CS & IT ENGINEERING

Data Structures & Programming

Tree

Lec- 06

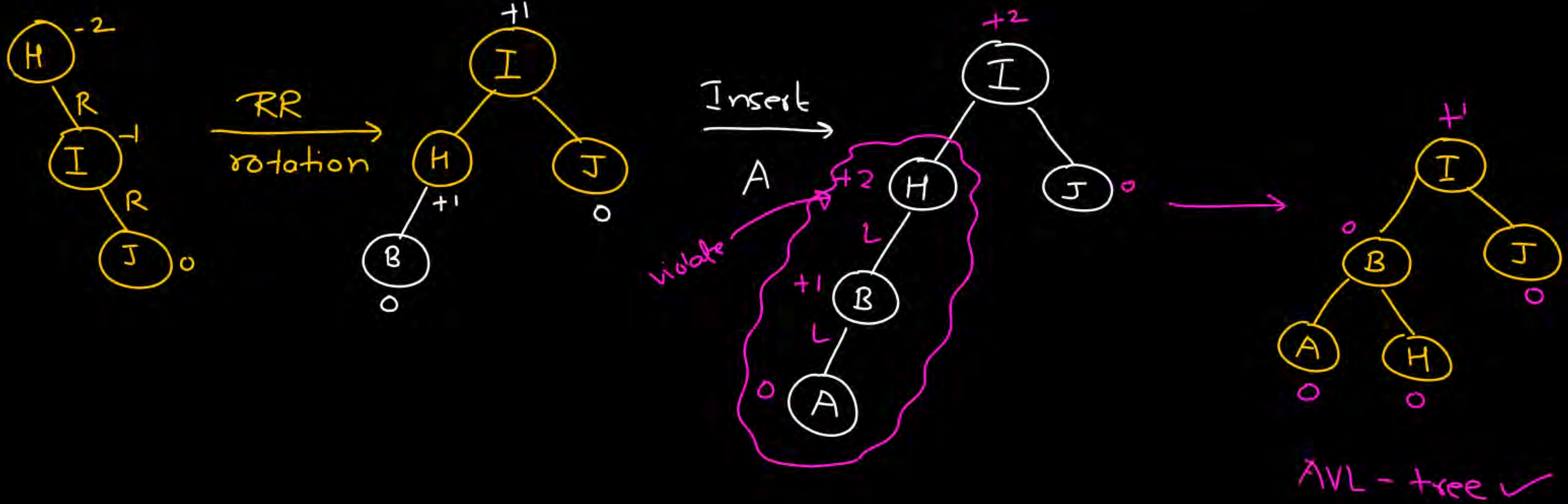
By- Pankaj Sharma sir

TOPICS TO BE COVERED

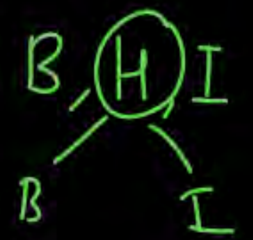
Tree-VI

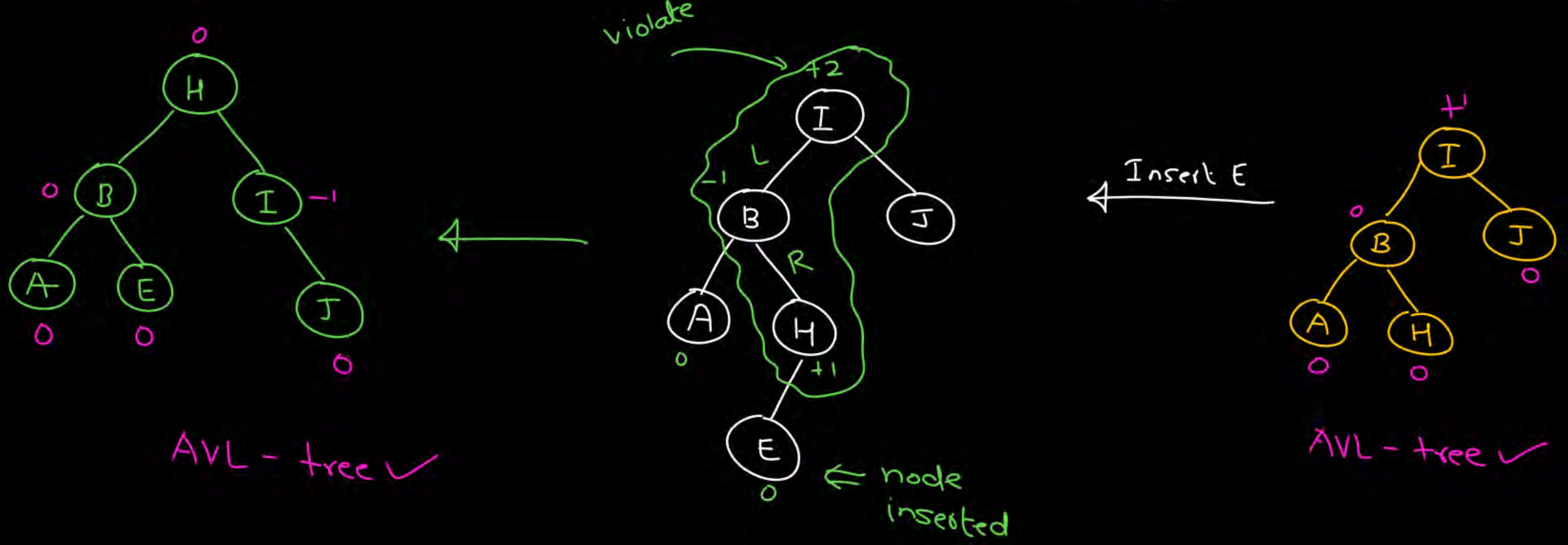
H, I, J, B, A, E, C, F, D, G, K, L

A, B, H →

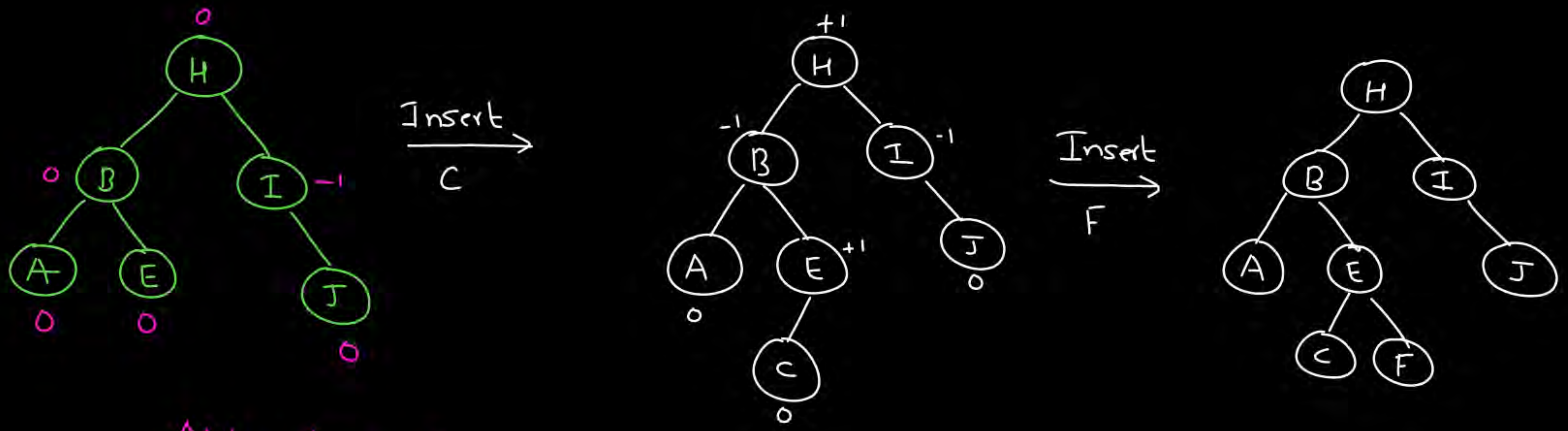


H, I, J, B, A, E, C, F, D, G, K, L



