CS & IT ENGINEERING

Data Structures

Tree

Lecture No.- 05

By- Pankaj Sharma Sir

Recap of Previous Lecture

Topic Tree Part-04

BST
- Construction
- No. of BSTs
- Insertion
- Search
- Deletion

Topics to be Covered

Topic Tree Part-05

AVL tree

Topic : Tree

Balanced BST

AVL search tree

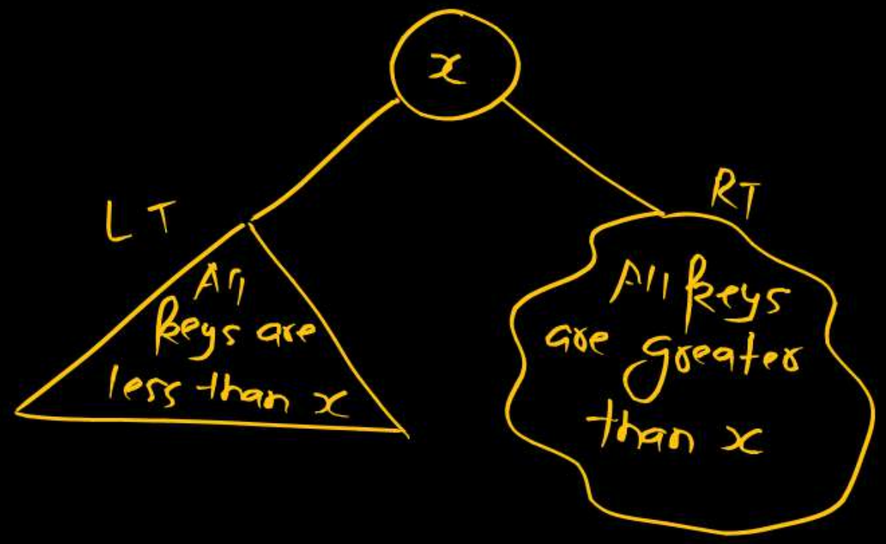
AVL tree

Every node, satisfies 2 property :

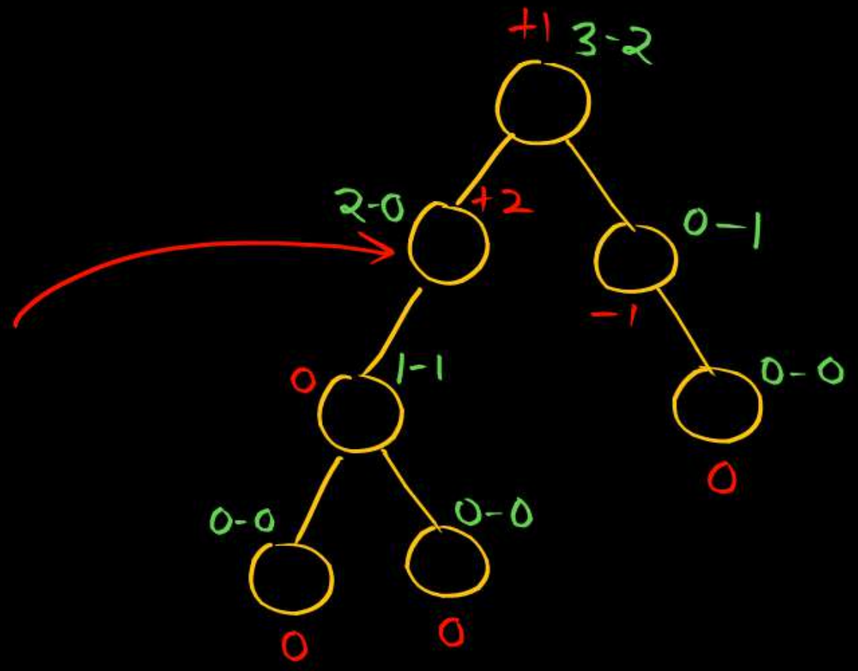
a) BST property : All the keys in the left subtree of a node are smaller than node value

&

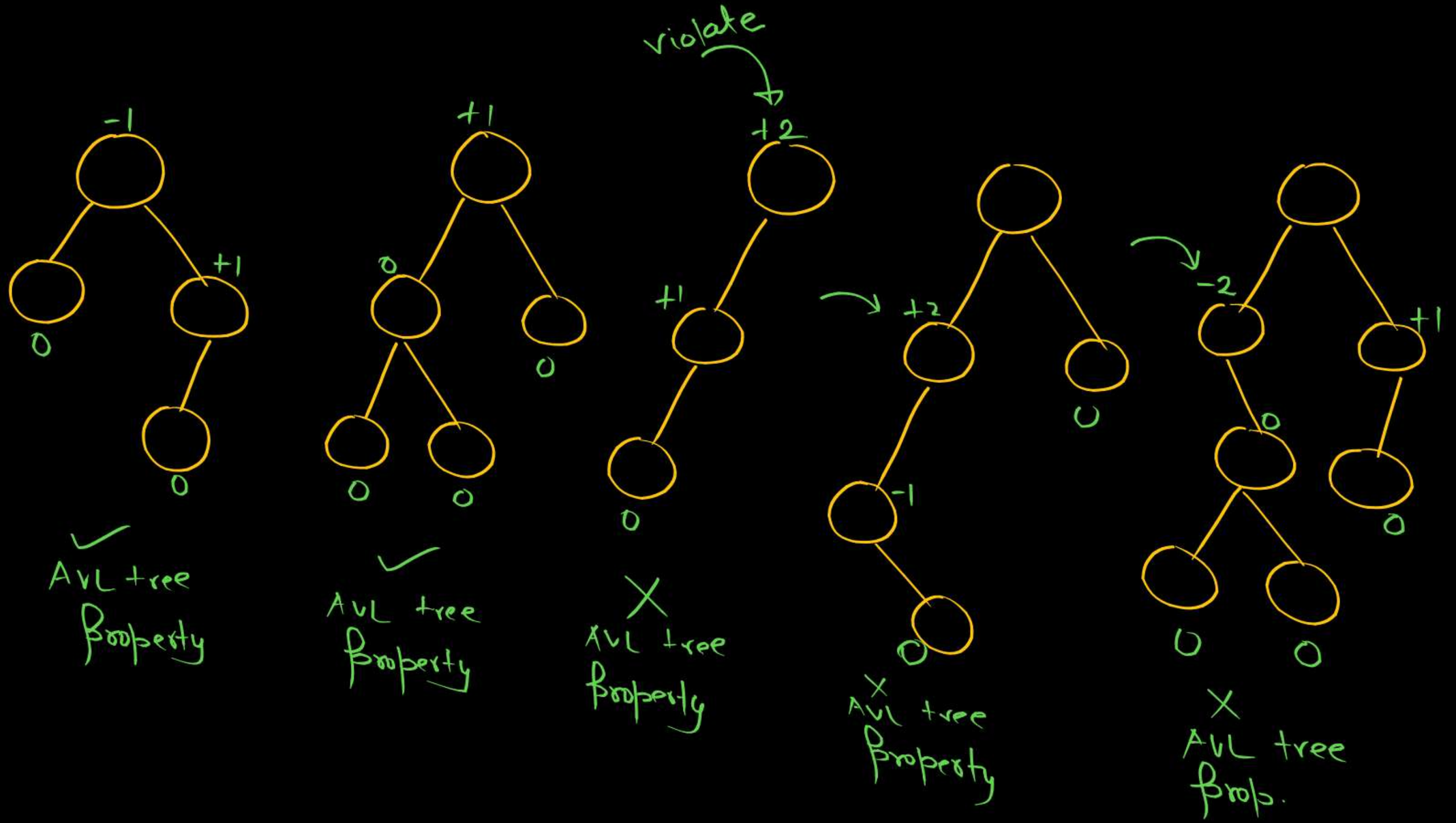
All the keys in the right subtree of a node are greater than node value.

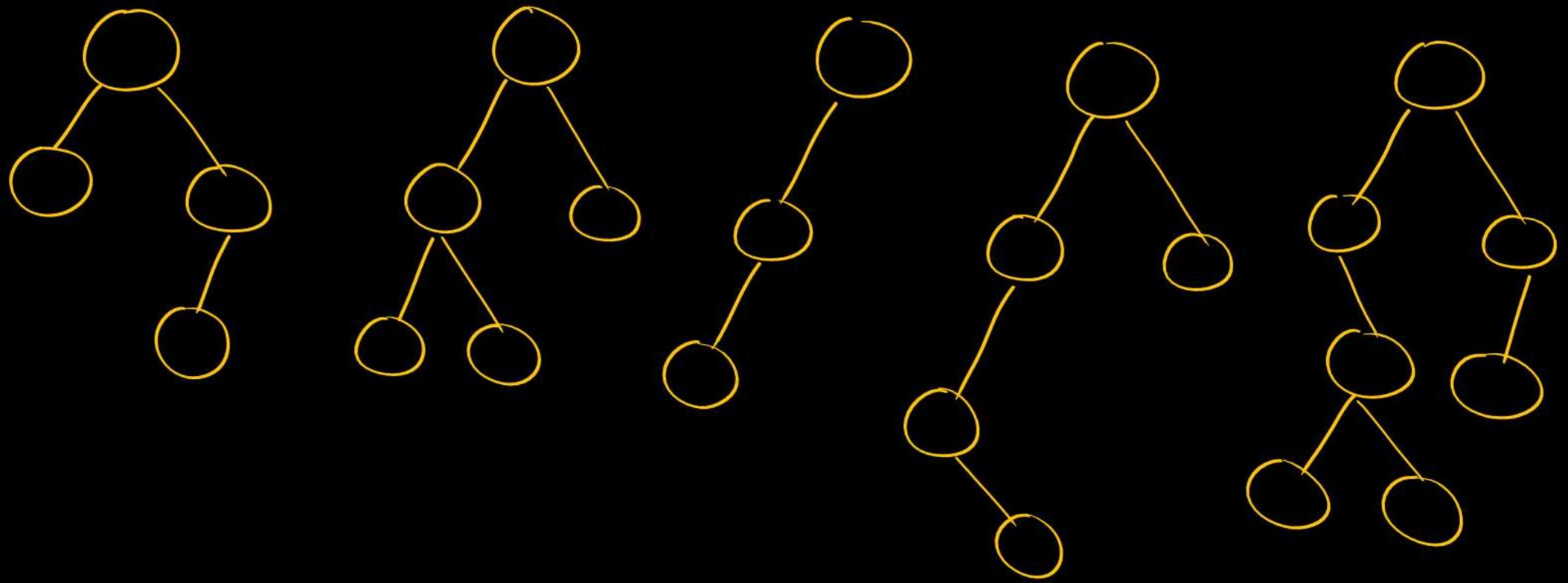


b) AVL tree property : The balancing factor of each node is +1, 0, -1.



