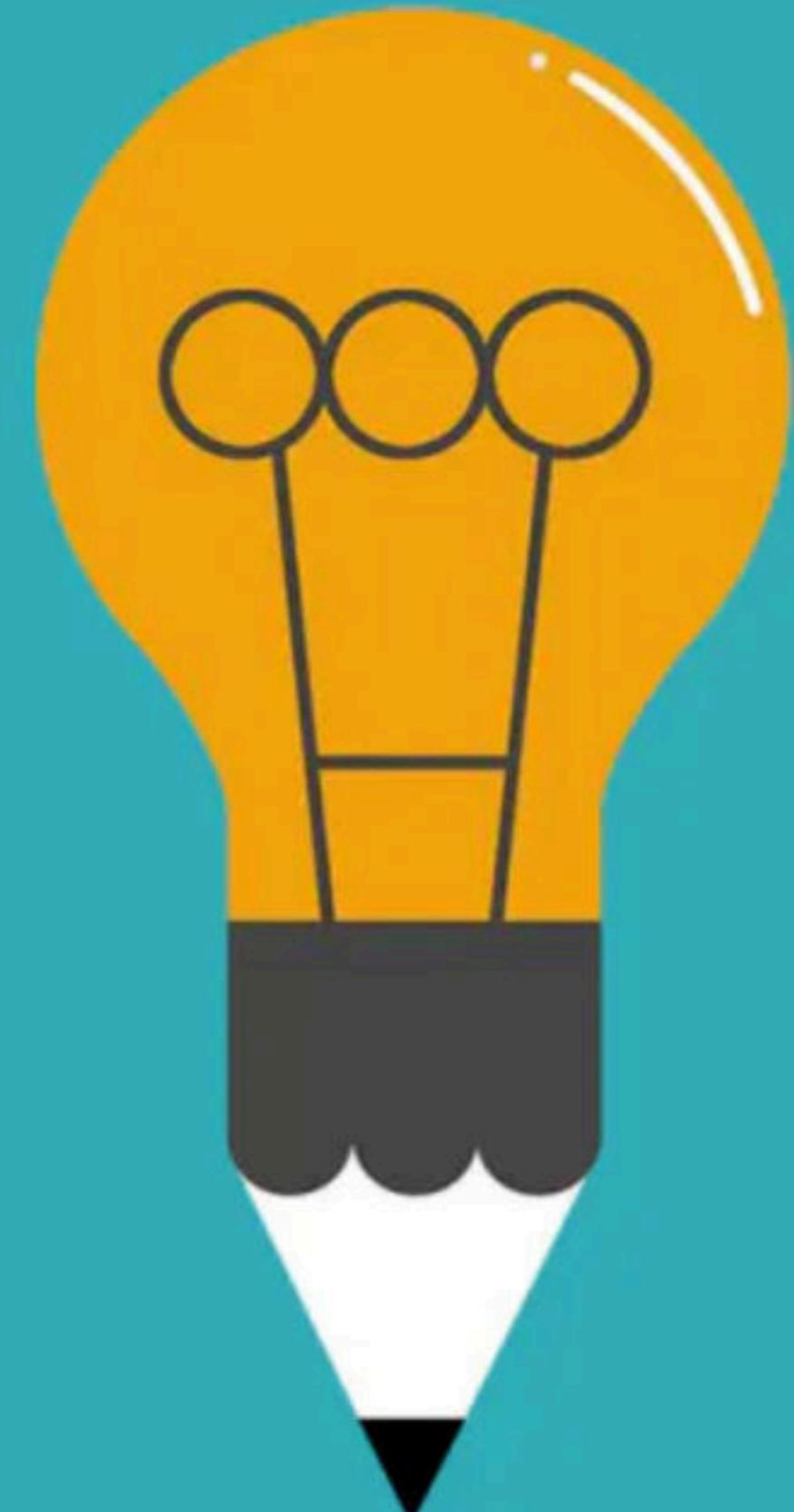
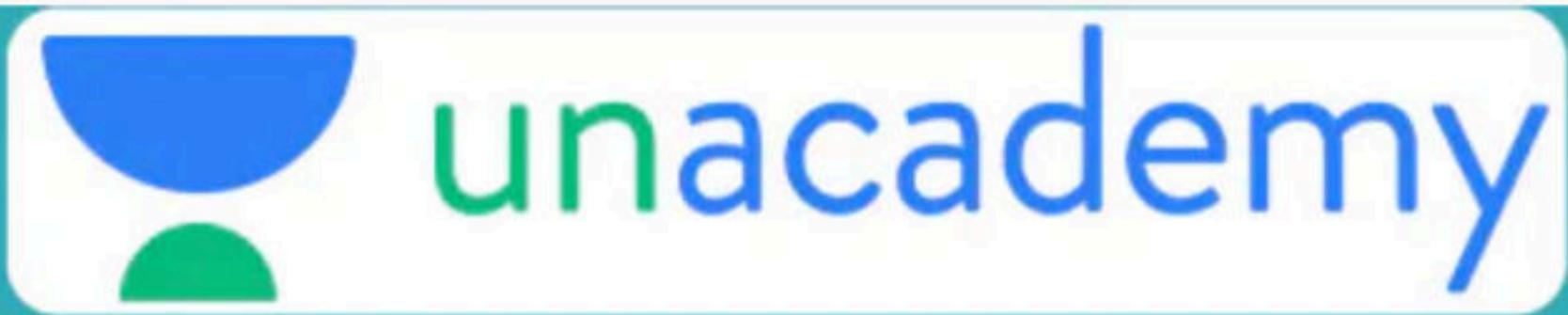