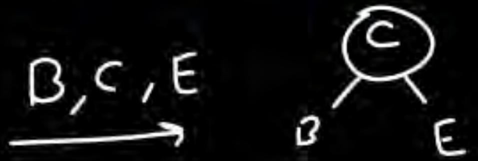


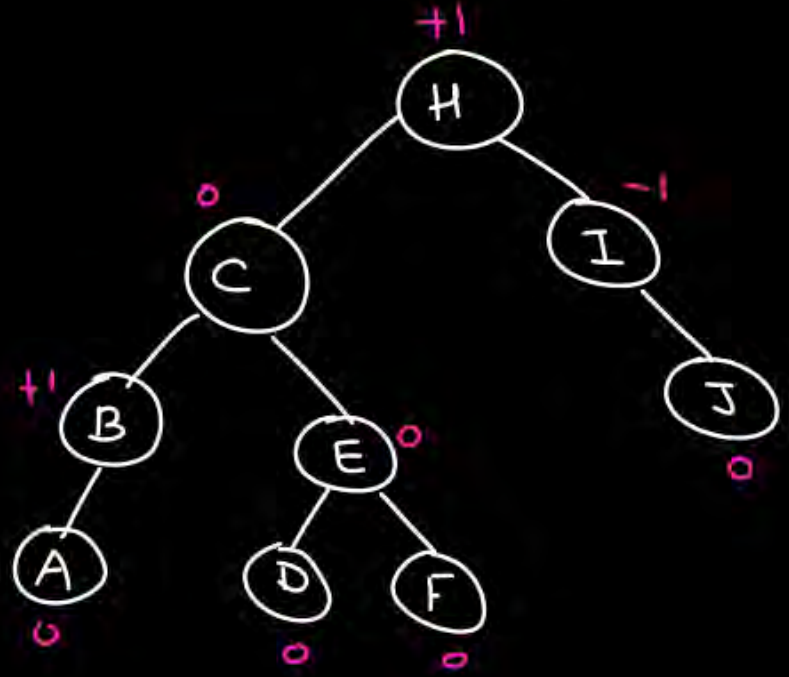
H, I, J, B, A, E, c, F. D. G, K, L

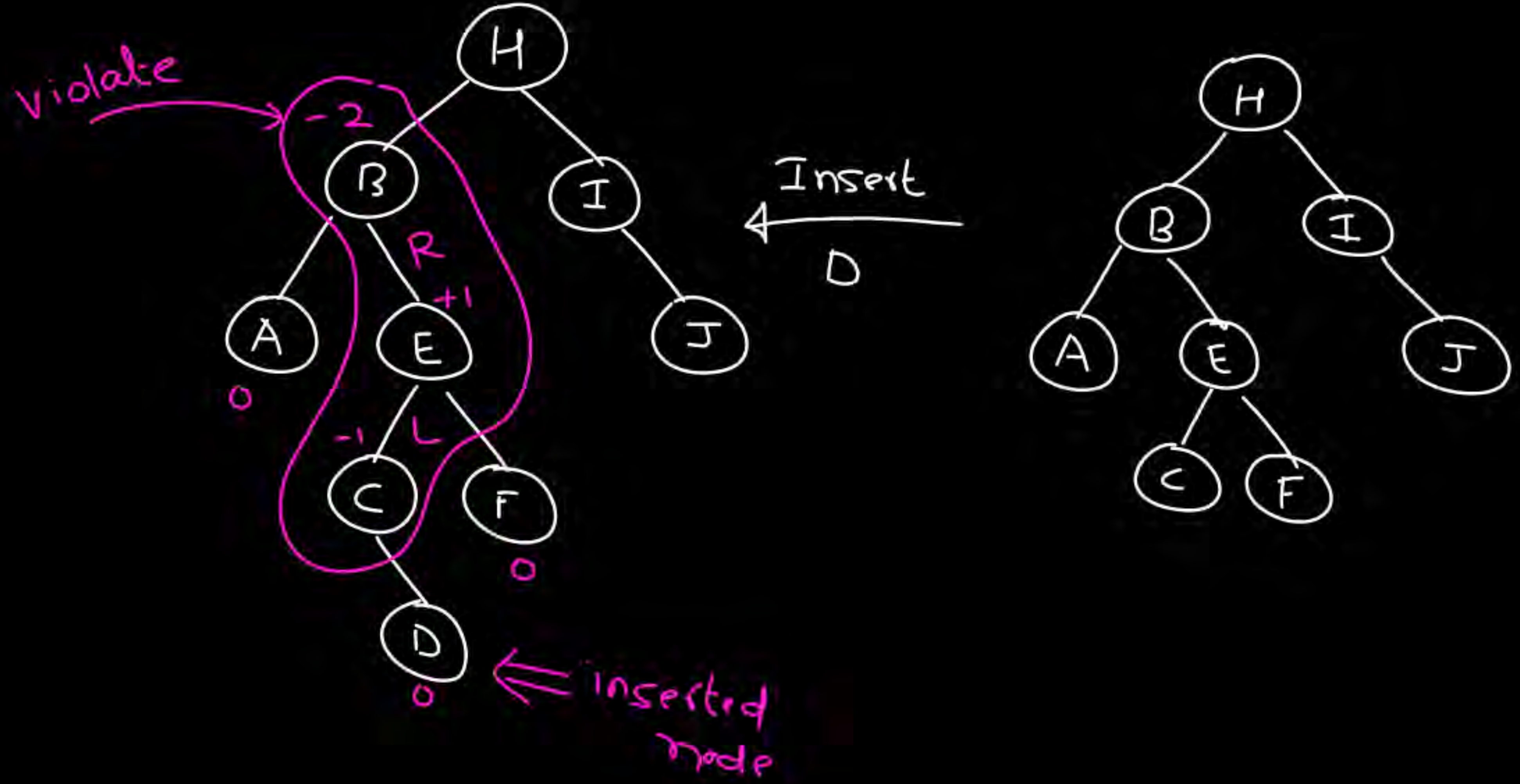


AVL - tree ✓

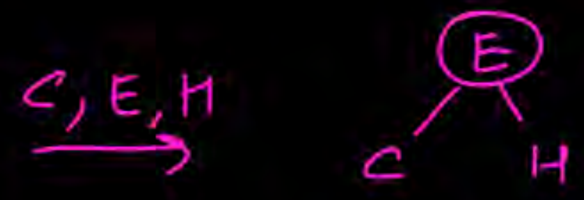
H, I, J, B, A, E, C, F. D. G, K, L

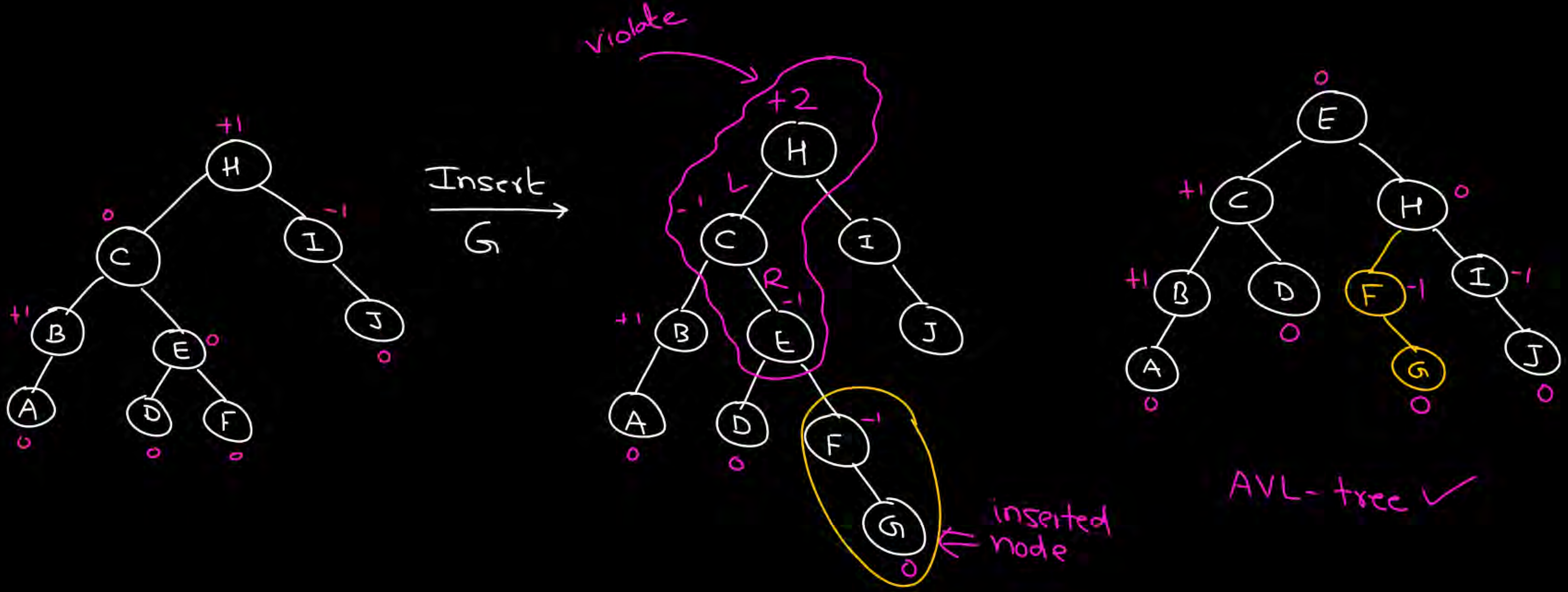




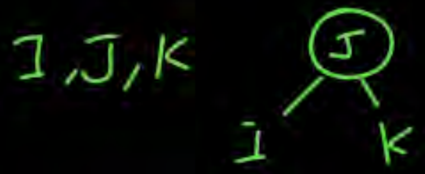