AVL tree property X


violate
-1
0
+1
0
AVL tree property
+1
0
0
0
0
AVL tree property
+2
+1
0
X
AVL tree property
+2
-1
0
X
AVL tree property
-2
+1
0
0
0
X
AVL tree prop.

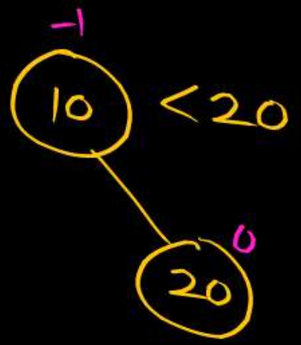


Construct an AVL tree by inserting keys 10, 20, 30 in this order.

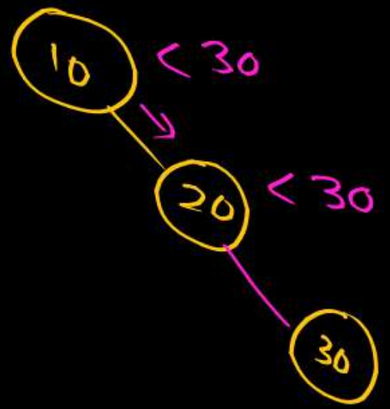
Insert is as same as insertion in BST.

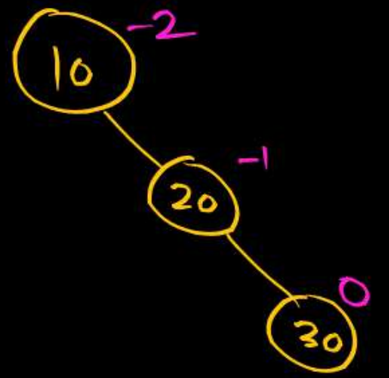
(i)

(ii) Insert 20



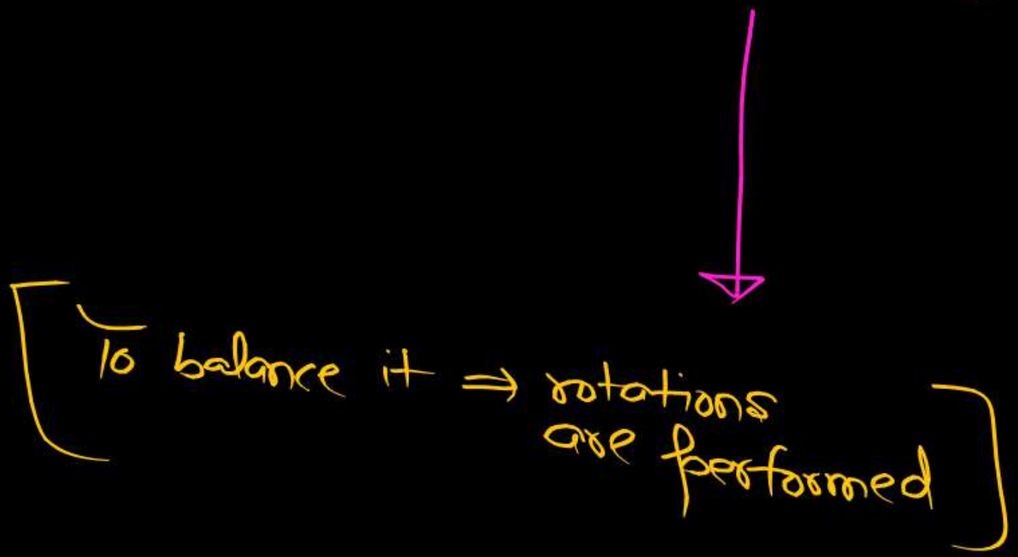
(iii) Insert 30



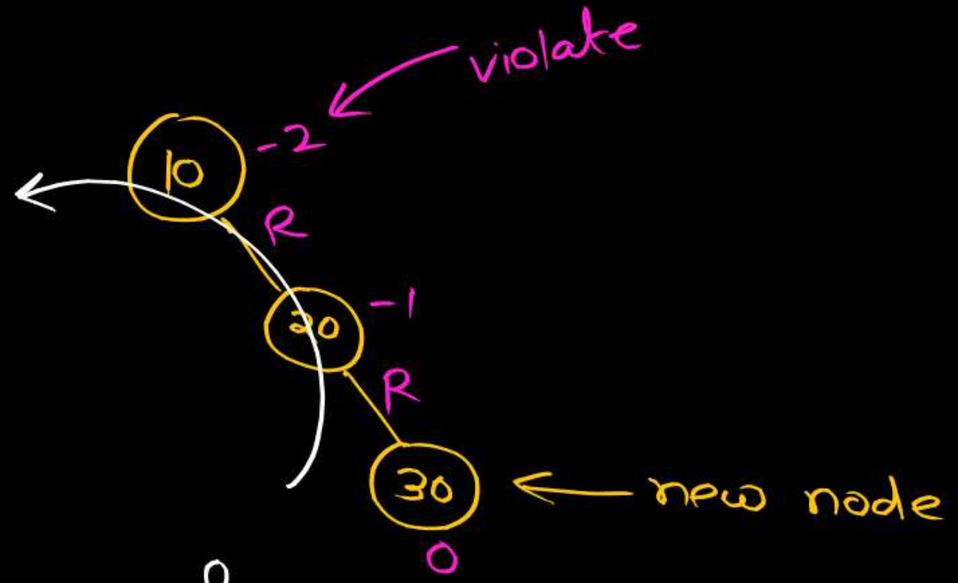


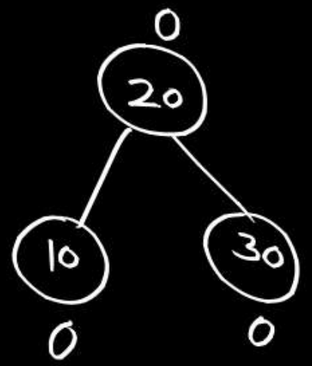
Insertion of a key may cause the balancing factor of a node become other than +1, -1 or 0

(unbalanced)



① Insert keys 10, 20, 30

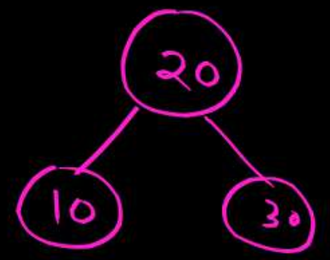




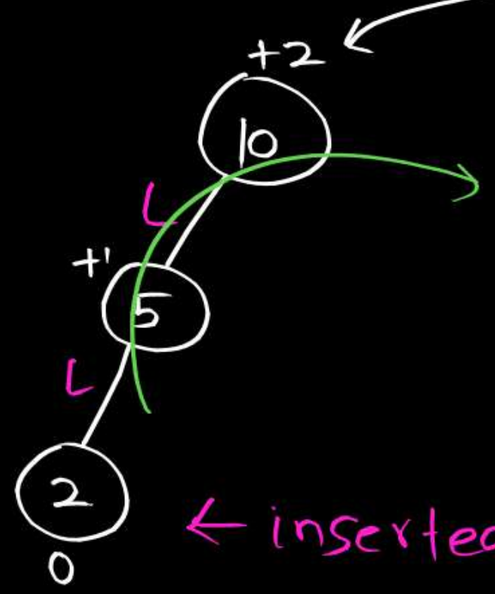
RR rotation →

1st way: Tri-node

10, 20, 30

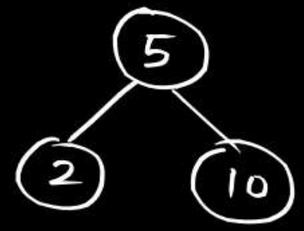


2: Insert 10, 5, 2

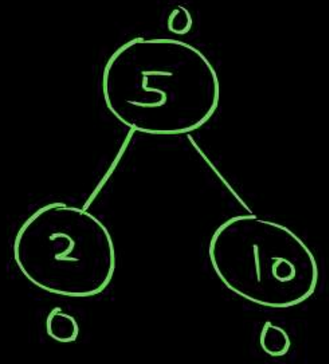


LL rotation

(i) inc.

