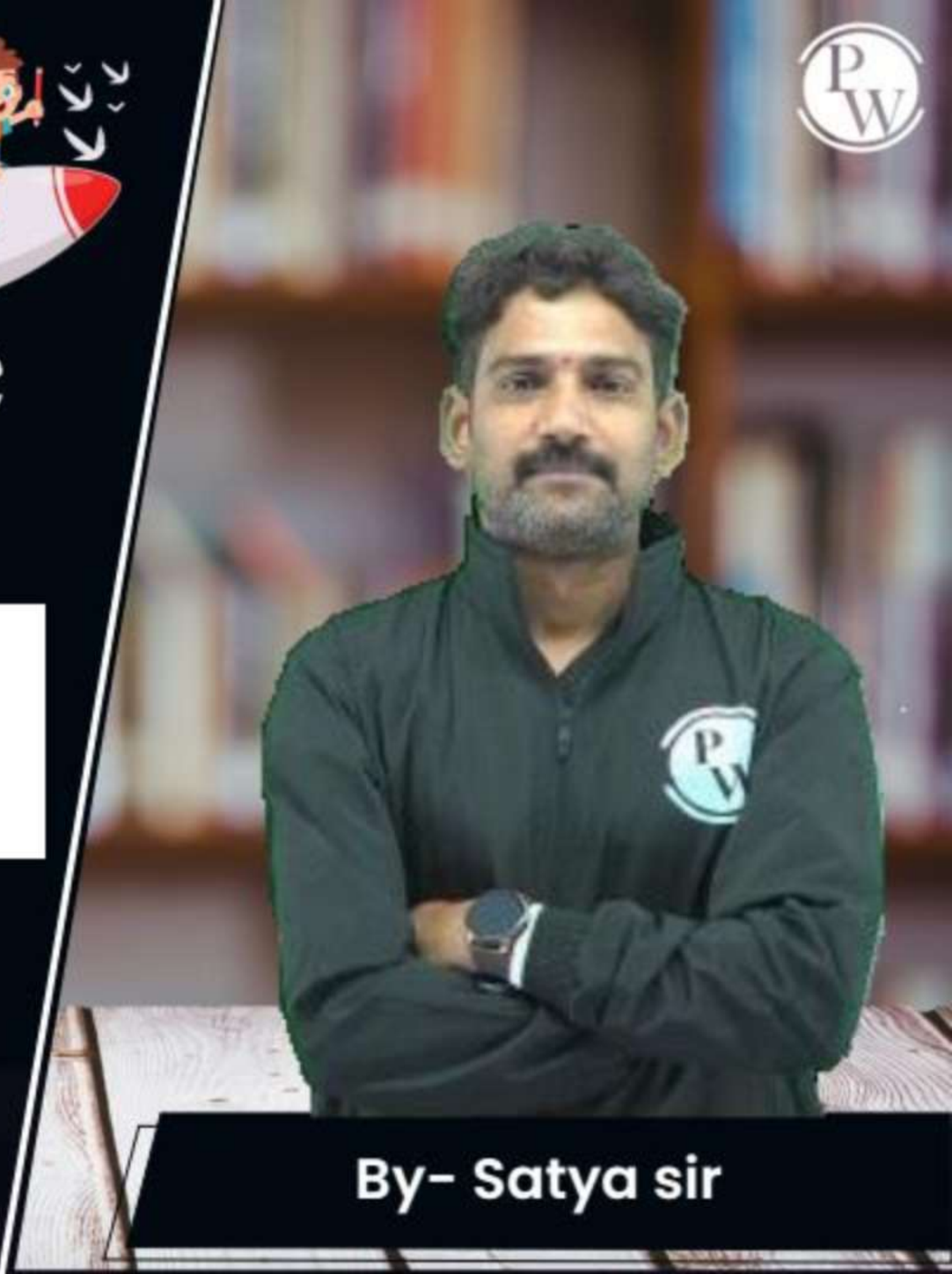
Data Science & Artificial Intelligence

Data Structures Through Python

TREES

Lecture No.- 03



By- Satya sir

Recap of Previous Lecture

Formulae on Trees / Binary Trees

- 'i' leaf Nodes ⇒ No. of Nodes with degree == 2 will be $(i-1)$
- FBT / PBT : $2x+1$ Total Nodes — x internal, $(x+1)$ External nodes
- The Numbers of Trees Possible
  - with 'n' unlabelled Nodes : $\frac{2n C_n}{(n+1)}$
  - With 'n' Labelled Nodes : $\left(\frac{2n C_n}{n+1}\right) * n!$
- 'N' Nodes : Min height $= \lceil \log_2^{(n+1)} \rceil - 1$ Max. Height $= (N-1)$
- 'H' height : Min Nodes : $(H+1)$ Max. Nodes : $2^{(H+1)} - 1$
- PBT, At Level 'L', The Number of Nodes $= 2^L$

Topics to be Covered

- Tree Traversals
- Binary Search Tree
  - Construction / Insertion
  - Search
  - Deletion from a BST