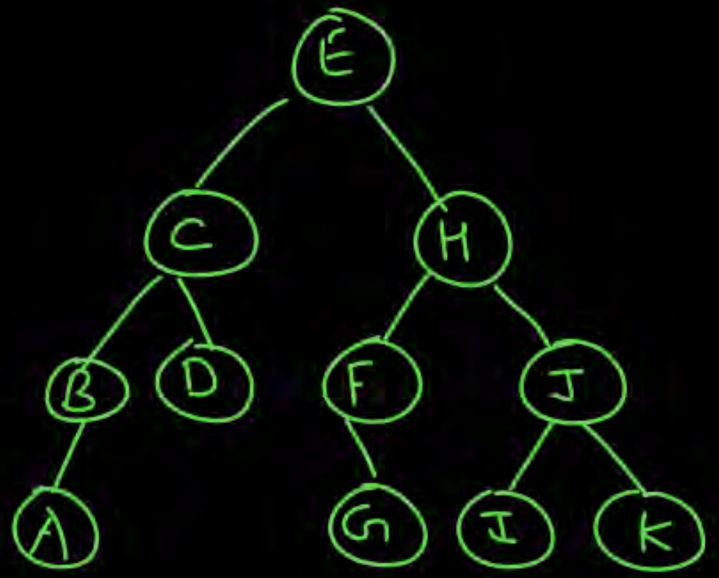
H, I, J, B, A, E, C, F. D. G, K, L

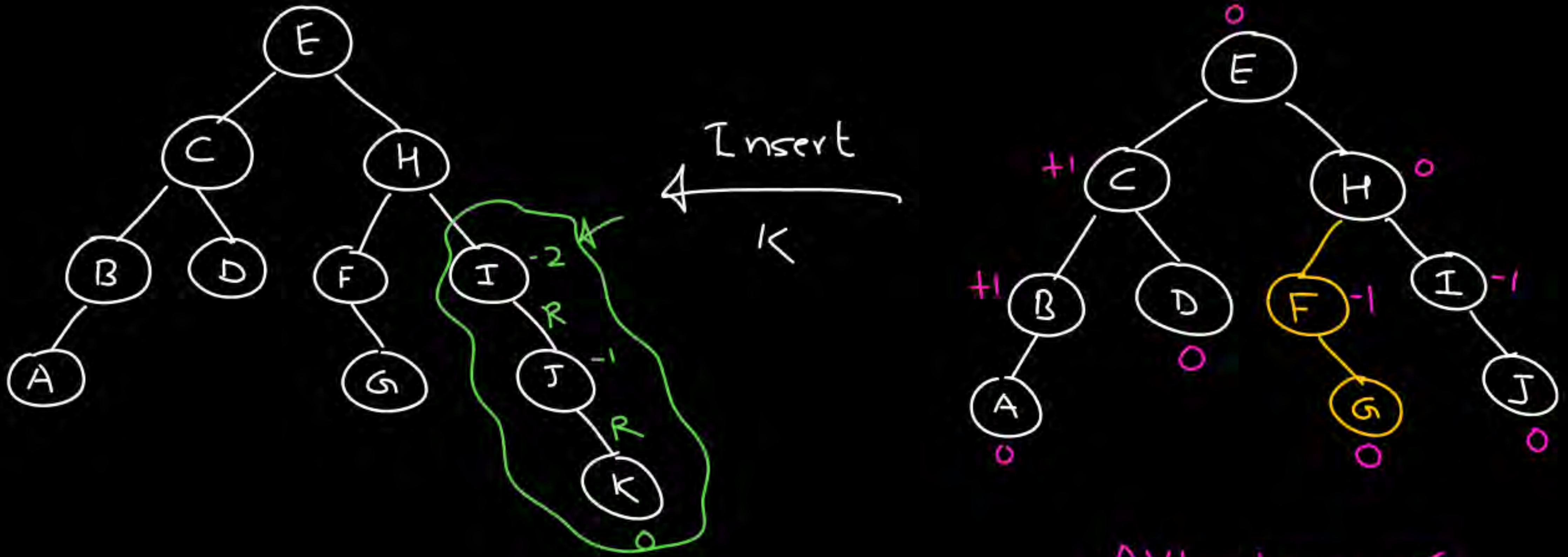




H, I, J, B, A, E, C, F, D, G, K, L



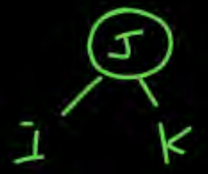


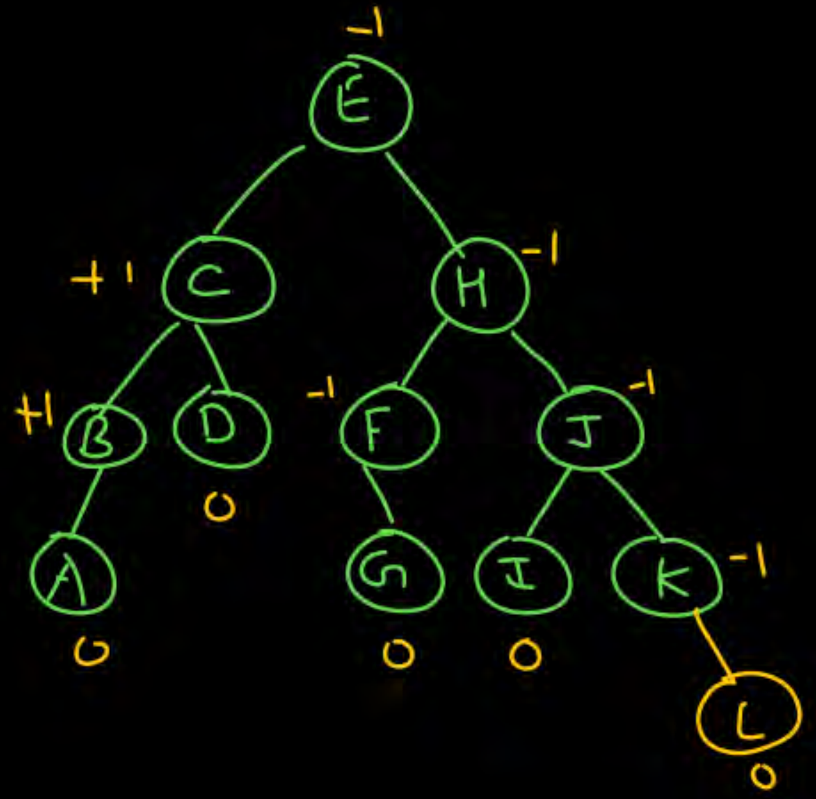


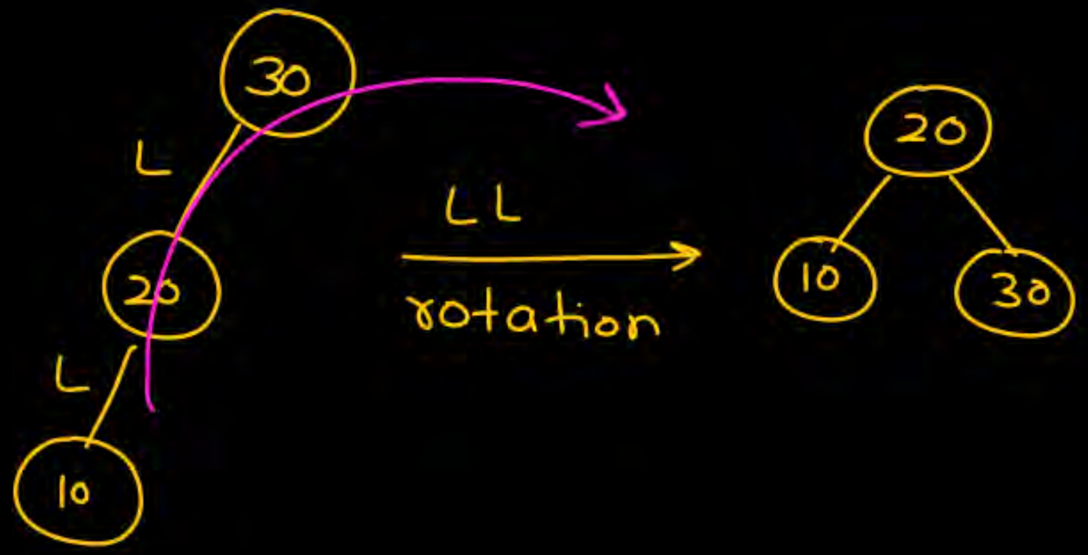
AVL-tree ✓

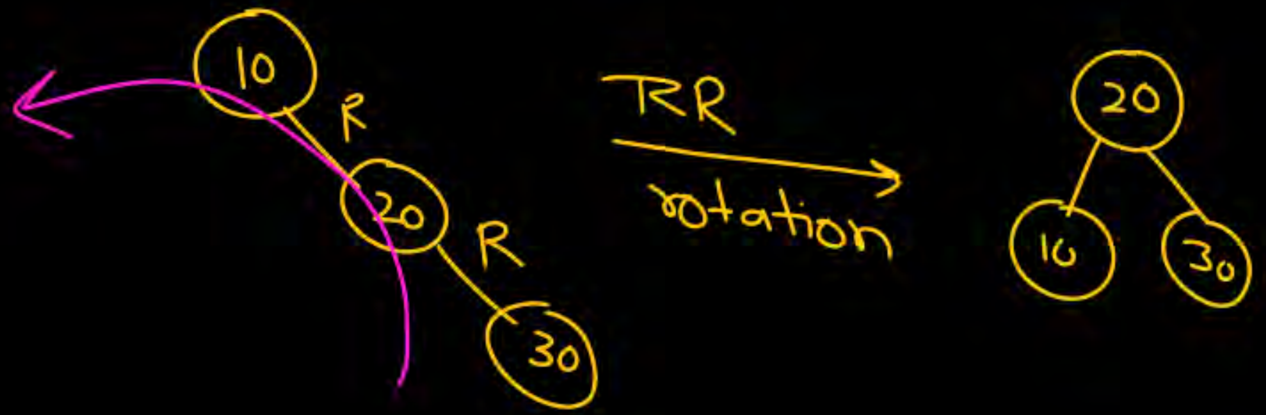
H, I, J, B, A, E, C, F, D, G, K, L

I, J, K