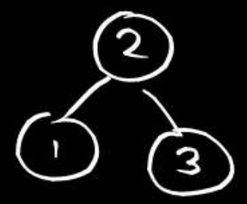


(ii)

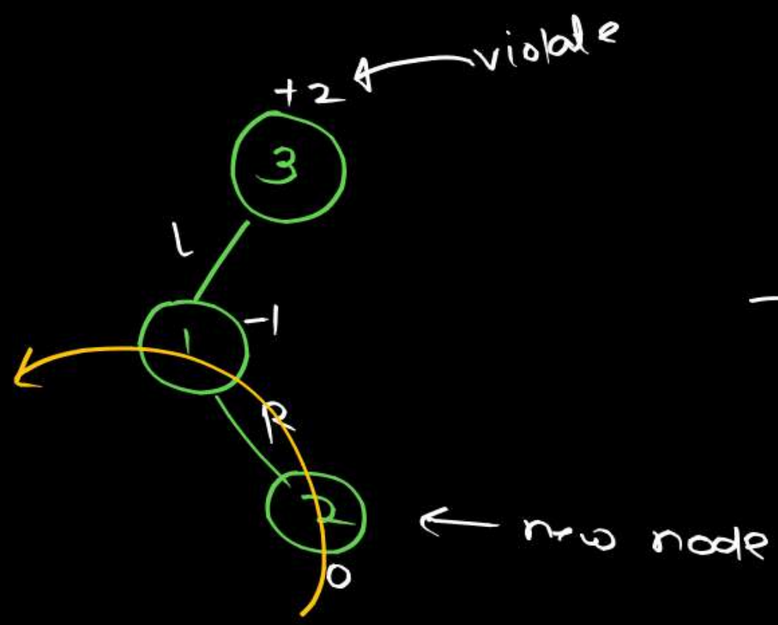


(i) Trinode 1, 2, 3

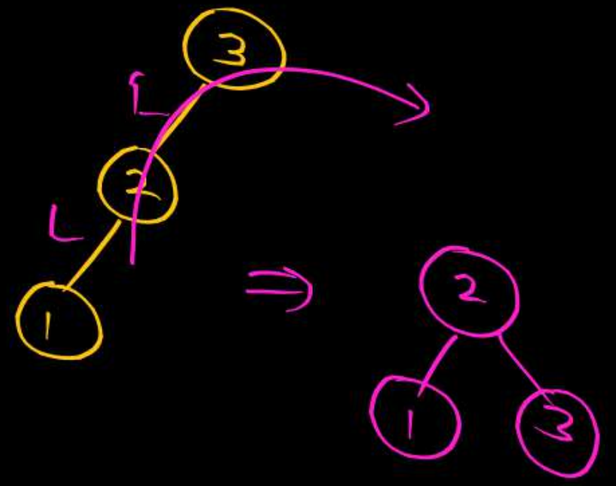
root

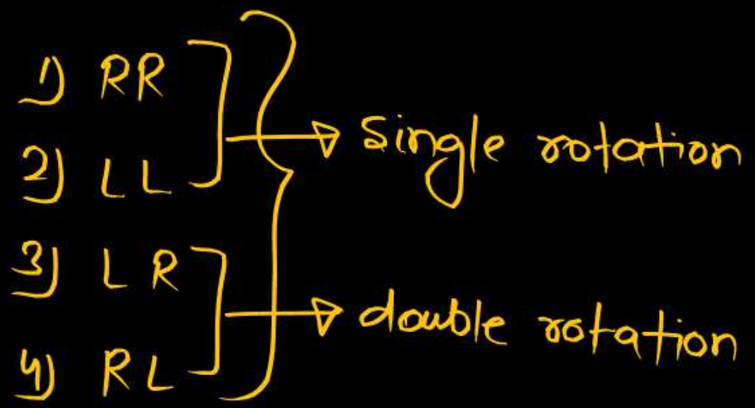


3: Insert 3, 1, 2

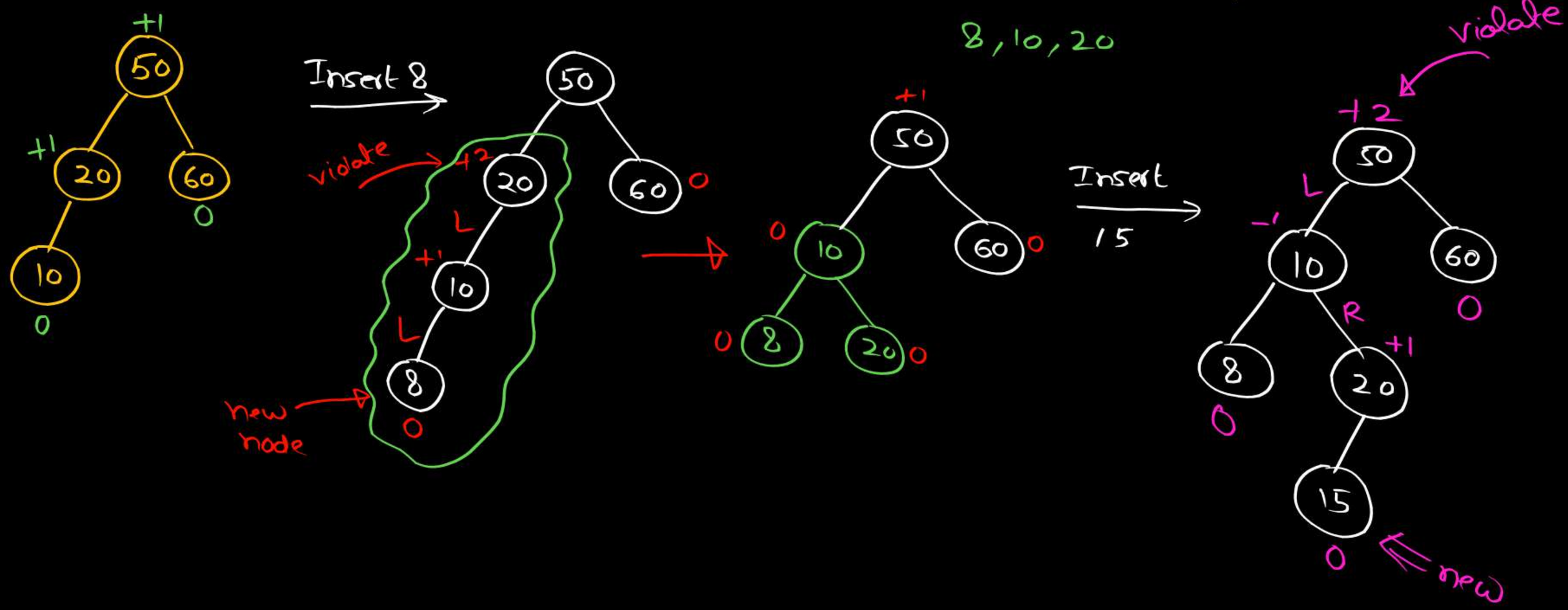


LR rotation → (ii) 2 rotations



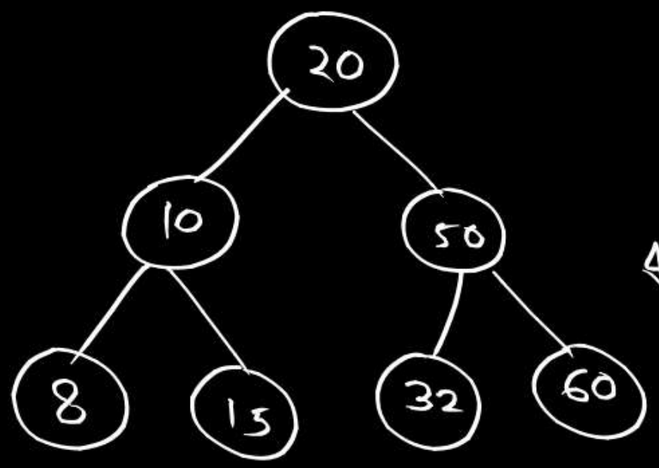

1) RR
2) LL
Single rotation
3) LR
4) RL
double rotation

1: Const. AVL tree by inserting keys 50, 20, 60, 10, 8, 15, 32, 46, 11, 48.

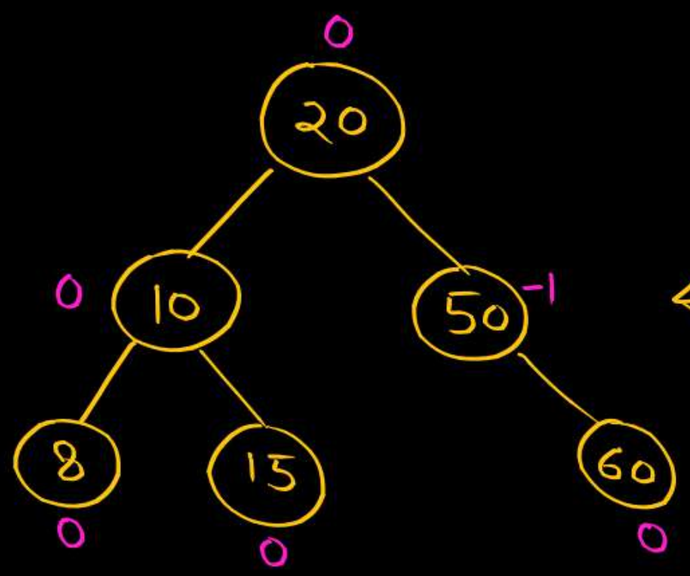


1: Const. AVL tree by inserting keys 50, 20, 60, 10, 8, 15, 32, 46, 11, 48.