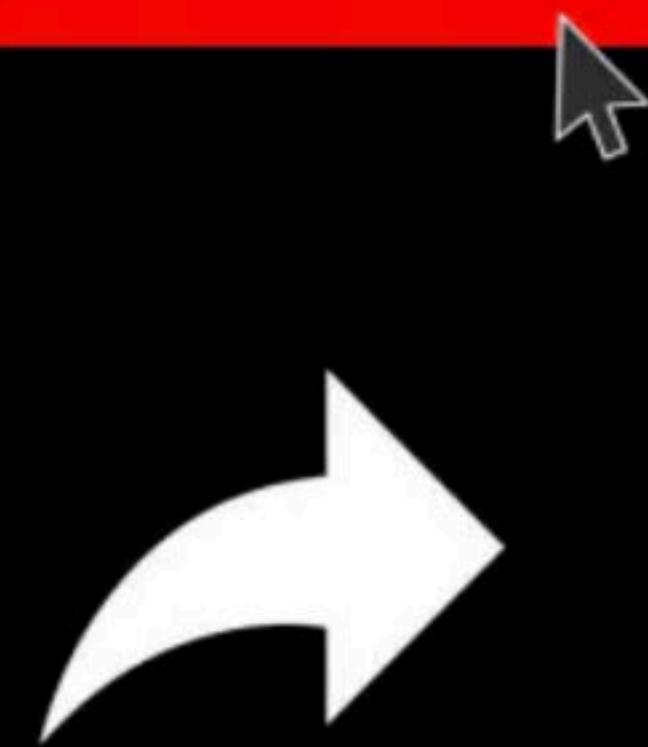
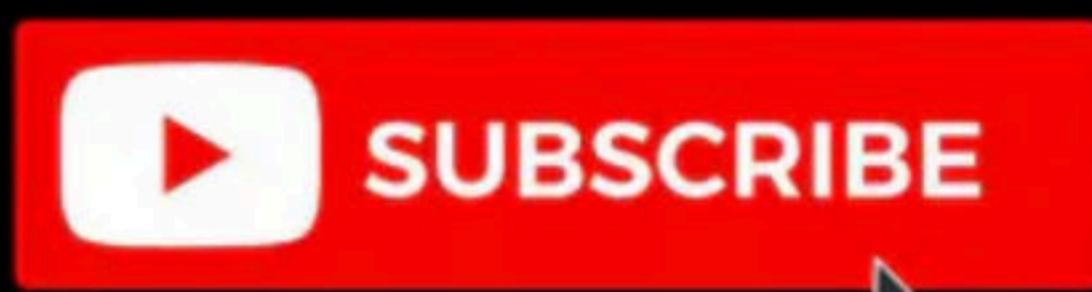
Special class on

