

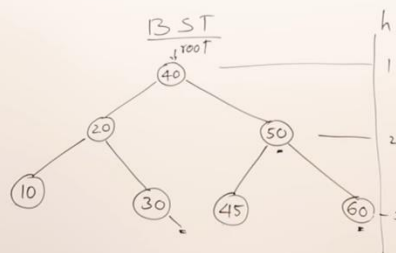
AVL Trees

1. What is a Binary Search Tree (BST)
2. Drawback of BST
3. How BST can be improved
4. What is an AVL Tree
5. Rotations in AVL Tree
6. How to create AVL Tree

AVL Trees

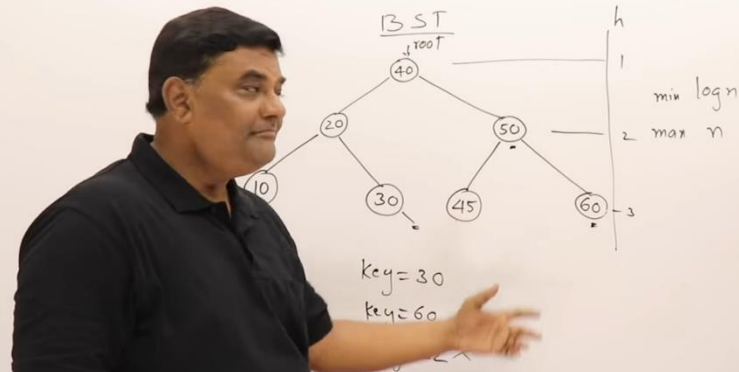
1. What is a Binary Search Tree (BST)
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AVL Trees



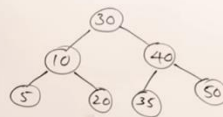
key = 30
 key = 60
 key = 32 x

AVL Trees



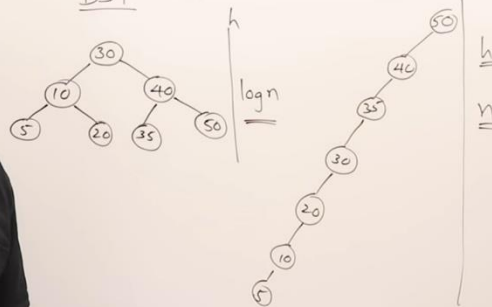
AVL Trees

Keys: 30, 40, 10, 50, 20, 5, 35
 BST
 50
 Key: 50, 40, 35, 30, 20, 10, 5



AVL Trees

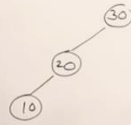
Keys: 30, 40, 10, 50, 20, 5, 35
 BST
 50
 Key: 50, 40, 35, 30, 20, 10, 5



