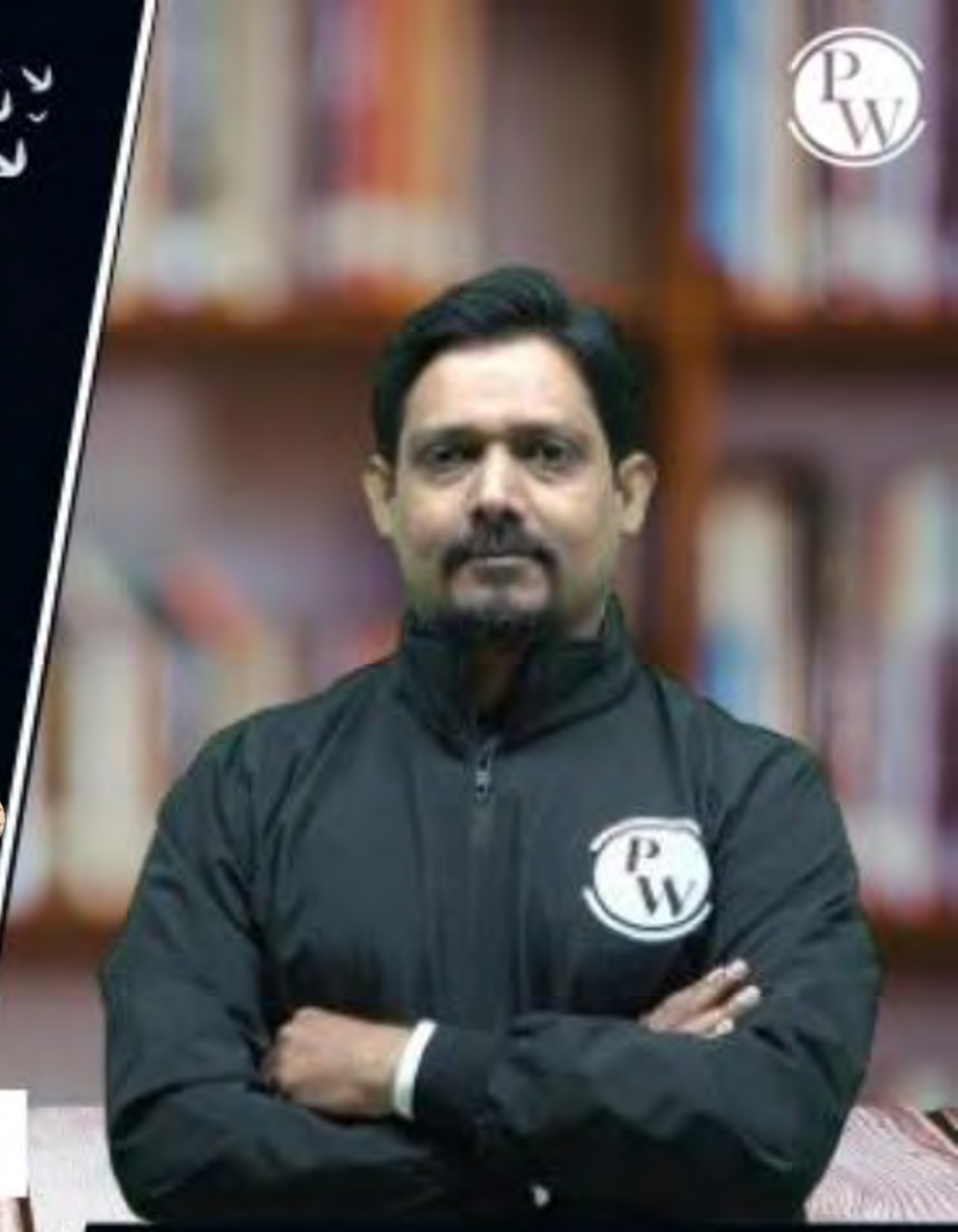
Computer Science & IT

Data Structure & Programming

Tree

Lecture No. 07



By- Abhishek Sir

Recap of Previous Lecture

- Topic
- Topic
- Topic
- Topic
- Topic

Deletion from BST

Slide

Topics to be Covered

- Topic — Counting of BST
- Topic — AVL tree
- Topic
- Topic
- Topic

Slide

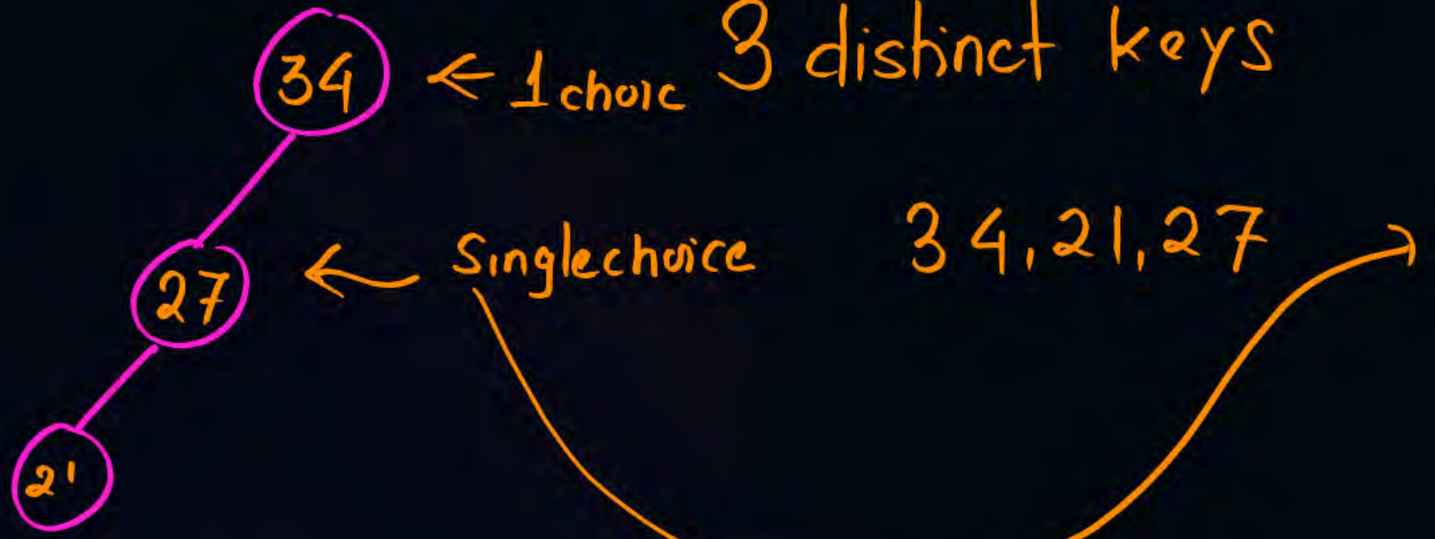
Topic : Tree

BST Counting
AVL tree insertion & rotation

Slide

Topic : Binary Search Tree

if I give a unlabelled binary tree



← 1 choice

3 distinct keys

← Single choice

34, 21, 27

1 way

fill the keys such that tree becomes BST

How many ways we can fill it.

