CS & IT ENGINEERING

Data Structure & Programming

Tree

Lec - 01

By- Pankaj Sharma sir

TOPICS TO BE COVERED

Tree-1

Tree

1. Directory structure

2. Organization

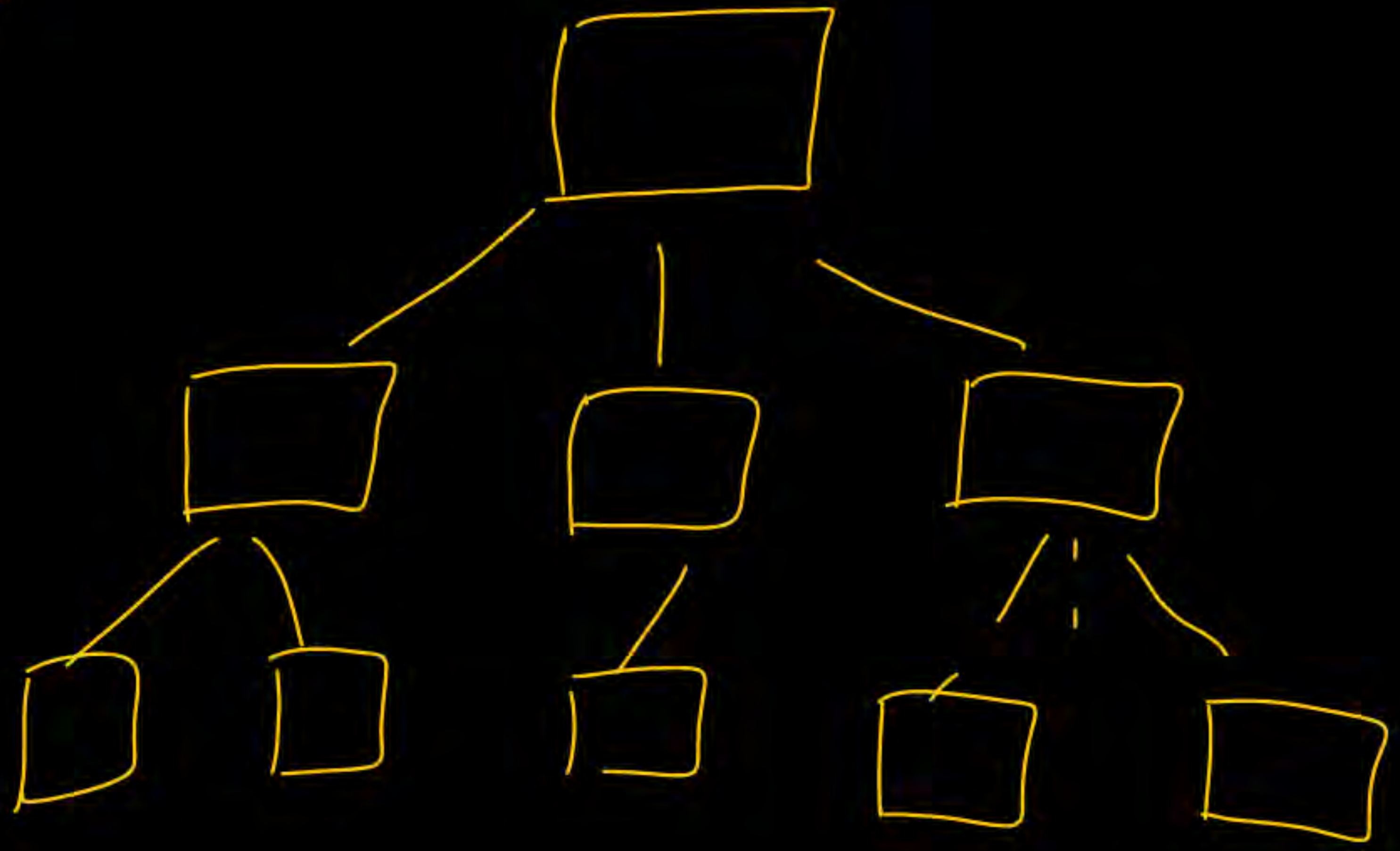
3) HTML/XML

4) Parse tree

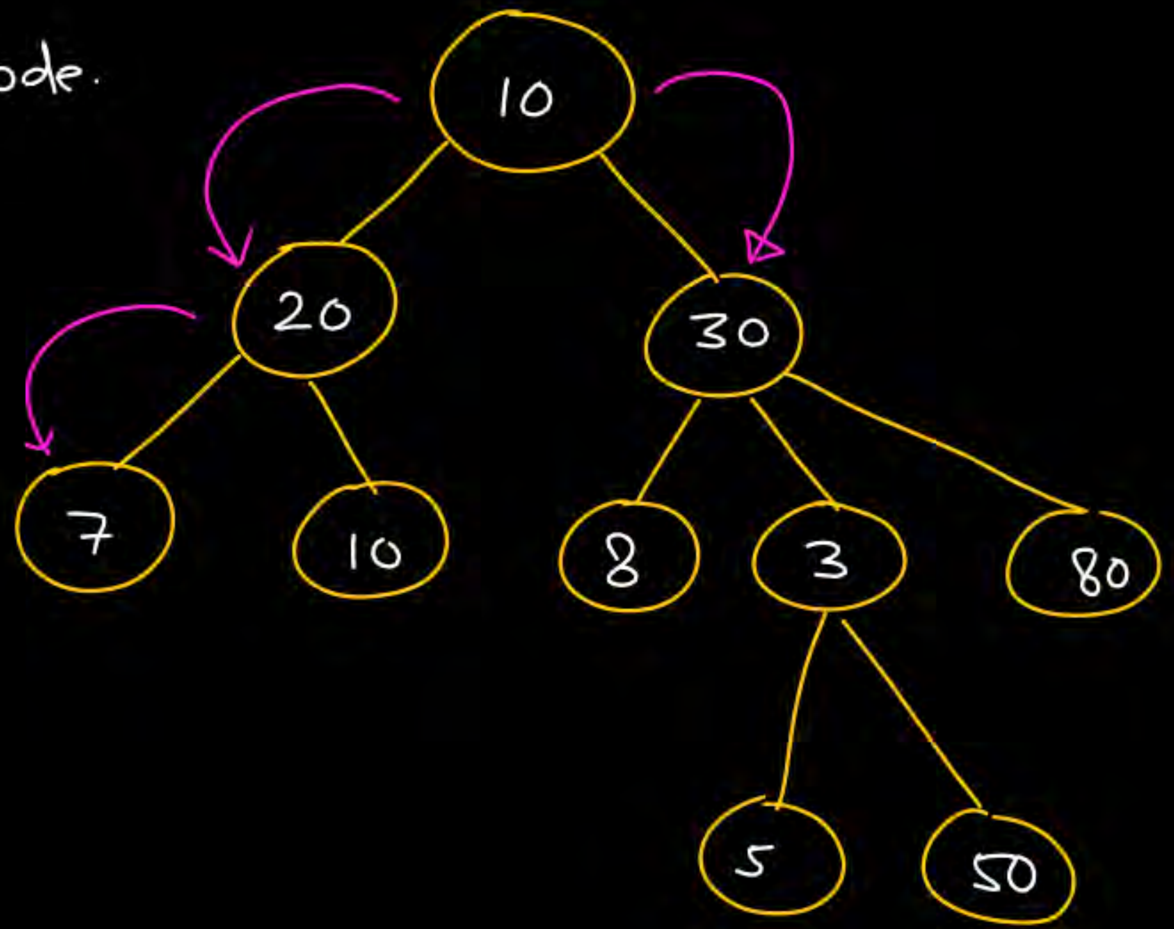
5) Binary Search tree

6) Binary Heap.

7) B-Tree, B+-Trees → DBMS



① Node : Each element is rep. by a node.



② child : 20 and 30 are child for node 10

7 is the child of 20

10 is the child of 20

③ Parent :

① Node : Each element is rep. by a node.

② child : 20 and 30 are child for node 100

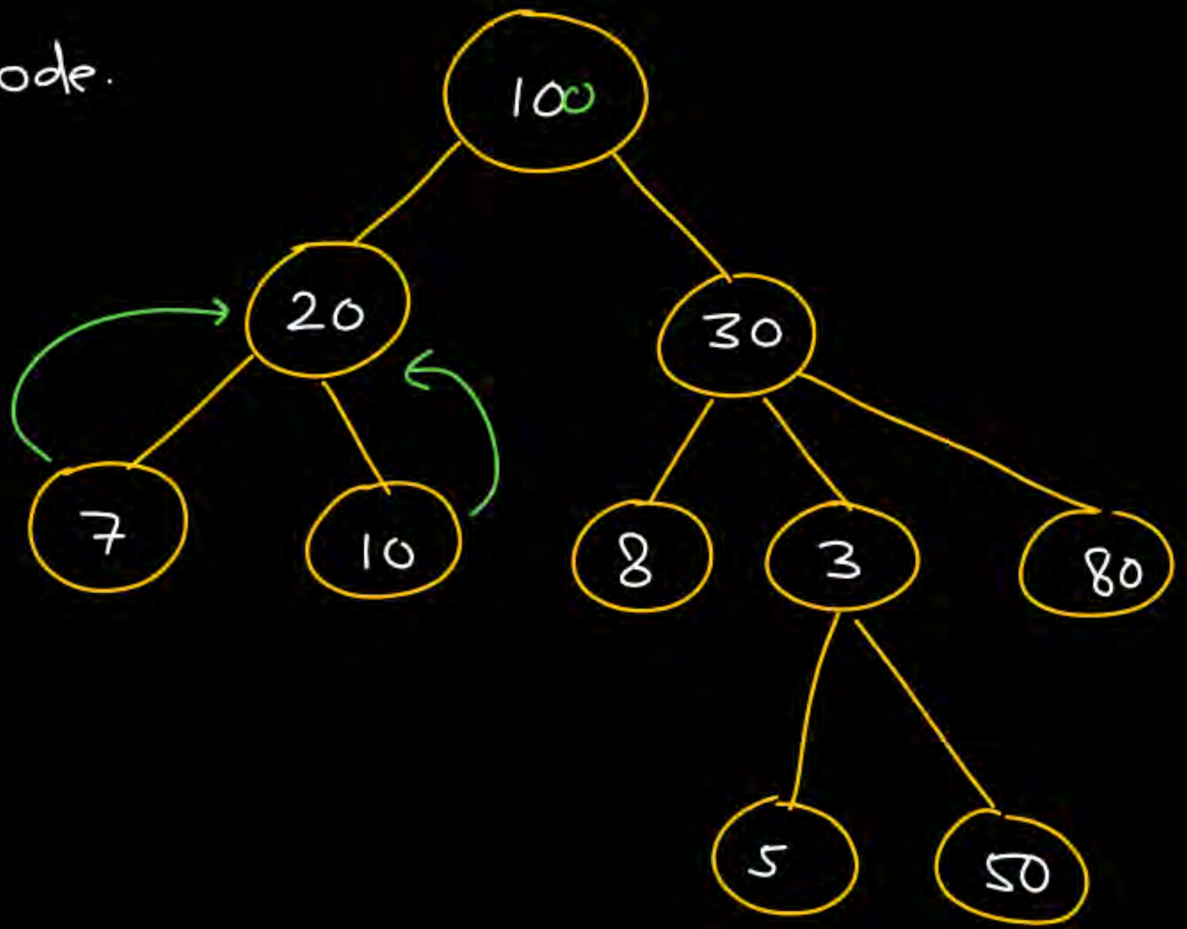
7 is the child of 20

10 is the child of 20.

③ Parent : 20 is the parent of 7.

20 is the parent of 10.

