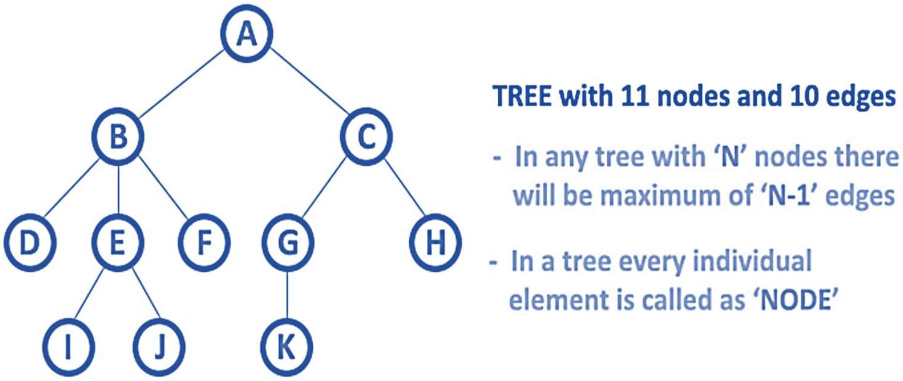
➢ Tree: -

Tree is a non-linear data structure which organizes data in hierarchical structure and this is a recursive definition.

A Tree is a finite set of nodes with finite set of edges that define parent child relationship and there are no circuit



TREE with 11 nodes and 10 edges

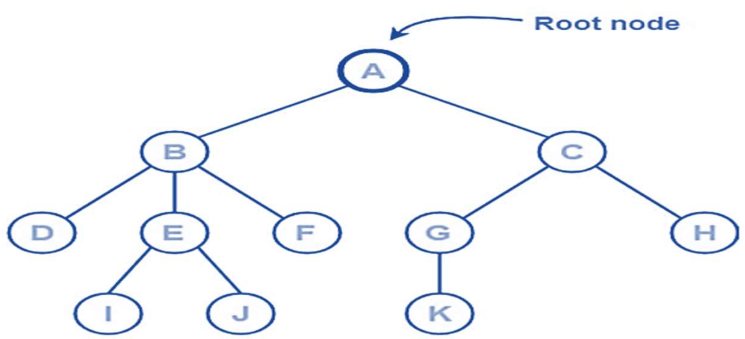
- In any tree with 'N' nodes there will be maximum of 'N-1' edges
- In a tree every individual element is called as 'NODE'

Properties: -

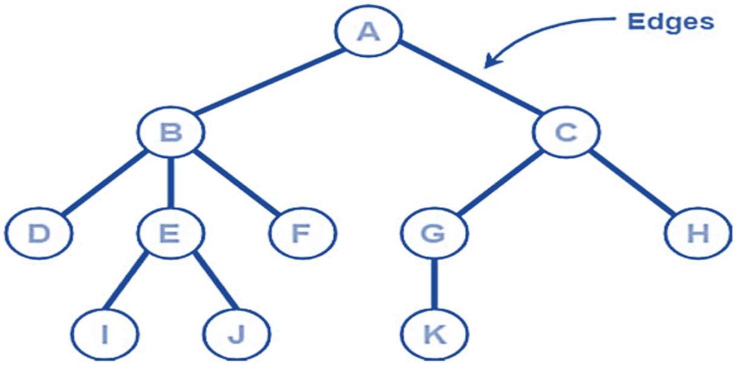
1. There are only one root having no parent
2. Except root each node has exactly one parent
3. A node may have zero or more children
4. There is unique path from root to each node

➢ Tree Terminology: -

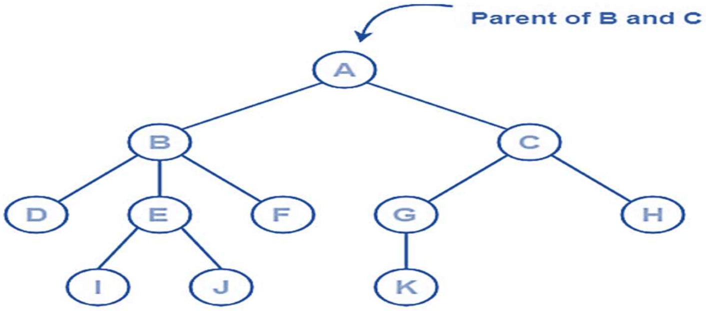
1. **Root: -**
   - The first node from where the tree originates is called as a root node.
   - In any tree, there must be only one root node.
   - We can never have multiple root nodes in a tree data structure.



2. **Edge: -**
   - 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.