Slide

Topic : Binary Search Tree

34, 27, 21

Slide

Topic : Binary Search Tree

if n distinct keys are present the total No. of

BST = total No. of unlabelled trees

$$\text{Catalan No.} = \frac{1}{n+1} {}^{2n}C_n$$

Slide

Topic : AVL Tree

Search
Insert
min
Max
Delete

Binary Search

BST $O(h) = O(n)$

Balanced BST : $O(\log_2 n)$

Slide

Topic : AVL Tree

AVL tree balanced BST (Height balanced BST)

Balancing factor of a Node is defined as

difference between

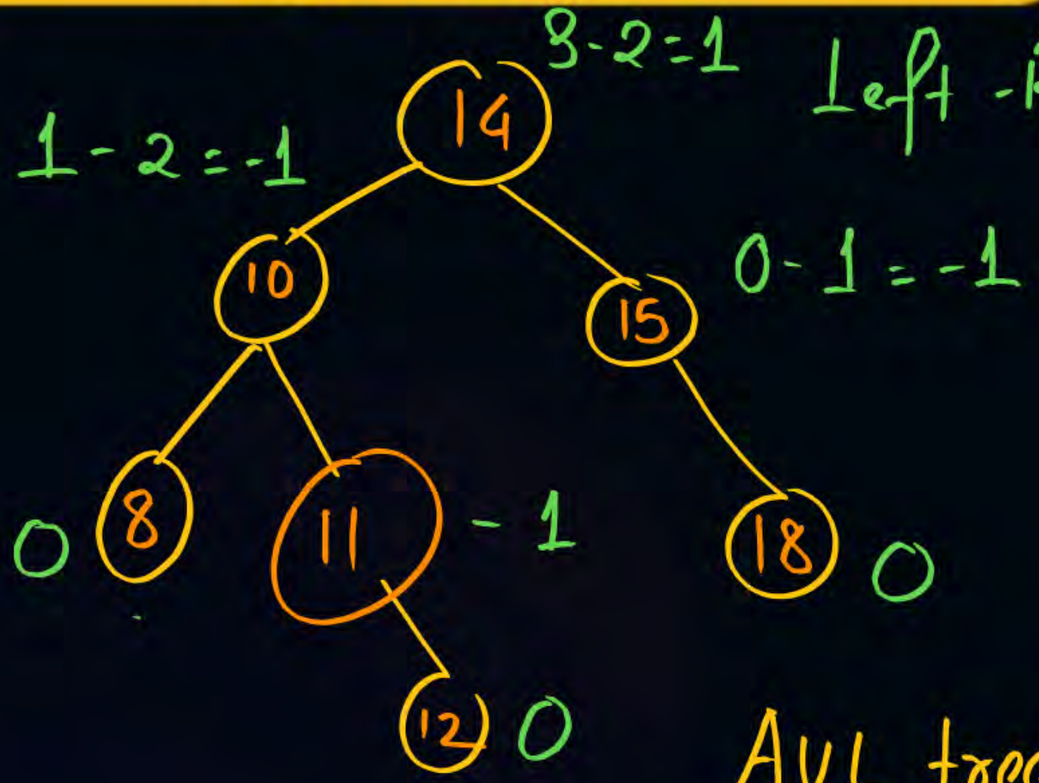
height on left subtree & right subtree

Height on Left subtree - height on Right subtree