Topic : Tree Traversals

Traversal : Visiting/Accessing a Node

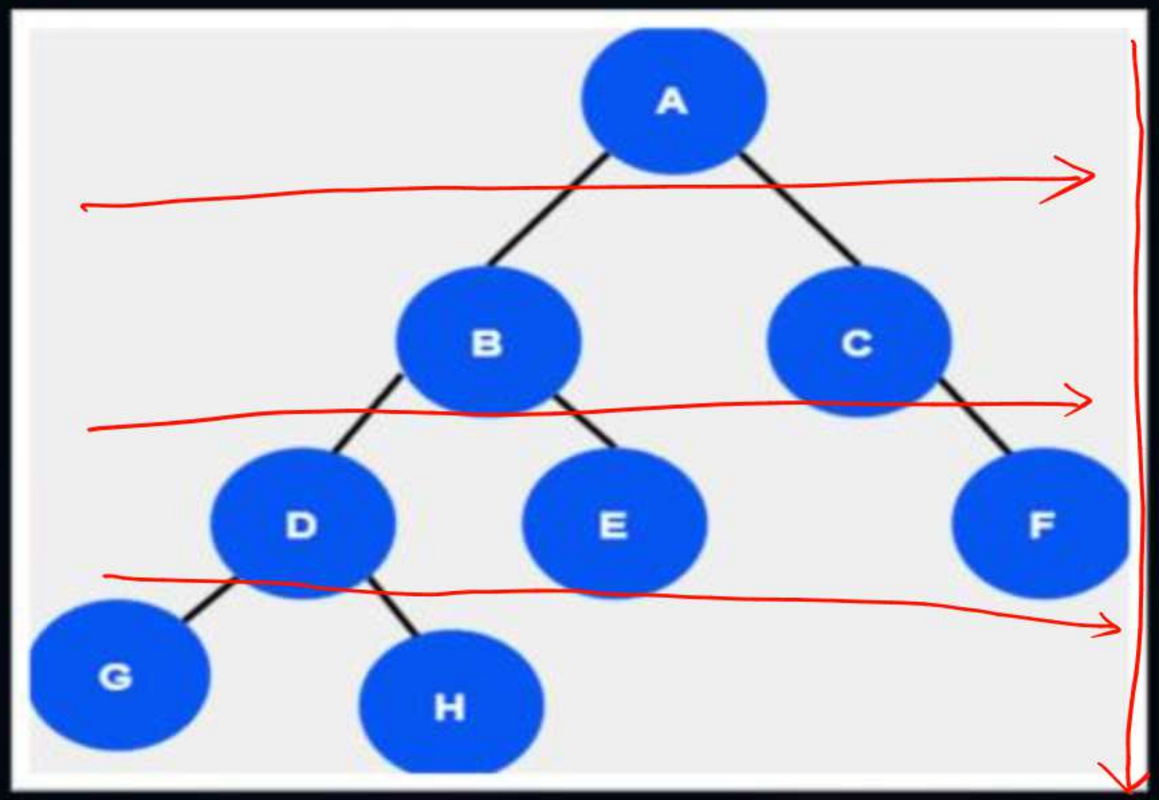
- The order in which, the Nodes of a Tree are visited is called as Tree Traversal.

- 2 Types of Traversals : ① Breadth-First Traversal / Level-order Traversal

② Depth-First Traversal

- In-order Traversal (LPR) : Left Subtree, Parent, Right Subtree
- Pre-order Traversal (PLR) : Parent, Left Subtree, Right Subtree
- Post-order Traversal (LRP) : Left Subtree, Right Subtree, Parent