AVL Trees

Keys = 30, 20, 10

order → 30, 20, 10



30, 10, 20



10, 30, 20



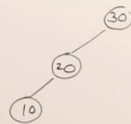
10, 20, 30



AVL Trees

Keys = 30, 20, 10 B! = 6

order → 30, 20, 10



30, 10, 20



10, 30, 20



10, 20, 30



20, 10, 30

20, 30, 10



AVL Trees

Keys = 30, 20, 10 B! = 6

order → 30, 20, 10



30, 10, 20



10, 30, 20



10, 20, 30



20, 10, 30

20, 30, 10



AVL Trees

Keys - 30, 20, 10 $BF = 6$

30, 20, 10

30, 10, 20

10, 30, 20

10, 20, 30

20, 10, 30
20, 30, 10

AVL Trees

Keys - 30, 20, 10 $BF = 6$

30, 20, 10

30, 10, 20

10, 30, 20

10, 20, 30

20, 10, 30
20, 30, 10

AVL Trees

Keys - 30, 20, 10 $BF = 6$

30, 20, 10

30, 10, 20

10, 30, 20

10, 20, 30

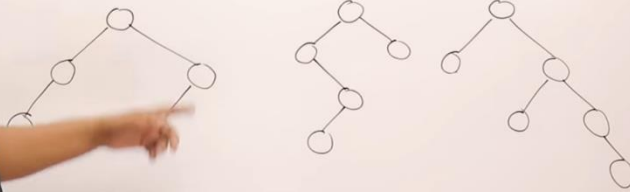
20, 10, 30
20, 30, 10

AVL Trees

balance factor = height of left subtree - height of right subtree

$$bf = hl - hr = \{-1, 0, 1\}$$

$$|bf| = |hl - hr| \leq 1$$

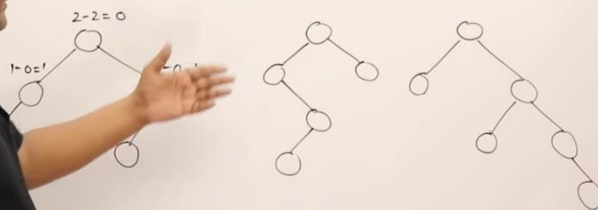


AVL Trees

balance factor = height of left subtree - height of right subtree

$$bf = hl - hr = \{-1, 0, 1\}$$

$$|bf| = |hl - hr| \leq 1$$

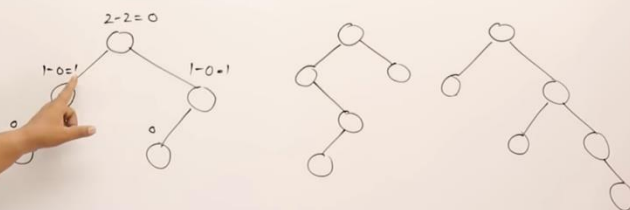


AVL Trees

balance factor = height of left subtree - height of right subtree

$$bf = hl - hr = \{-1, 0, 1\}$$

$$|bf| = |hl - hr| \leq 1$$

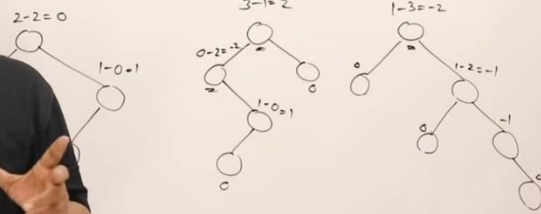


AVL Trees

balance factor = height of left subtree - height of right subtree

$$bf = hl - hr = \{-1, 0, 1\}$$

$$|bf| = |hl - hr| \leq 1$$

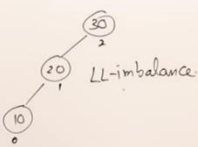


AVL Trees

Initially

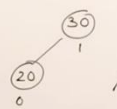


Insert 10

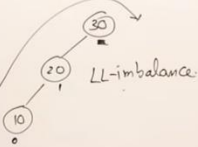


AVL Trees

Initially



Insert 10



After LL-Rotation

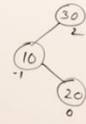


AVL Trees

Initially



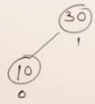
Insert 20



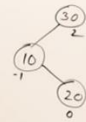
After - Rotation

AVL Trees

Initially



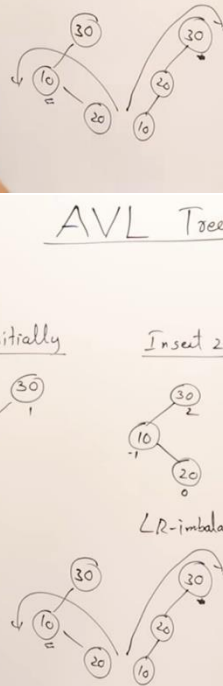
Insert 20



After - Rotation

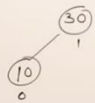


LR-imbalance.

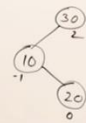


AVL Trees

Initially



Insert 20



After LR-Rotation



LR-imbalance.