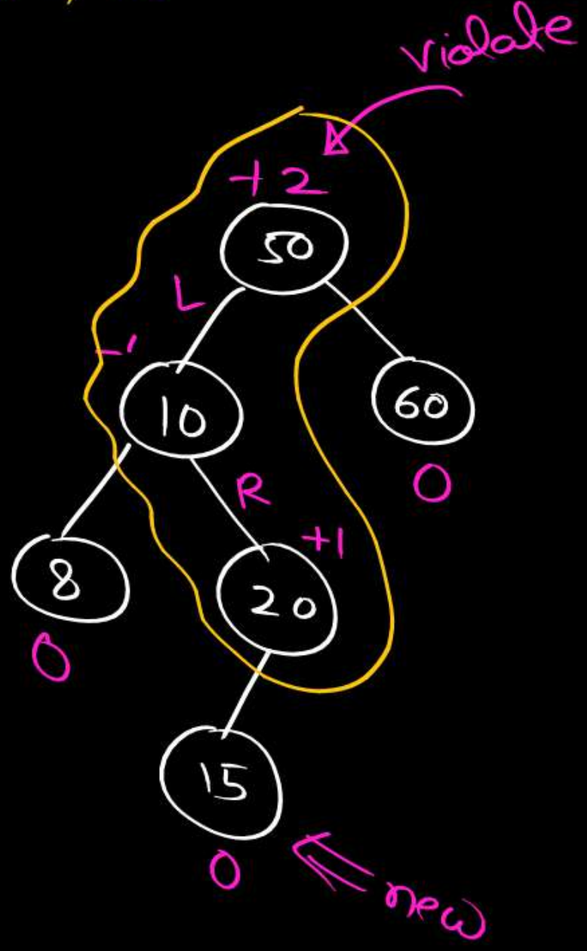
10, 20, 50



insert 32



LR rotation



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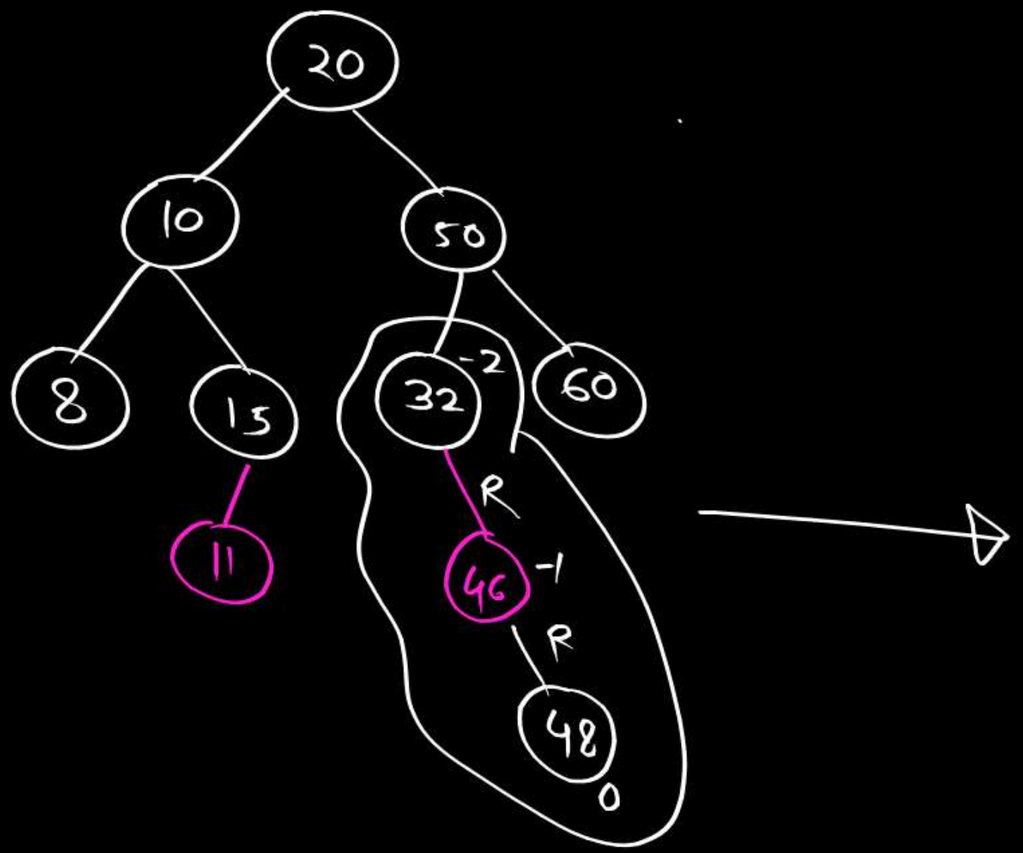
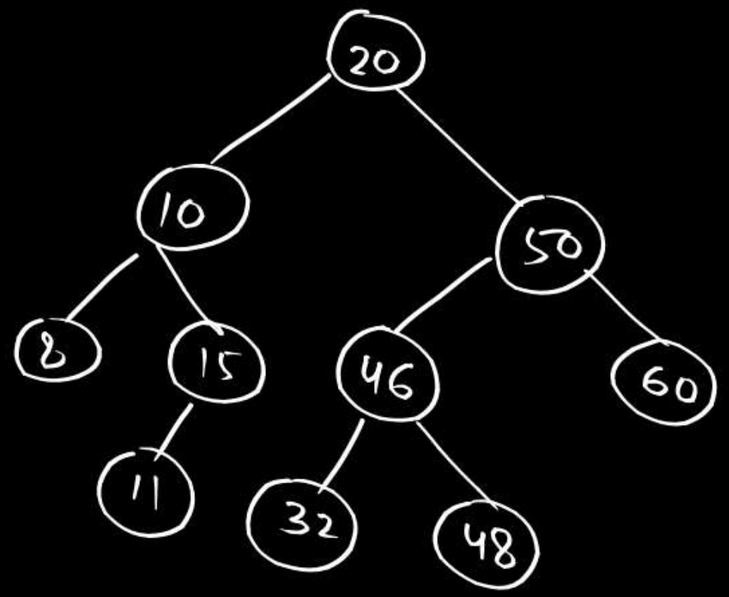


32, 46, 48

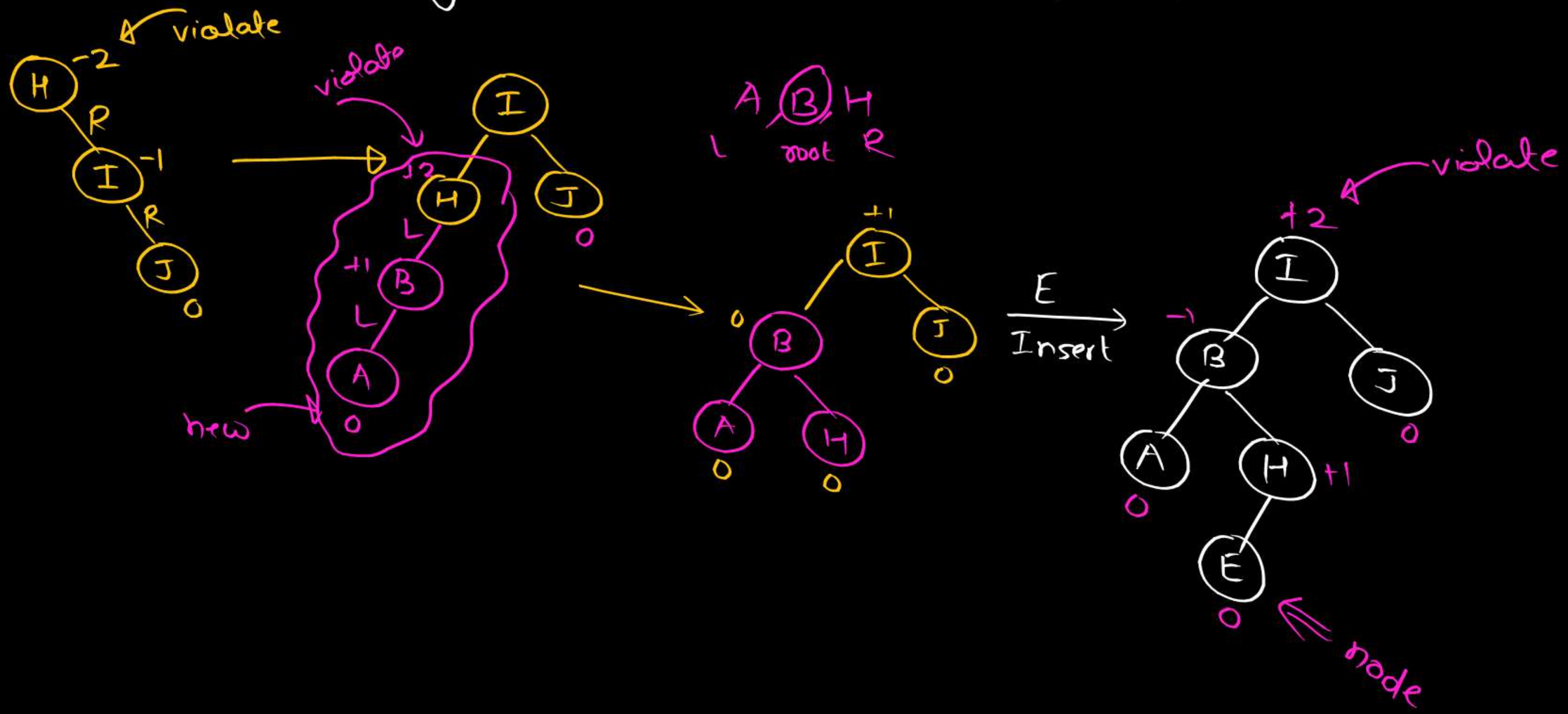


e

new

2: Const. AVL tree by inserting keys H, I, J, B, A, E, C, F, D, G, K, L in order.