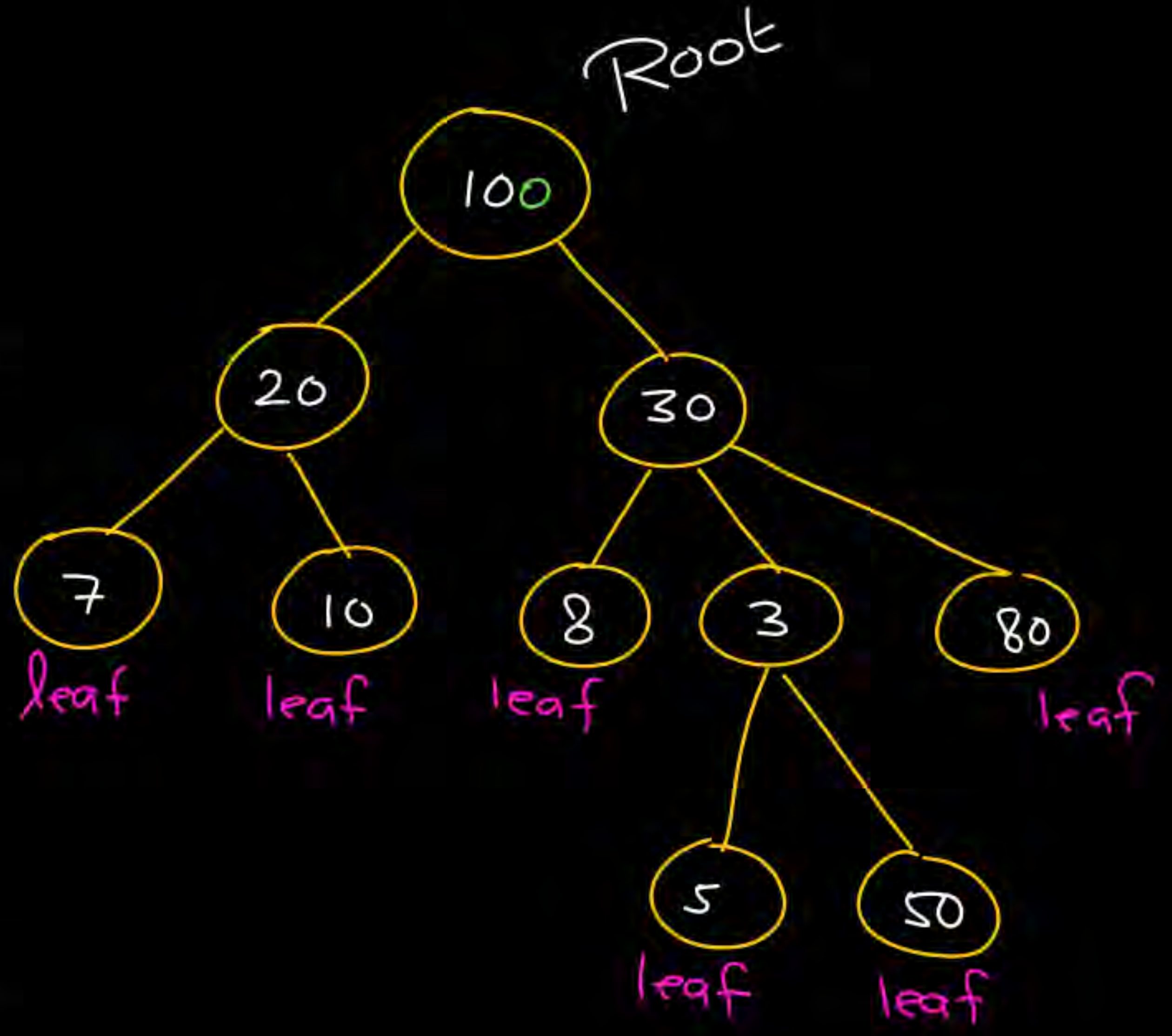
30 is the parent of 8, 3, 80



4) Root Node : Distinguishable node

Only node without any Parent.

100 is the root node.



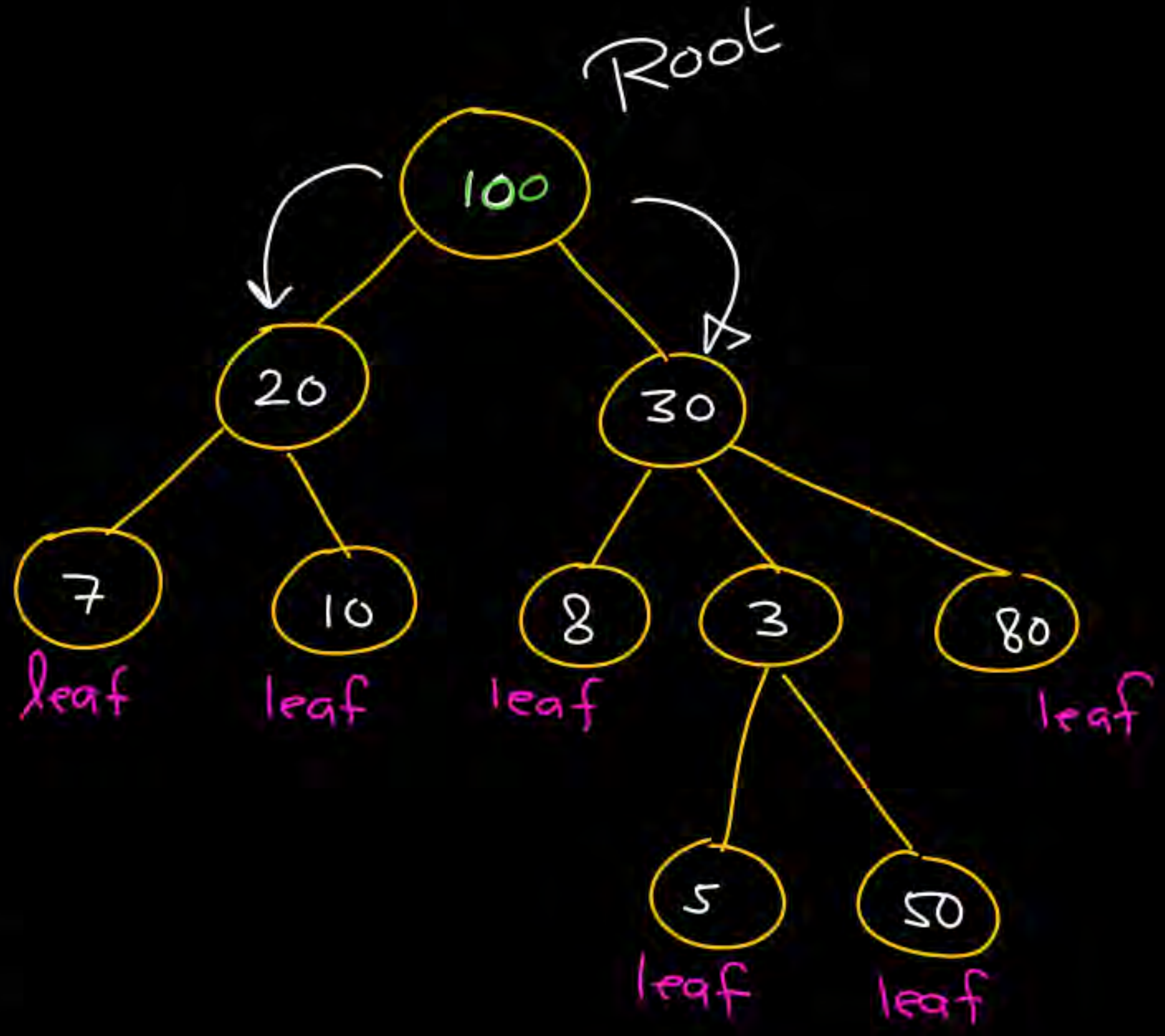
5) Leaf Node : A node without any childs.

7, 10, 8, 5, 50, 80
all are leaf nodes.

6) Internal Node : Node with atleast 1 child.

(1 or more childs)

100, 20,30,3 are Internal nodes



7) Degree of a node : In tree,

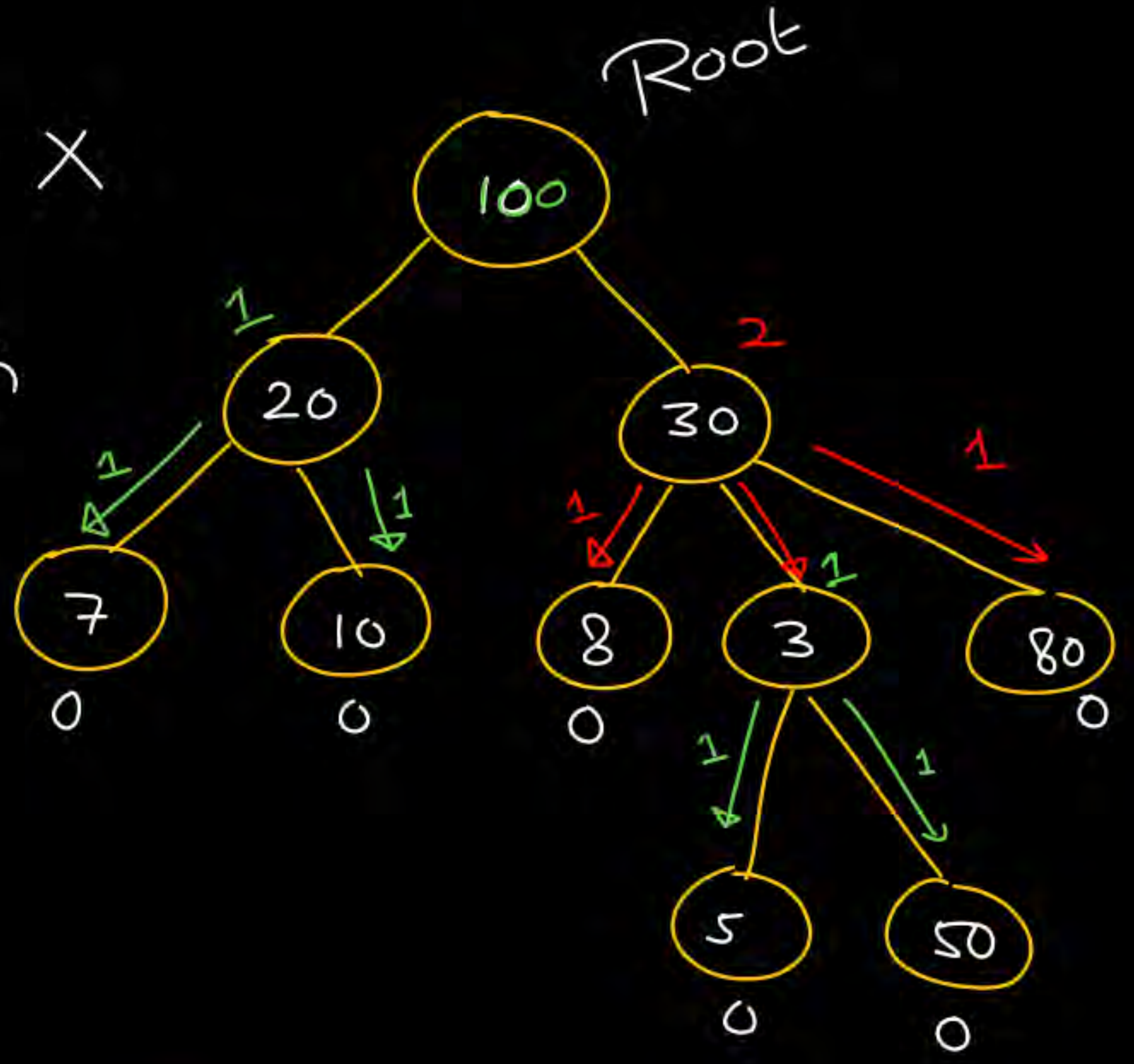
degree of a node represents the no. of childs of a node.

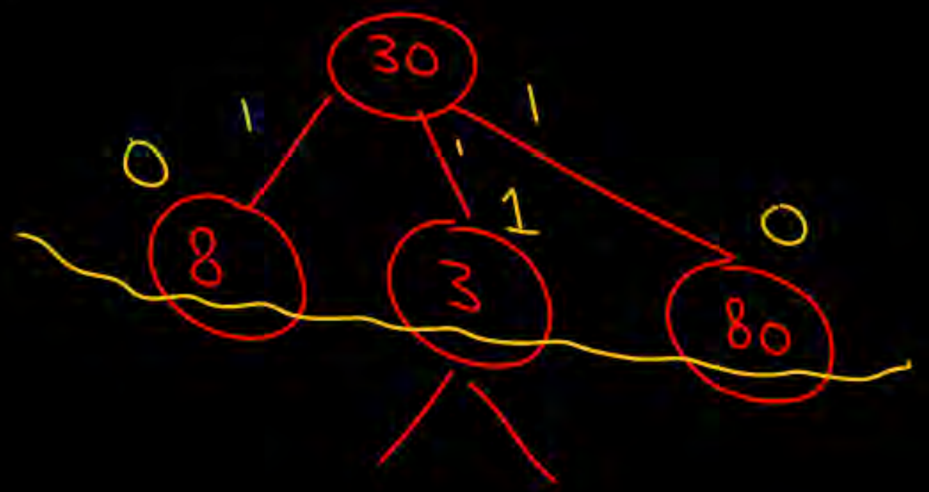
degree of node with key 100 ⇒ ?