Topic : Tree Traversals

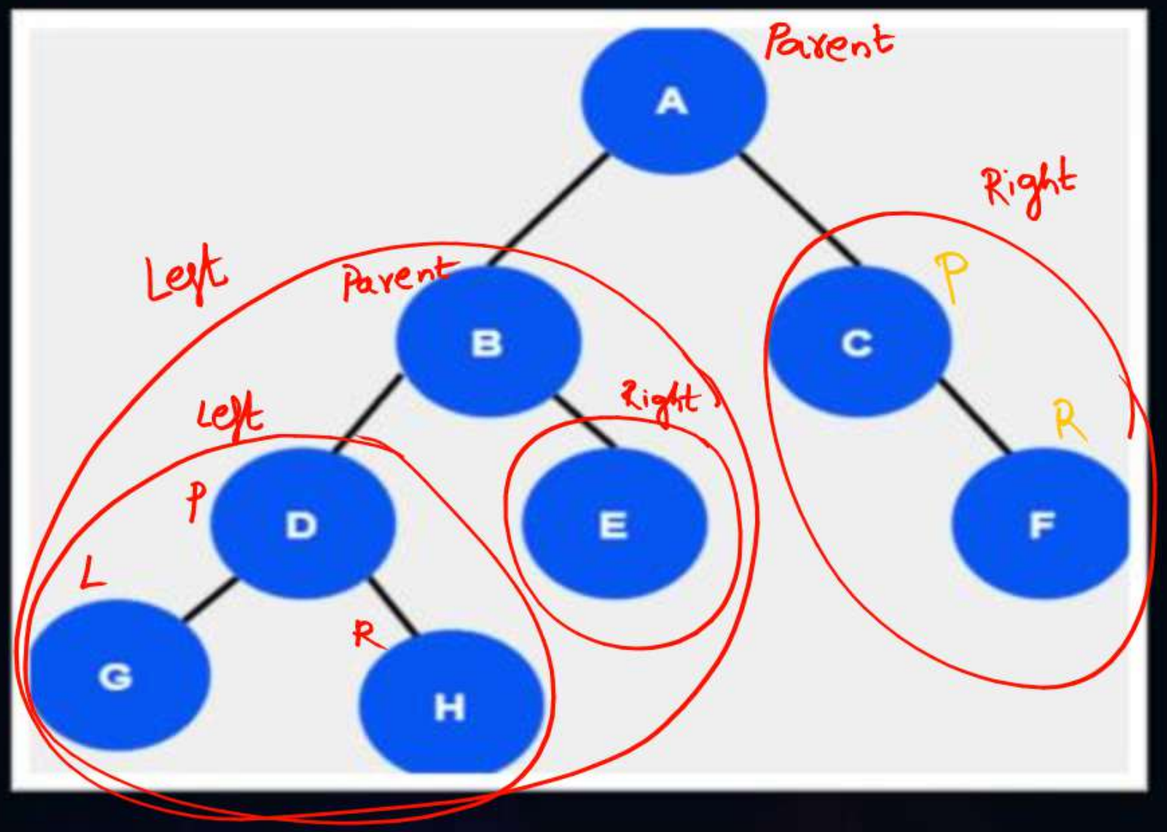


Breadth-First Traversal

Root level to Leaf level, Left to Right

A, B, C, D, E, F, G, H

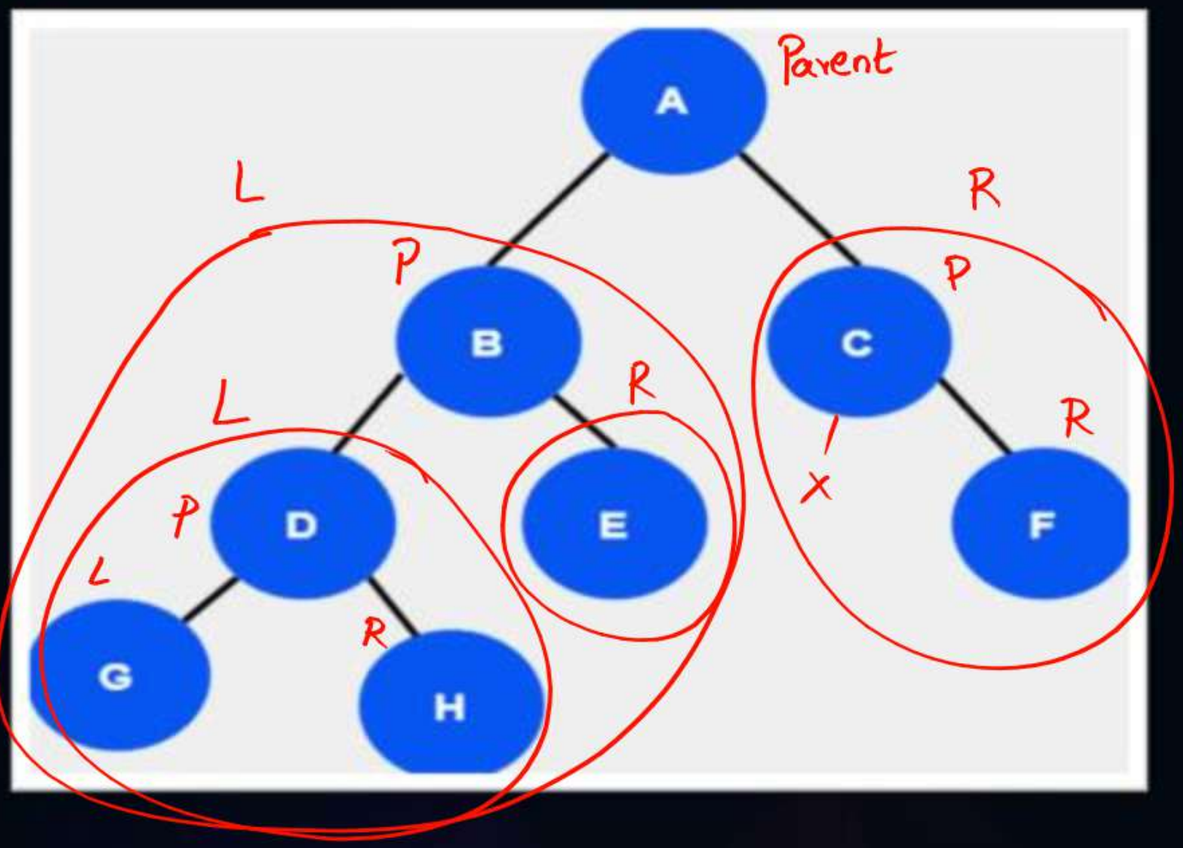
Topic : Tree Traversals



In order Traversal (L P R)