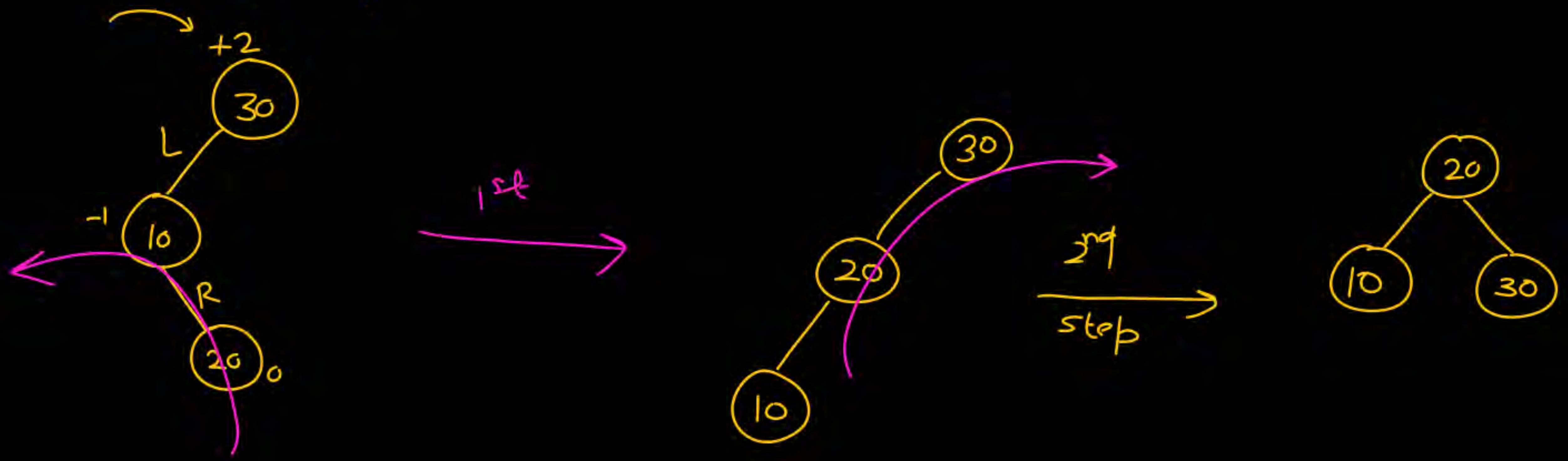




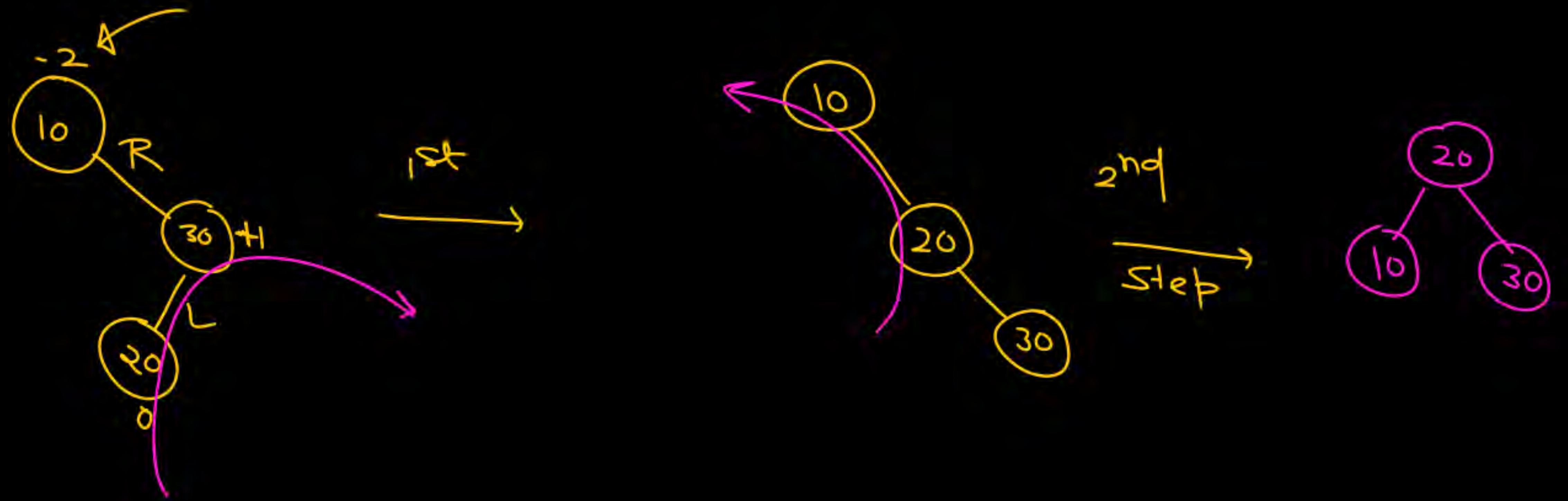

30
L
20
L
10
LL
rotation
20
10
30


10
R
20
R
30
RR
rotation
20
10
30

30,10,20



+2
30
L
-1
10
R
20
0
1st
30
20
10
2nd
step
20
10
30



-2
10
R
30
+1
L
20
0
1st
10
20
30
2nd
step
20
10
30

LL Rotation

RR Rotation

Single rotation

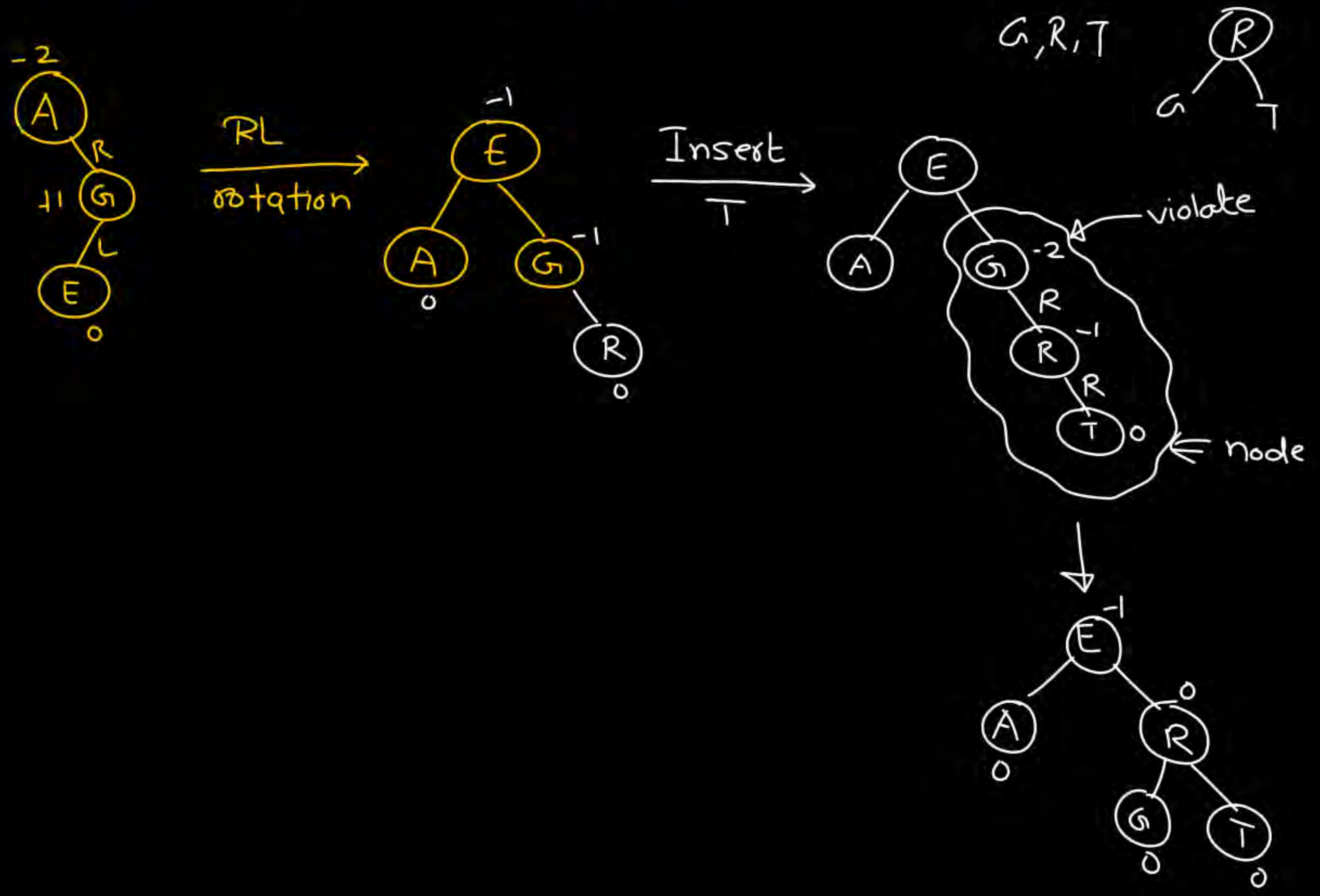
