

# TREES

September 17 and 19,  
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## Aula 08 e 09

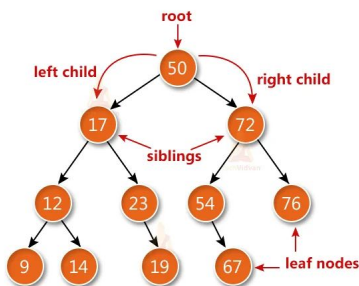
## DEFINITION

### 01. What is a Tree in programming?

Trees are well-known as a non-linear data structure. They don't store data in a linear way. They organize data hierarchically.

### 02. Terminology summary

- Root is the topmost node of the tree
- Edge is the link between two nodes
- Child is a node that has a parent node
- Parent is a node that has an edge to a child node
- Siblings have the same parent
- Leaf is a node that does not have a child node in the tree

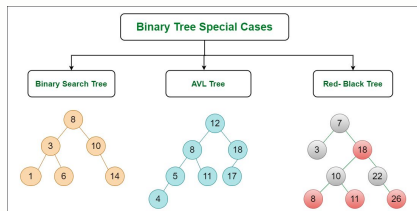


### 03. Properties of Tree Data Structure:

- Number of edges: An edge can be defined as the connection between two nodes. If a tree has  $N$  nodes then it will have  $(N-1)$  edges.
- Depth of a node: The depth of a node is defined as the length of the path from the root to that node.
- Height of a node: The height of a node can be defined as the length of the longest path from the node to a leaf node of the tree.
- Height of the Tree: The height of a tree is the length of the longest path from the root of the tree to a leaf node of the tree.
- Degree of a Node: The total count of subtrees attached to that node is called the degree of the node. The degree of a leaf node must be 0.
- The degree of a tree is the maximum degree of a node among all the nodes in the tree.

## COMMON TYPES

- Binary Search Tree (BST): A binary tree where the left child contains values less than the parent, and the right child contains values greater. It also has  $O(h)$  time complexity, but can become unbalanced.
- AVL Tree: A self-balancing BST that maintains a height difference of no more than 1 between child nodes. This guarantees  $O(\log n)$  time complexity for operations.
- Red-Black Tree: Another self-balancing BST that uses color properties to ensure balance. It also achieves  $O(\log n)$  time complexity for inserts and deletes.
- Binary Tree: A tree where each node can have up to two children. Operations like insertion and searching have a time complexity of  $O(h)$ , where  $h$  is the height of the tree.



## TREE TRANSVERSAL

Tree traversal involves searching a tree data structure one node at a time, performing functions like checking the node for data or updating the node. There are two common classifications for tree traversal algorithms:

- Depth-first search (DFS) starts with the root node and first visits all nodes on one branch before backtracking.
- Breadth-first search (BFS) starts from the root node and visits all nodes at its current depth before moving to the next depth in the tree.