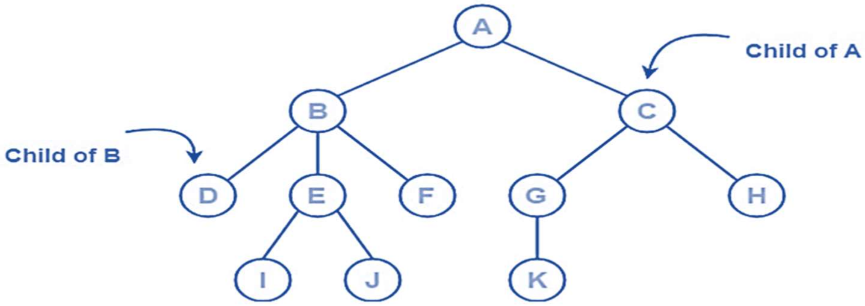


3. **Parent: -**
   - The node which has a branch from it to any other node is called as a parent node.
   - In other words, the node which has one or more children is called as a parent node.
   - In a tree, a parent node can have any number of child nodes.



- Node A is the parent of nodes B and C
- Node B is the parent of nodes D, E and F
- Node C is the parent of nodes G and H
- Node E is the parent of nodes I and J
- Node G is the parent of node K

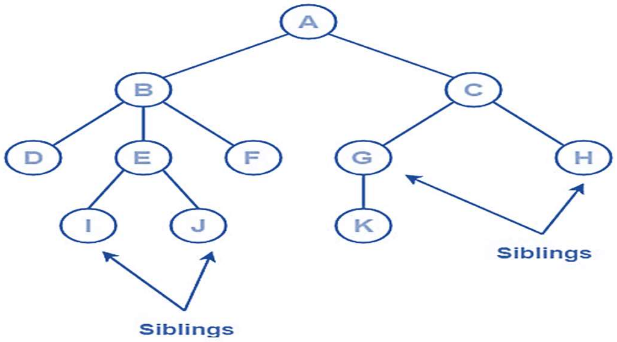
4. **Child: -**
   - The node which is a descendant of some node is called as a child node.
   - In simple words, the node which has a link from its parent node is called as child node.
   - All the nodes except root node are child nodes.



- Nodes B and C are the children of node A
- Nodes D, E and F are the children of node B
- Nodes G and H are the children of node C
- Nodes I and J are the children of node E
- Node K is the child of node G

5. **Siblings: -**

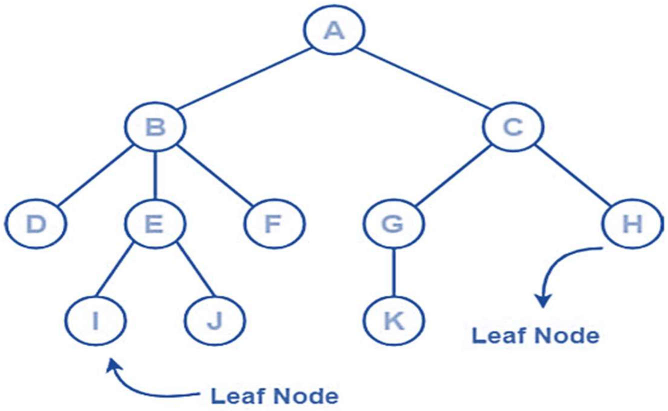
- Nodes which belong to the same parent are called as siblings.
- In other words, nodes with the same parent are sibling nodes.



- Nodes B and C are siblings
- Nodes D, E and F are siblings
- Nodes G and H are siblings
- Nodes I and J are siblings

6. **Leaf Node: -**

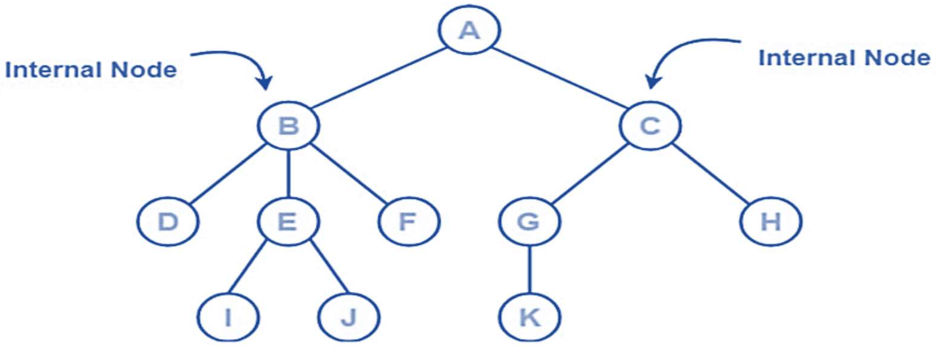
- The node which does not have any child is called as a leaf node.
- Leaf nodes are also called as external nodes or terminal nodes.