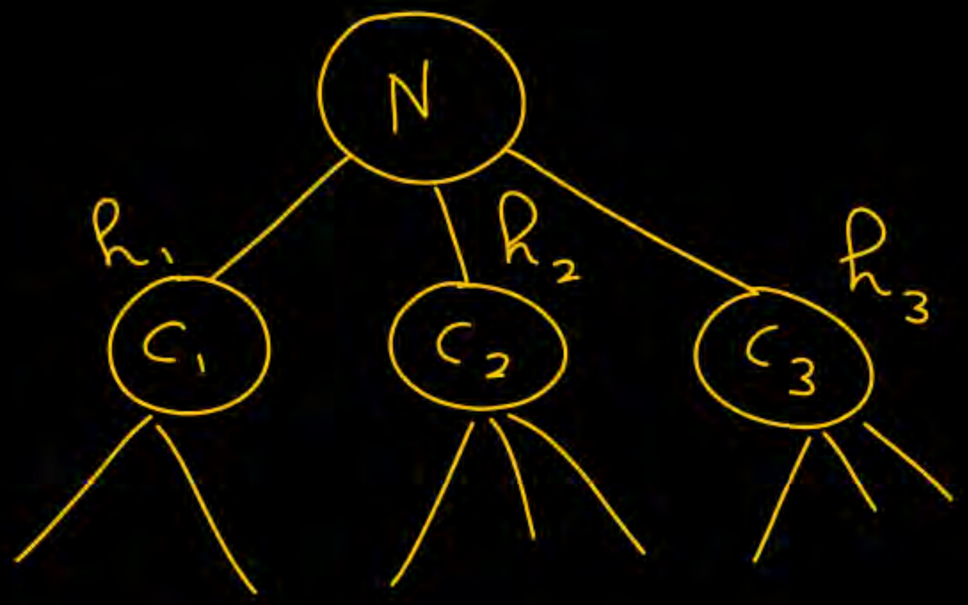
" " " 30 ⇒ 3

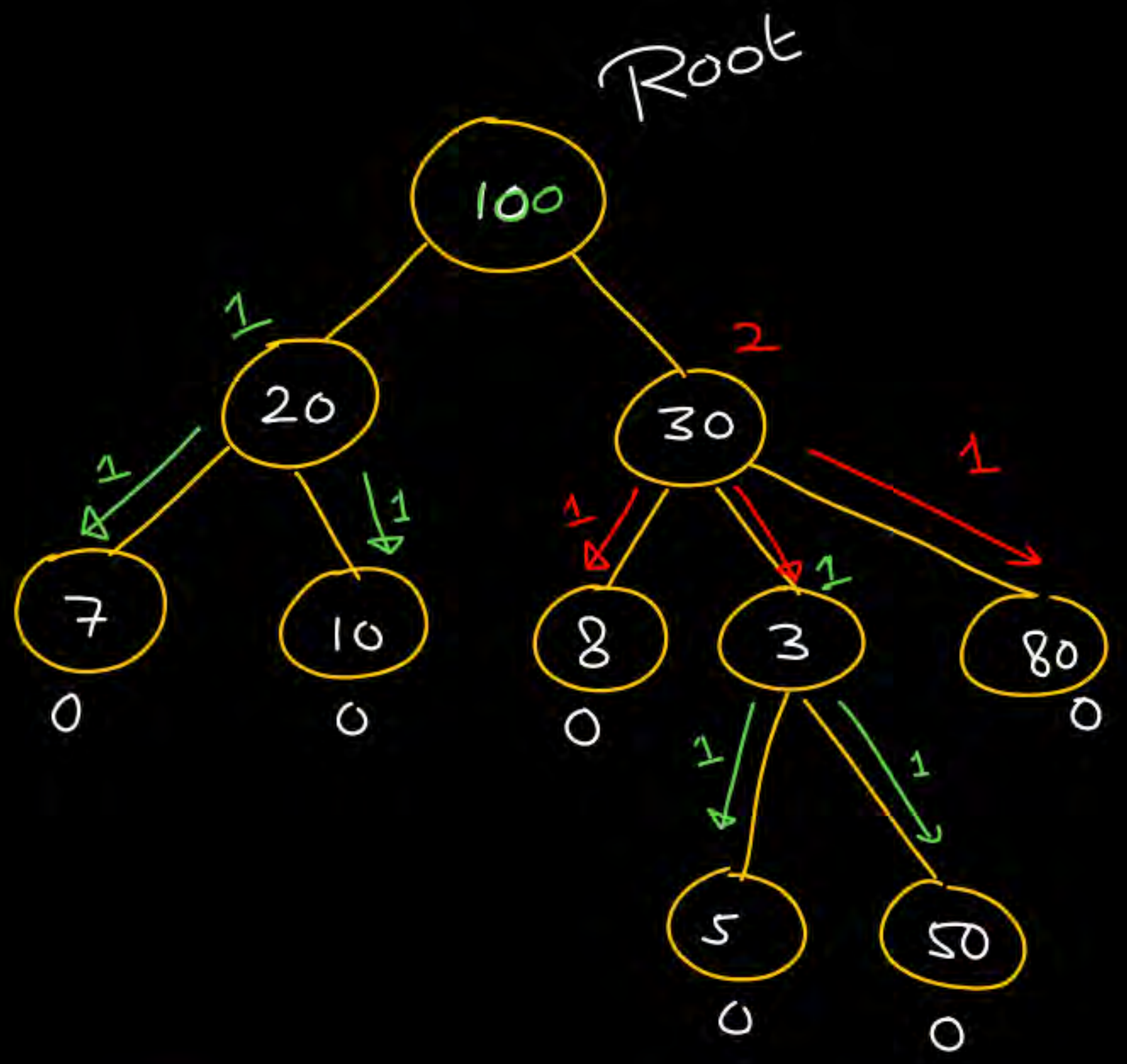
8) Height of a node : Height of a node X is the length of path from node X to the farthest leaf node.