Zero to Hero - Tree Part 2



By: Vishvadeep Gothi

Use Code: **VDEEPLIVE**



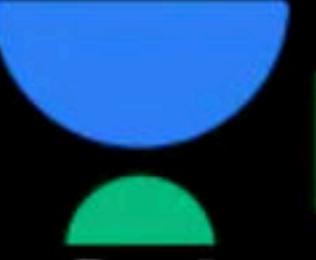
Tree

Use Code

VDEEPLIVE

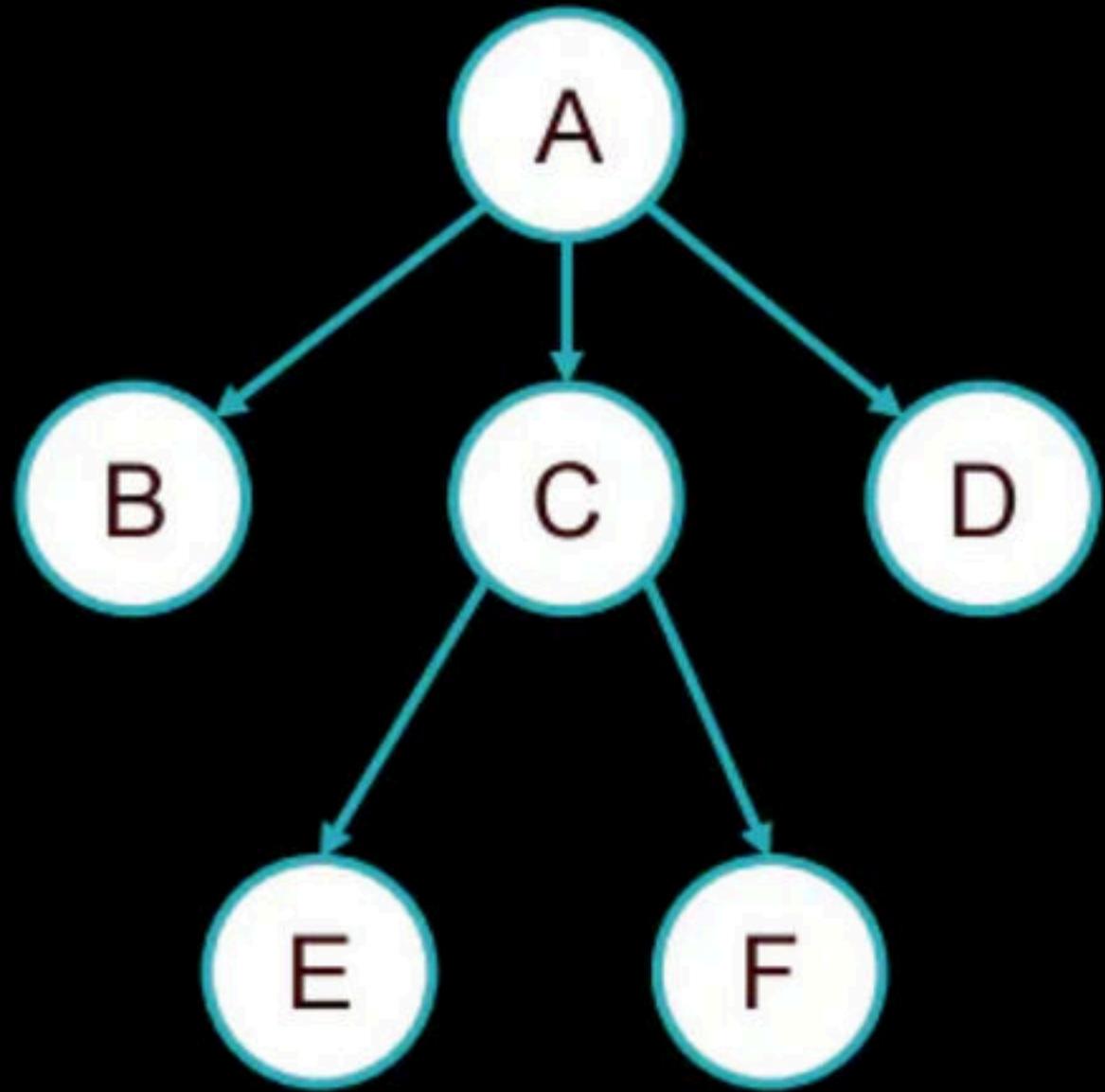
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Tree: Basic Terms