Here, nodes D, I, J, F, K and H are leaf nodes.

7. **Internal Node: -**

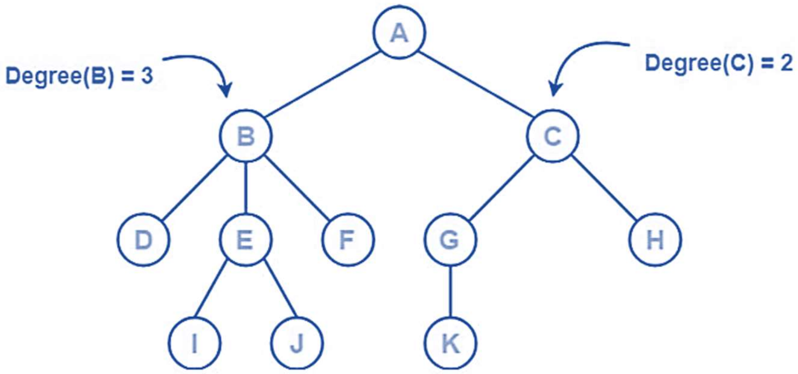
- The node which has at least one child is called as an internal node.
- Internal nodes are also called as non-terminal nodes.
- Every non-leaf node is an internal node.



Here, nodes A, B, C, E and G are internal nodes.

8. **Degree: -**

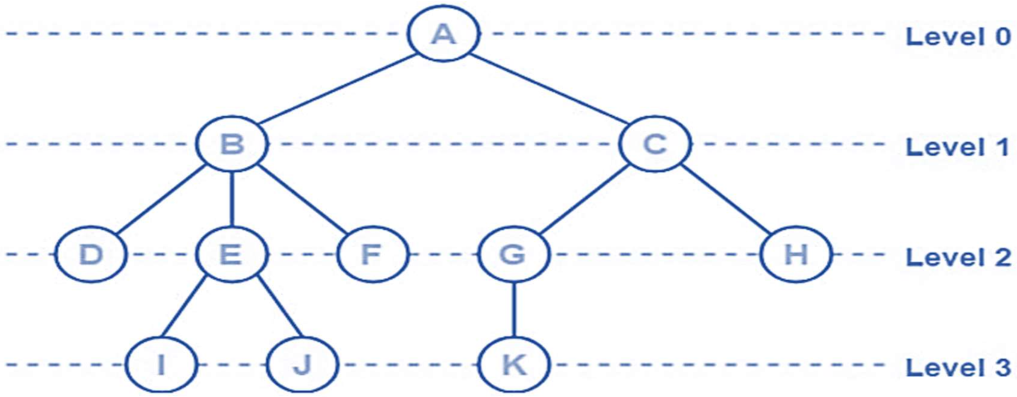
- Degree of a node is the total number of children of that node.
- Degree of a tree is the highest degree of a node among all the nodes in the tree.



- Degree of node A = 2
- Degree of node B = 3
- Degree of node C = 2
- Degree of node D = 0
- Degree of node E = 2
- Degree of node F = 0
- Degree of node G = 1
- Degree of node H = 0
- Degree of node I = 0
- Degree of node J = 0
- Degree of node K = 0

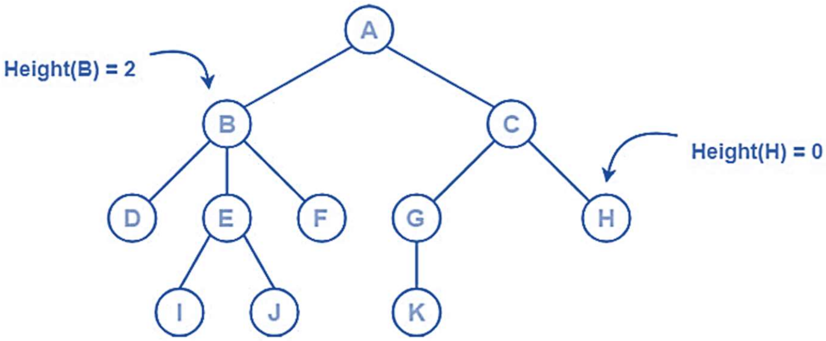
9. **Level: -**

- In a tree, each step from top to bottom is called as level of a tree.
- The level count starts with 0 and increments by 1 at each level or step.