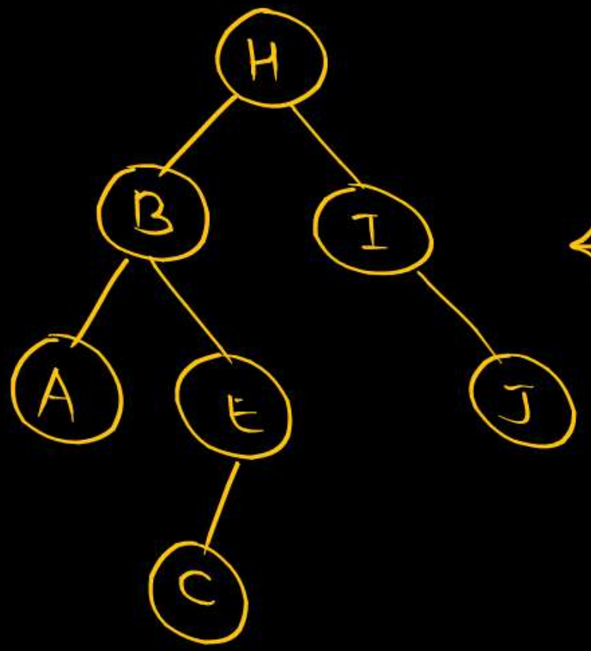
5 min



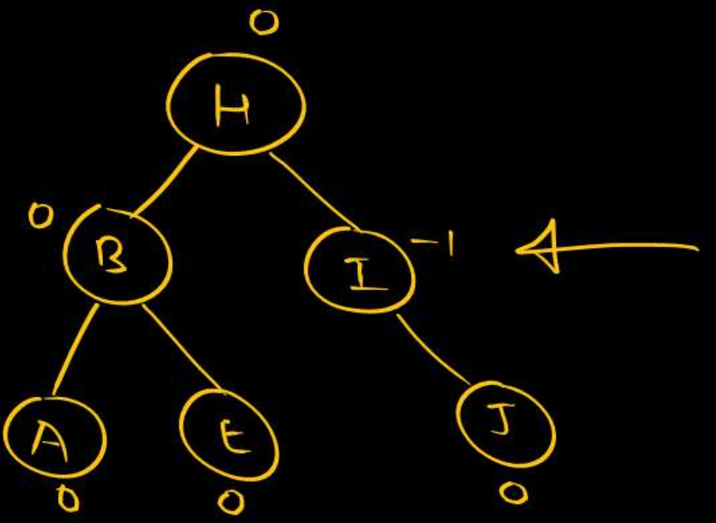
2: Const. AVL tree by inserting keys H, I, J, B, A, E, C, F, D, G, K, L in order.

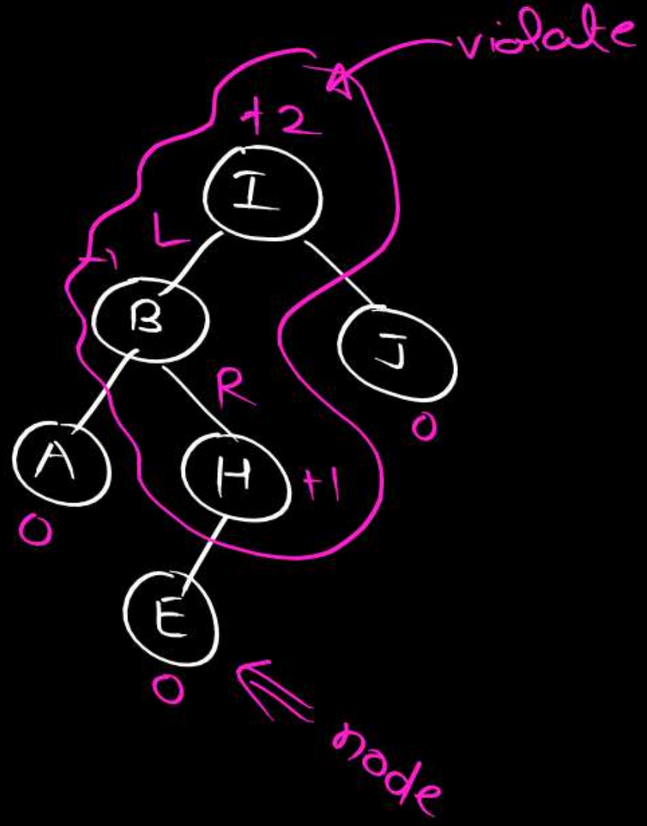
5 min

B, H, I
root



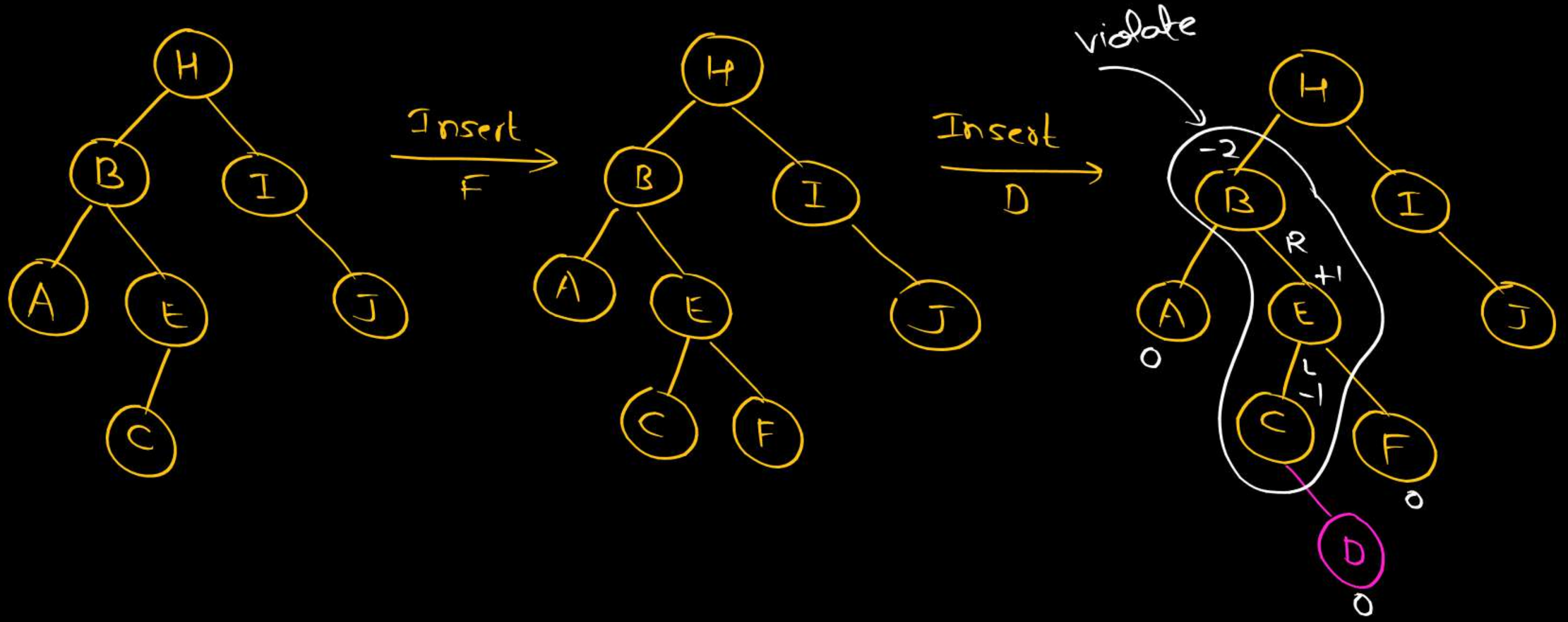
Insert C





2: Const. AVL tree by inserting keys H, I, J, B, A, E, C, F, D, G, K, L in order.