height of a leaf node = 0

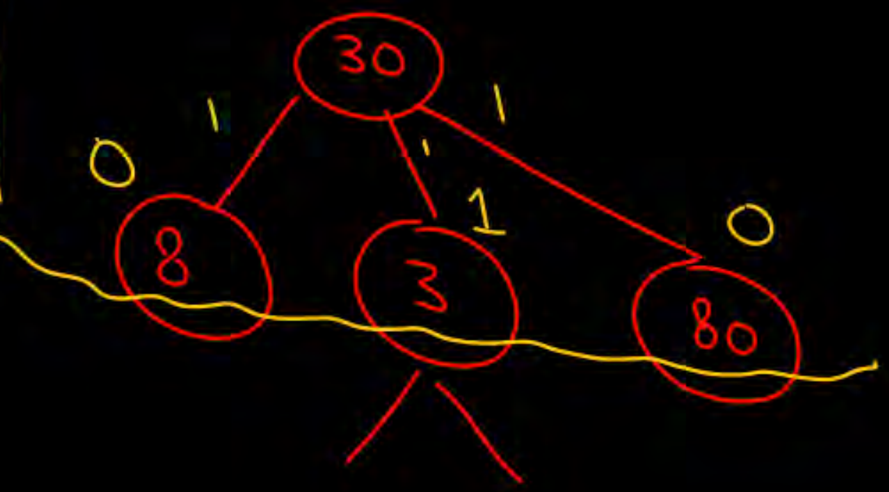






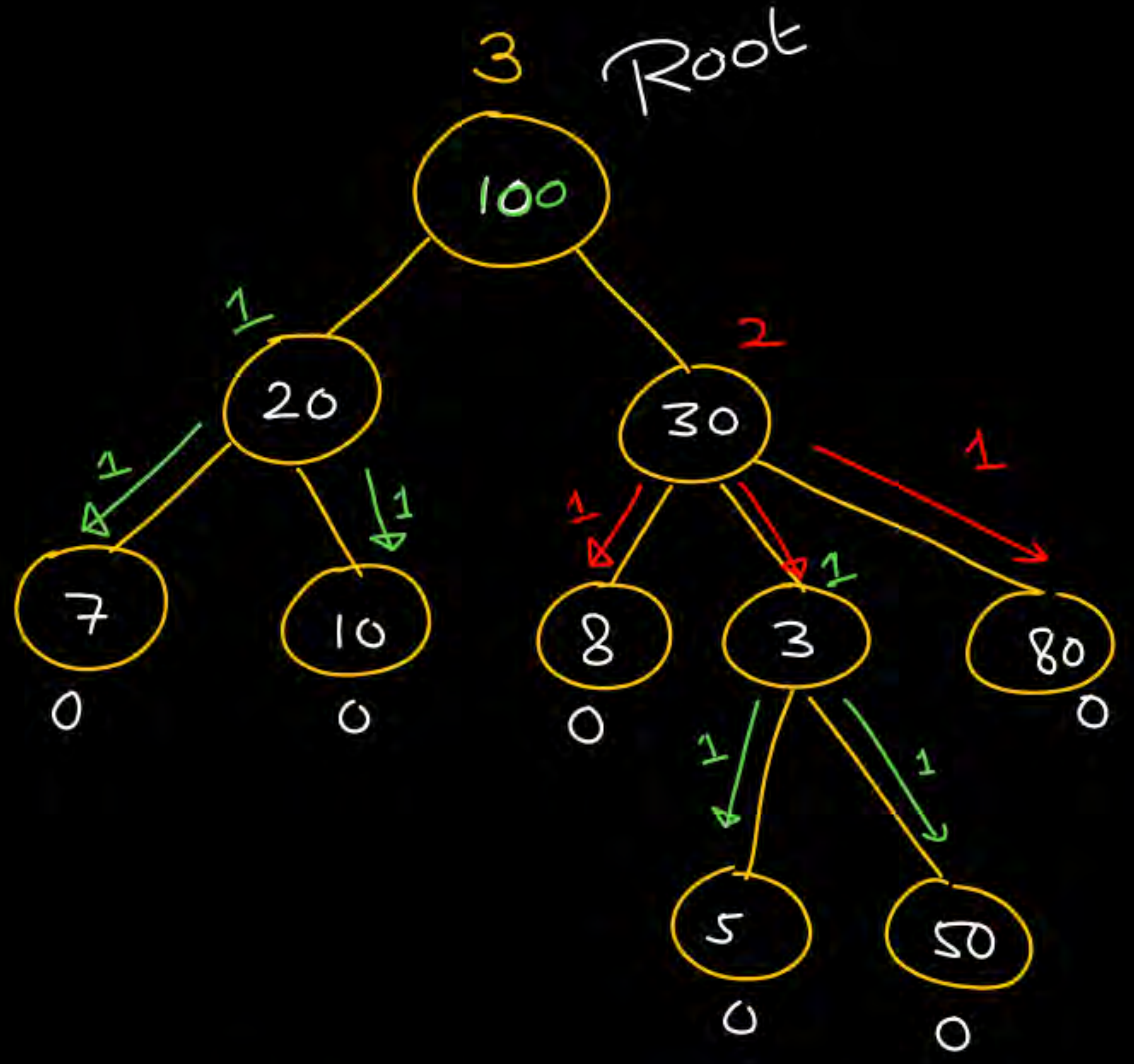


$$\boxed{h(N) = 1 + \max(h_1, h_2, h_3)}$$



Height of tree

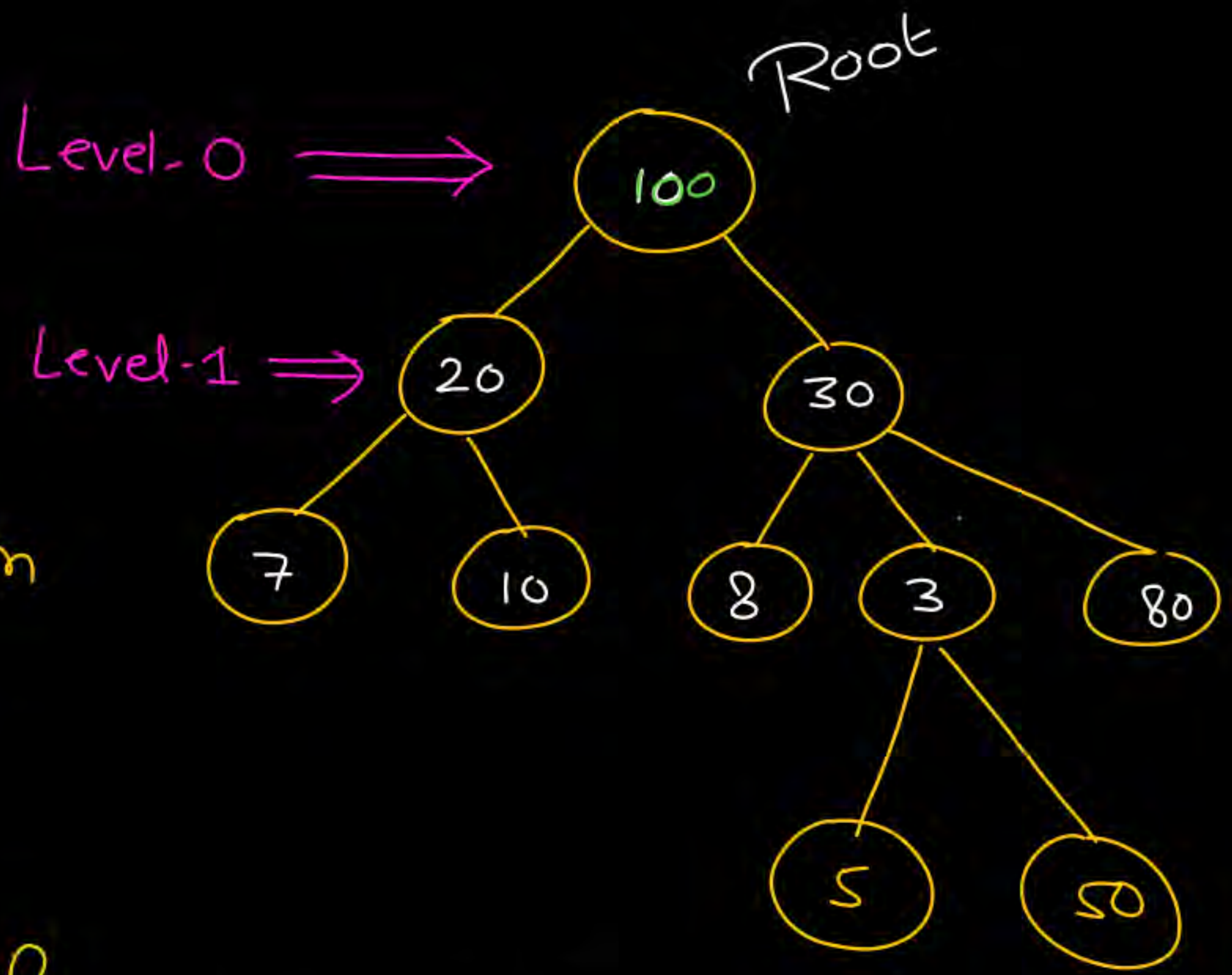
= height of root node



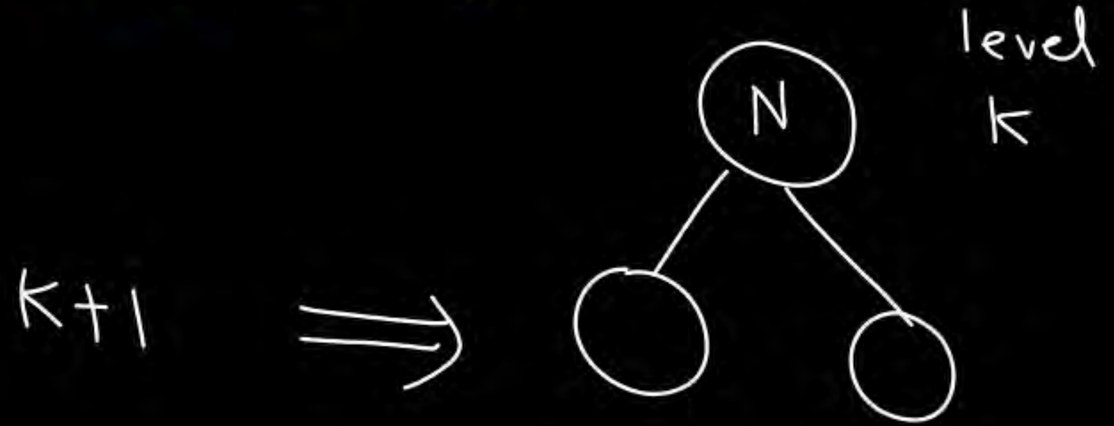
tree with height = 3

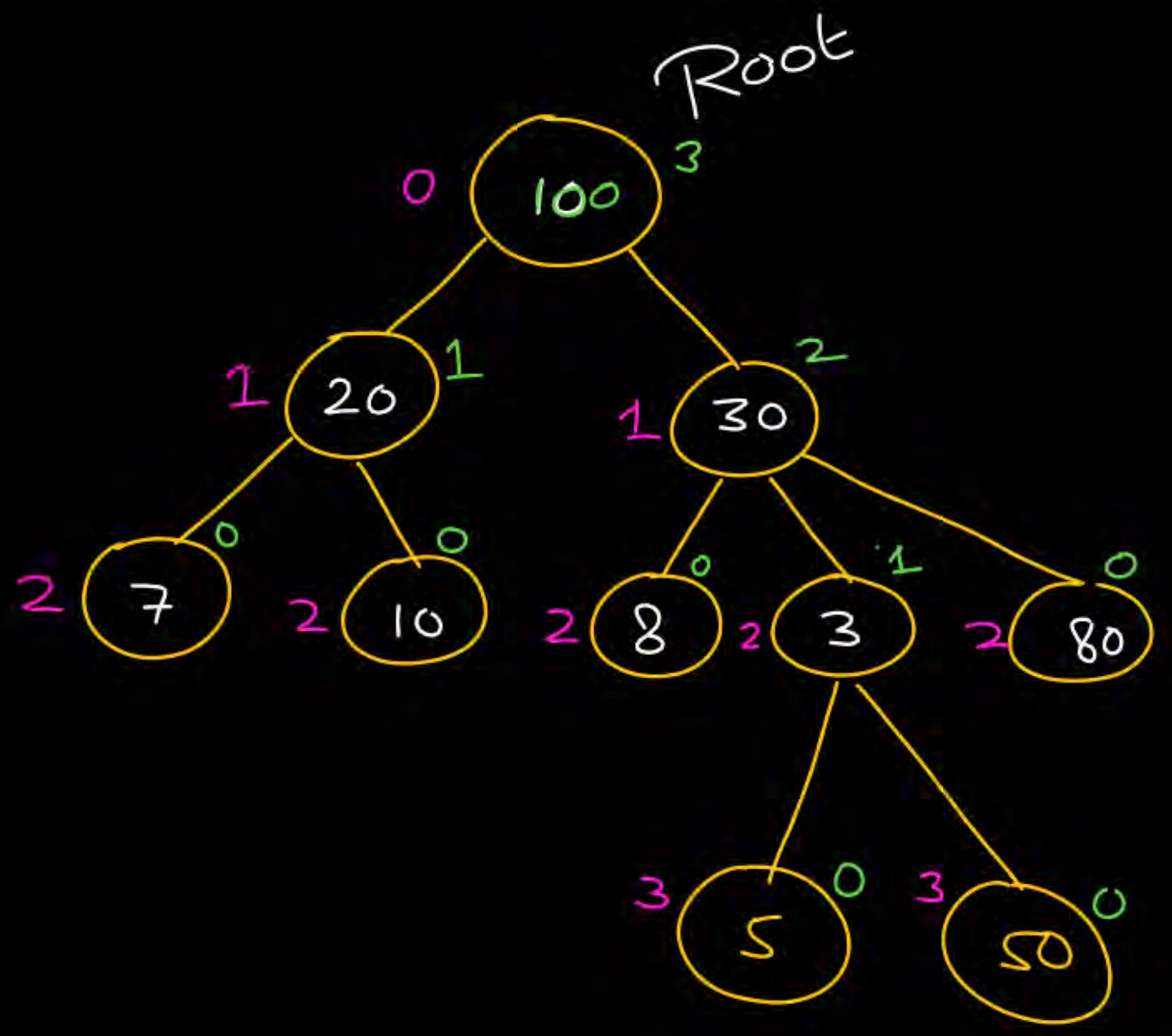
9.] Level/Depth of a Node :

Level of a node X is the length of path from root node to node X.



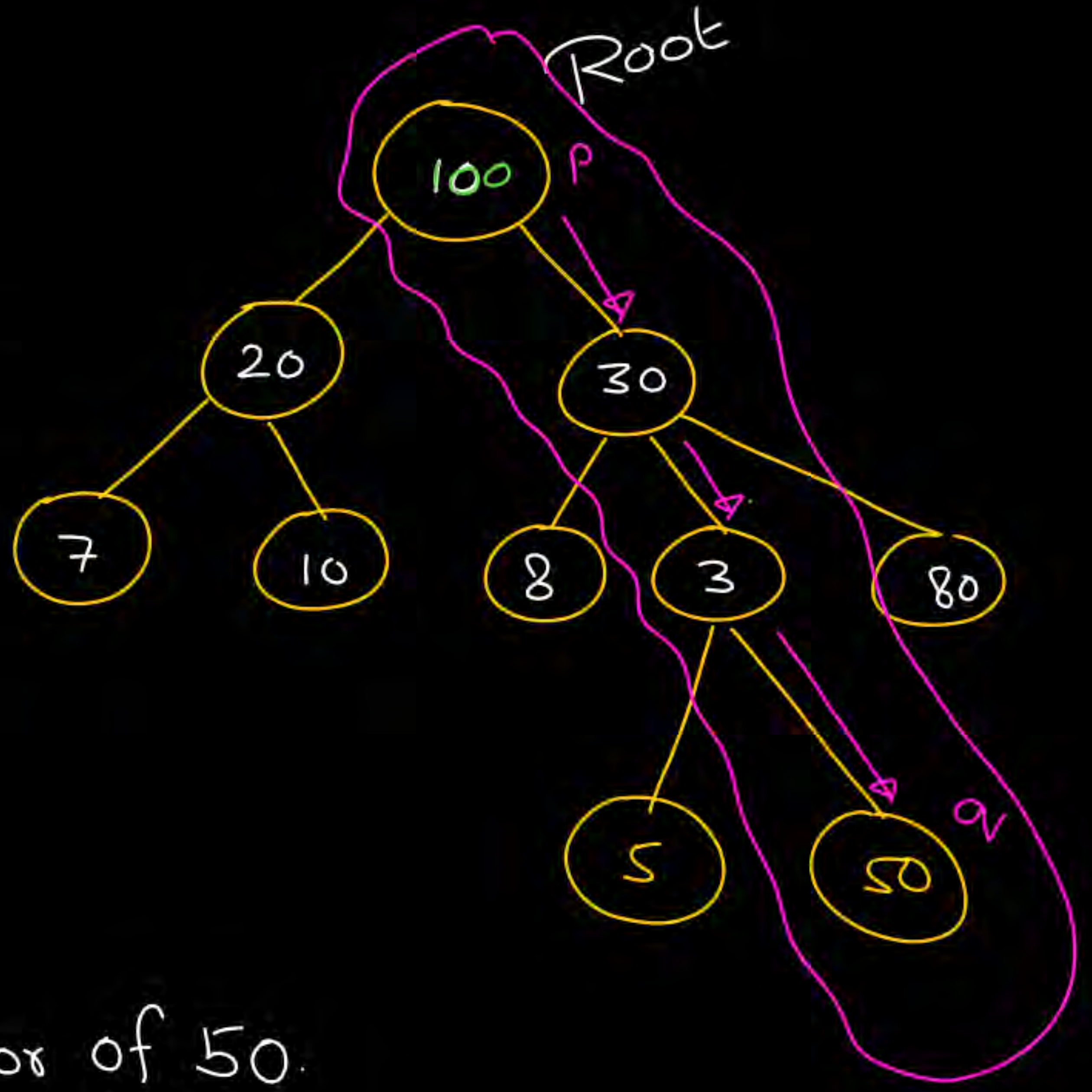
Level of root node = 0




Root
100
0
3
20
1
1
30
1
2
7
2
0
10
2
0
8
2
0
3
2
1
80
2
0
5
3
0
50
3
0

10) Ancestor of a node :

If there is a path from node p to node q, then all the nodes in the path other than q are called as ancestor of q.