- Root:
- B, C and D are A's:
- A is B, C and D's:
- B, C and D are each others:
- Internal Nodes:
- External Nodes (Leaf nodes):
- Levels



Use Code

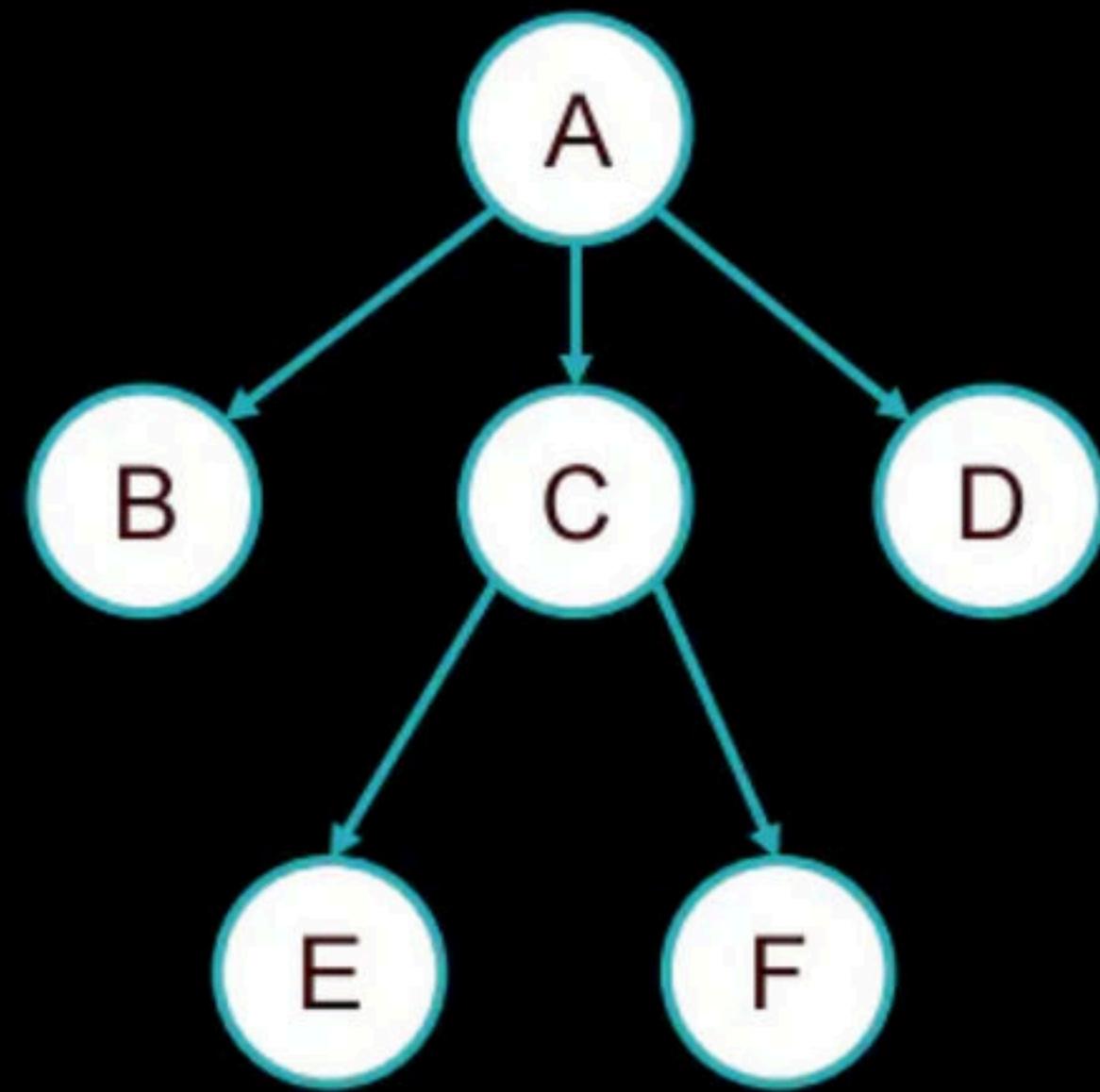
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Implementation of Tree