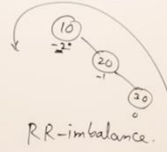


AVL Trees

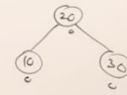
Initially



Insert 30

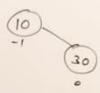


After RR-Rotation



AVL Trees

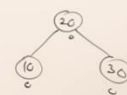
Initially



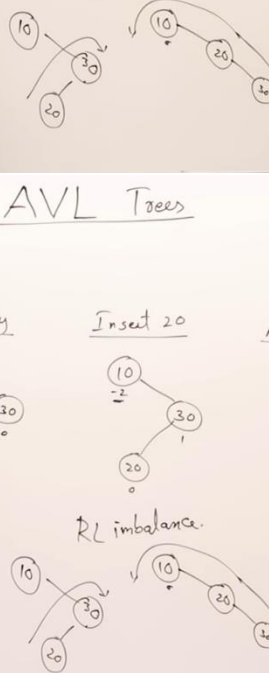
Insert 20



After RL-Rotation

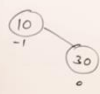


RL imbalance



AVL Trees

Initially



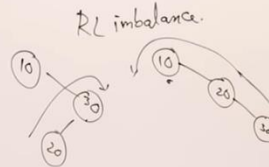
Insert 20



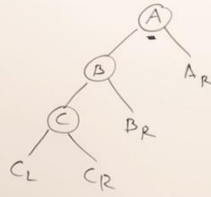
After RL-Rotation



LL
RR
LR
RL

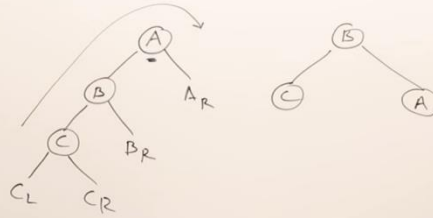


AVL Trees



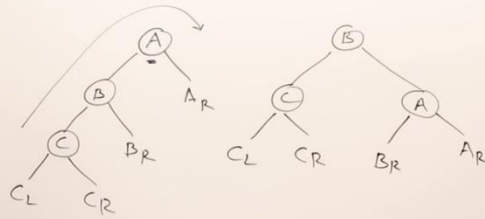
AVL Trees

LL-Rotation



AVL Trees

LL-Rotation



AVL Trees

LL-Rotation

The diagram illustrates an LL-Rotation. On the left, a tree structure is shown with root node A. Node A has a left child B, and node B has a left child C. An arrow indicates a rotation around node B. To the right, the resulting tree structure is shown with root node B. Node B has a left child C and a right child A. Below the trees, there are two small diagrams showing the rotation of a line segment, representing the geometric interpretation of the rotation.