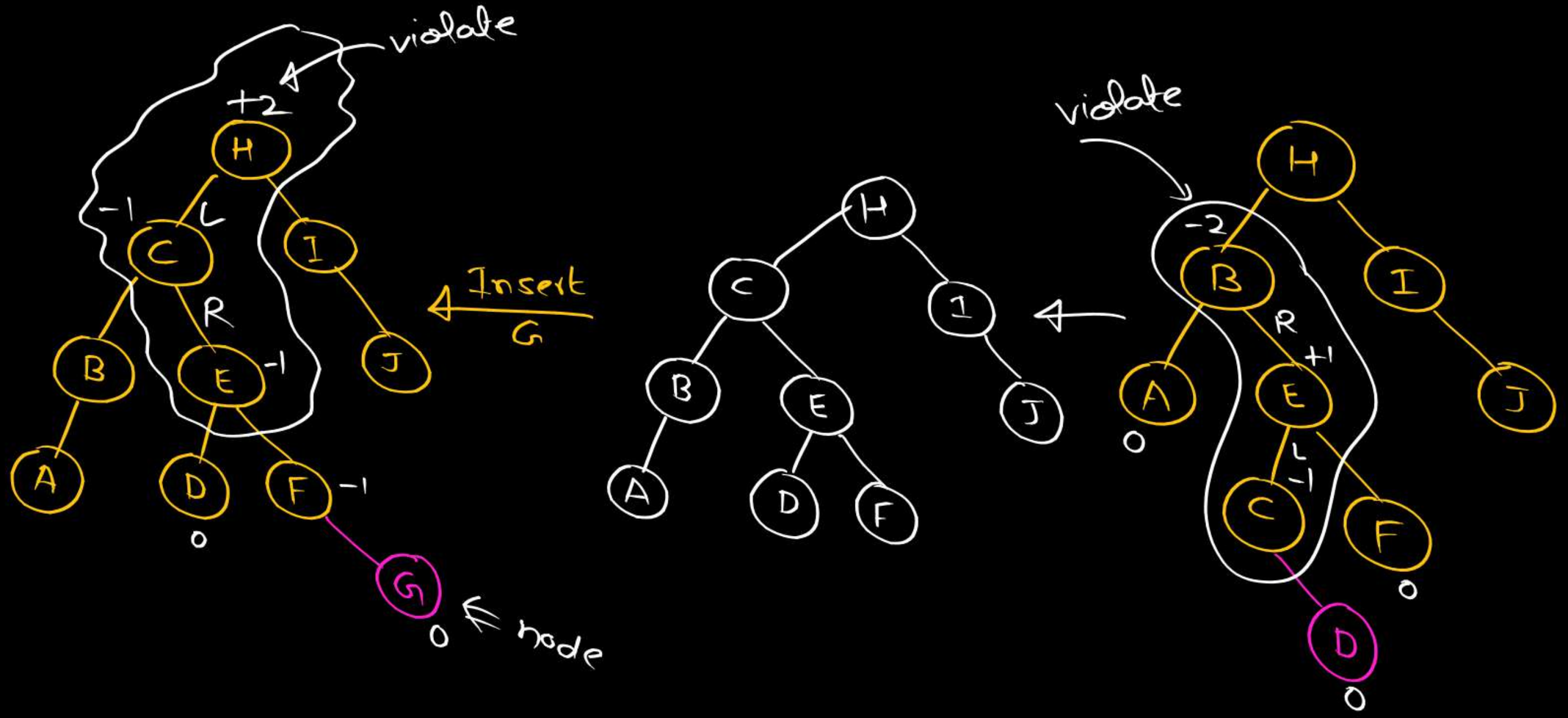
5 min



2. Const. AVL tree by inserting keys H, I, J, B, A, E, C, F, D, G, K, L in order.

5 min

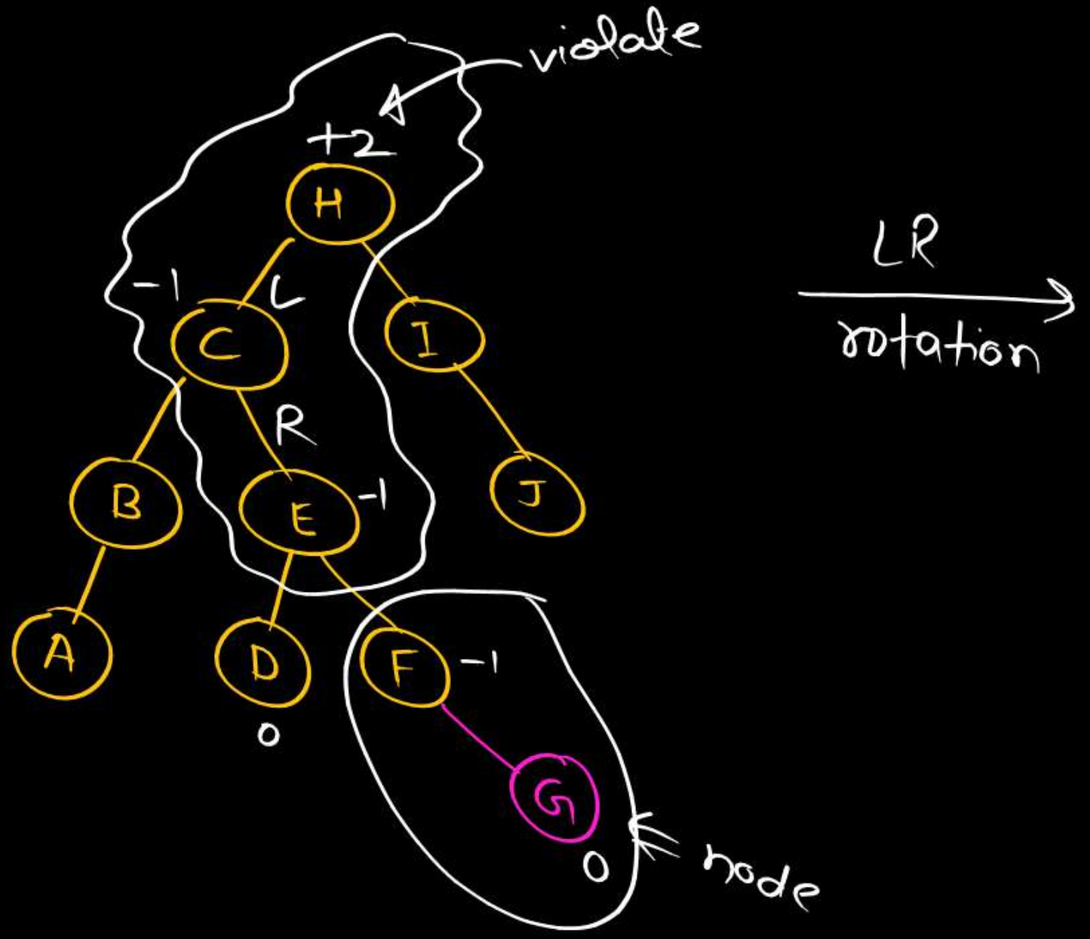
B C E



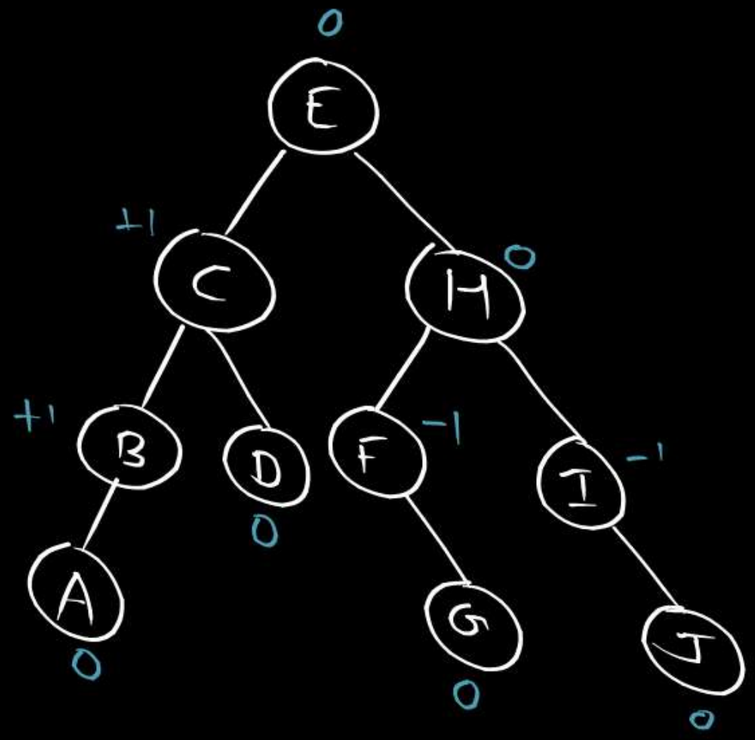
2: Const. AVL tree by inserting keys H, I, J, B, A, E, C, F, D, G, K, L in order.

5 min

C, E, H



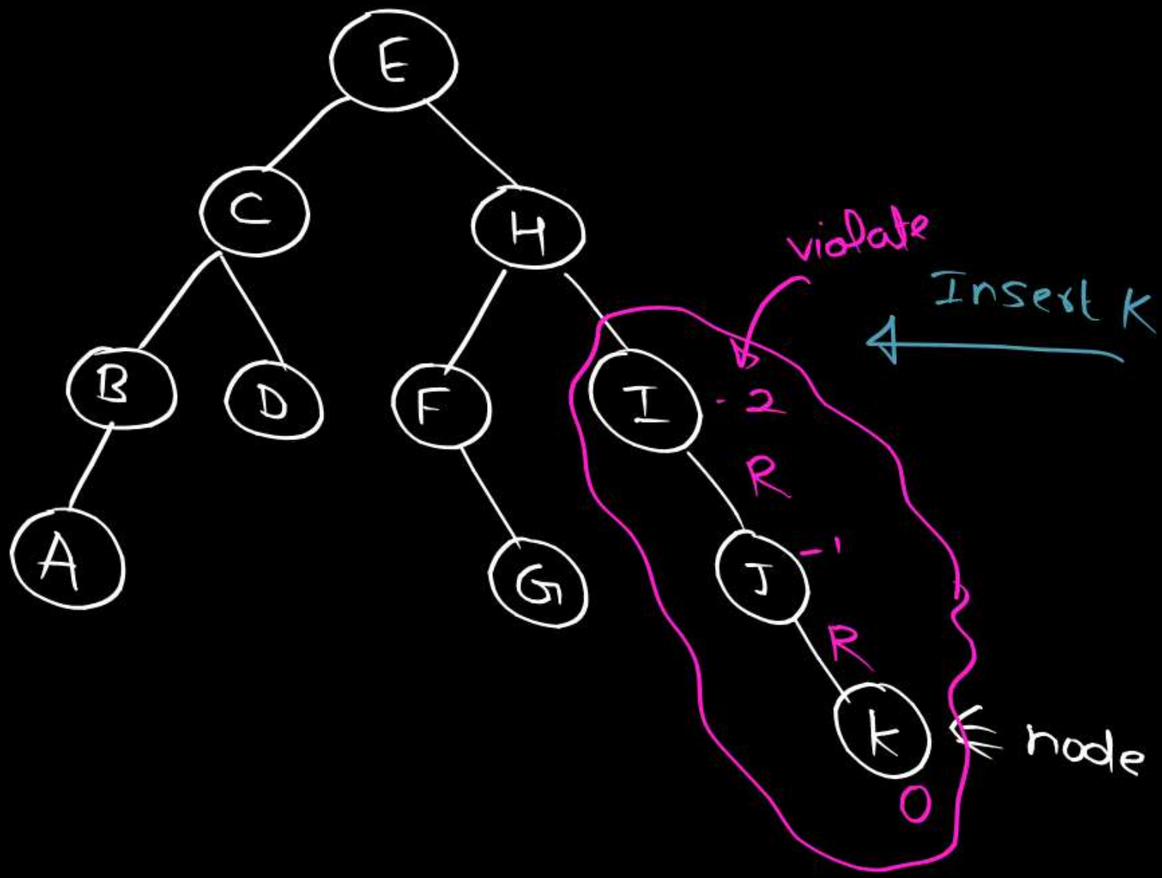
LR rotation

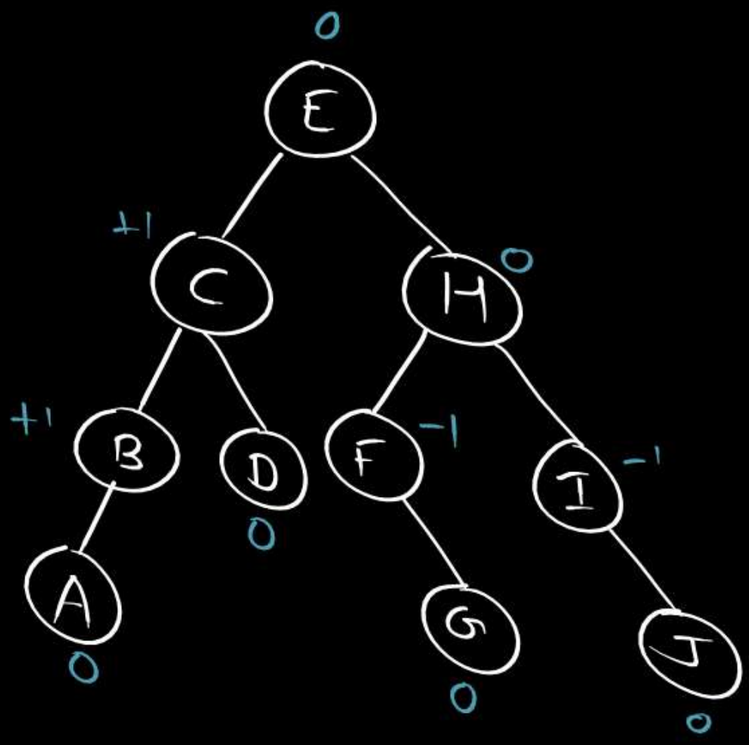


2: Const. AVL tree by inserting keys H, I, J, B, A, E, C, F, D, G, K, L in order.