Height on Right subtree - height on Left subtree

Slide

Topic : AVL Tree



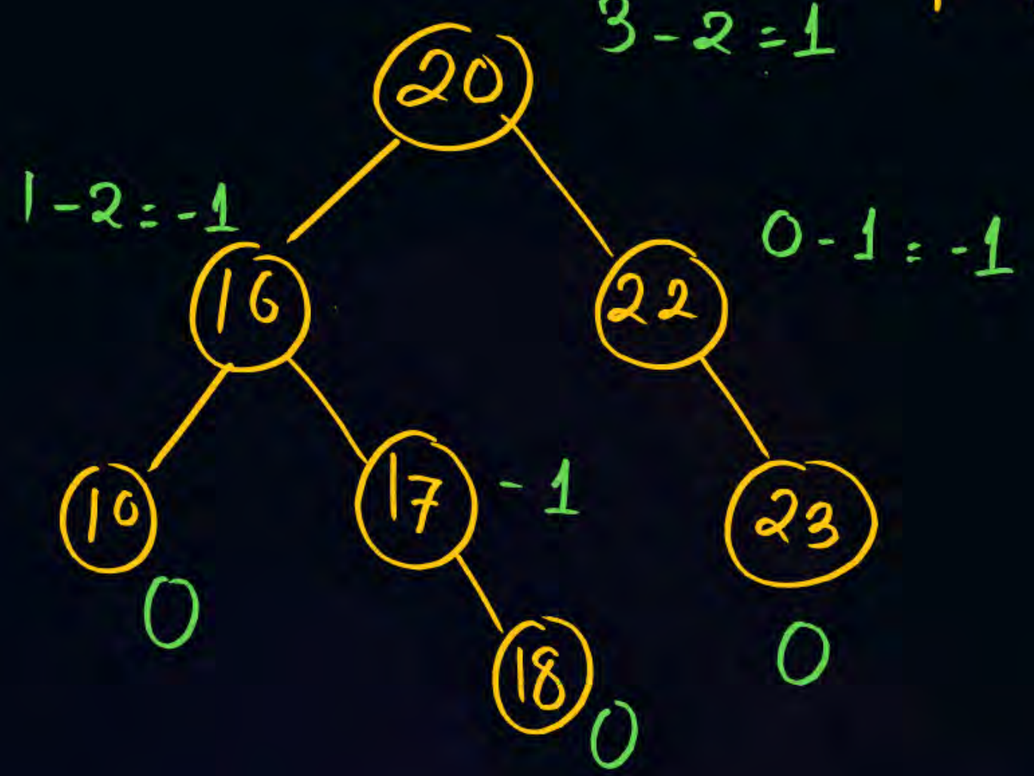
Balancing factor

A BST is called an AVL tree if balancing factor of each Node is 0, 1, or -1

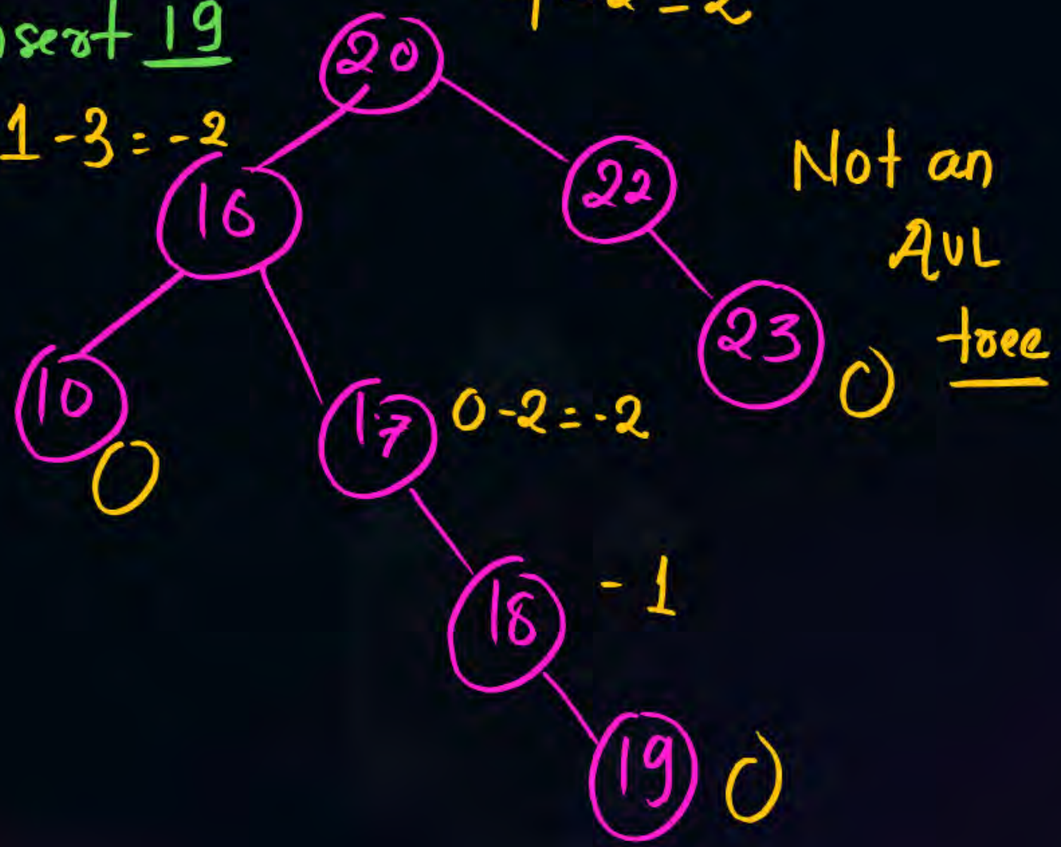
Slide

Topic : AVL Tree

When Insertion is performed then balancing factor of Nodes changes



Insert 19



Slide

Topic : AVL Tree

To convert to AVL tree we Need to

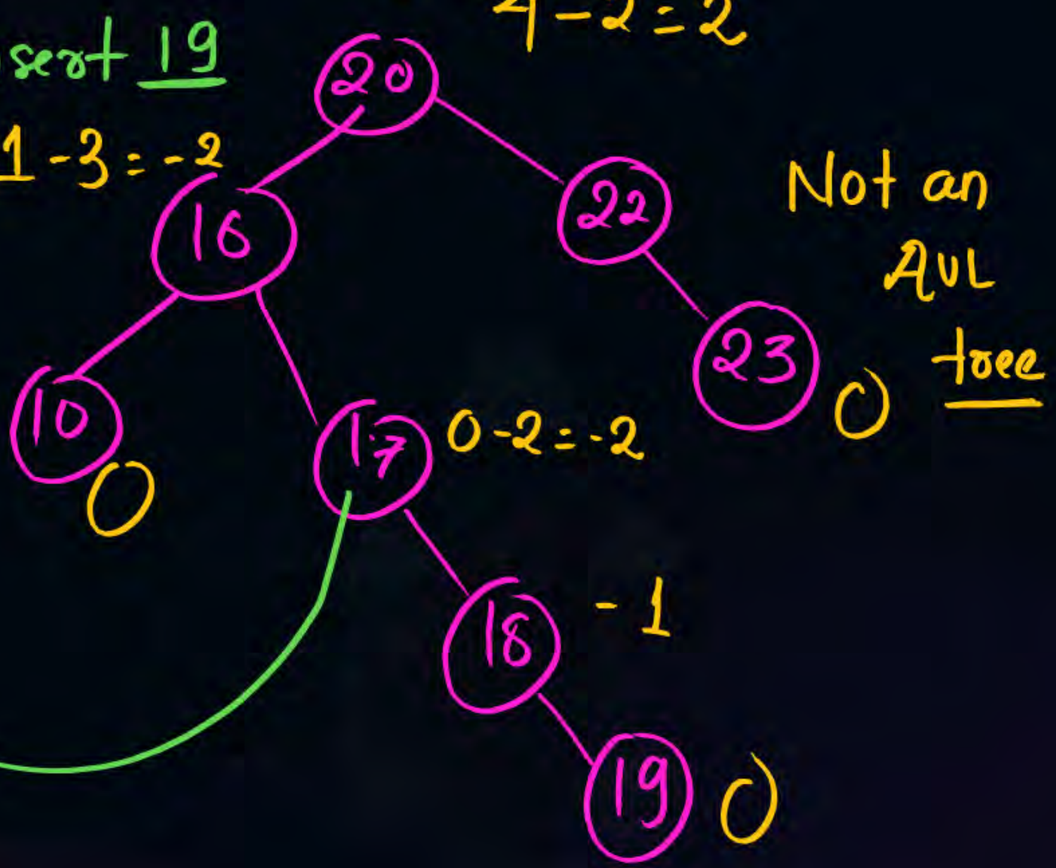
I. Identify critical Node

II perform Rotation ✓

Slide

Topic : AVL Tree