G, D, H, B, E, A, C, F

Topic : Tree Traversals



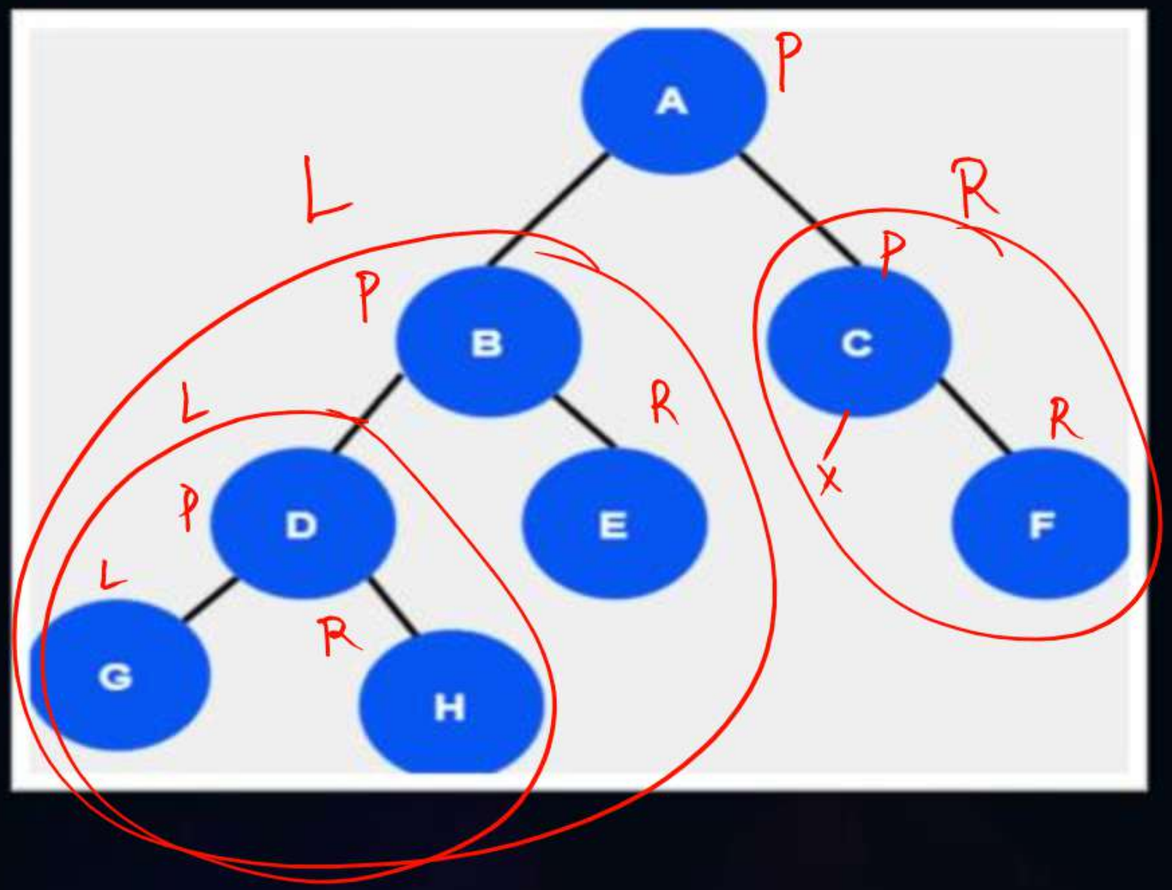
Pre-order Traversal (P L R)

P L R P R

A, B, D, G, H, E, C, F

P L R

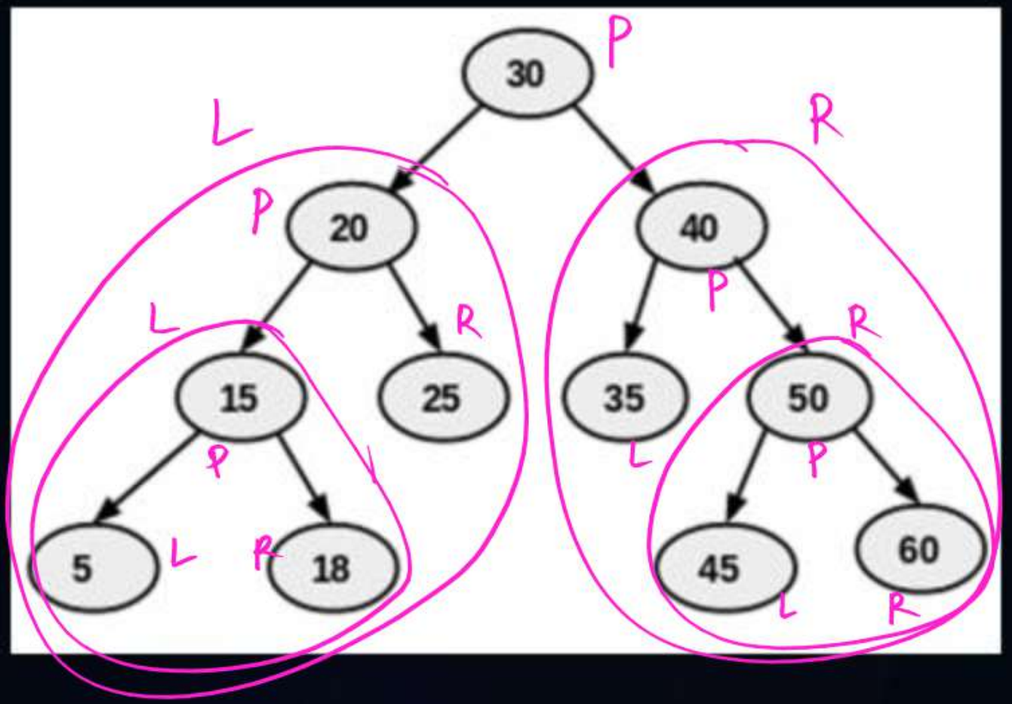
Topic : Tree Traversals



Post-order Traversal (L R P)