3, 30 and 100 are ancestor of 50.

10) Ancestor of a node :

If there is a path from node p to node q, then all the nodes in the path other than q are called as ancestor of q.

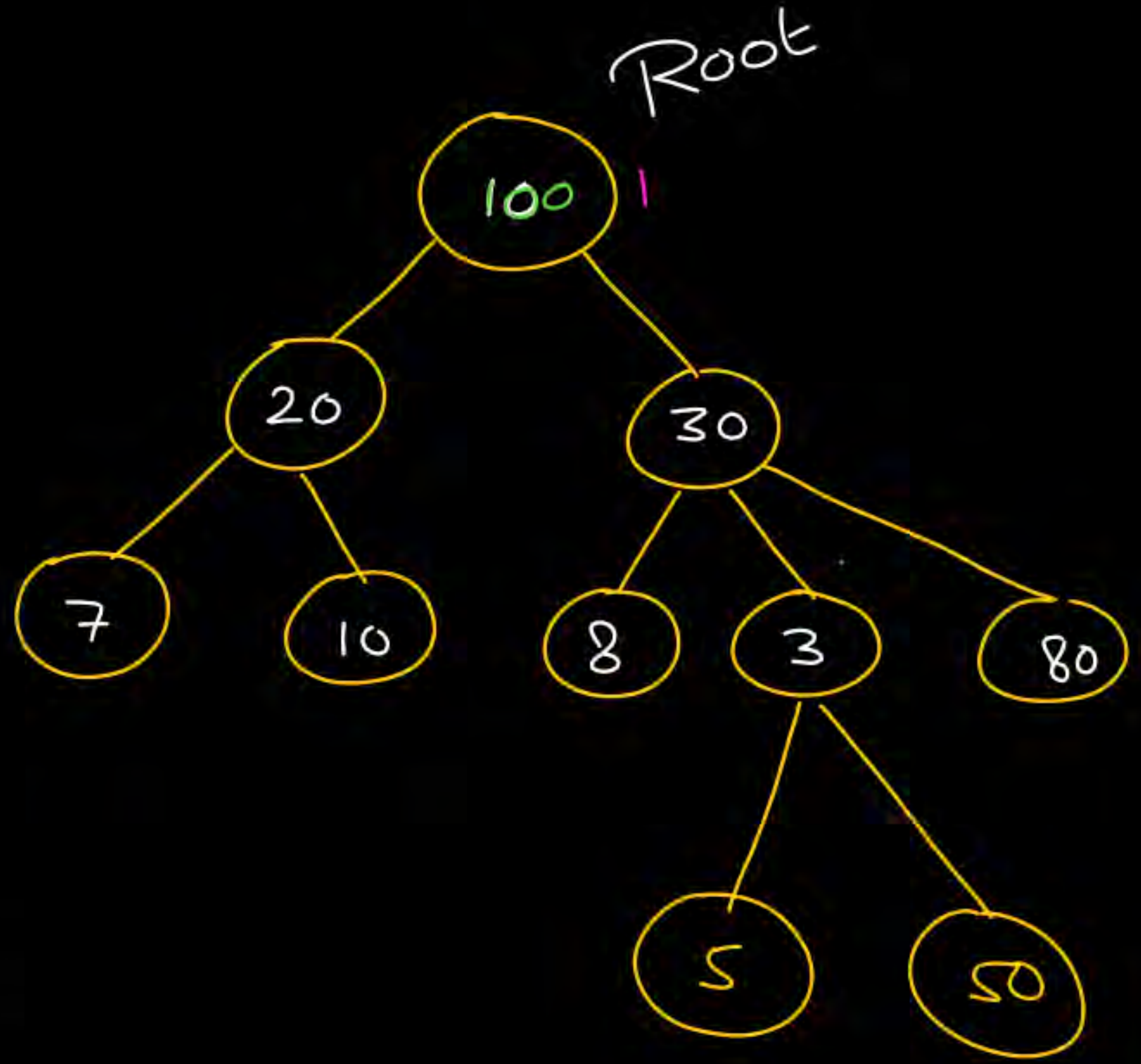
3, 30 and 100 are ancestor of 50.

OR

(i) Parent of a node is an ancestor.

and

(ii) Parent of some ancestor is also an ancestor



5 ⇒ direct Parent 3

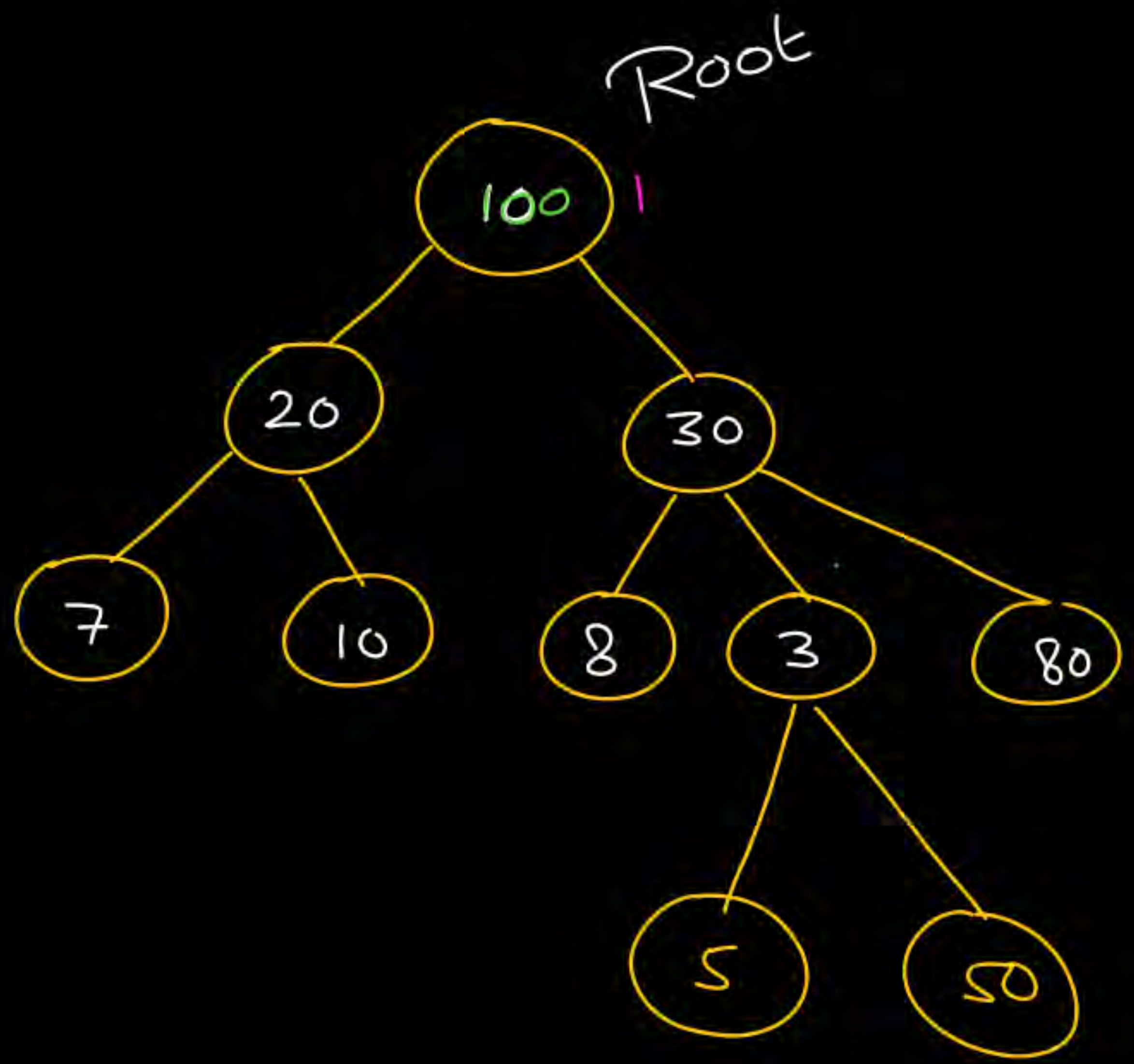
30 is the parent of 3

⇒ 30 is also ancestor of 5

⇒ Parent of 30 is also an ancestor.

10) Ancestor of a node :

100	—	None
20	—	100
30	—	100
7	—	20, 100
10	—	20, 100
8	—	30, 100
3	—	30, 100
80	—	30, 100
5	—	3, 30, 100
50	—	3, 30, 100



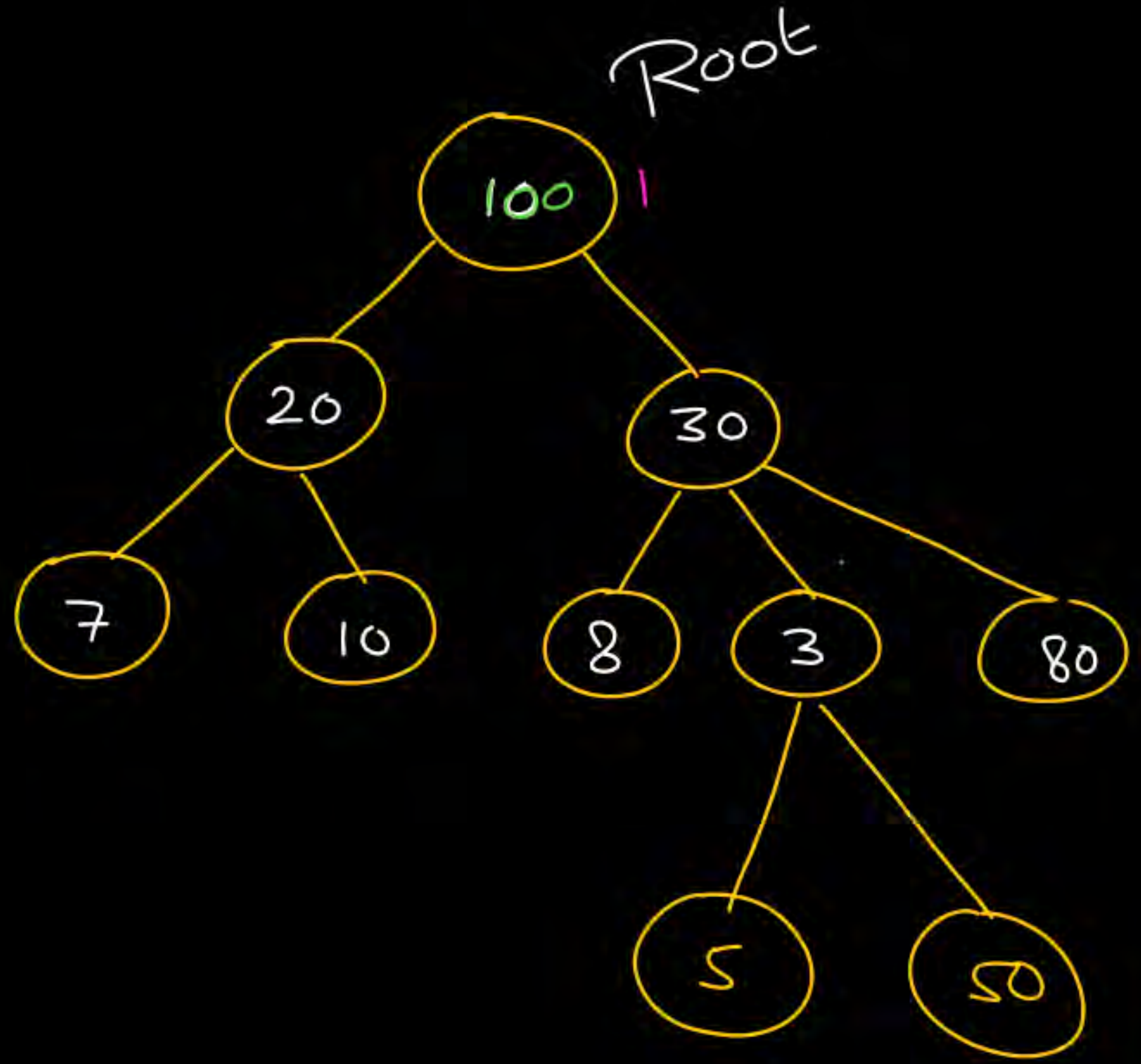
10) descendent of a node :