LR Rotation

RL Rotation

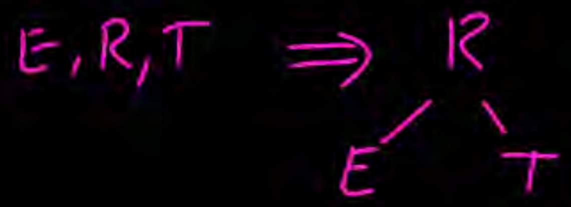
double rotation

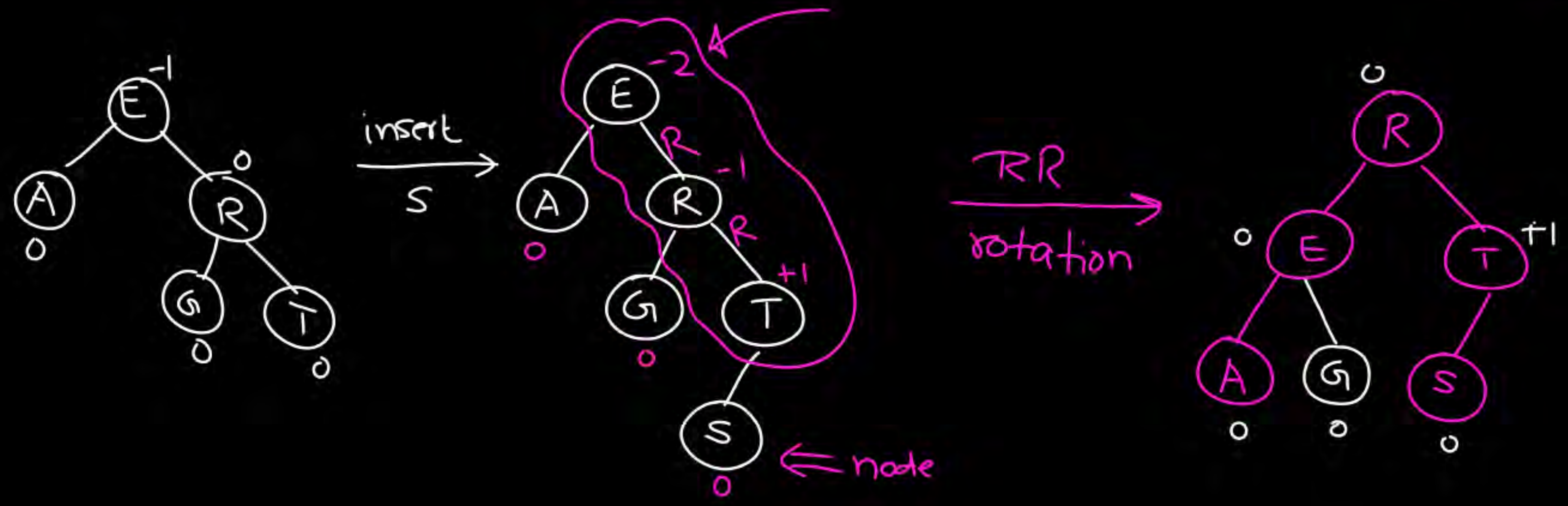
A, E, G

A, G, E, R, T, S, P, Q, W, C, M, D, X

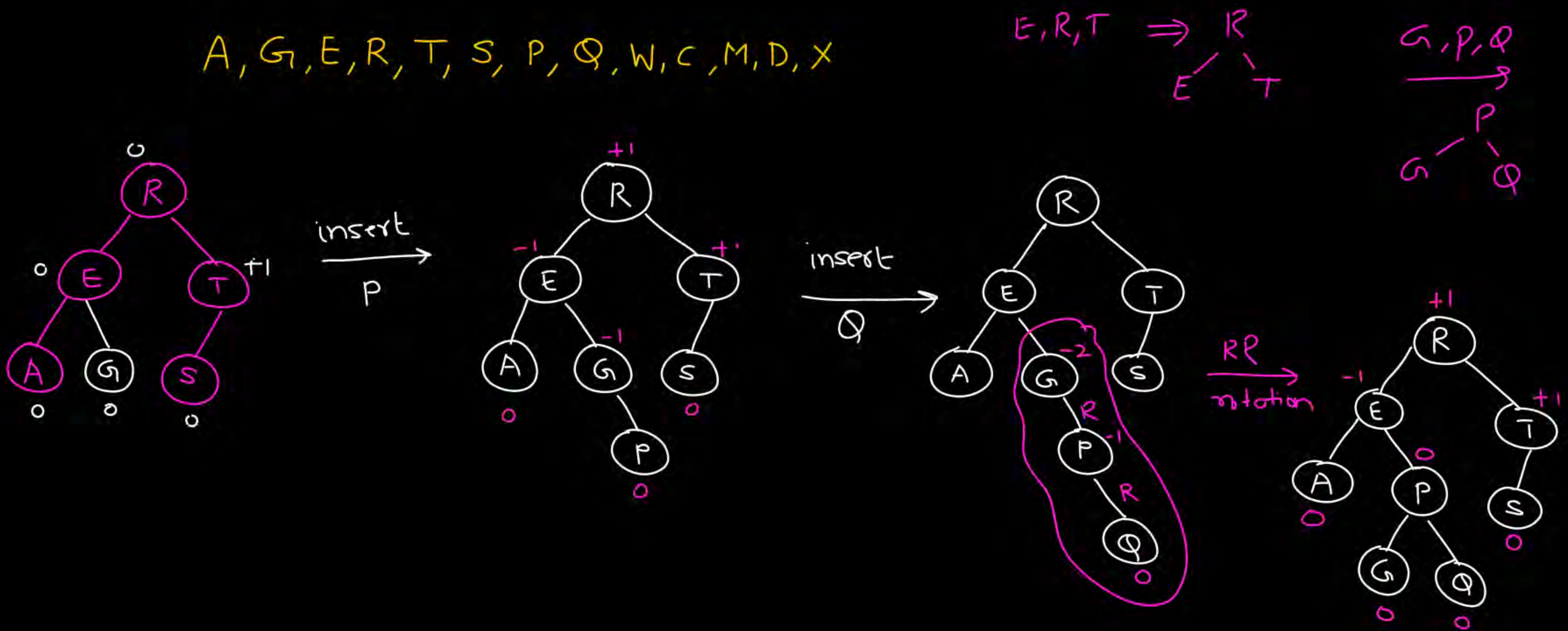


A, G, E, R, T, S, P, Q, W, C, M, D, X

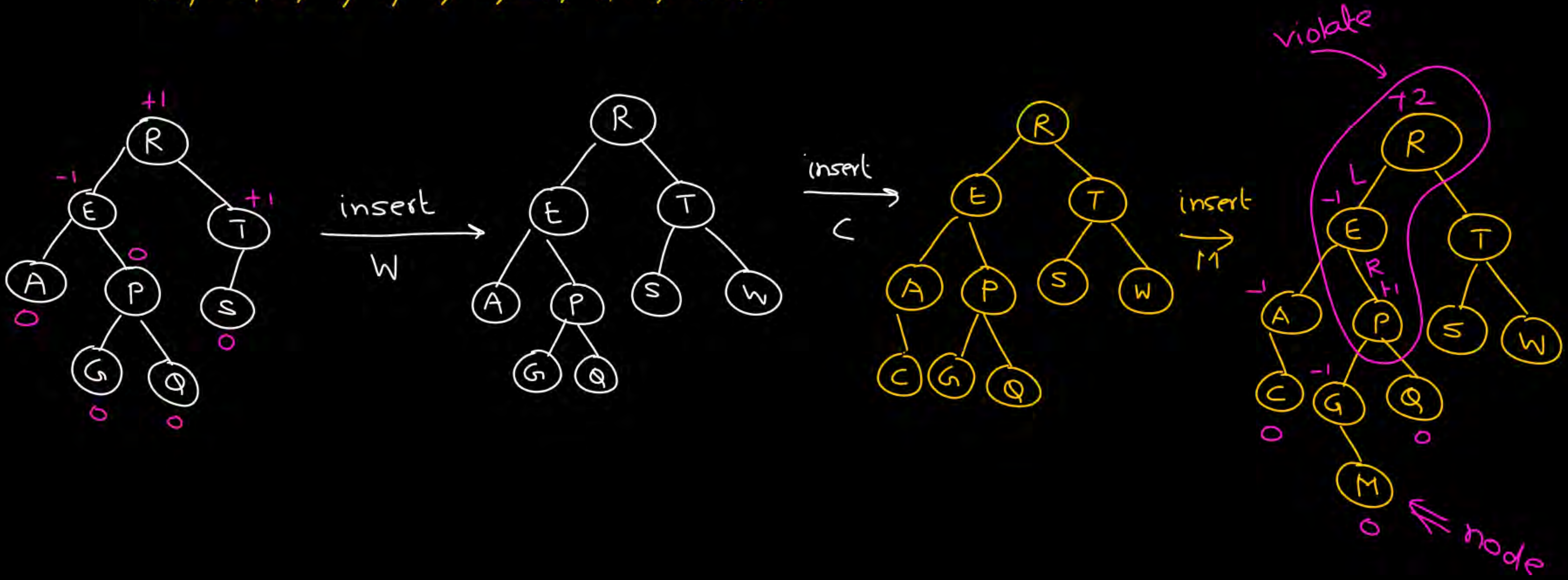




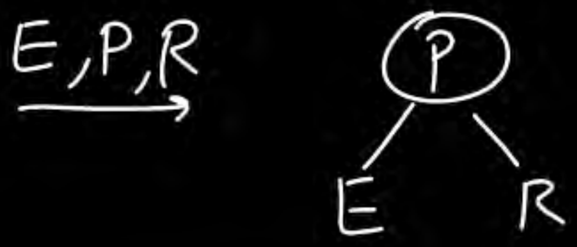
A, G, E, R, T, S, P, Q, W, C, M, D, X