When Insertion is performed then balancing factor of Nodes changes



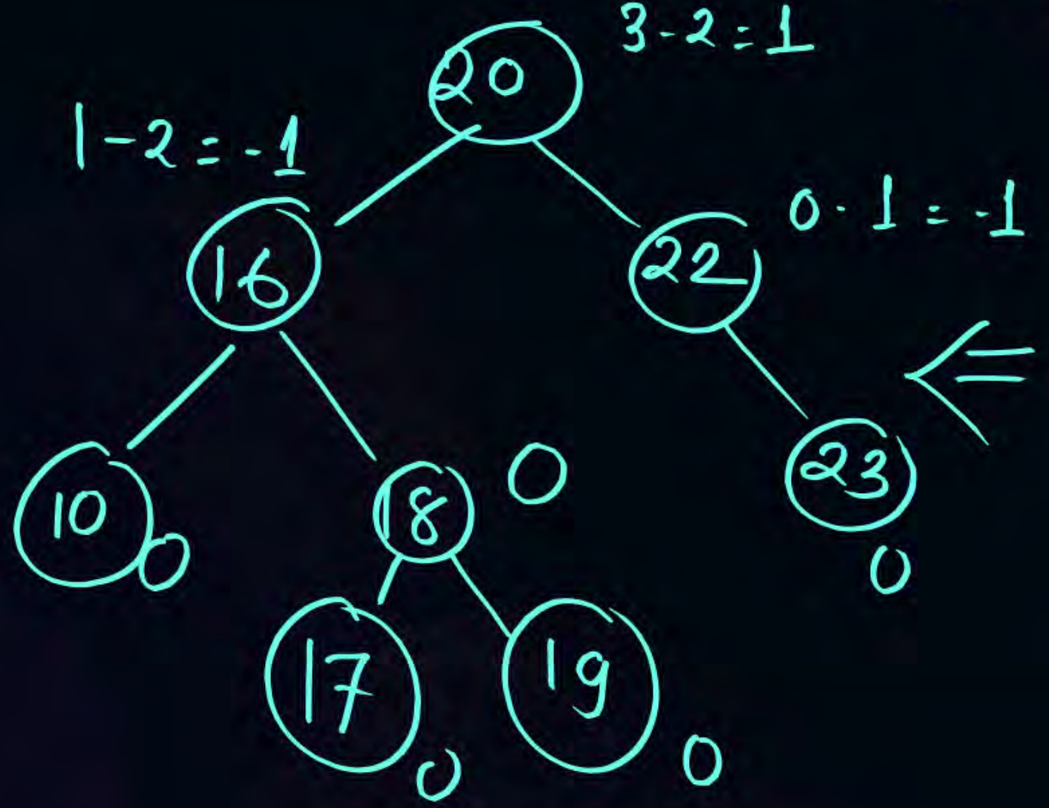
Critical Node

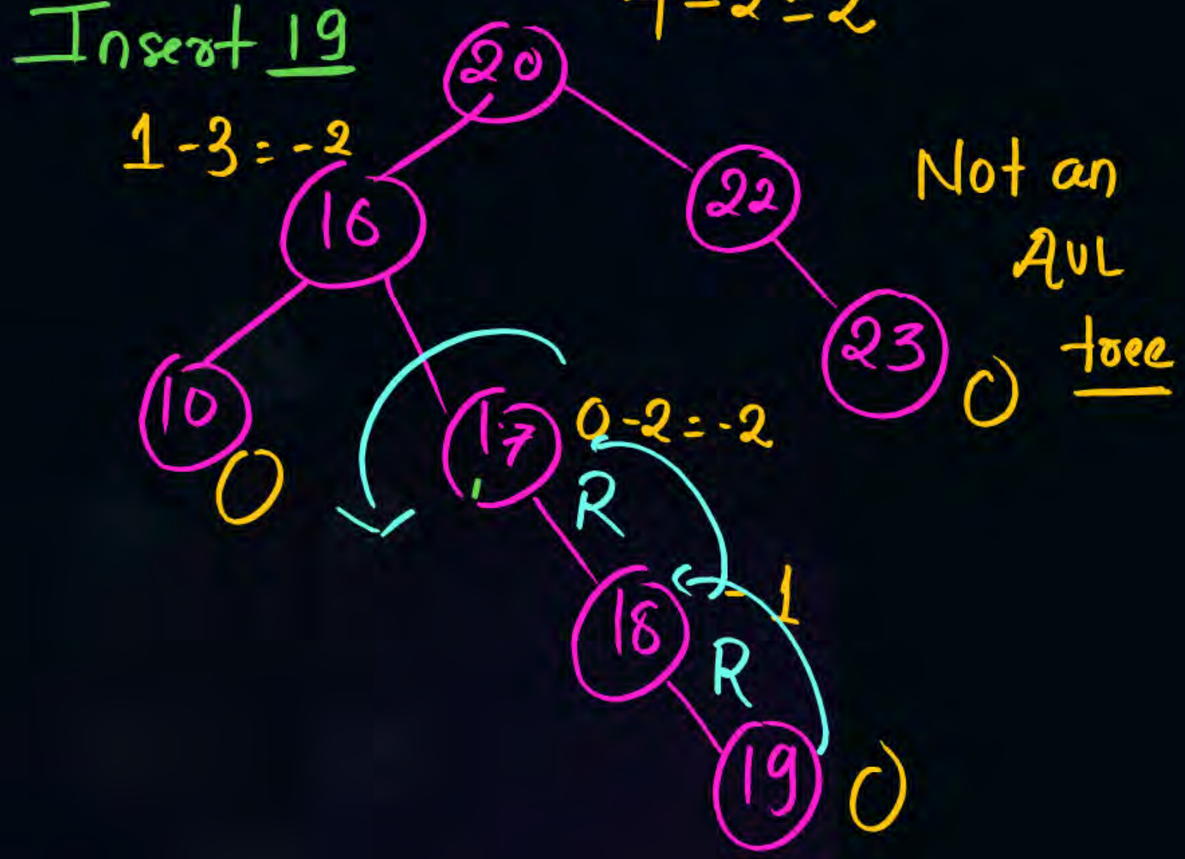
you fix critical Node
& entire tree
will become AVL tree

Slide

Topic : AVL Tree

When Insertion is performed then balancing factor of Nodes changes





Topic : AVL Tree

Critical Node :- from Newly inserted Node to root path the first Node that violates balancing property is criticalNode

Slide

Topic : AVL Tree

- Rotation
  - Single Rotation
    - LL Rotation
    - RR Rotation
  - Double Rotation
    - LR Rotation
    - RL Rotation