Ancestor

7 → 20, 100

7 is a descendent for 20

7 " " " 100



11.) Sibling : Nodes with same Parent

7, 10 are sibling

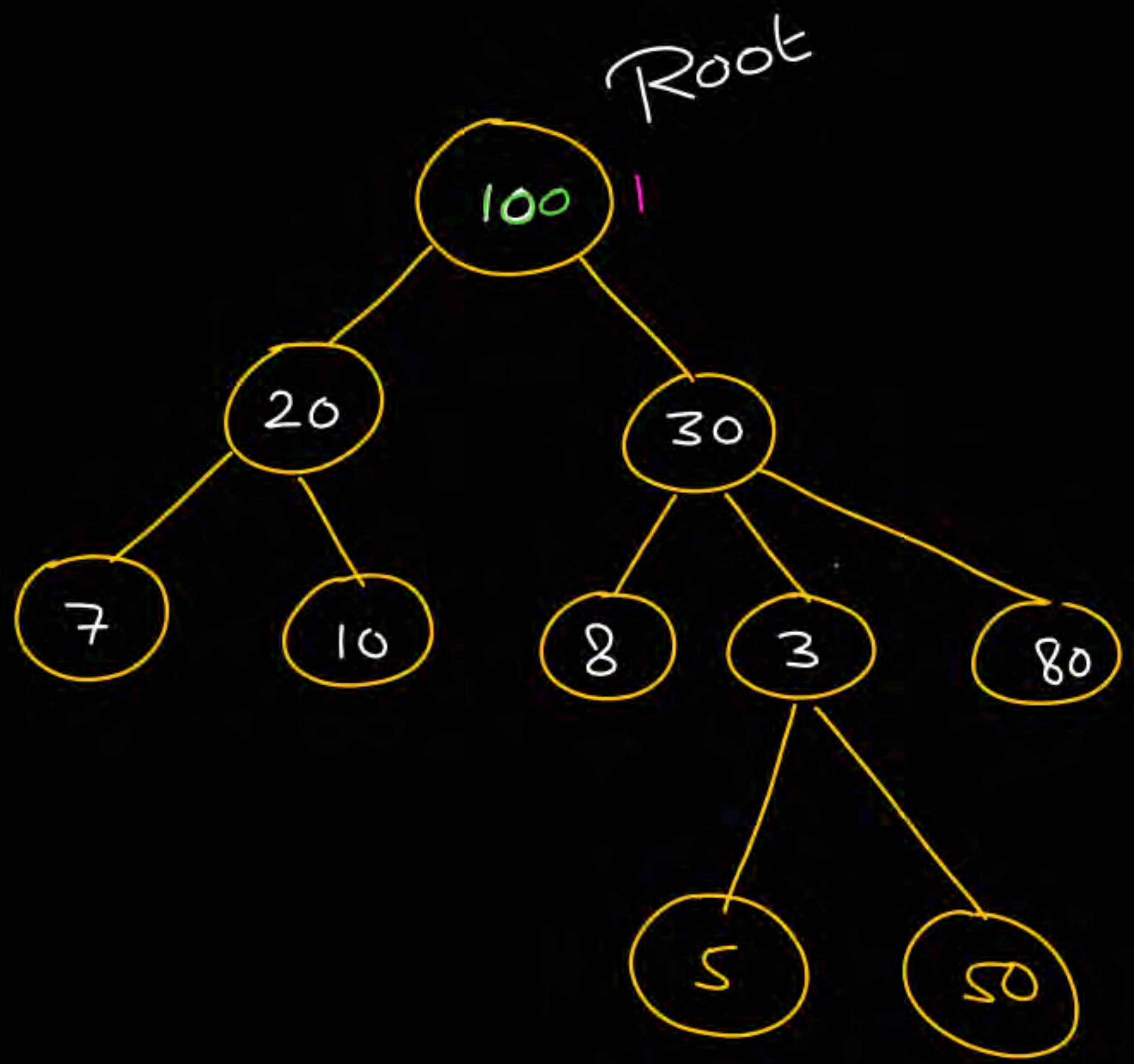
8, 3, 80 are siblings.

20, 30 are siblings.

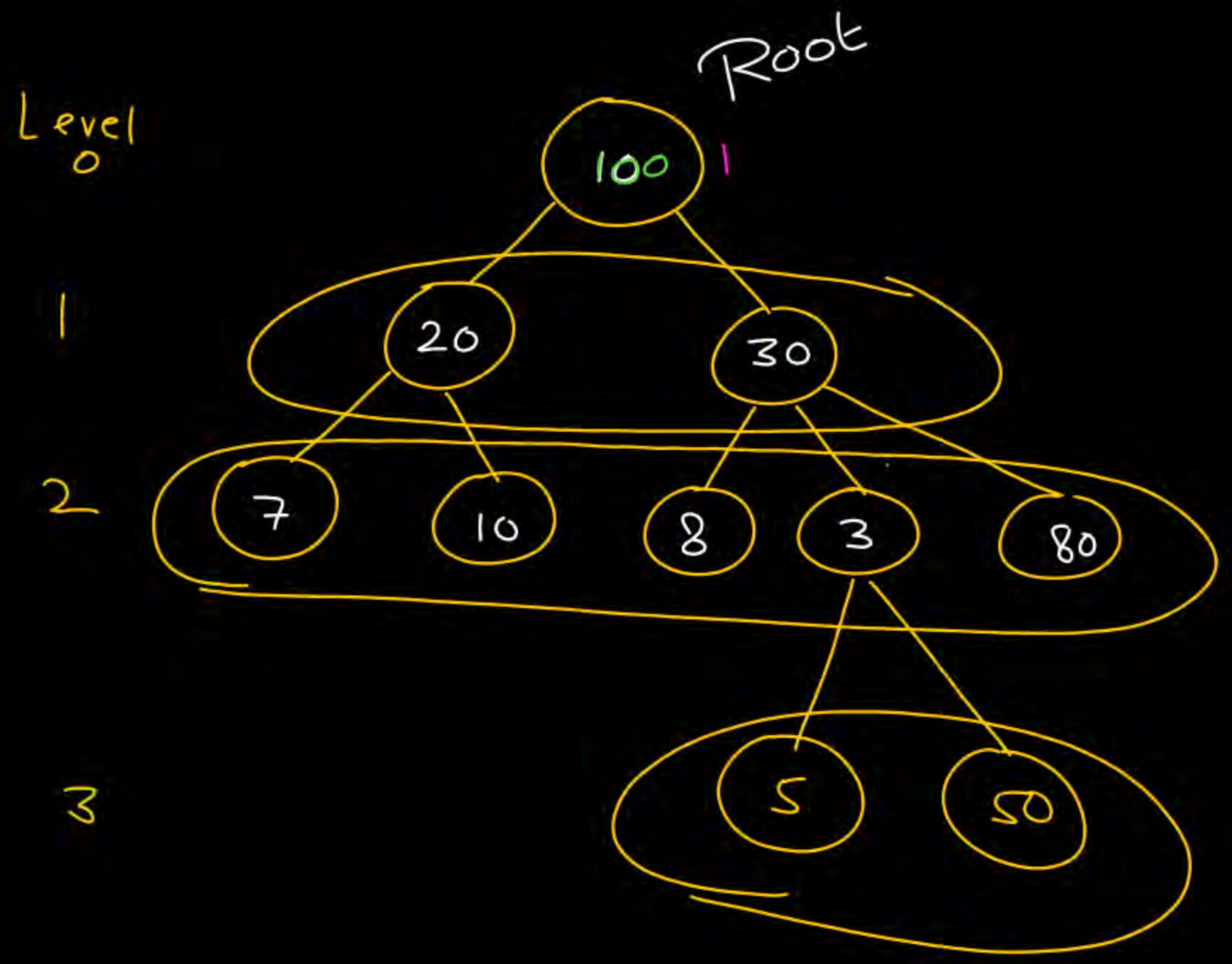
5, 50 sibling

10, 8 → ~~sibling~~

Root Node can not have a sibling

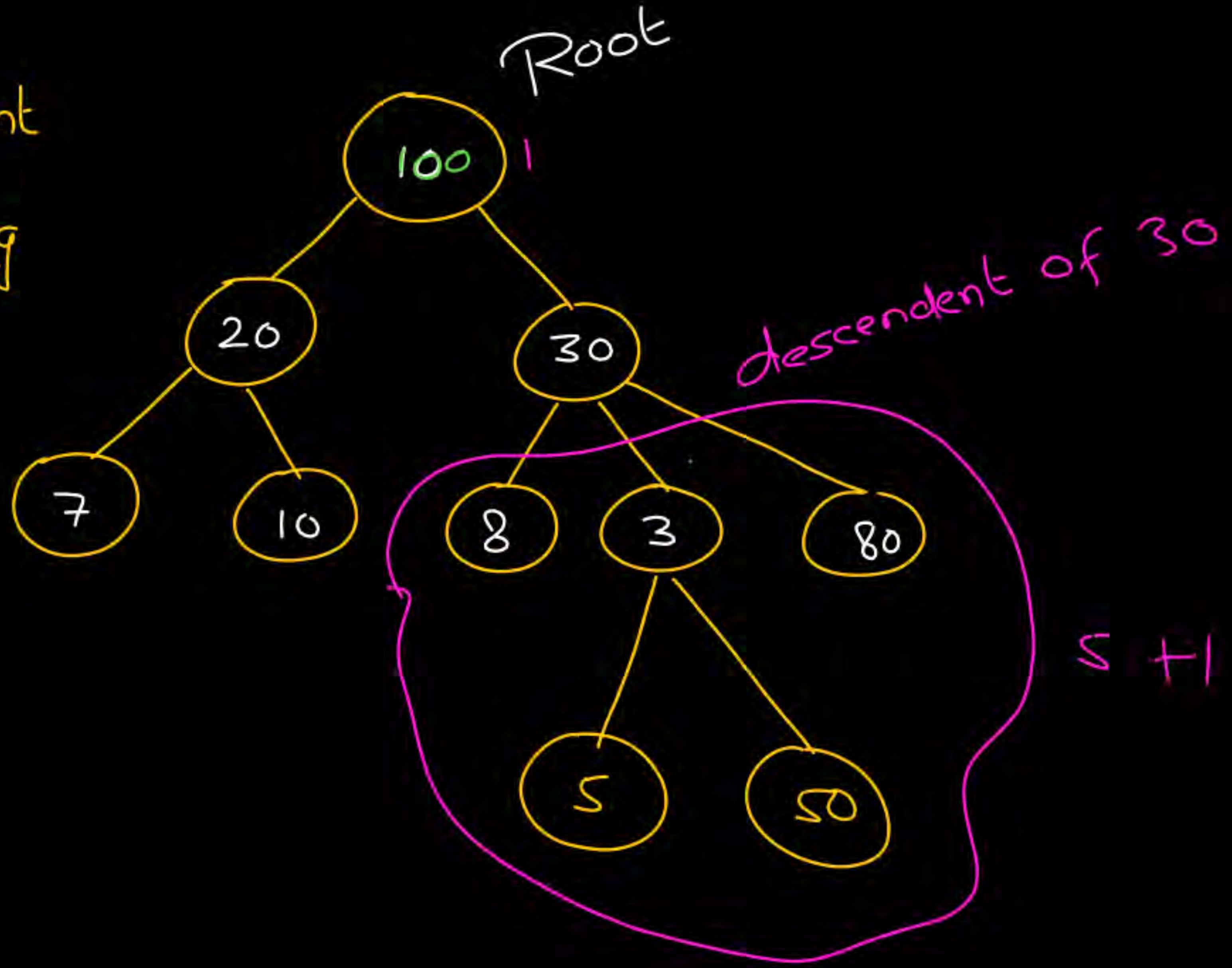


12. Generation : All Nodes at a particular level belongs to same generation.



13. **Size of a node**: The no. of descendent of a node (including the node itself) is called as size of the node.

