

TREES

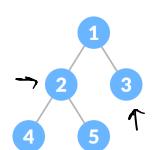
It is a non-linear data structure. They are used to represent data in hierarchical relationship. It consists of nodes connected by edges.

TERMINOLOGY

- 1) NODE : Item of information with branches to other items.
- 2) ROOT : A node without any parent.
- 3) CHILDREN : The successors of a node.
- 4) SIBLINGS : The children of the same parent.
- 5) DEGREE : The number of subtrees (or children) of a node is called its degree.
- 6) DEGREE of tree : Maximum degree of the nodes in the tree.
- 7) INTERNAL NODE : Node with atleast one child.
- 8) EXTERNAL NODE : Nodes which have degree ZERO.
- 9) LEVEL : (i) The root of the tree is at level one.
(ii) If a node is at level L, then its children are level L+1
- 10) Height (or depth) : Its the maximum level of any node in the tree.
- 11) FOREST : A set of zero or more disjoint trees. The removal of the root node from a tree results in a forest.

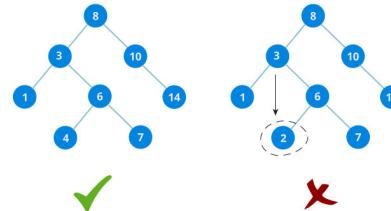
TYPES OF TREE:

1. BINARY TREE
2. BINARY SEARCH TREE
..... and more will come later.



BINARY TREE : In this, each parent node, can have at most two children.
or Internal Node

BINARY SEARCH TREE : It allows us to maintain sorted list of numbers.
Each tree node has maximum of two children
used to search for the presence of a number in $O(\log(n))$ time.



PROPERTIES:

1. All nodes of left subtree are less than root node.
2. All nodes of right subtree are more than root node.
3. All subtrees of each node are also BST's i.e. they have the above two properties.

TREE TRAVERSAL : In order to perform any operation on a tree, we need to reach to the specific node. So, we do tree traversal

Linear data structures can be traversed in only one way but hierarchical data structures such as trees can be traversed in different ways:

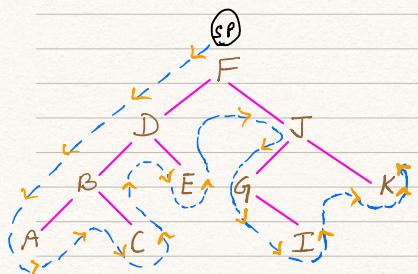
There are mainly two traversals:

- Depth first search (DFS)
- Breadth first search (BFS)

DEPTH FIRST SEARCH

INORDER TRAVERSAL

ROOT, LEFT, RIGHT

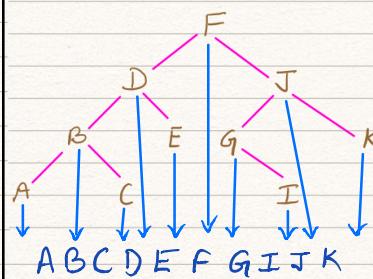


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- First visit all the nodes in the left subtree.
- Then the root node.
- Visit all the nodes in the right subtree.

PREORDER TRAVERSAL

LEFT, ROOT, RIGHT
(FREE FALL)

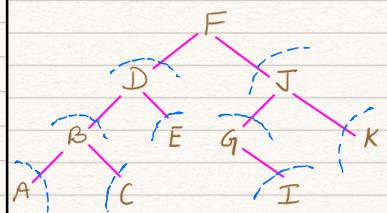


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- Visit all the nodes in the left subtree.
- Visit the root node.
- Visit all the nodes in the right subtree.

POSTORDER TRAVERSAL

LEFT, RIGHT, ROOT
(LEAF BREAK)



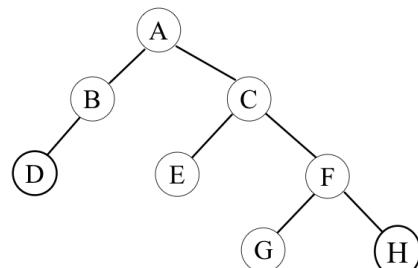
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- Visit all the nodes in the left subtree.
- Visit all the nodes in the right subtree.
- Visit the root node.

BREADTH FIRST SEARCH : It is also called level-order, where every node is visited on a level before next level.
It is implemented using a queue.

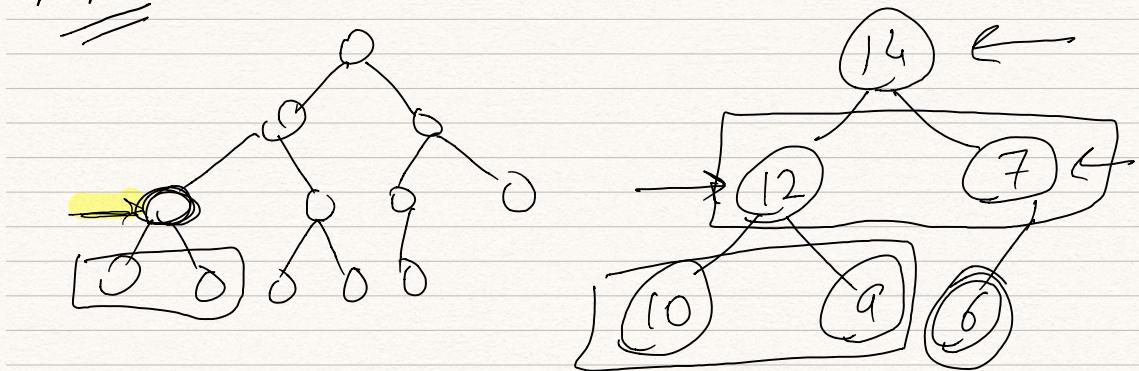
TRAVERSAL

ABCD EFGH

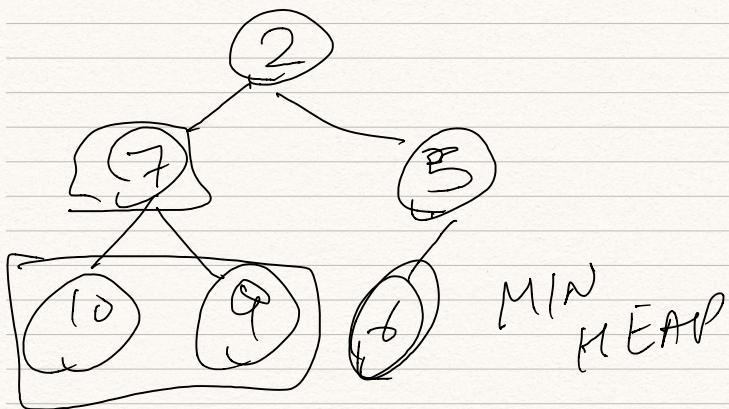


HEAP

Heap is a **binary tree** that must satisfy the following properties:



MAX HEAP



MIN HEAP