10. Height: -

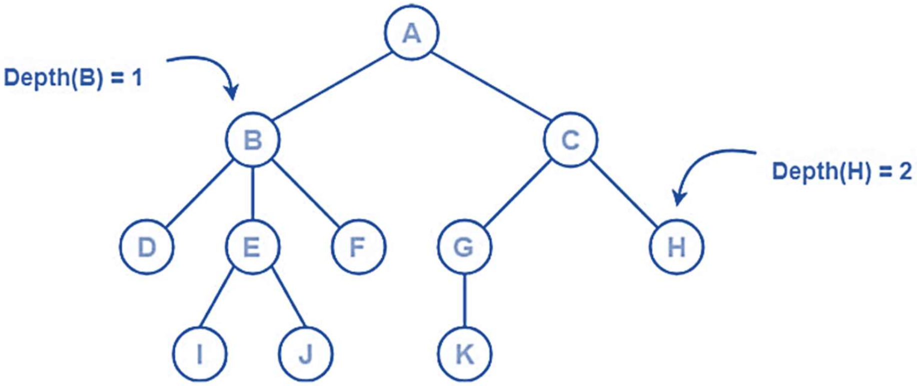
- Total number of edges that lies on the longest path from any leaf node to a particular node is called as height of that node.
- Height of a tree is the height of root node.
- Height of all leaf nodes = 0



- Height of node A = 3
- Height of node B = 2
- Height of node C = 2
- Height of node D = 0
- Height of node E = 1
- Height of node F = 0
- Height of node G = 1
- Height of node H = 0
- Height of node I = 0
- Height of node J = 0
- Height of node K = 0

11. Depth: -

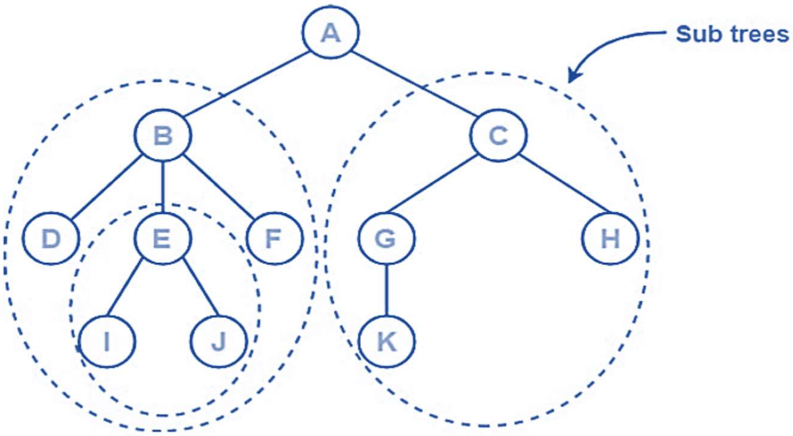
- Total number of edges from root node to a particular node is called as depth of that node.
- Depth of a tree is the total number of edges from root node to a leaf node in the longest path.
- Depth of the root node = 0
- The terms “level” and “depth” are used interchangeably.



- Depth of node A = 0
- Depth of node B = 1
- Depth of node C = 1
- Depth of node D = 2
- Depth of node E = 2
- Depth of node F = 2
- Depth of node G = 2
- Depth of node H = 2
- Depth of node I = 3
- Depth of node J = 3
- Depth of node K = 3

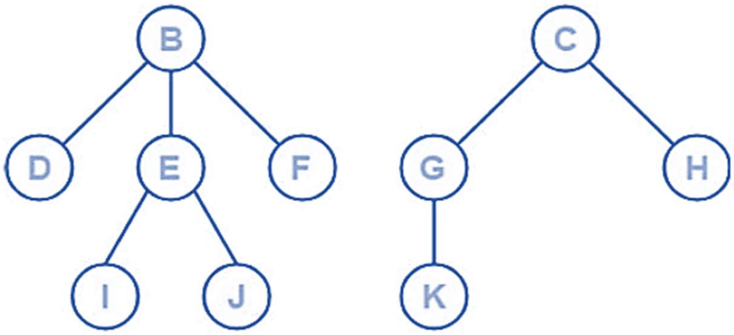
12. Subtree: -

- In a tree, each child from a node forms a subtree recursively.
- Every child node forms a subtree on its parent node.



13. Forest: -

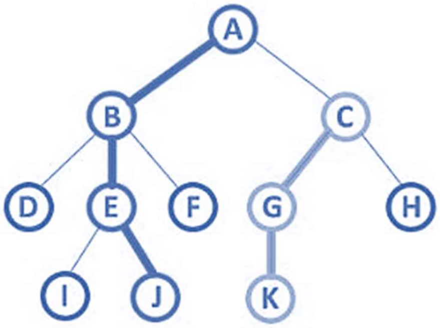
A forest is a set of disjoint trees



Forest

14. Path: -

- 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.


A
B
C
D
E
F
G
H
I
J
K