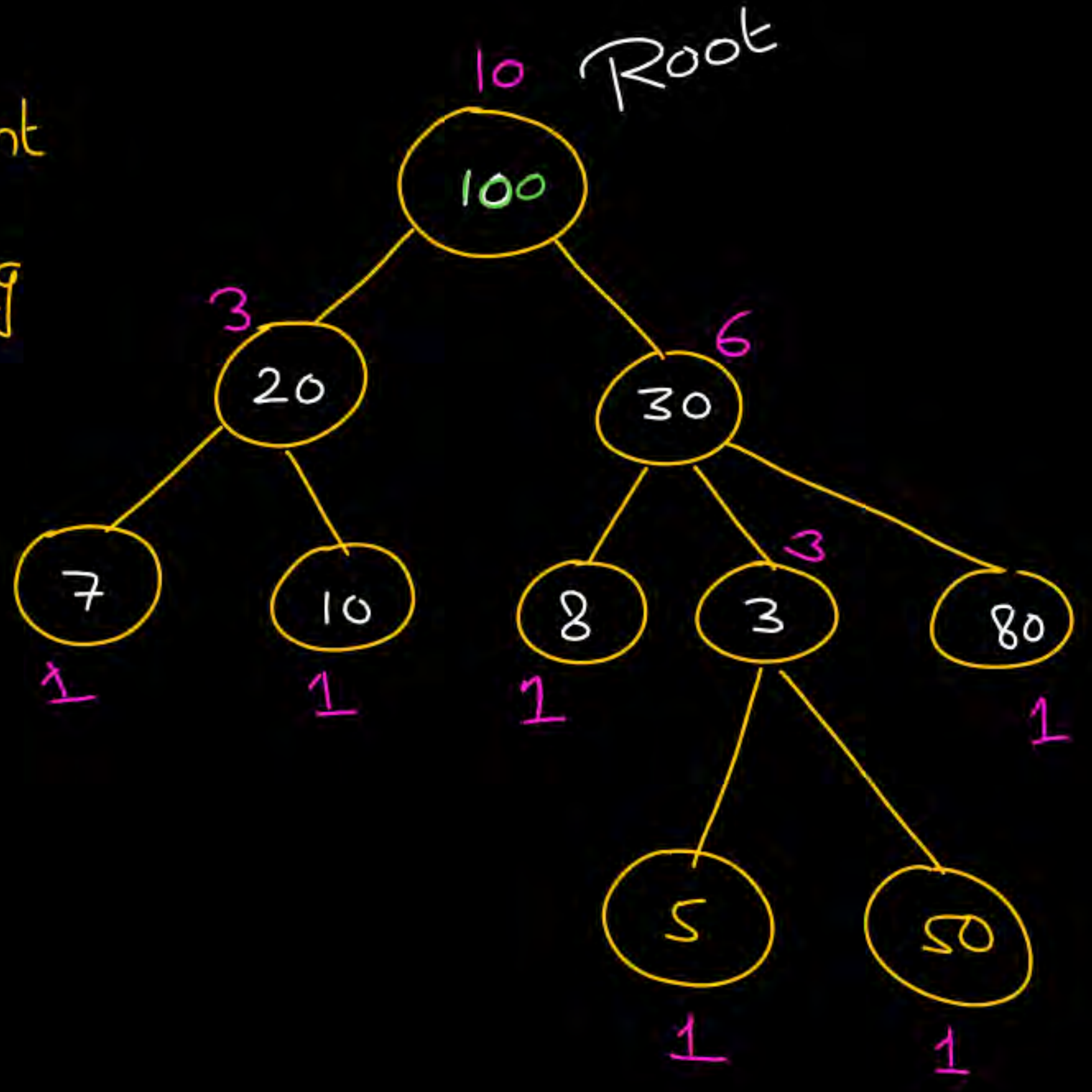
Size of node 30 ⇒ 6



13. **Size of a node** : The no. of descendent of a node (including the node itself) is called as size of the node.

Size of node 30 ⇒ 6

Size of leaf node ⇒ 1



Binary tree

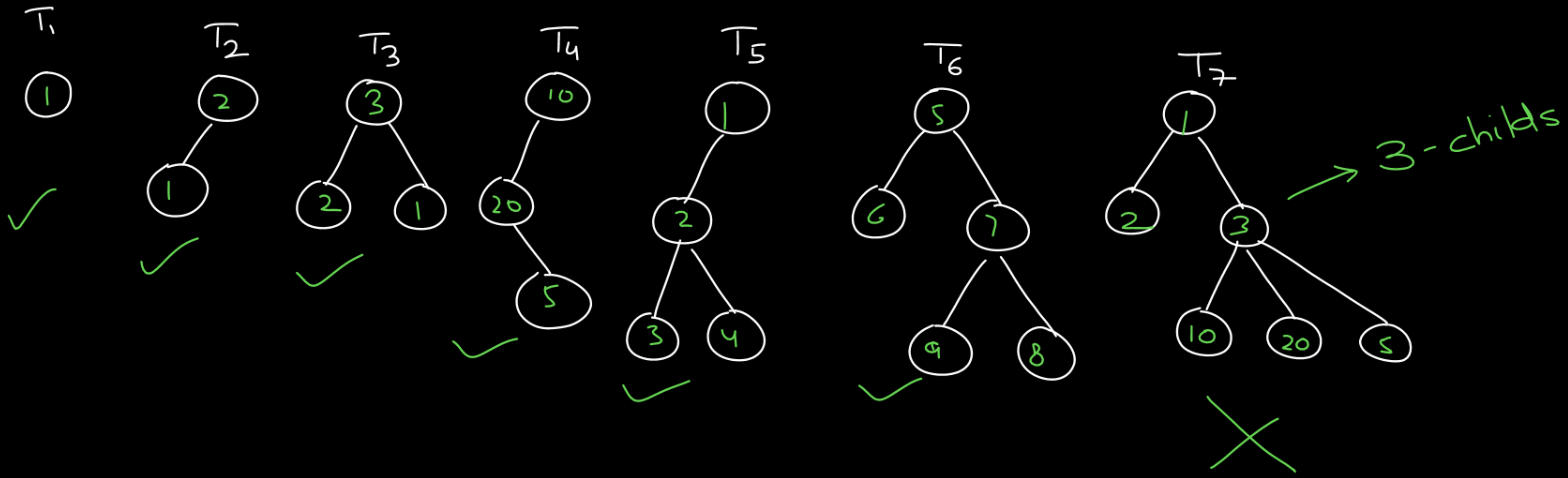
Every node can have atmost 2-child.

Node can have ⇒ 0 – child (leaf node)

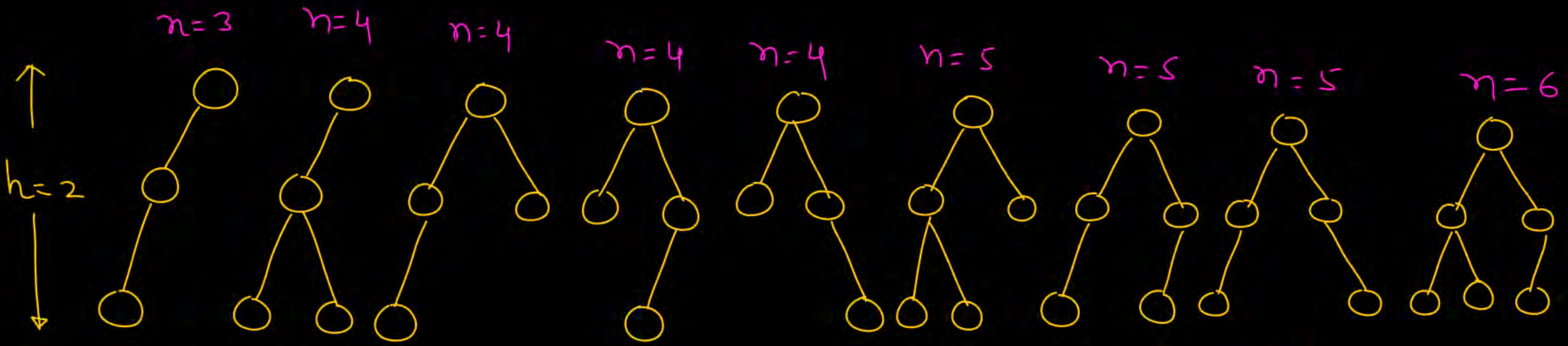
1 – child

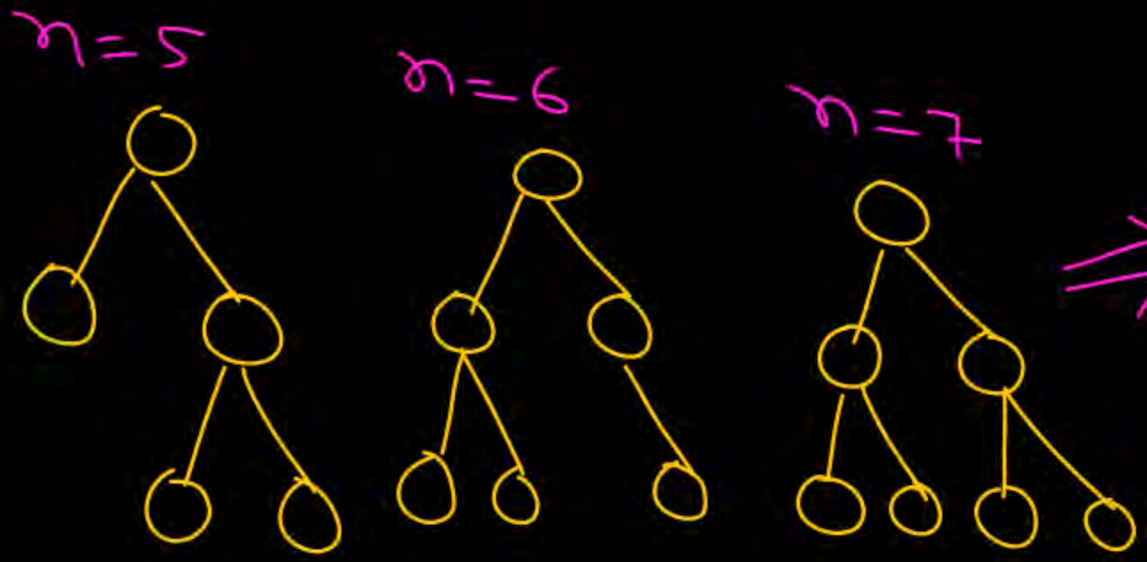
2 - child

[Internal node]


T1
1
✓
T2
2
1
✓
T3
3
2
1
✓
T4
10
20
5
✓
T5
1
2
3
4
✓
T6
5
6
7
9
8
✓
T7
1
2
3
10
20
5
3-childs
✗

No. of nodes

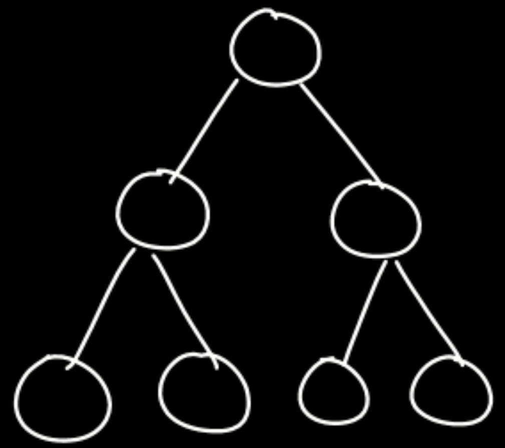




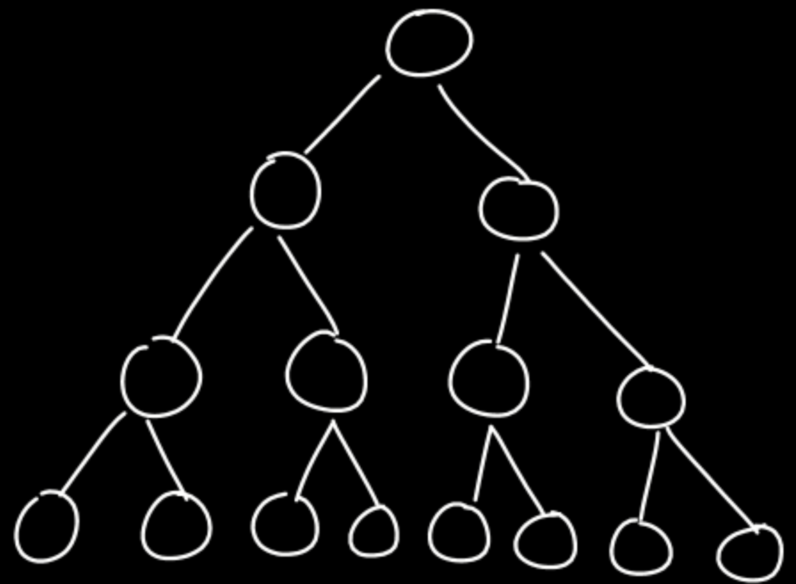
⇒ FBT (Full Binary Tree)