5 min

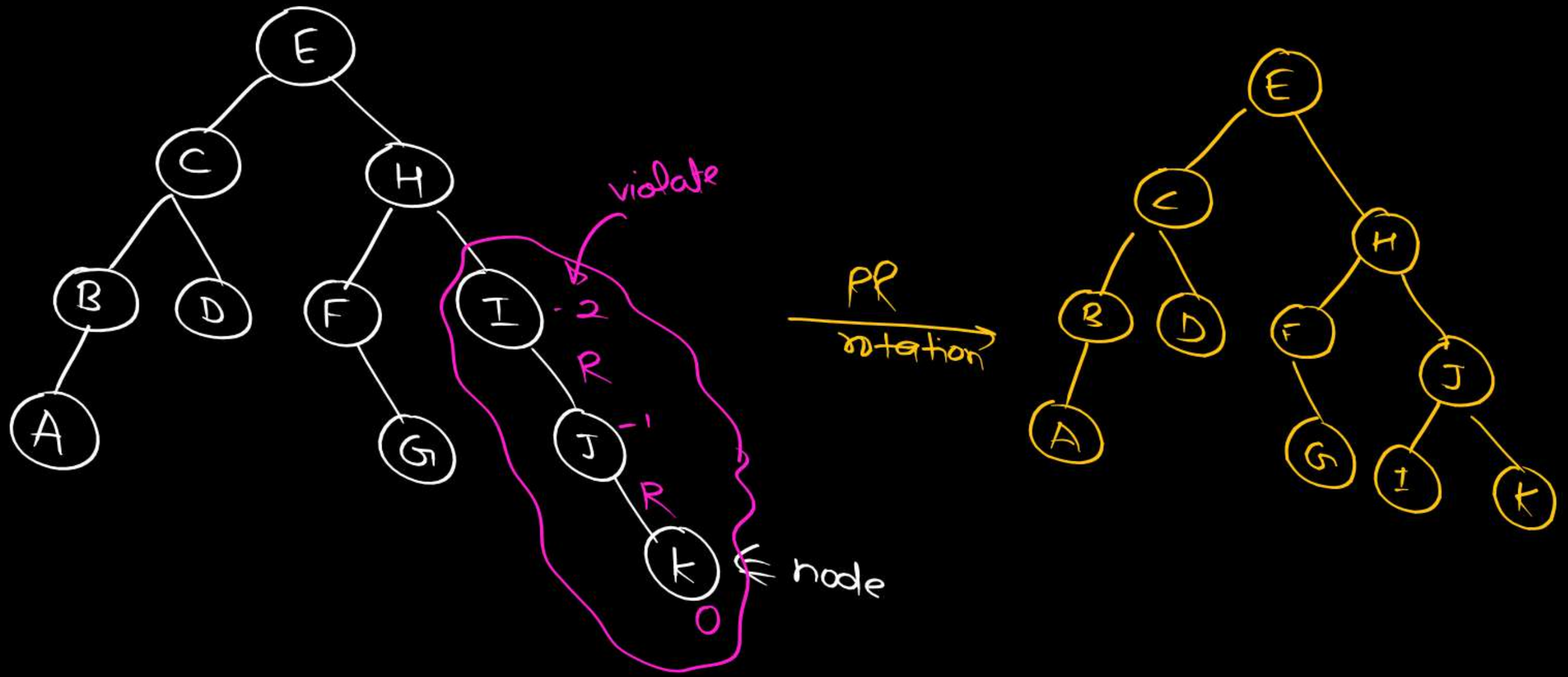
C, E, H





2: Const. AVL tree by inserting keys H, I, J, B, A, E, C, F, D, G, K, L in order. (5 min)

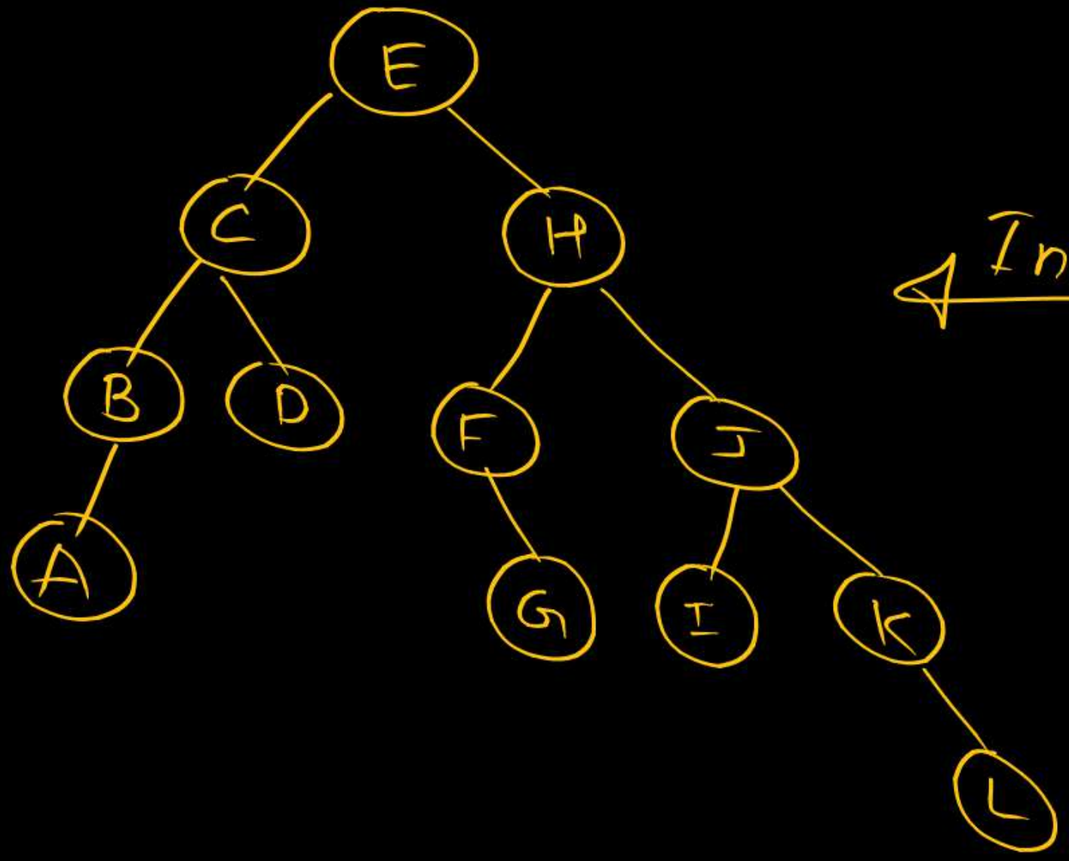
C, E, H I, J, K



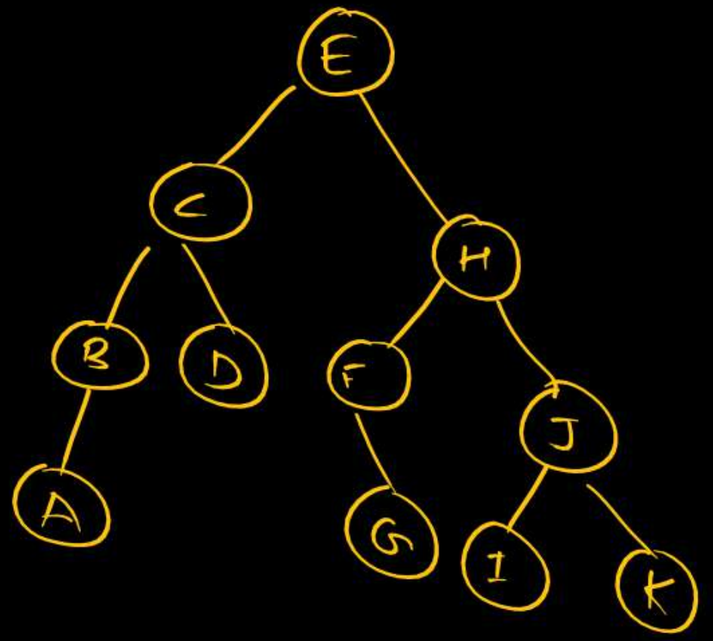
2: Const. AVL tree by inserting keys H, I, J, B, A, E, C, F, D, G, K, L in order.