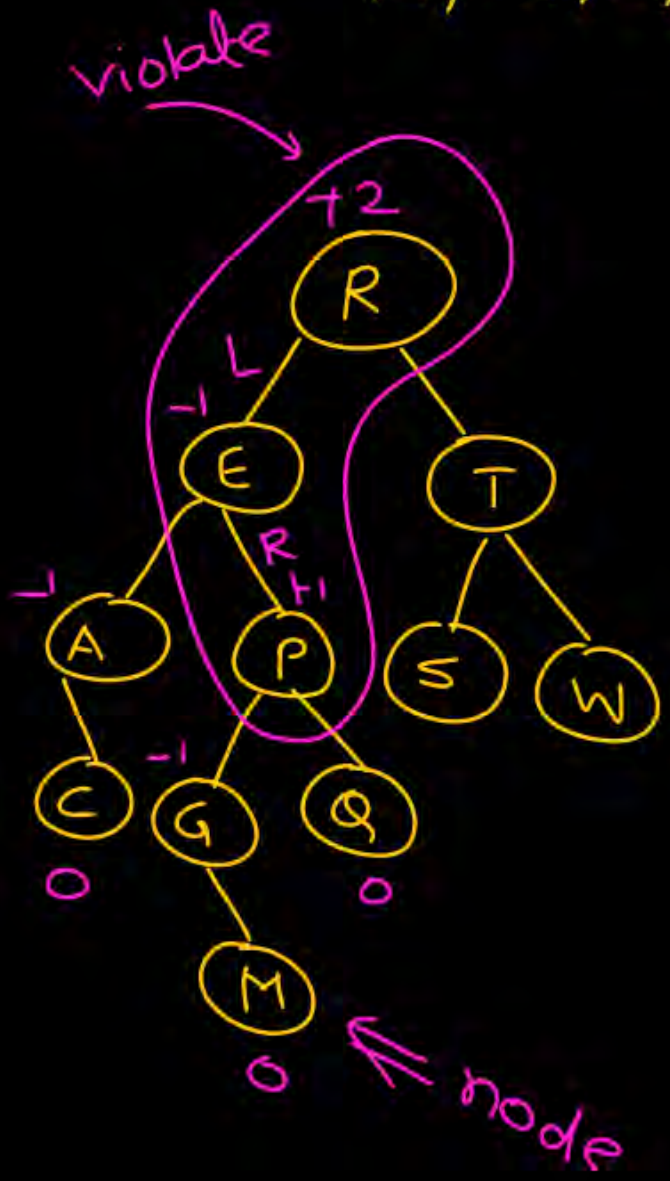


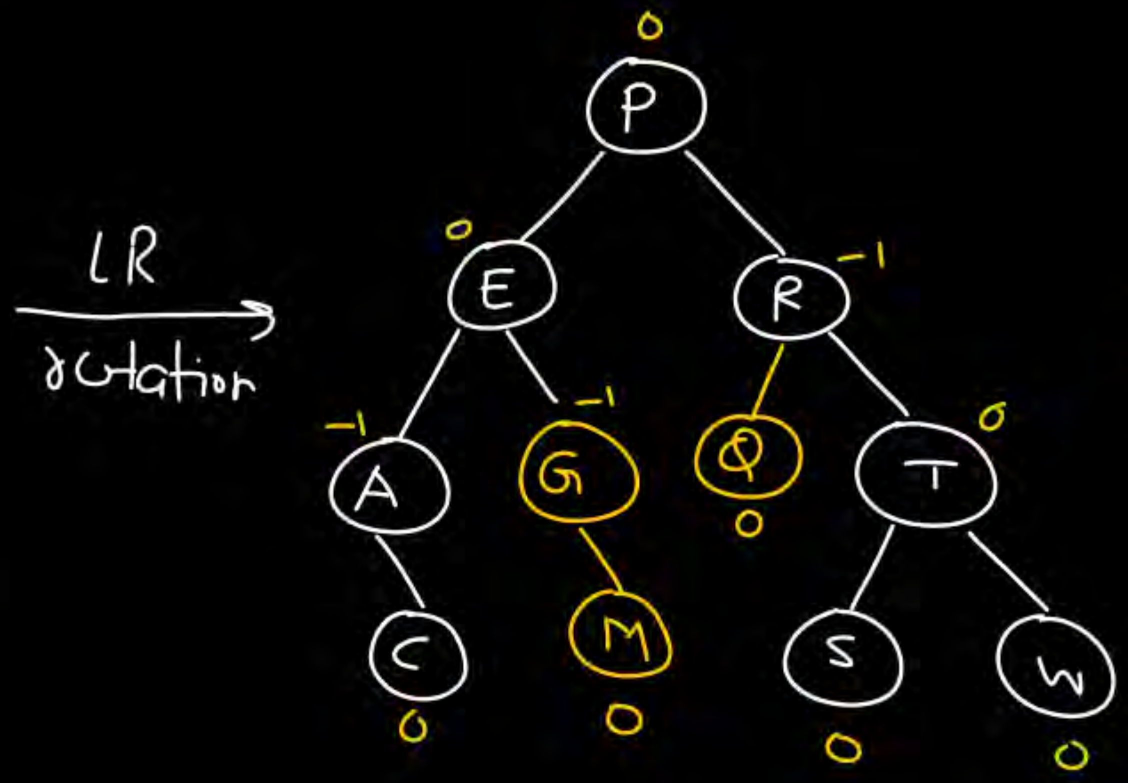
A, G, E, R, T, S, P, Q, W, C, M, D, X

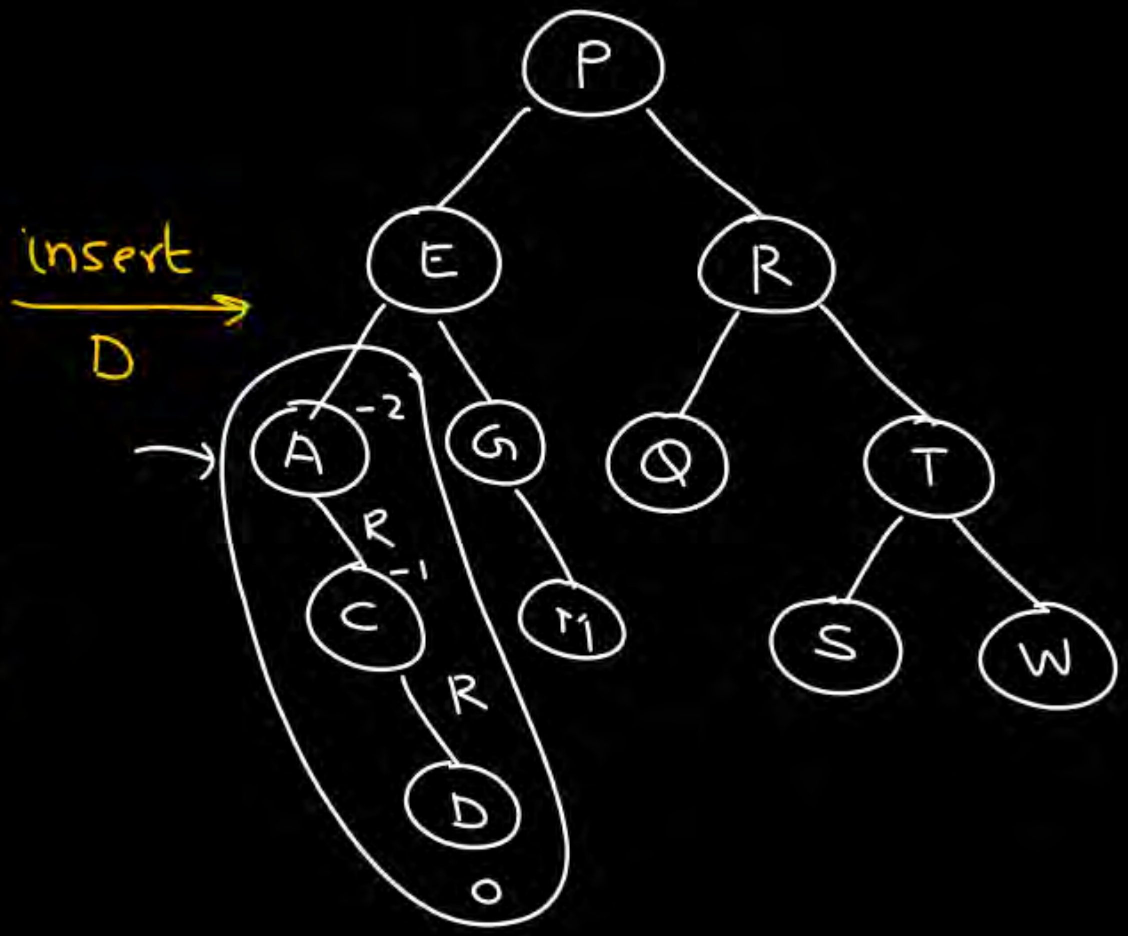


A, G, E, R, T, S, P, Q, W, C, M, D, X

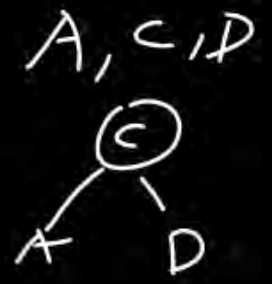


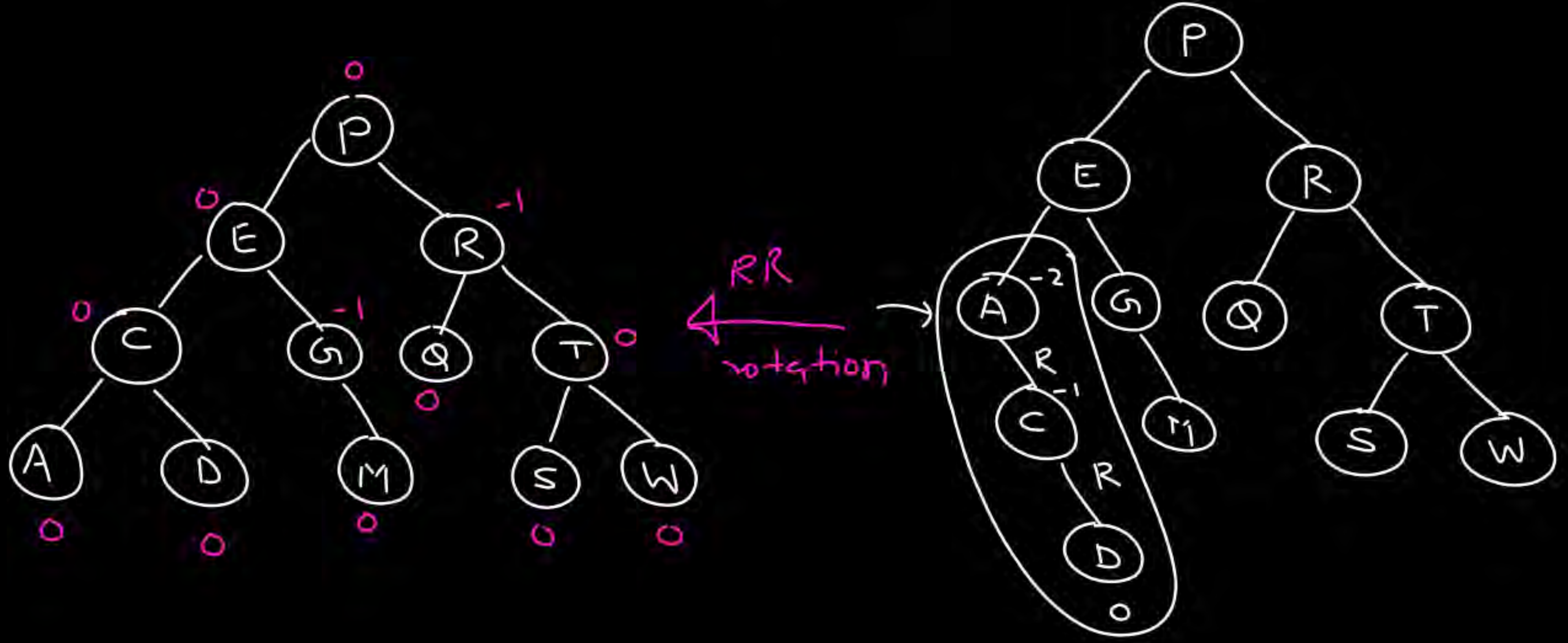




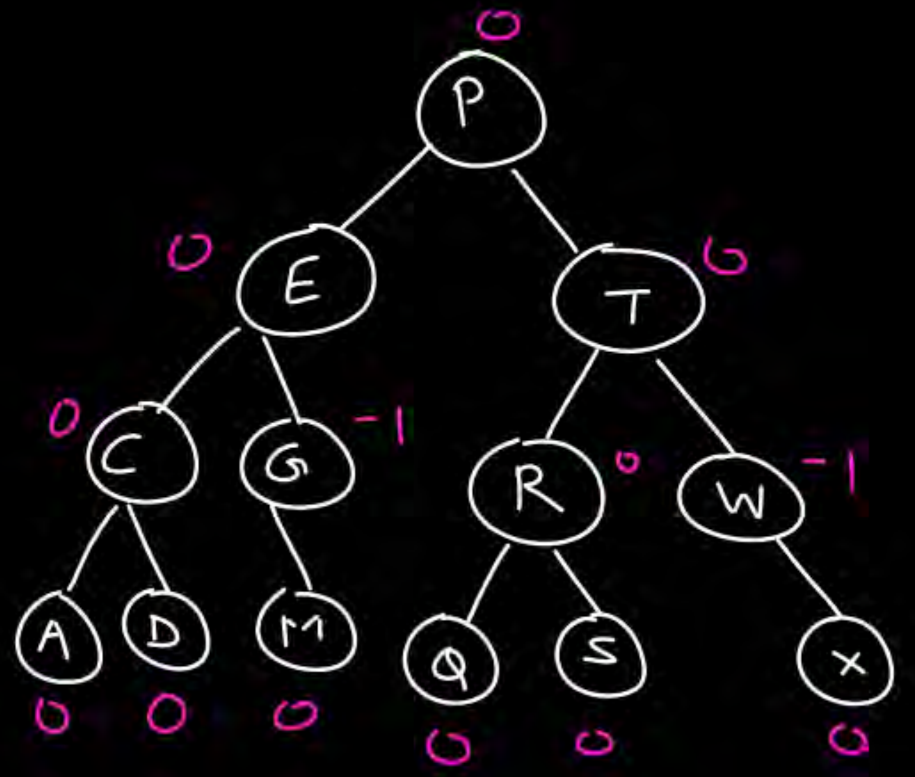