AVL Trees

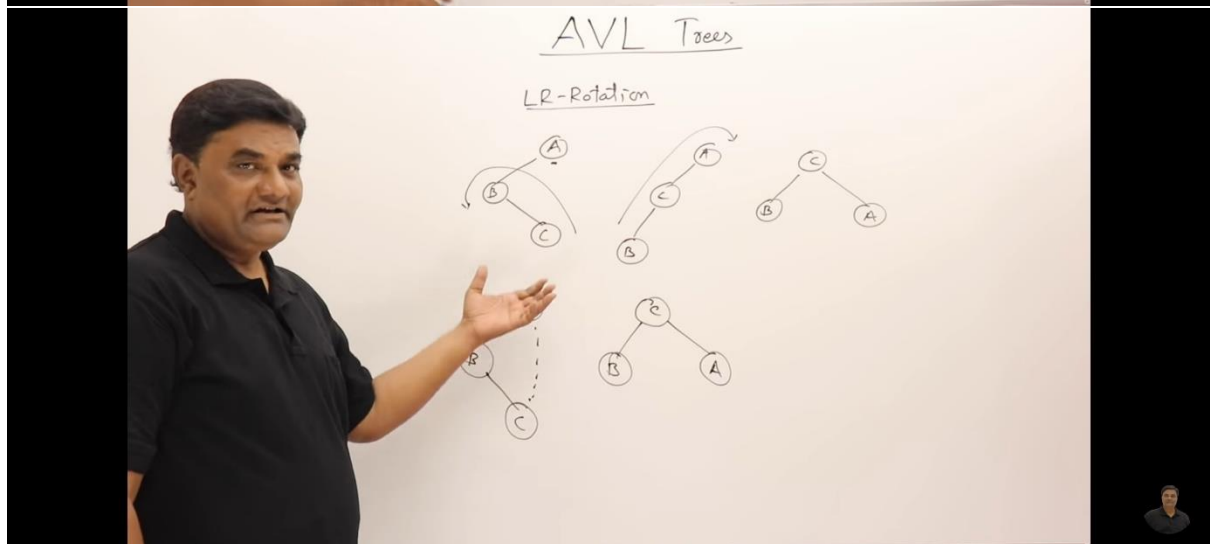
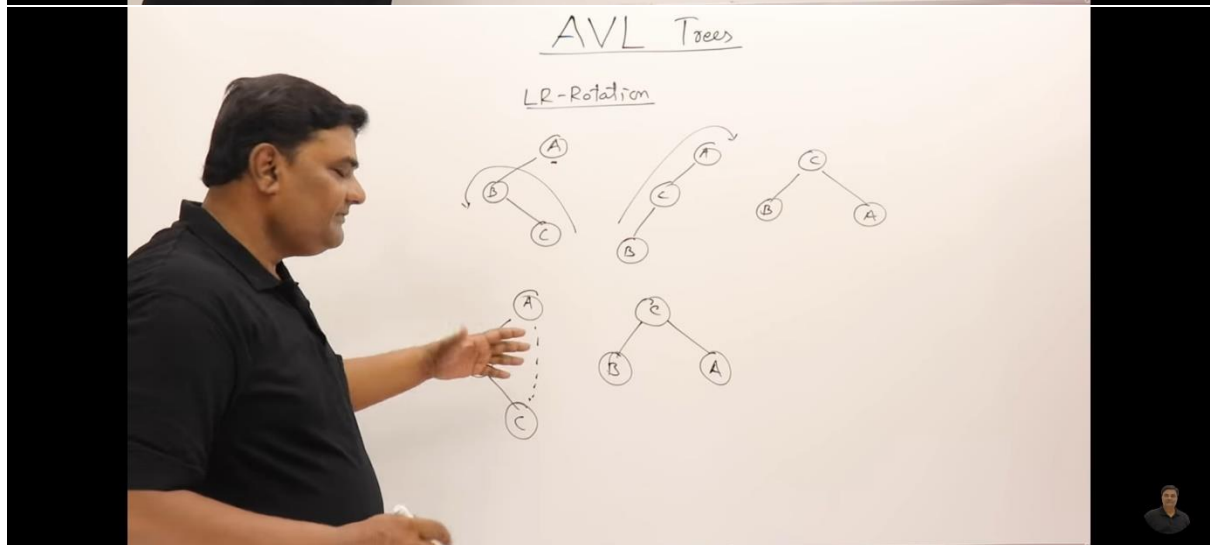
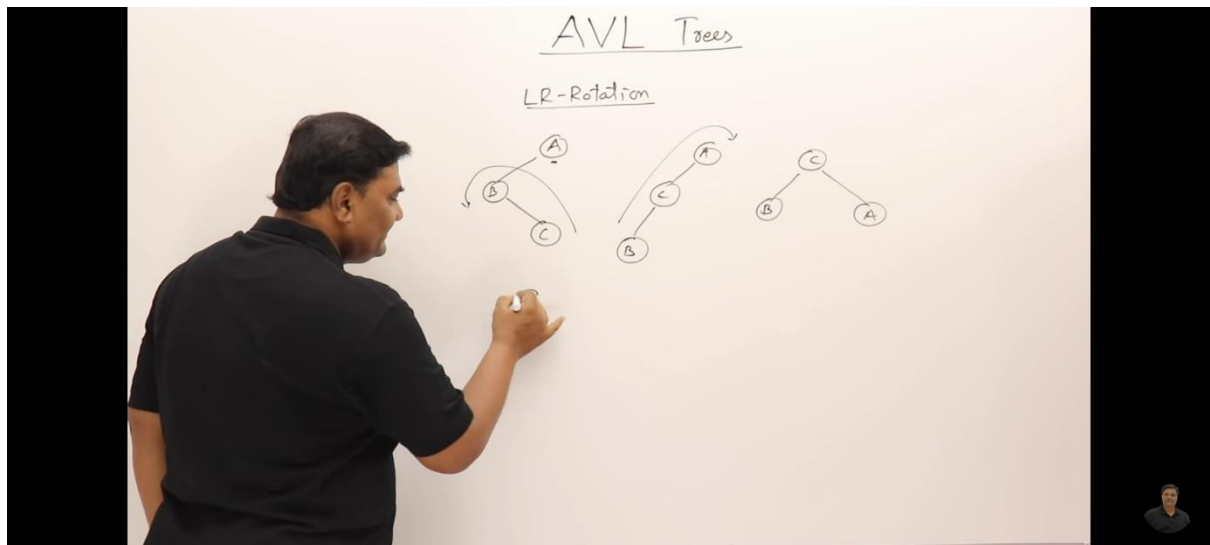
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AVL Trees