5 min

C, E, H I, J, K

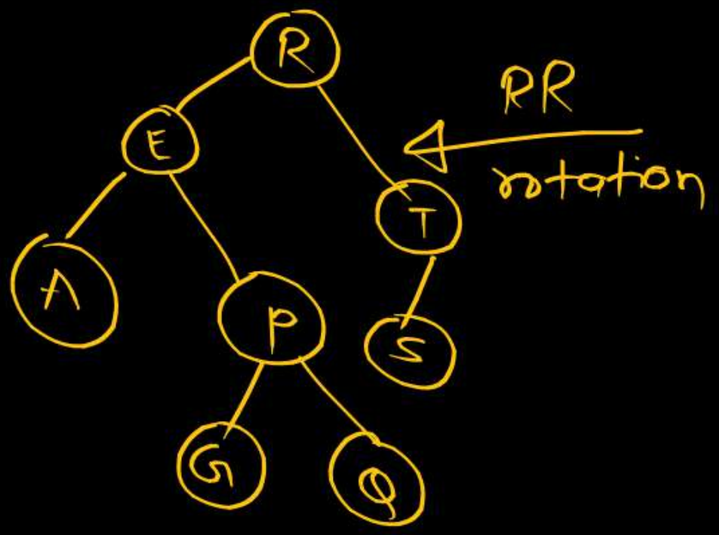


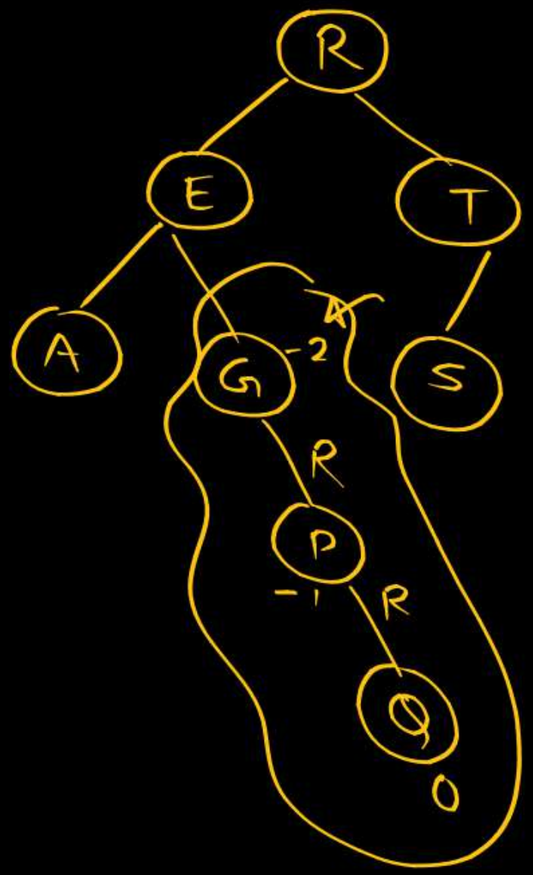
Insert-L

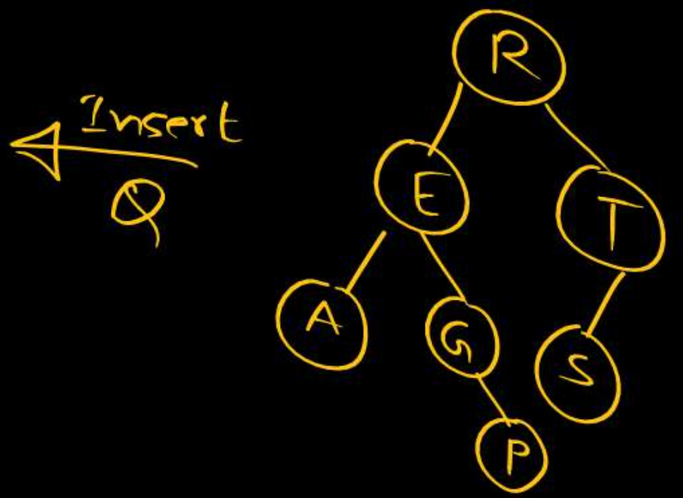


Q3: Const. AVL tree by inserting keys: A, G, E, R, T, S, P, Q, W, C, M, D, X

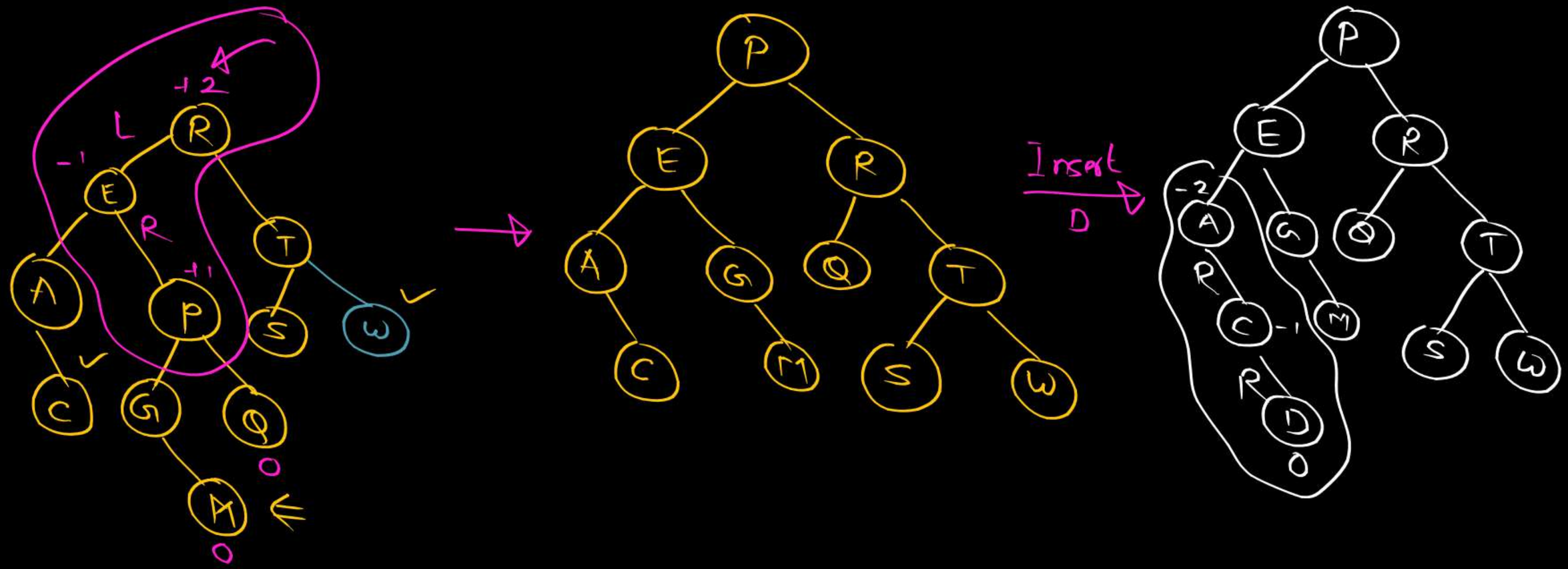
Q3: Const. AVL tree by inserting keys: A, G, E, R, T, S, P, Q, W, C, M, D, X



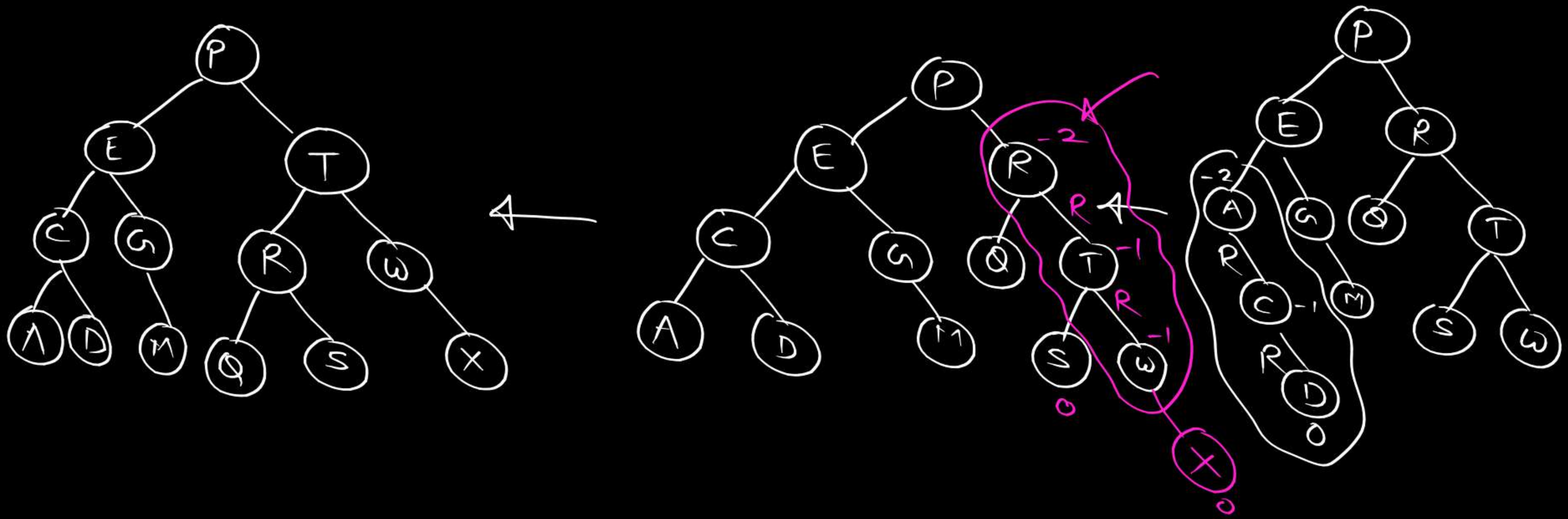




Q3: Const. AVL tree by inserting keys: A, G, E, R, T, S, P, Q, W, C, M, D, X



Q3: Const. AVL tree by inserting keys: A, G, E, R, T, S, P, Q, W, C, M, D, X



THANK - YOU