Slide

Topic : AVL Tree

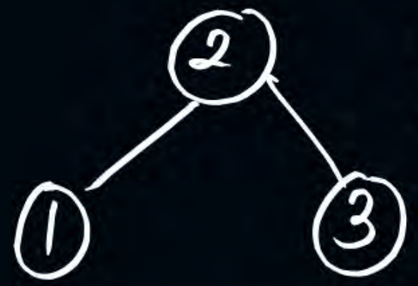
1. LL Rotation

Critical Node to Newly Inserted Node we Need 2 edge

3, 2, 1

to fix

Single Right Rotation



Rule

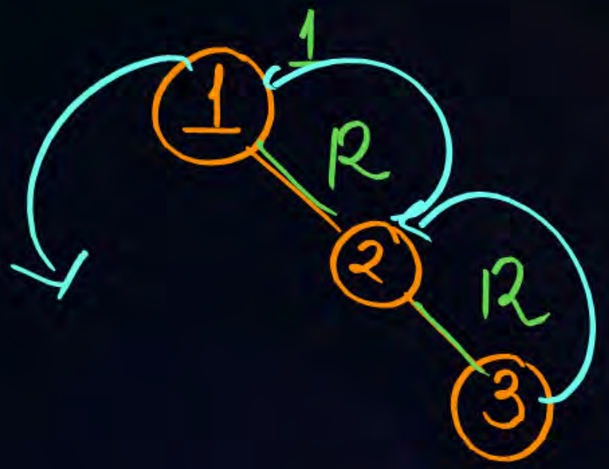
Slide

Topic : AVL Tree

2. RR Rotation

Critical Node

Insert values 1, 2, 3



1 Left Rotation

Slide

Topic : AVL Tree

Double Rotation (LR Rotation)

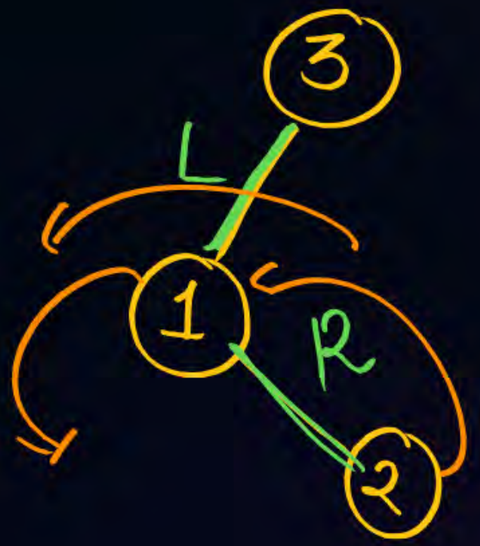
3 is critical Node

LR

↳ Left child of critical Node rotated Left

↳ critical Node Rotated Right

Insert 3, 1, 2



Left Rotation

Right Rotation

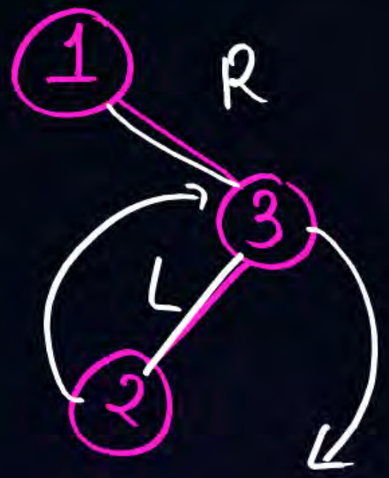
Slide

Topic : AVL Tree

Double Rotation

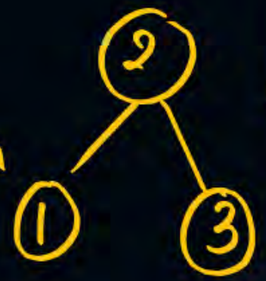
RL Rotation

Insert 1, 3, 2



Right Rotation

Left Rotation



R L

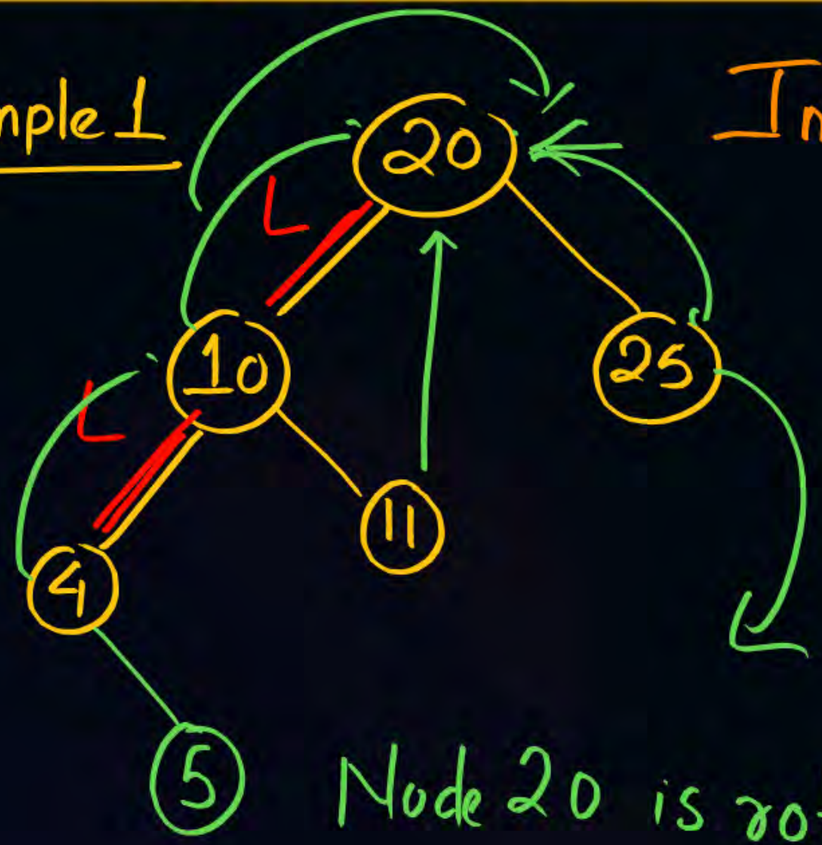
→ Right child of Critical Node rotated right

Critical Node rotated left.