A, G, E, R, T, S, P, Q, W, C, M, D, X

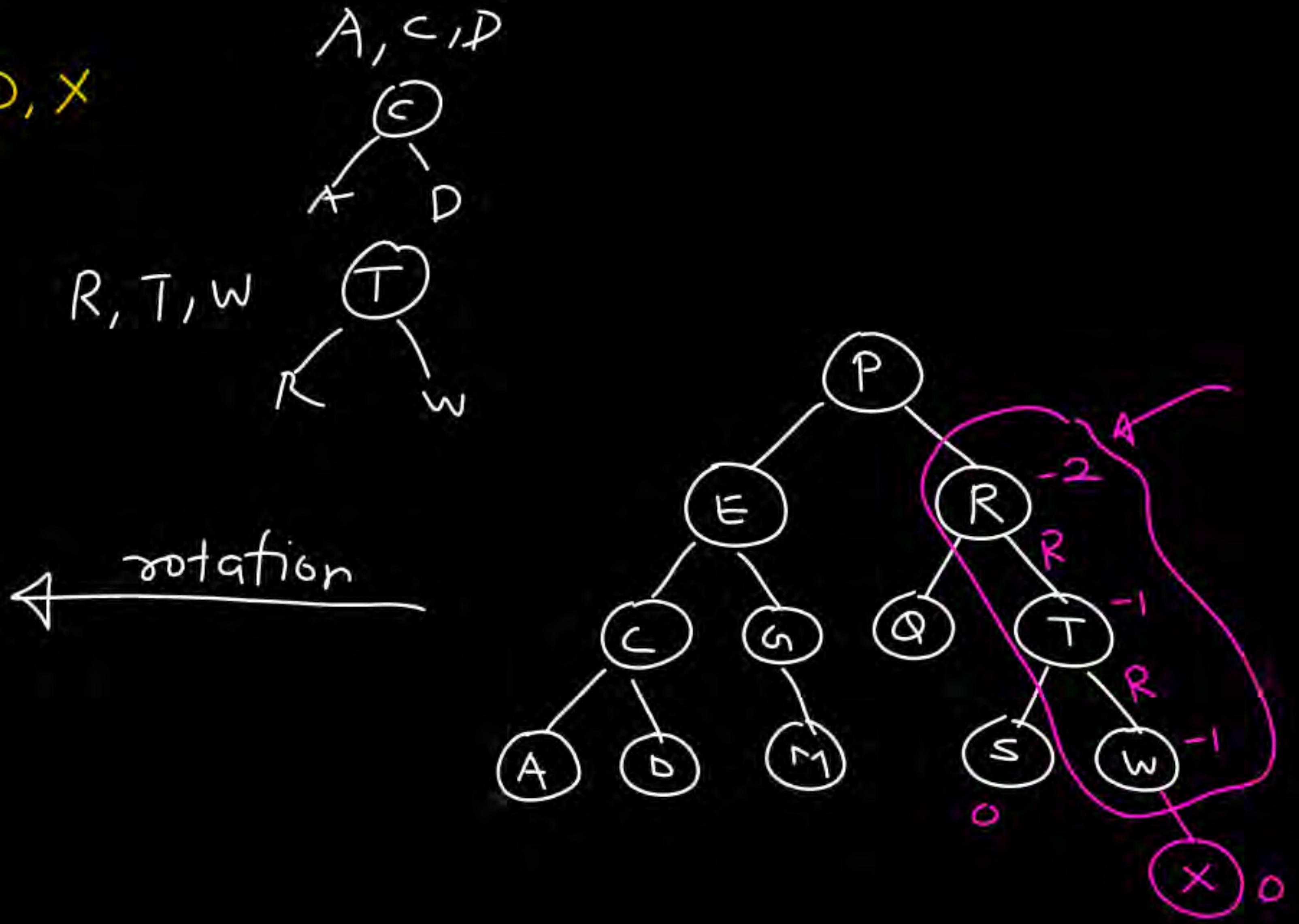




A, G, E, R, T, S, P, Q, W, C, M, D, X



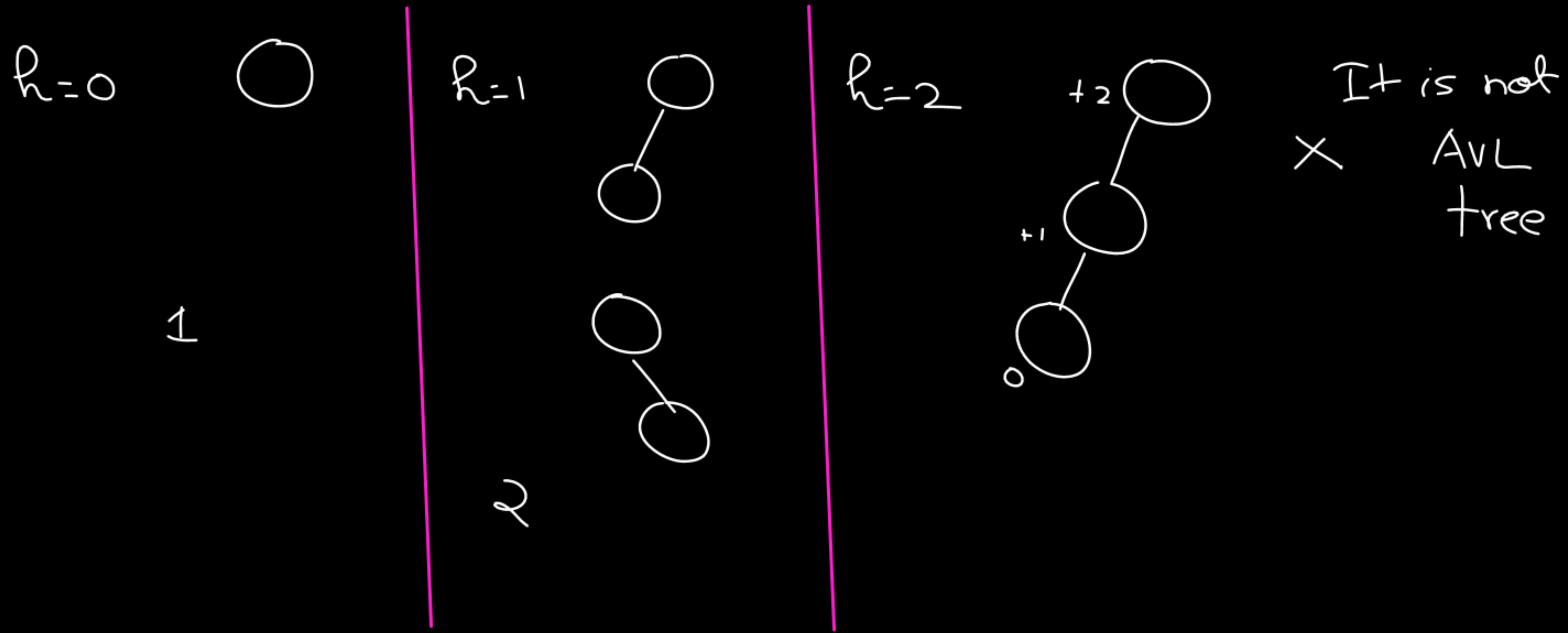
AVL tree ✓



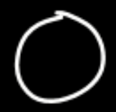
Maximum no. of nodes in an AVL-tree of height h

$$= 2^{h+1} - 1$$

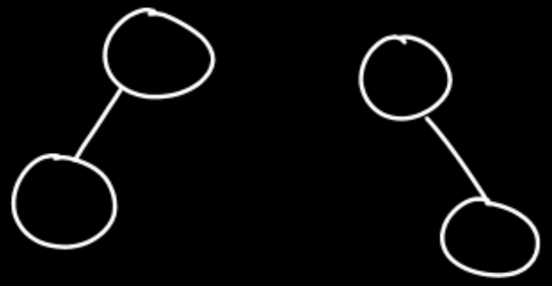
Min. no. of nodes in an AVL-tree of height h.