- Parenthesis Representation:



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Practice Question

- Construct the tree:
a (b, c, d (e (f, g, h), i), j)

Use Code

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Binary Tree

Use Code

VDEEPLIVE

TO GET

MAX DISCOUNT on



Implementation of Binary Tree

- Linked Representation:

Use Code

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Implementation of Binary Tree

```
struct BTnode  
{  
    char data;  
    struct Btnode *Lchild;  
    struct Btnode *Rchild;  
}
```

Use Code

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Question GATE-2000

Consider the following nested representation of binary trees: (X Y Z) indicates Y and Z are the left and right sub stress, respectively, of node X. Note that Y and Z may be NULL, or further nested. Which of the following represents a valid binary tree?

- (A) (1 2 (4 5 6 7))
- (B) (1 (2 3 4) 5 6) 7)
- (C) (1 (2 3 4)(5 6 7))
- (D) (1 (2 3 NULL) (4 5))

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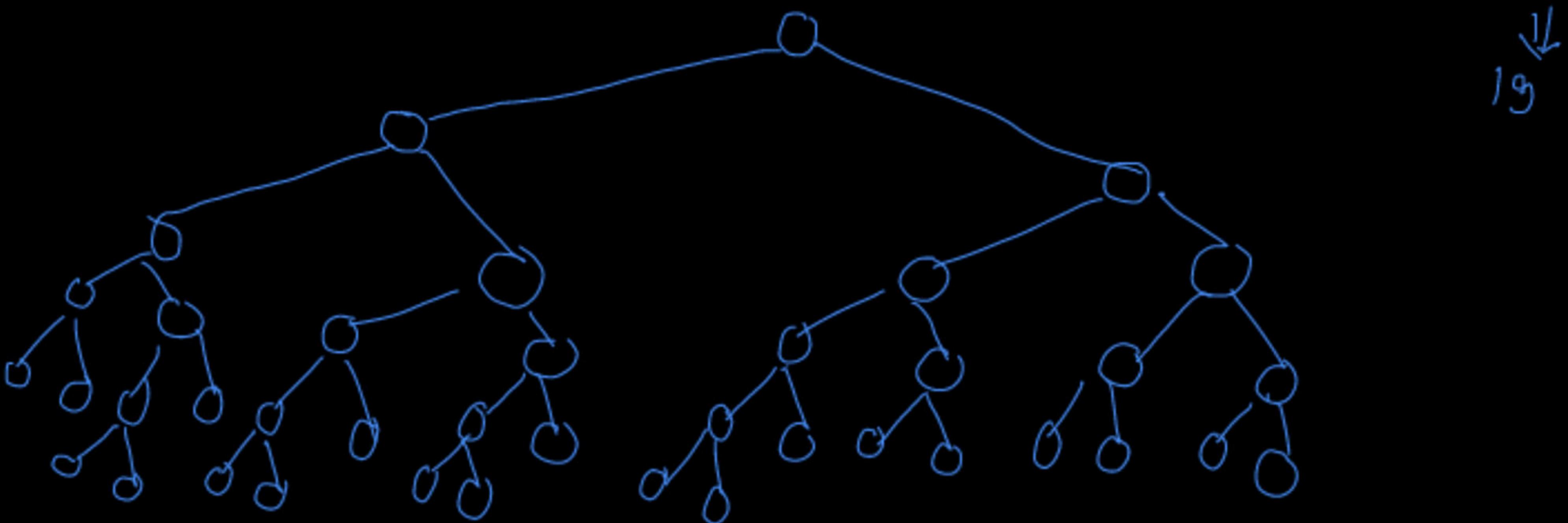
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Question GATE-2015