Slide

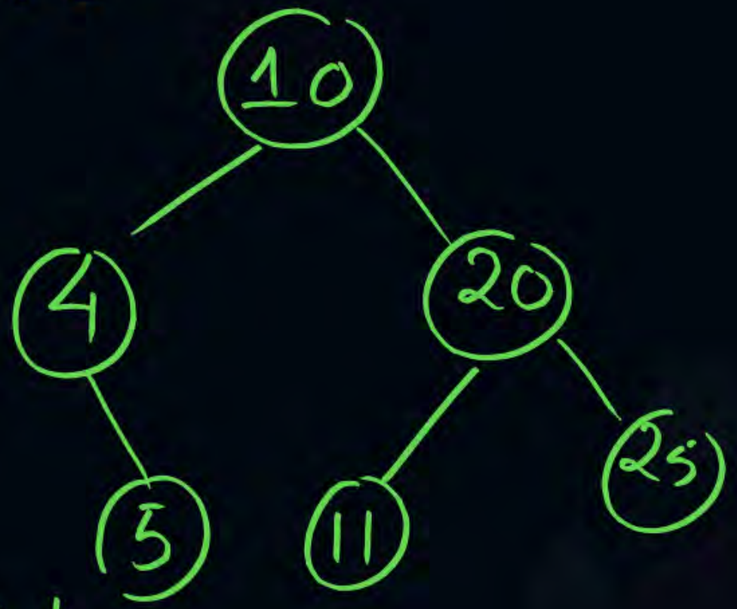
Topic : AVL Tree

Example 1



Insert 5

Critical Node & Rotation

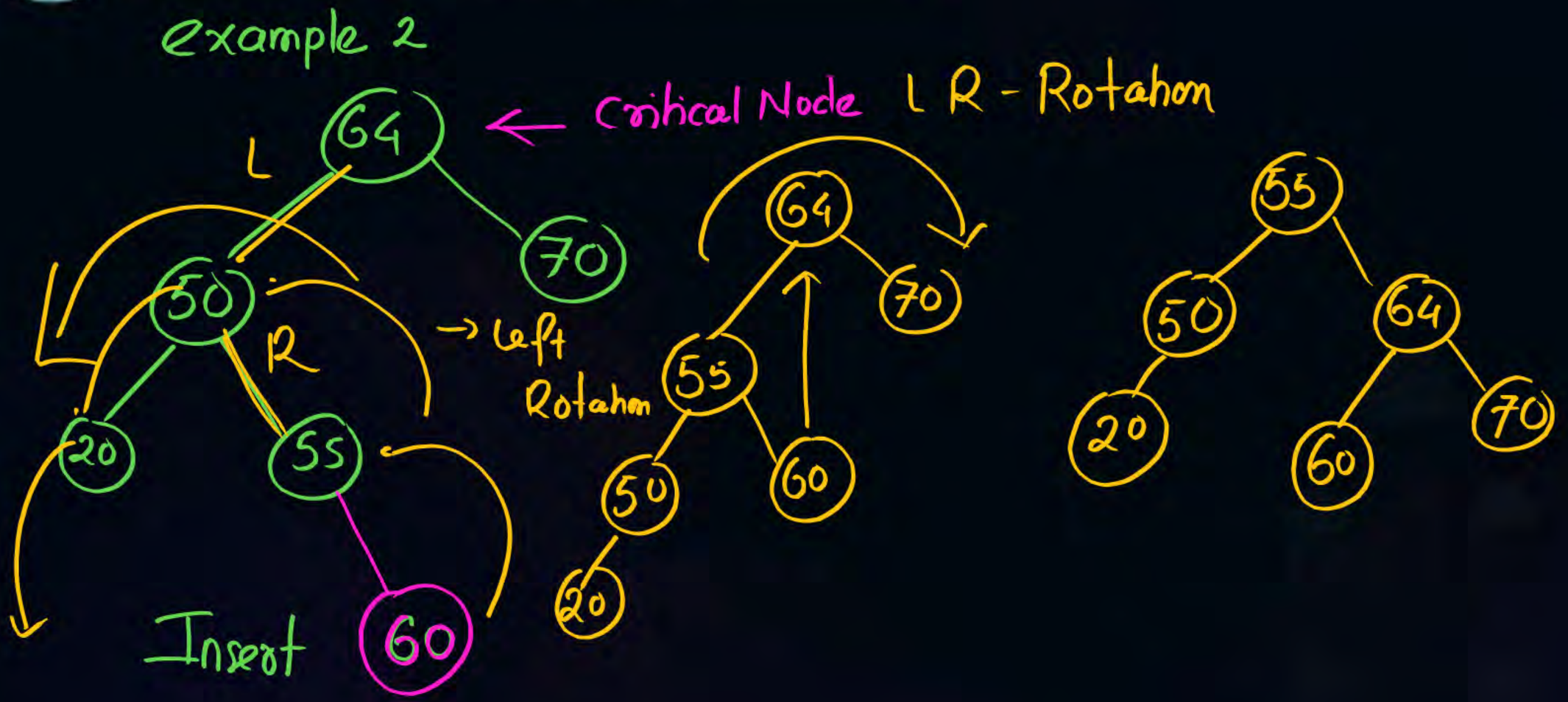


Node 20 is rotated

11 is left side of 20 after rotation 11 will be Left Child of 20

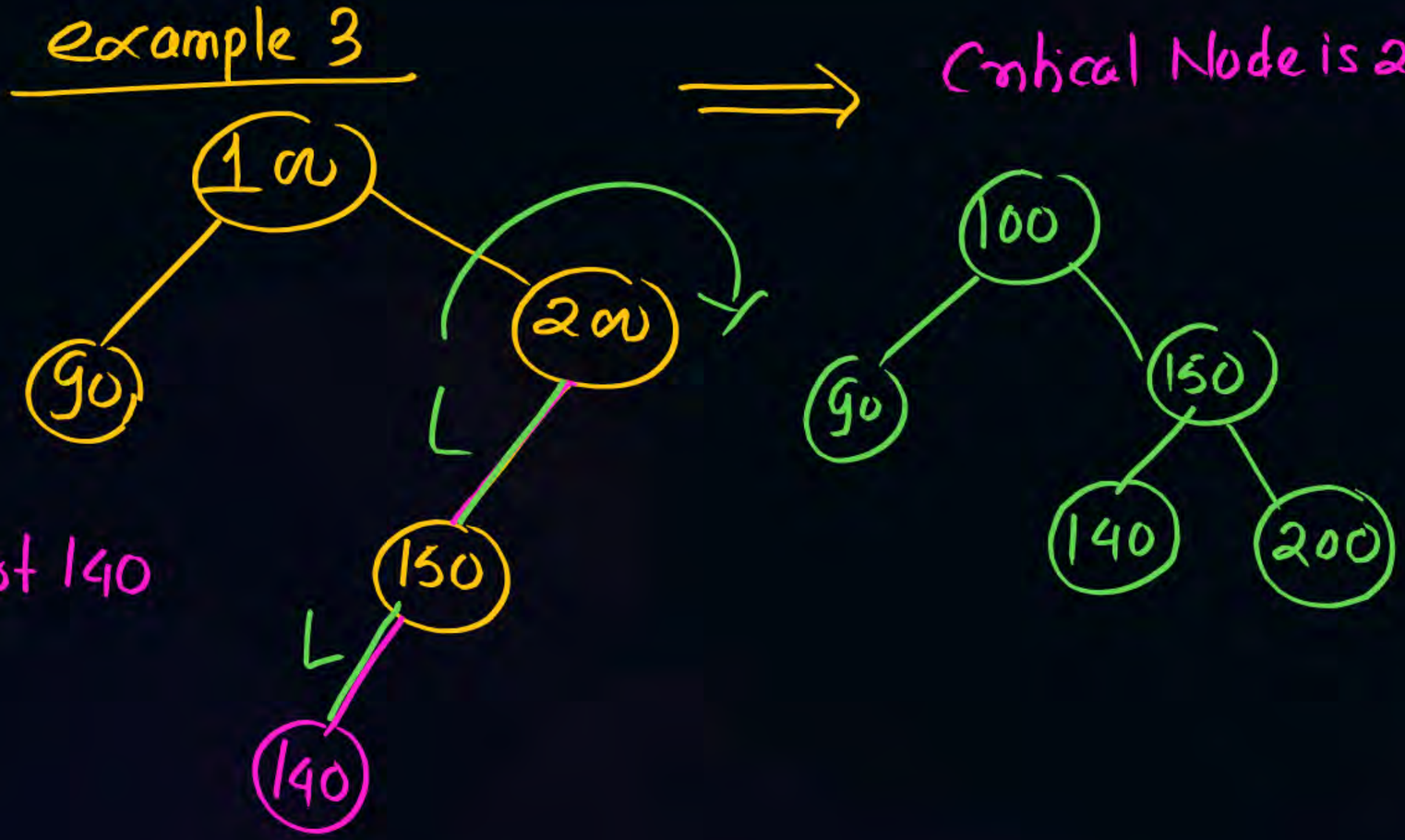
Slide

