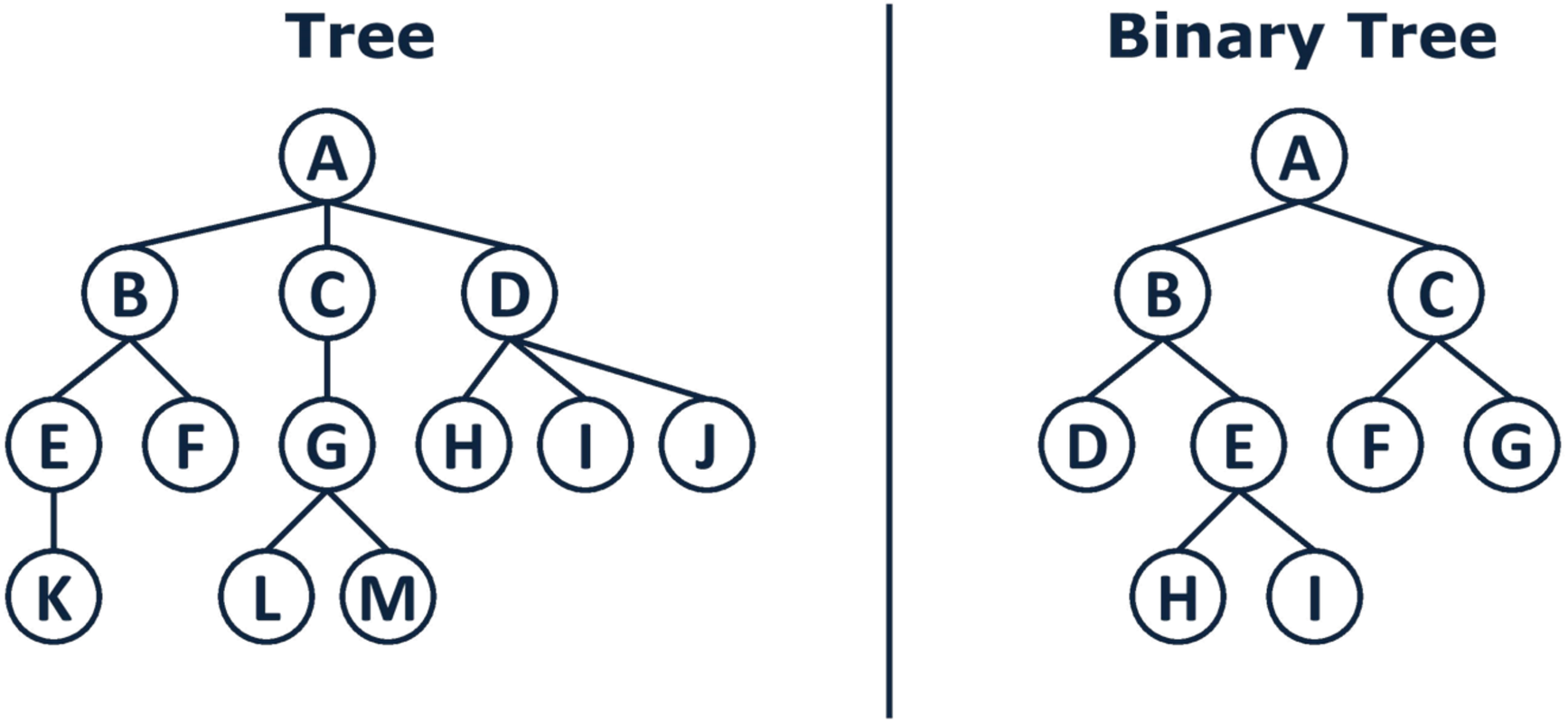
***Check if a given graph is tree or not

- Google

Binary Tree Data structure

- **A tree in which every node can have a maximum of two children is called Binary Tree.**