A binary tree T has 20 leaves. The number of nodes in T having two children is ____?



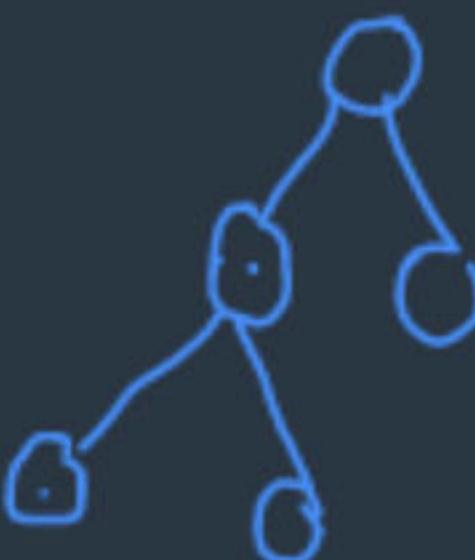
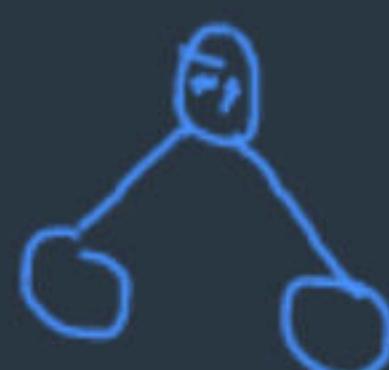
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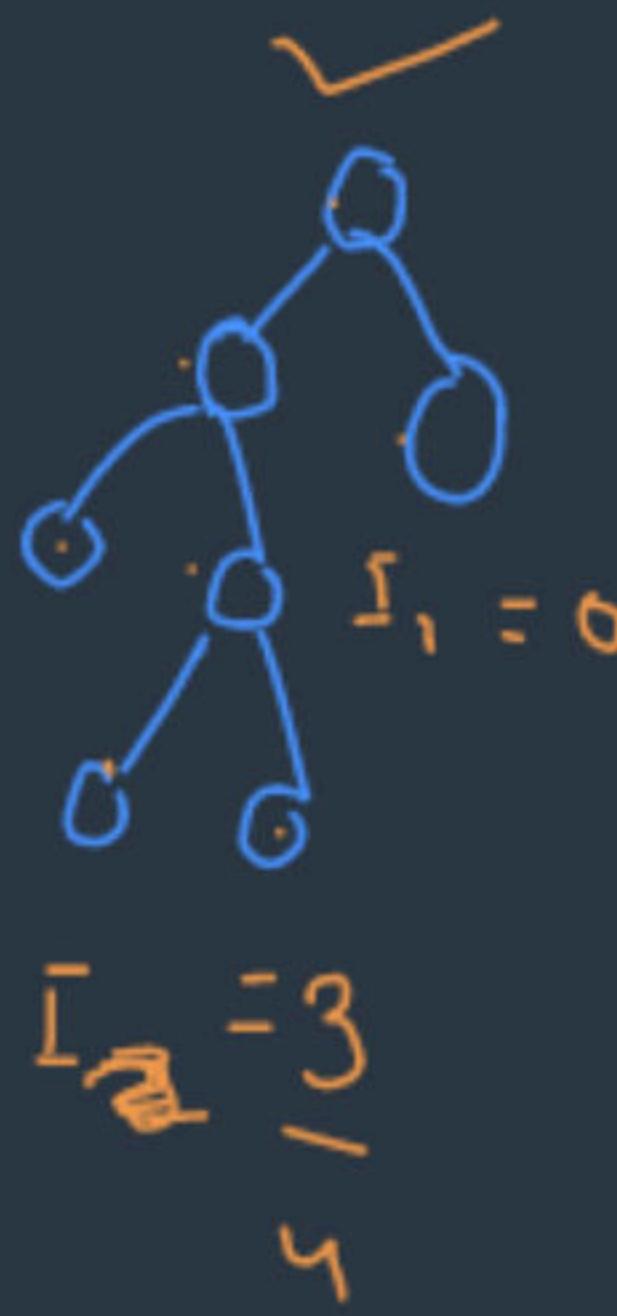
TO GET
MAX DISCOUNT on