G, H, D, E, B, F, C, A

Topic : Tree Traversals



BFT: 30, 20, 40, 15, 25, 35, 50, 5, 18, 45, 60

In (LPR): 5, 15, 18, 20, 25, 30, 35, 40, 45, 50, 60

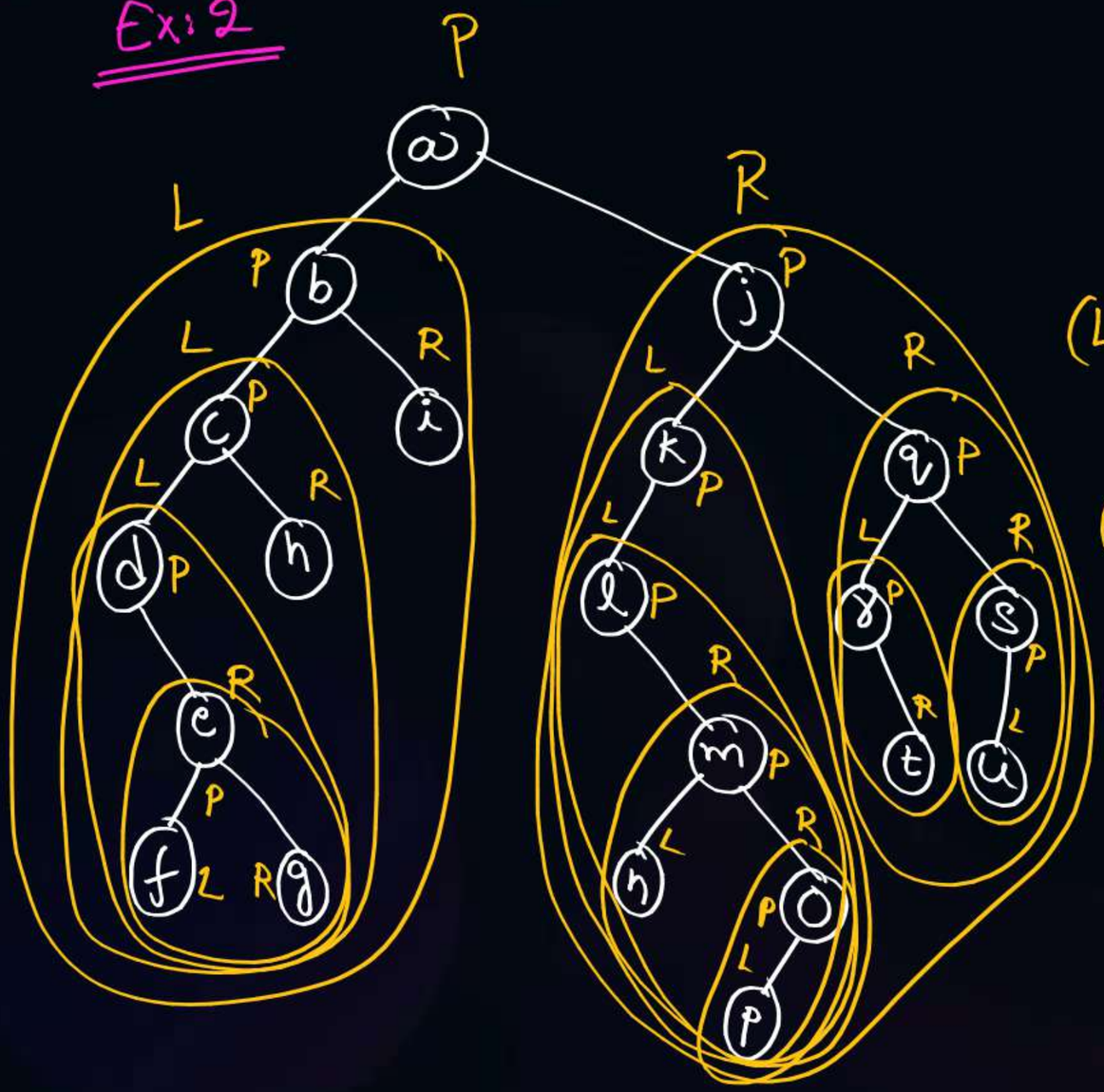
Pre (PLR): 30, 20, 15, 5, 18, 25, 40, 35, 50, 45, 60