Topic : AVL Tree



Slide

Topic : AVL Tree



Slide

Topic : AVL Tree

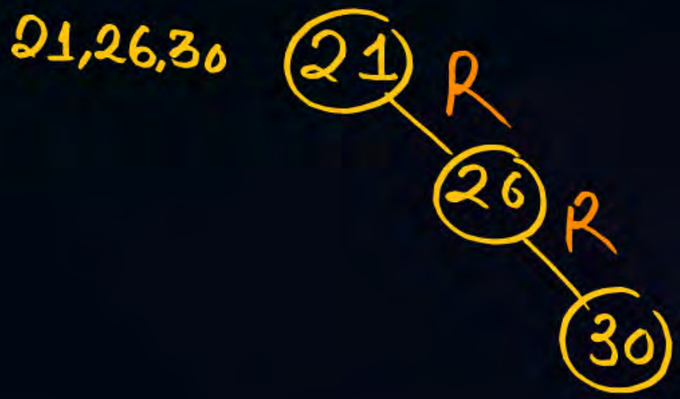
Create AVL tree ?

21,26,30,9,4,14,28,18,15,10,2,3,7,

Root element is___

9,4,14

21,26,30



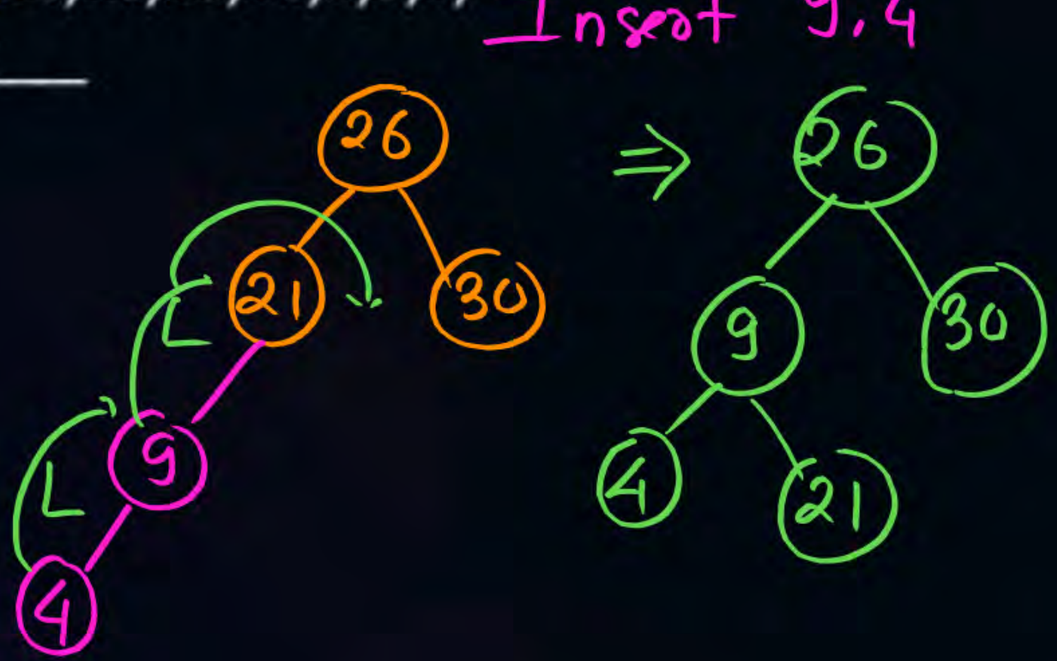
Slide

Topic : AVL Tree

Create AVL tree ?