What is the max. no. of nodes possible in a binary tree of height h ?

h = 2



Level	# of node
0	2^0
1	2^1
2	2^2
	7

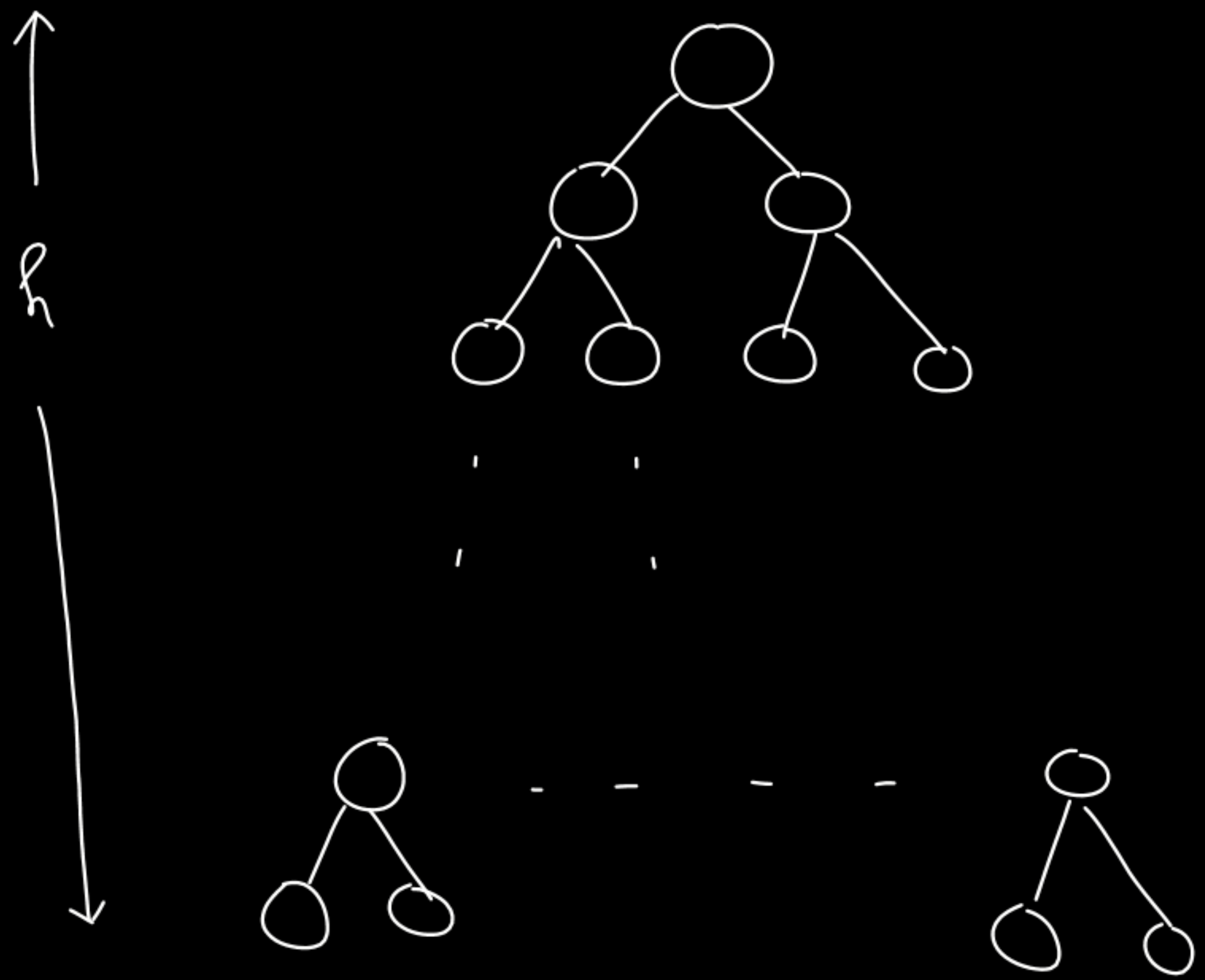


Level	# nodes
0	2^0
1	2^1
2	2^2
3	2^3

$$\# \text{nodes} = 2^0 + 2^1 + 2^2 + 2^3 \quad (\text{G.P})$$

$$= \frac{2^4 - 1}{2 - 1} = 2^4 - 1$$

$$= \boxed{15}$$



Level	Nodes
0	2^0
1	2^1
2	2^2
⋮	⋮
h-1	2^{h-1}
h	2^h

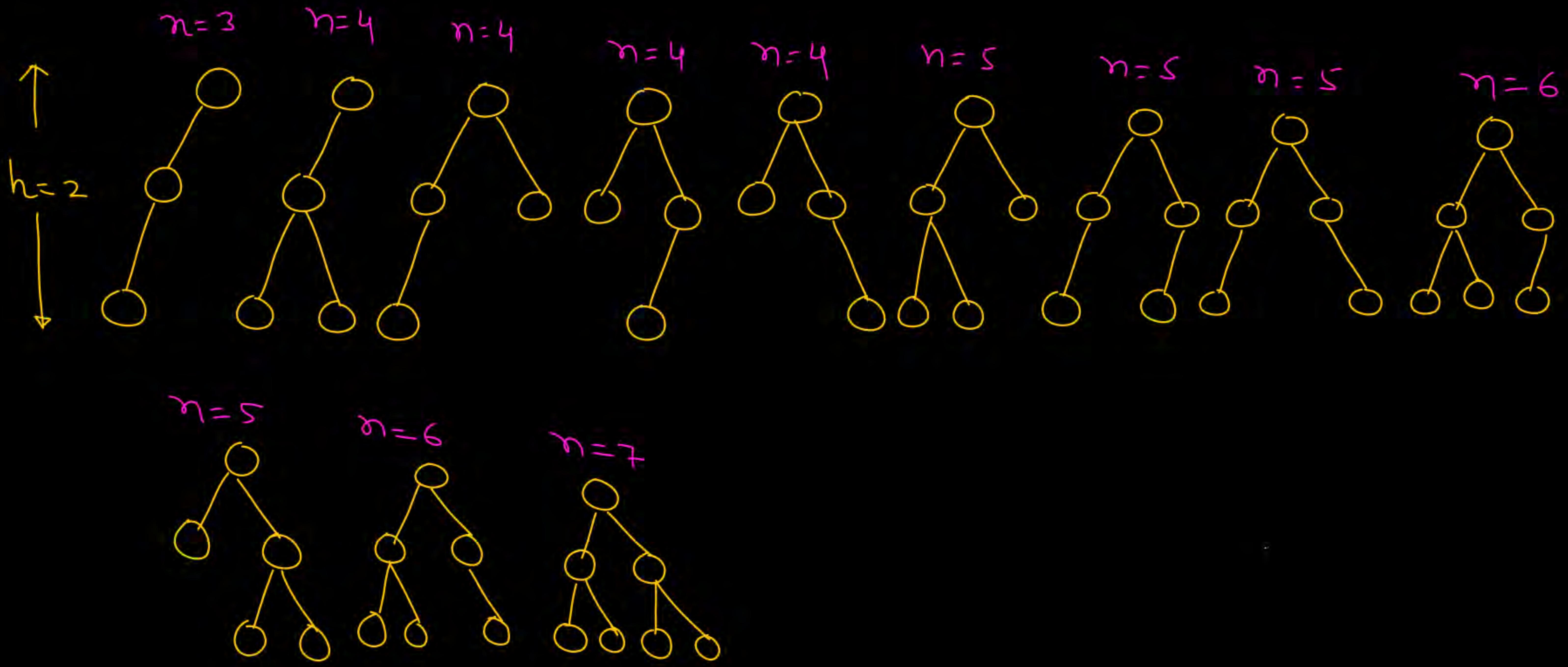
$$\text{Total} = 2^0 + 2^1 + 2^2 + \cdots + 2^h$$

$$= 1 + 2^1 + 2^2 + \cdots + 2^h$$

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

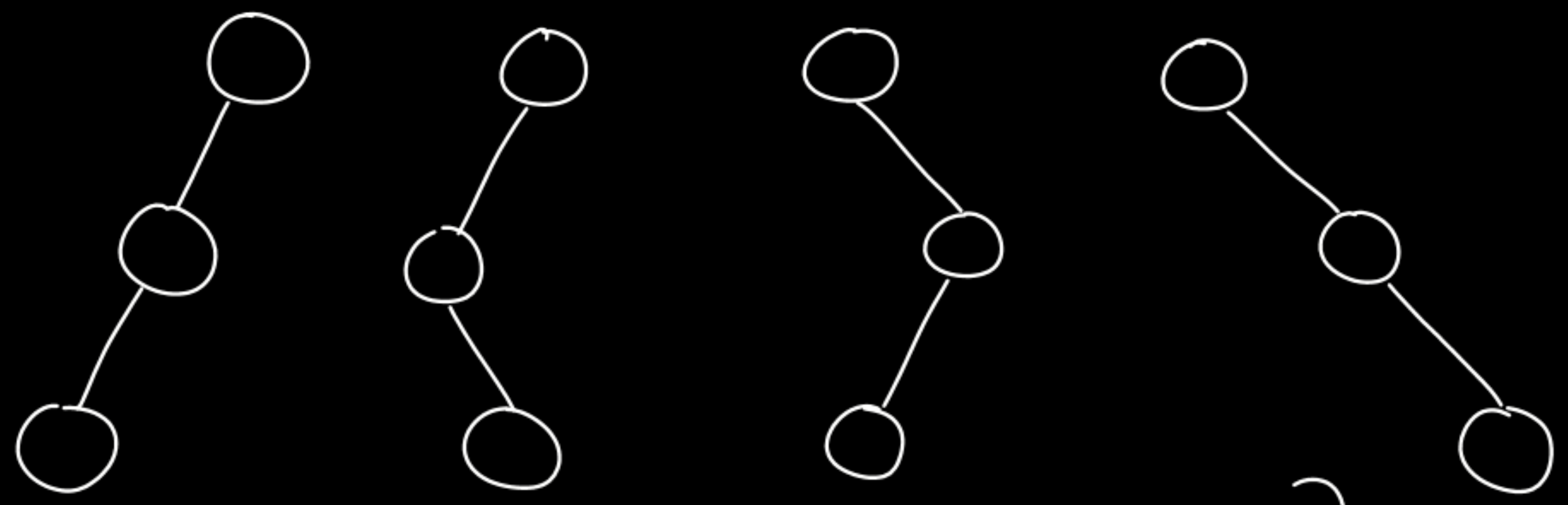
$$\boxed{n_{max} = 2^{h+1} - 1}$$

No. of nodes



What is the min. no. of nodes in a binary tree of height h ?

$h = 2$



$$\boxed{n_{min} = h+1}$$

gmp → D.S
→ Gate

PYQ → more than 80

Doubt ?

logic →
- → with time
- →

CP

→ Prog lang

C++ Java

STL Collections

C, DS, Algo — Min 18

18-22 marks

1st year / 2nd year] standard Text books

→ 10 subjects

Sem

C, Maths ✓

$\boxed{6-7}$

College

→ bus/ ✓

→ Young

24 Hrs

5 AM → 1 hr

Whatsapp X

↳ 1 hr

Job

Sat
Sun ⇒ 10 hrs × 2 = 20 hrs

weekdays ⇒ 2 hrs

30 hrs

```
int a ;
```

```
scanf("%d", &a);
```

```
cin>>a ;
```

THANK YOU GW SOLDIERS !