1) $h=0$

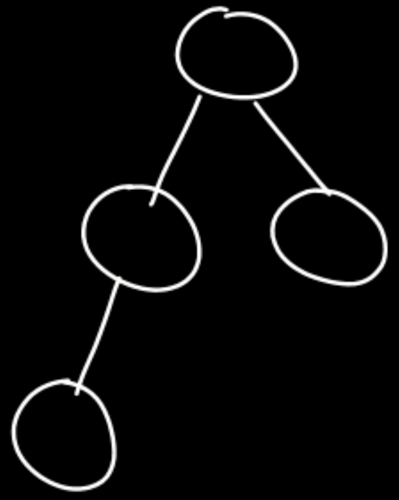


2) $h=1$



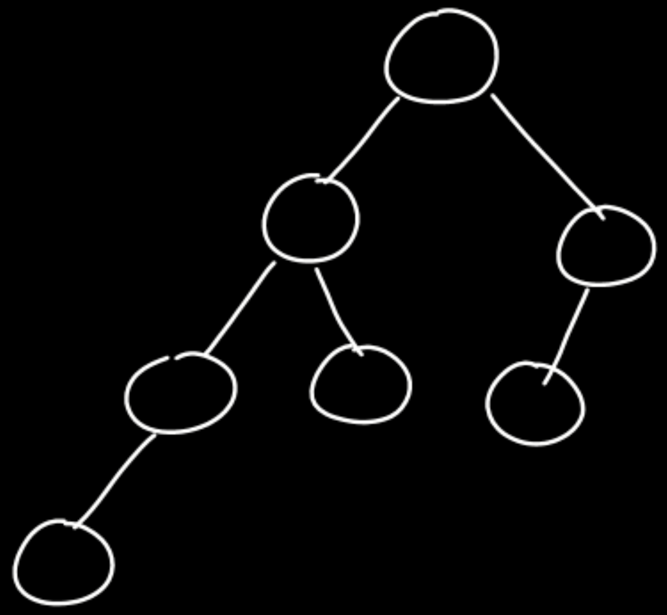
2 nodes

3) $h=2$

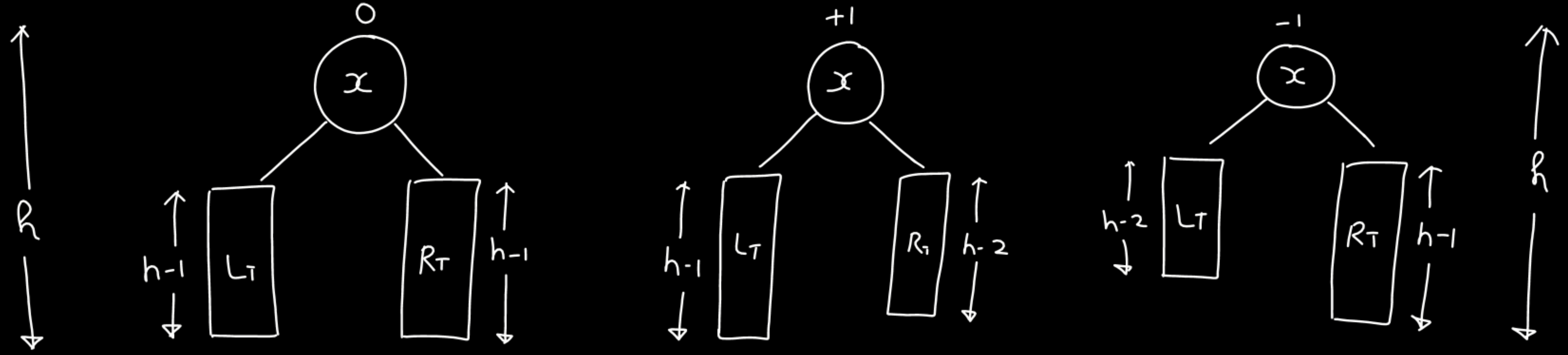


4 nodes

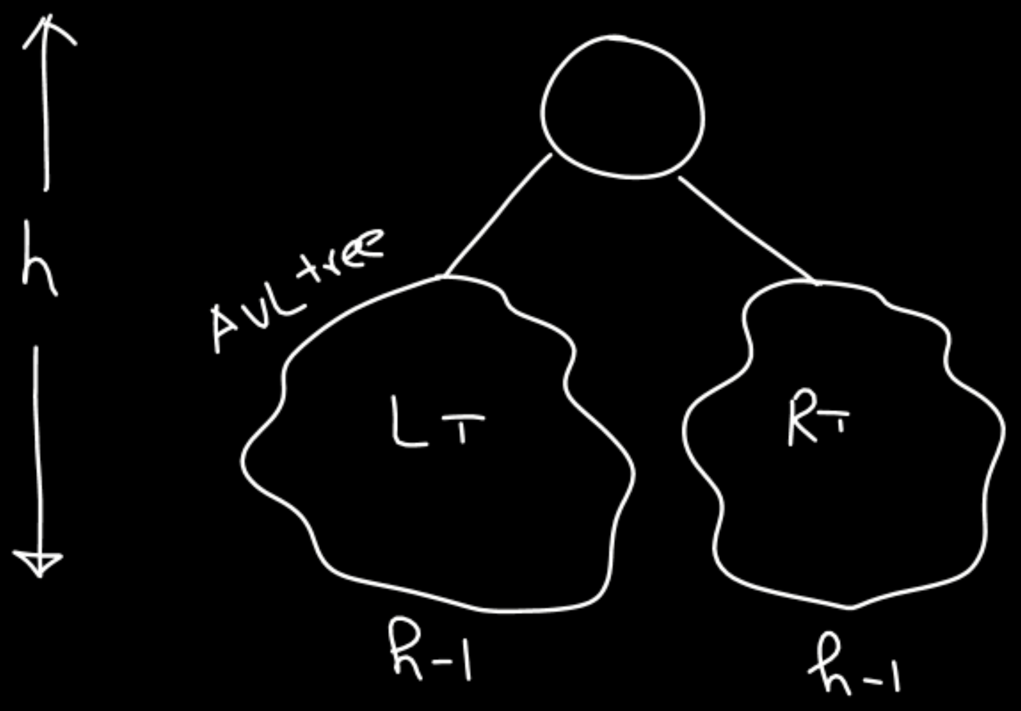
$h=3$



= 7 nodes

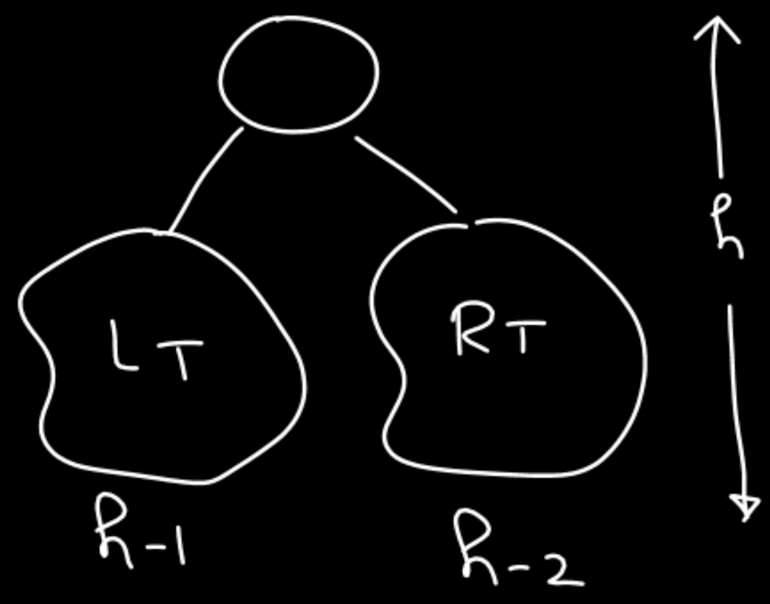

h
0
x
h-1
L_T
R_T
h-1
+1
x
h-1
L_T
R_T
h-2
-1
x
h-2
L_T
R_T
h-1
h

let $n(h)$ be the min. no. of nodes in an AVL-tree of h height.



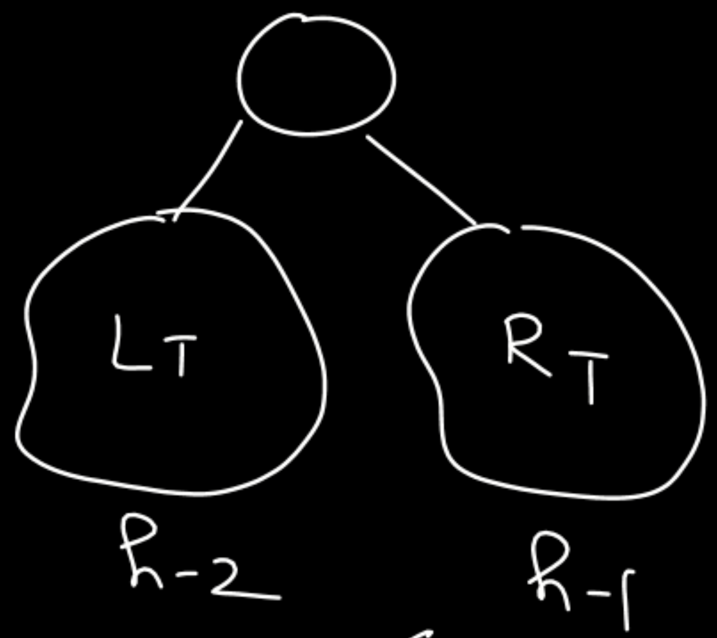
$$\cancel{n(h) = n(h-1) + n(h-1) + 1}$$

Not minimum



$$n(h) = 1 + n(h-1) + n(h-2)$$

✓



✓

$$n(h) = 1 + n(h-2) + n(h-1)$$

$$\boxed{n(h) = 1 + n(h-1) + n(h-2)}$$

$$n(0) = 1$$

$$n(1) = 2$$

$$n(2) = 1 + n(1) + n(0) = 1+2+1 = 4$$

$$n(3) = 1 + n(2) + n(1) = 1+4+2 = 7$$

$$\vdots$$

$n(0)=1$

$n(1)=2)$

k	0	1	2	3	4	5	6	7	8	- - -
$n(k)$	1	2	4	7	12	20	33	54	88	- - -

H.W

1. A binary tree is such that the diff. b/w the no. of nodes in LT and no. of nodes in R_T is atmost 1 for each node. find the min. no. of nodes in such a tree of height 5.

Node balance

2. What is the (max. height possible) of on AVL tree with 7 nodes.

3. with 10 nodes

same concept

THANK YOU GW SOLDIERS !