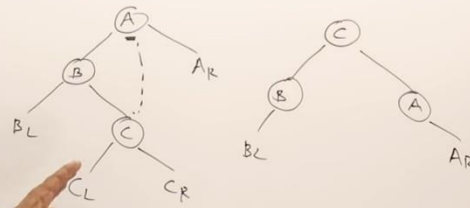
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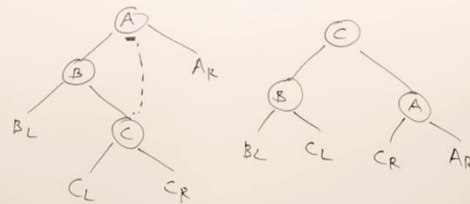
AVL Trees

LR-Rotation



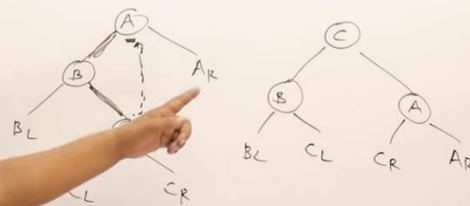
AVL Trees

LR-Rotation



AVL Trees

LR-Rotation



AVL Trees

Keys: - 40, 20, 10, 25, 30, 22, 50

40
2

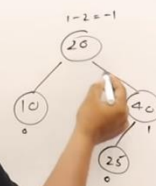
AVL Trees

Keys: - 40, 20, 10, 25, 30, 22, 50



AVL Trees

Keys: - 40, 20, 10, 25, 30, 22, 50



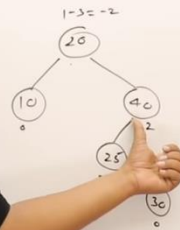
AVL Trees

Keys: - 40, 20, 10, 25, 30, 22, 50



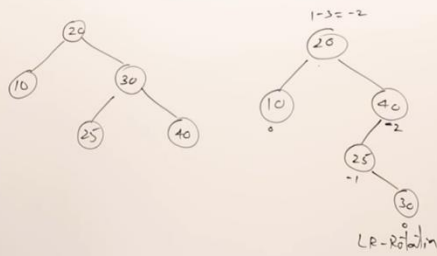
AVL Trees

Keys: - 40, 20, 10, 25, 30, 22, 50



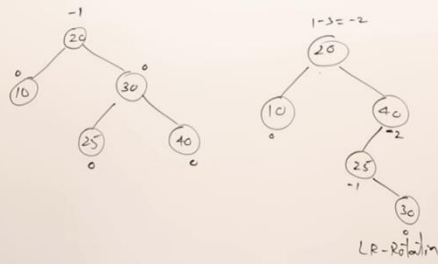
AVL Trees

Keys: - 40, 20, 10, 25, 30, 22, 50



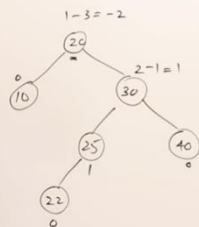
AVL Trees

Keys: 40, 20, 10, 25, 30, 22, 50



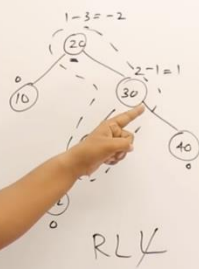
AVL Trees

Keys: 40, 20, 10, 25, 30, 22, 50



AVL Trees

Keys: 40, 20, 10, 25, 30, 22, 50



AVL Trees

Keys: — 40, 20, 10, 25, 30, 22, 50

RL

AVL Trees

Keys: — 40, 20, 10, 25, 30, 22, 50

RL

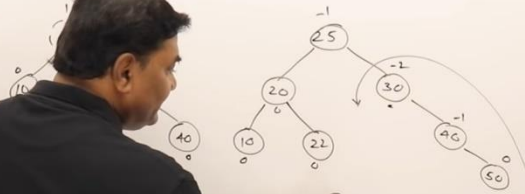