Post (LRP): 5, 18, 15, 25, 20, 35, 45, 60, 50, 40, 30

Topic : Binary Search Tree

Tree Traversals

Ex: 2



BFT: abjcikqdhlrsemtufgnOP

In: (LPR) dfegchbialn mpOkjrtqus

Pre: (PLR) abcdefghijklmnopqrtsu

Post: (LRP) fgedhcibnpOmlktrusqja

Topic : Tree Traversals

Pre/Post : Parent Identification

In : Left, Right Subtree Identification

#Q. Consider the In-order traversal of a binary tree is C B G E D F H A J I L K and Pre order traversal is A B C D E G F H I J K L. The Post Order Traversal is _____

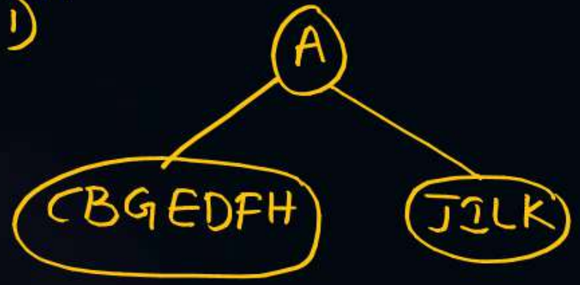
a. C G E H F B D J L K I A

b. C G E F H D B J L K I A

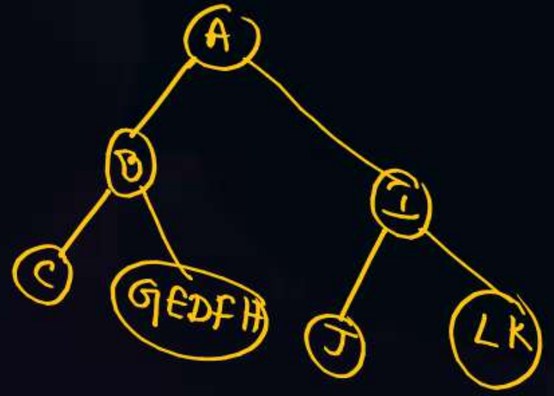
c. C G E H F D B J L K I A

d. C G E H F D B L J K I A

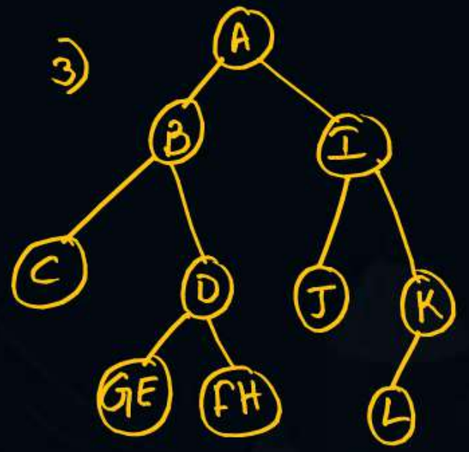
1)



2)



3)



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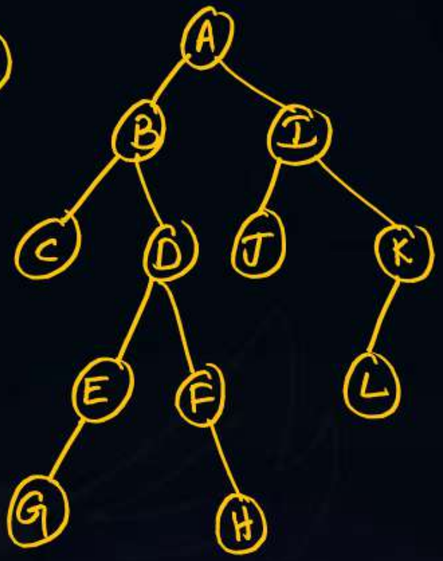


Post order: (LRP) CGEHFDBJLKIA

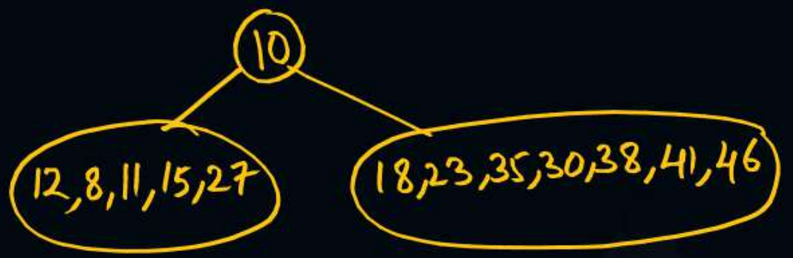
Topic : Tree Traversals

#Q. Consider the In-order traversal of a binary tree is 12 8 11 15 27 10 18 23 35 30 38 41 46 and Post order traversal is 12 11 27 15 8 23 30 38 46 41 35 18 10. The Pre Order Traversal is