21,26,30,9,4,14,28,18,15,10,2,3,7,

Root element is___



Slide

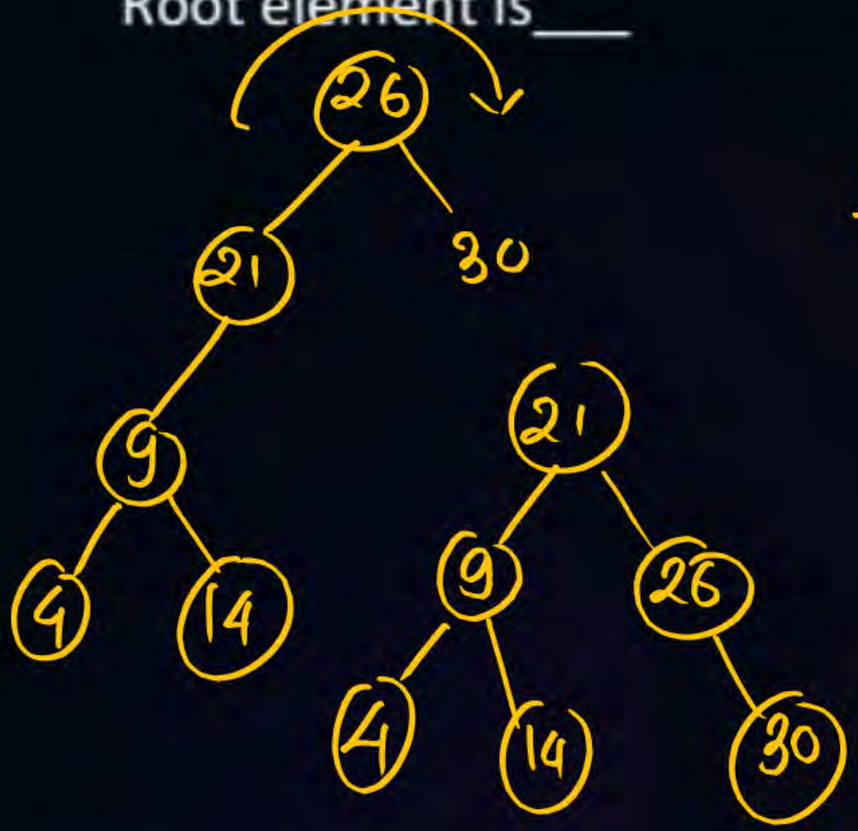
Topic : AVL Tree

HW group

Create AVL tree ?

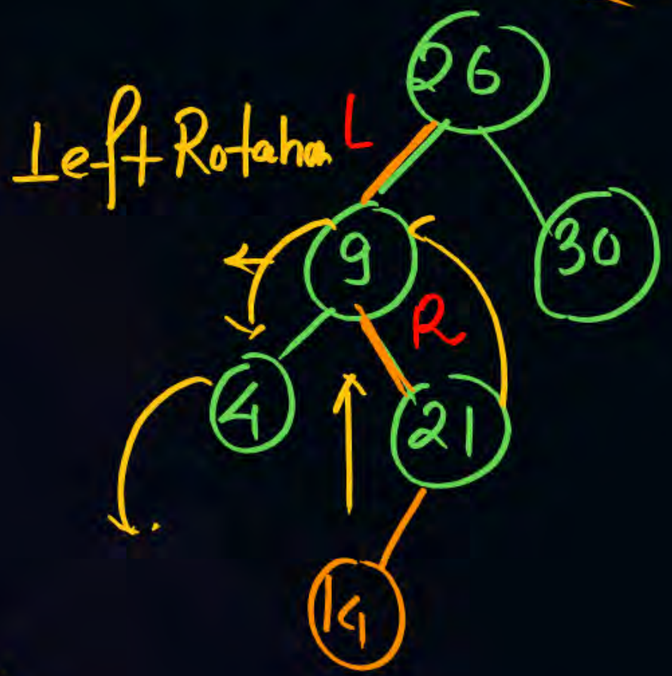
21,26,30,9,4,14,28,18,15,10,2,3,7,

Root element is ___



Insert 14

Critical



fix

L R Rotation

↑

Left child Critical Node

Rotated left

Slide

Topic : AVL Tree

Create AVL tree ?

21,26,30,9,4,14.28,18,15,10,2,3,7,

Root element is___

Topic : AVL Tree

Create AVL tree ?

21,26,30,9,4,14.28,18,15,10,2,3,7,

Root element is___

Topic : AVL Tree

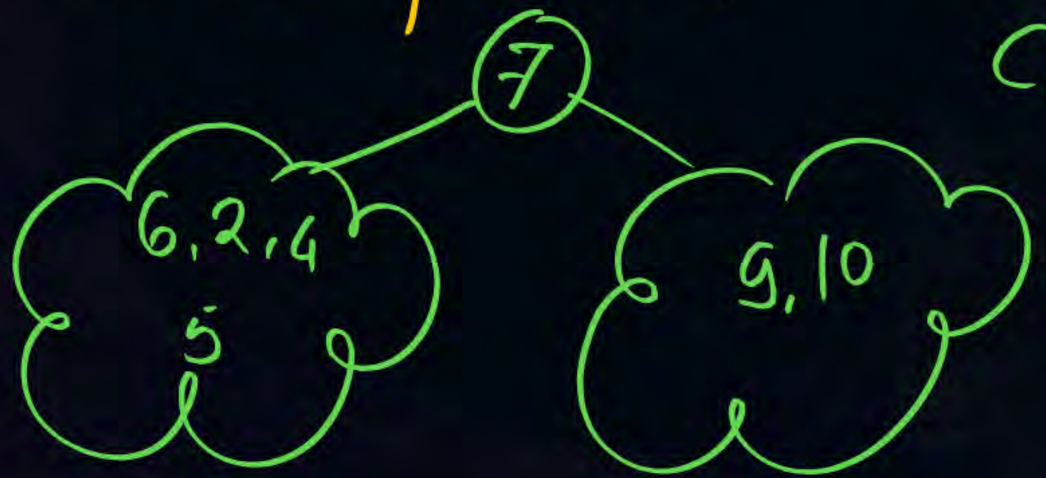
If BST is constructed with

6, 2, 5, 4 7, 9, 10

and 7 is root the No. of BST posible

$C_4 = \underline{14}$

$C_2 = 2$



$14 * 2 = 28$

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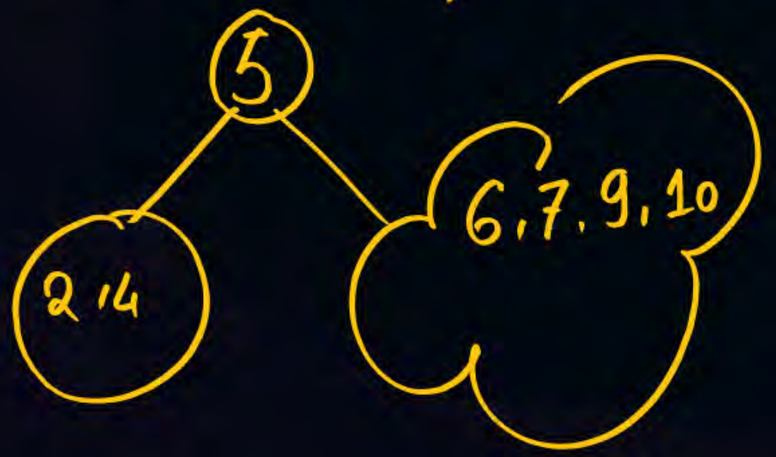
Topic : AVL Tree

If BST is constructed with

6, 2, 5, 4 7, 9, 10

and 5 is root the No. of BST posible 28



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Topic : AVL Tree

n_q distinct keys — total BST with max Height is 2^{n-1}

if BST constructed with elements , 24, 29, 32, 60

How many BST will have height 3 — 8

Slide

2 mins Summary

Topic — AVL tree

Topic — AVL Rotation

Topic — Counting of BST

Topic

Topic

THANK - YOU

Slide