AVL Trees

Keys: — 40, 20, 10, 25, 30, 22, 50

RL

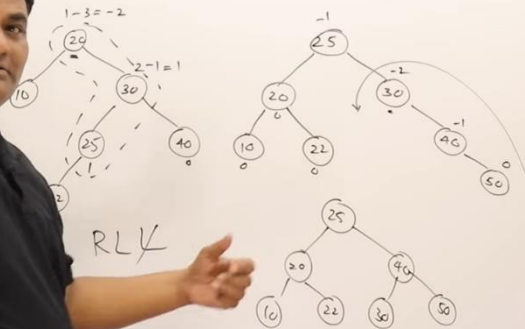
AVL Trees

Keys: 40, 20, 10, 25, 30, 22, 50



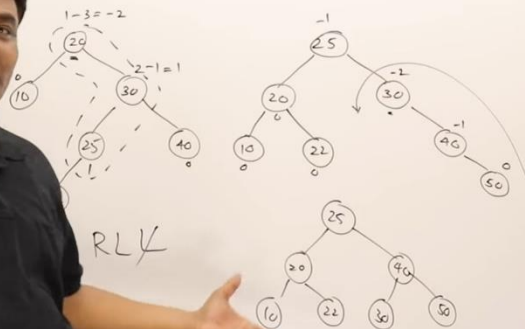
AVL Trees

Keys: 40, 20, 10, 25, 30, 22, 50



AVL Trees

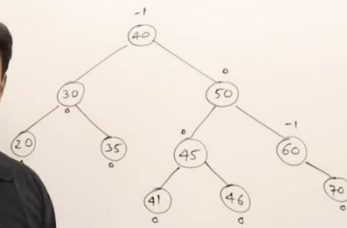
Keys: 40, 20, 10, 25, 30, 22, 50



12:49

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AVL Trees



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10.1 AVL Tree - Insertion and Rotations

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AVL Trees

Binary Search Trees

Drawbacks of Binary Search Tree

What are AVL Trees

Rotations in AVL Trees

Creating AVL Trees

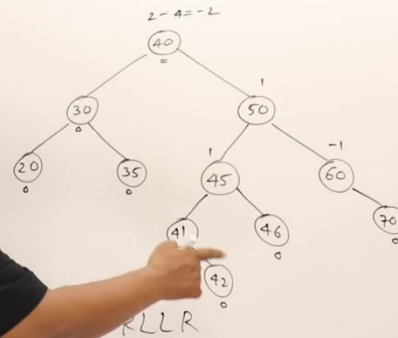
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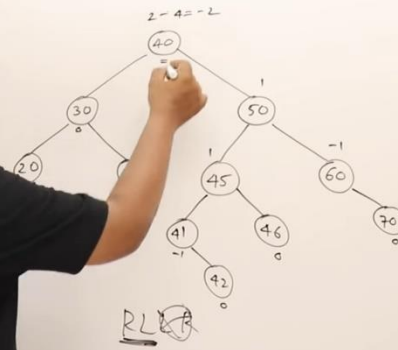
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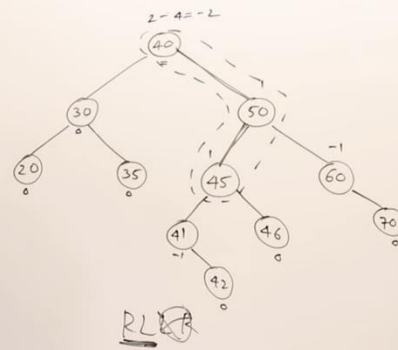
AVL Trees



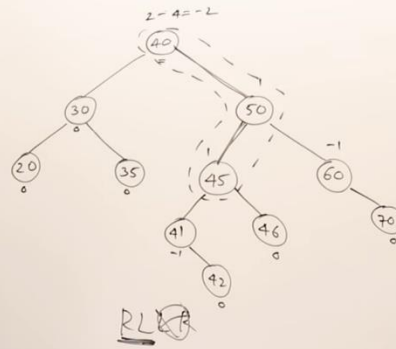
AVL Trees



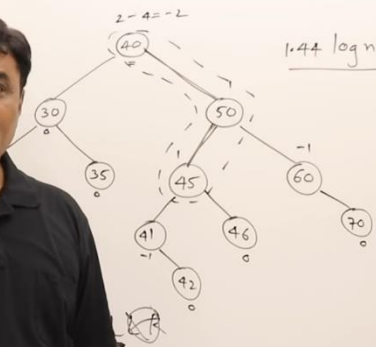
AVL Trees



AVL Trees



AVL Trees



AVL Trees