Tree vs. Binary Tree



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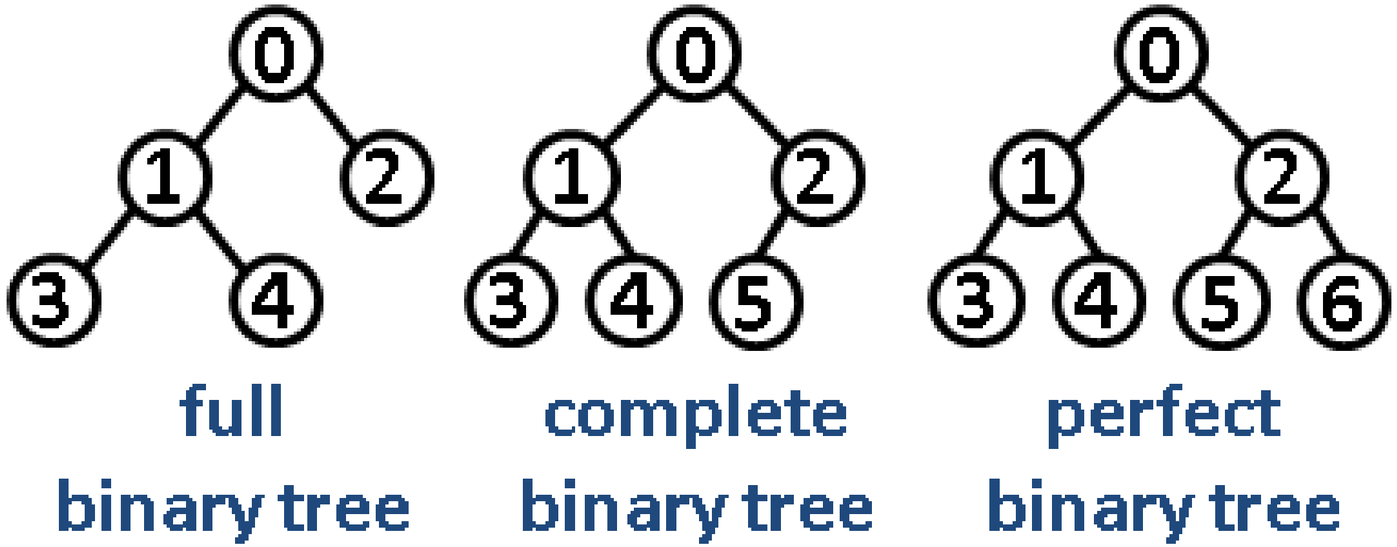
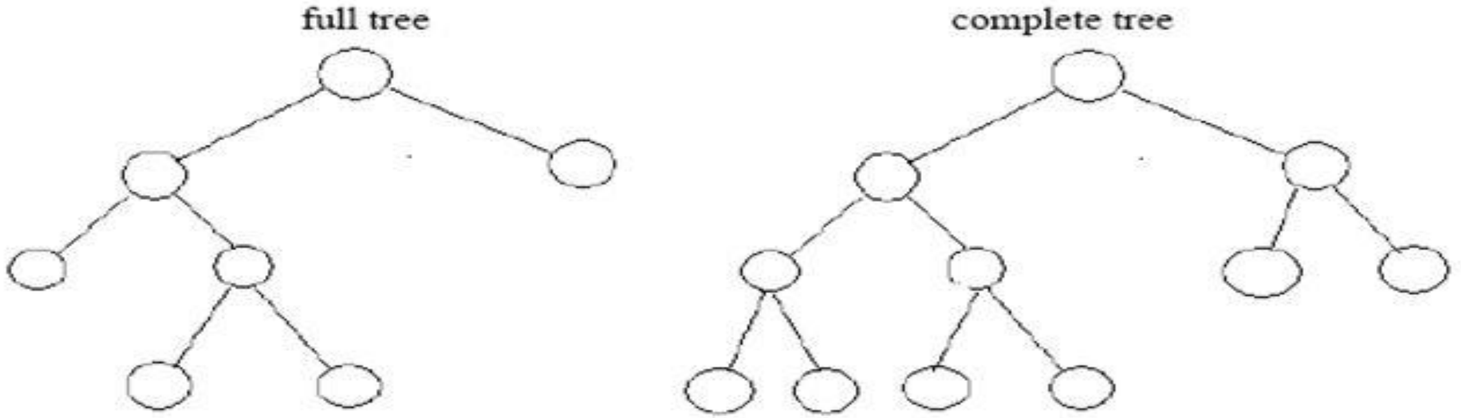
***Types of Binary Trees



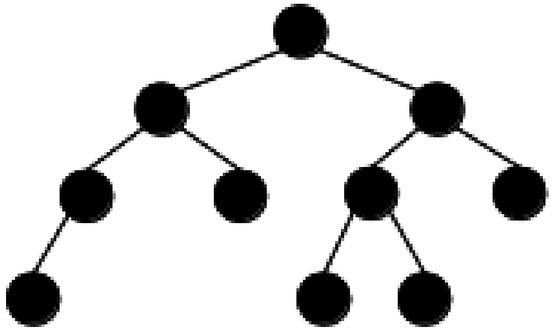
Types of Binary Trees

- A binary tree in which each node has exactly 0 or 2 children is called a full binary tree – there are no degree 1 nodes
- A complete binary tree is a tree which is completely filled, with the possible exception of the bottom level, which is filled from left to right

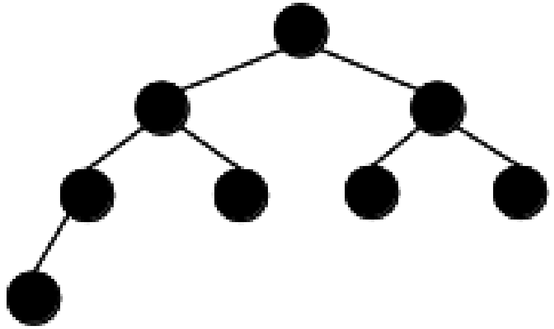


Types of Binary Trees

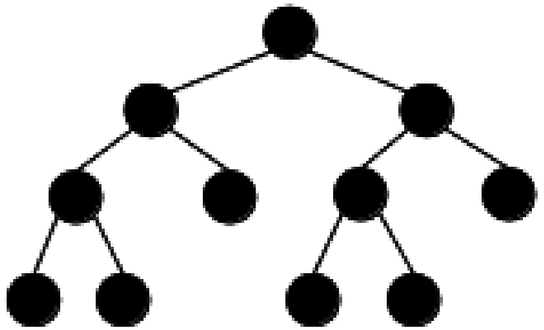
Neither complete nor full



Complete but not full



Full but not complete



Complete and full