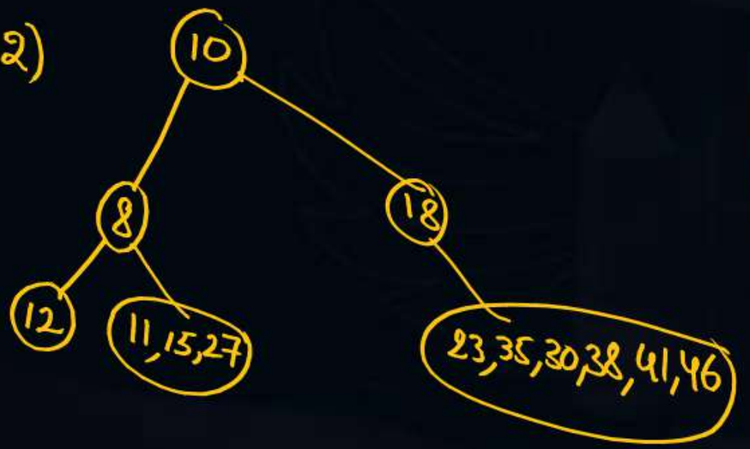
(LRP)

a. 10 8 12 15 11 27 18 35 41 23 38 30 46
b. 10 8 12 15 11 27 18 35 23 41 30 38 46
c. 10 8 12 15 11 18 27 35 23 41 38 30 46
d. 10 8 12 15 11 27 18 35 23 41 38 30 46

1)



2)

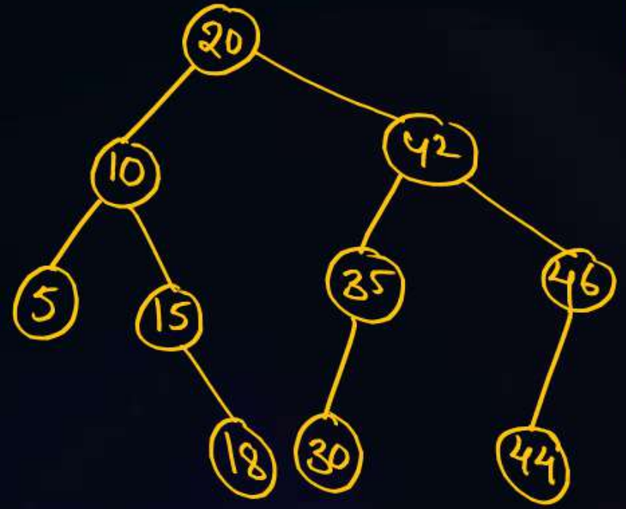


Pre order: 10,8,12,15,11,27,18,35,23,41,38,30,46
(PLR)

Topic : Binary Search Tree

- A Binary Tree in which **Left subtree < Parent < Right Subtree** at Each level.

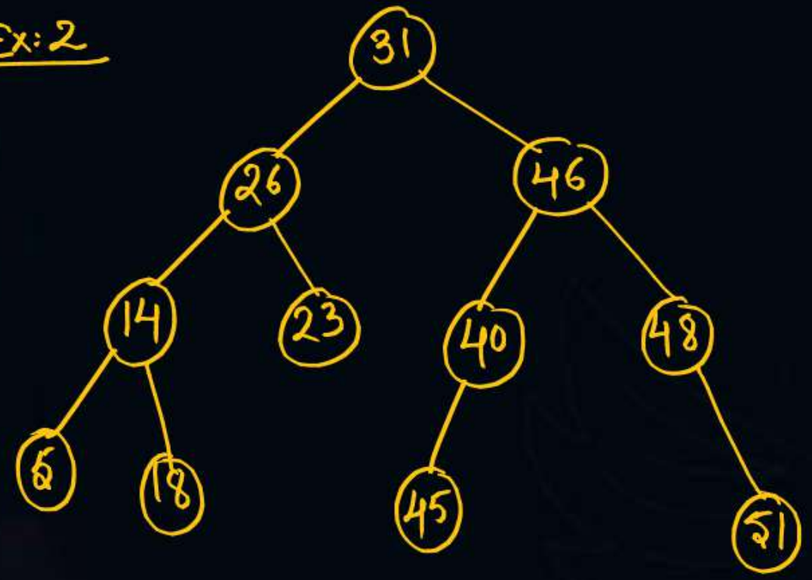
Ex: 1



BST

In order : 5, 10, 15, 20, 30, 35, 42, 44, 46

Ex: 2



26 > 23 40 < 45 Not BST

NOTE :

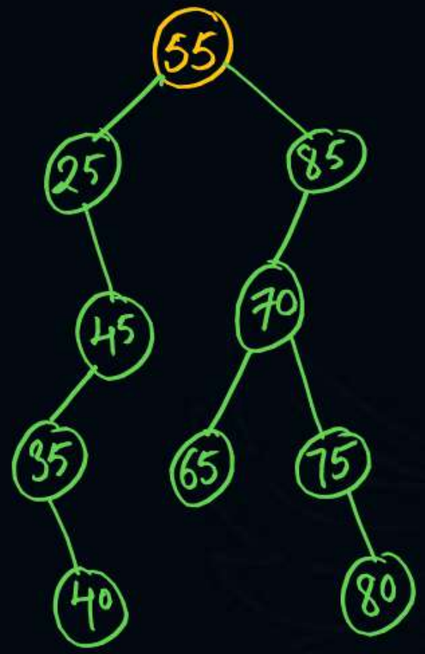
In order Traversal of BST will Produce values in Ascending order.

Topic : Binary Search Tree

In order Traversal : 25, 35, 40, 45, 55, 65, 70, 75, 80, 85

#Q. Consider a BST with Pre order traversal as 55, 25, 45, 35, 40, 85, 70, 65, 75, 80.
The Level order Traversal of the same is _____

a. 25, 35, 40, 45, 55, 65, 70, 75, 80, 85
b. 40, 35, 45, 25, 65, 80, 75, 70, 85, 55
c. 55, 25, 85, 45, 70, 35, 75, 65, 40, 80
d. 55, 25, 85, 45, 70, 35, 65, 75, 40, 80



level order (BFT)

55, 25, 85, 45, 70, 35, 65, 75, 40, 80

Topic : Binary Search Tree

H/W

#Q. Consider a BST with Post Order as 40, 41, 37, 35, 42, 56, 63, 71. Which of the below statement is Valid?

a. In Order == Level Order
b. In Order == Pre Order
c. Pre Order == Post Order
d. Level Order == Pre Order

BST Construction / Insertion

#Q. Construct a BST with Elements inserted in the order, 32, 46, 71, 20, 90, 7, 17, 41, 58, 61, 15

The resultant BST is _____

Root Node

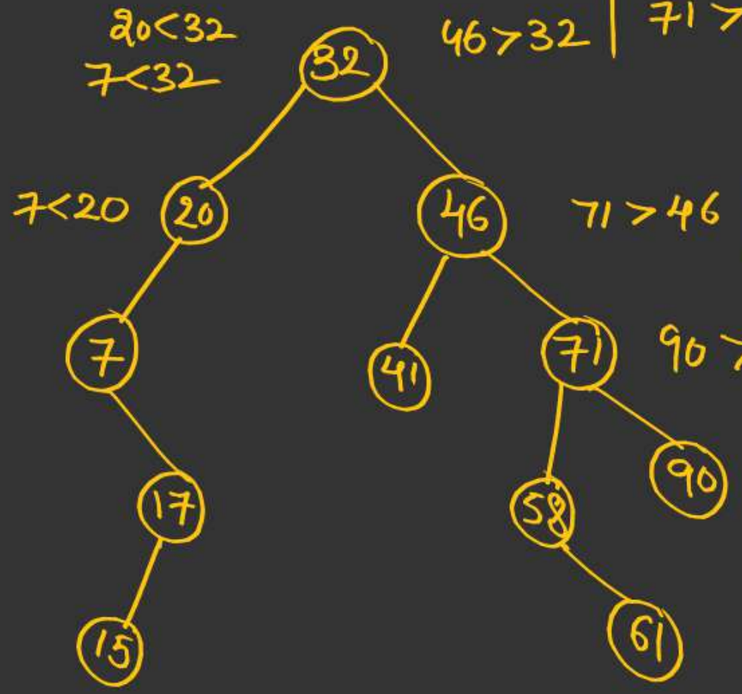
90<32
7<32

46>32 | 71>32 | 90>32

7<20

71>46 | 90>46

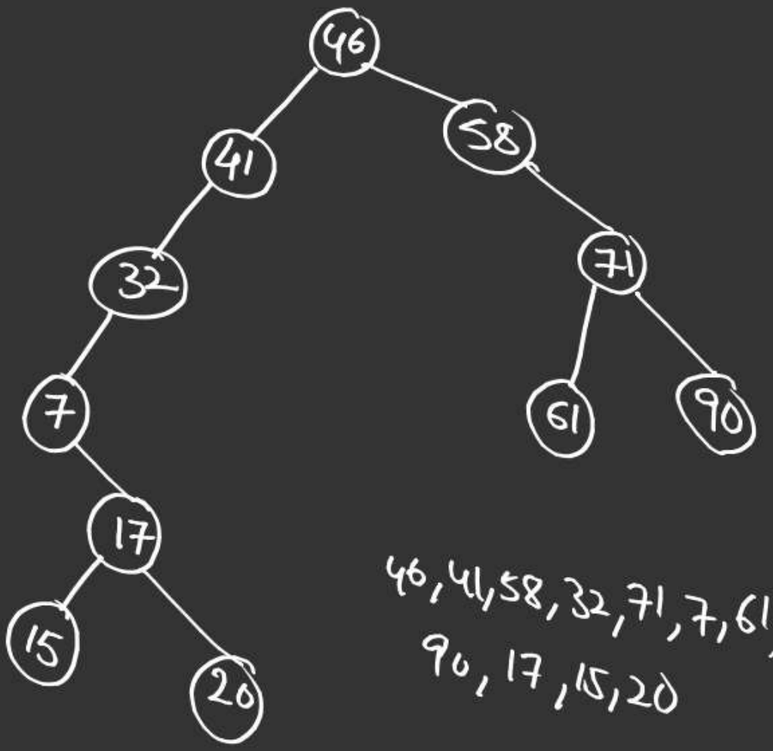
90>71



Resultant BST: 32, 20, 46, 7, 41, 71, 17, 58, 90, 15, 61

Insertion Sequence

46, 58, 41, 71, 32, 90, 61, 7, 17, 15, 20



46, 41, 58, 32, 71, 7, 61, 90, 17, 15, 20

2 mins Summary

- Tree Traversals
  - BFT
  - DFT
    - In order (LPR)
    - Pre order (PLR)
    - Post order (LRP)

- BST — Construction, Insertion

To be contd ...

THANK - YOU