0



$$L = I_2 + 1$$



$$I_2 = 3$$

$$I_1 = 0$$



$$I_2 = 3$$

$$I_1 = 0$$

I_2	0	1	2	3	...	19
L	1	2	3	4	...	20

I_2 = nodes with 2 children
 L = Leaf node

Question GATE-2015

A binary tree T has 200 leaves. The number of nodes in T having two children is ____?

$$L = I_2 + 1$$

$$200 = I_2 + 1$$

$$I_2 = 199$$

Use Code

VDEEPLIVE

TO GET

MAX DISCOUNT on



Question GATE-2006

In a binary tree, the number of internal nodes of degree 1 is 5 and the number of internal nodes with degree 2 is 10. The total number of nodes in the binary tree is?

Degree \Rightarrow outdegree \Rightarrow child

$$\left\{ \begin{array}{l} I_1 = 5 \\ I_2 = 10 \end{array} \right\} \xrightarrow{15}$$
$$\text{Leaf nodes} = I_2 + 1$$
$$= 10 + 1$$
$$= 11$$
$$N = I + L$$
$$= 15 + 11$$
$$= 26$$

Use Code

VDEEPLIVE

TO GET
MAX DISCOUNT on



$$I = I_1 + I_2$$

$$\underline{L = I_2 + 1}$$

$$N = I + L$$

$$= I_1 + I_2 + I_2 + 1$$

$$N = I_1 + 2I_2 + 1$$

$$= 5 + 2 * 10 + 1 = 26$$

I = total internal nodes

I_1 = internal nodes with 1 child

I_2 = " " " 2 "

L = leaf nodes

N = total no. of nodes

Question GATE-2005

In a complete k-ary tree, every internal node has exactly k children. The number of leaves in such a tree with n internal nodes is:

- (A) nk
- (B) $(n - 1)k + 1$
- (C) $n(k - 1) + 1$
- (D) $n(k - 1)$

$$k = 2$$

$$L = h + 1$$

Use Code

VDEEPLIVE

TO GET

MAX DISCOUNT on



$k = 3$

$\frac{h}{k}$



$$\frac{n * 2^h + 1}{k}$$

\leq

$$h * (k - 1) + 1$$

I	0	1	2	3		
L	-1	-3	-5	-7

Question GATE-2002

The number of leaf nodes in a rooted tree of n nodes, with each node having 0 or 3 children is?

- (A) $n/2$
- (B) $(n - 1) / 3$
- (C) $(n - 1) / 2$
- (D) $(2n + 1) / 3$

$$L : 2I + 1 \Rightarrow I = \frac{L-1}{2}$$
$$h = L + \frac{I}{2}$$
$$n = L + \frac{L-1}{2} \Rightarrow n = \frac{3L-1}{2} \Rightarrow \boxed{L = \frac{2h+1}{3}}$$

Use Code

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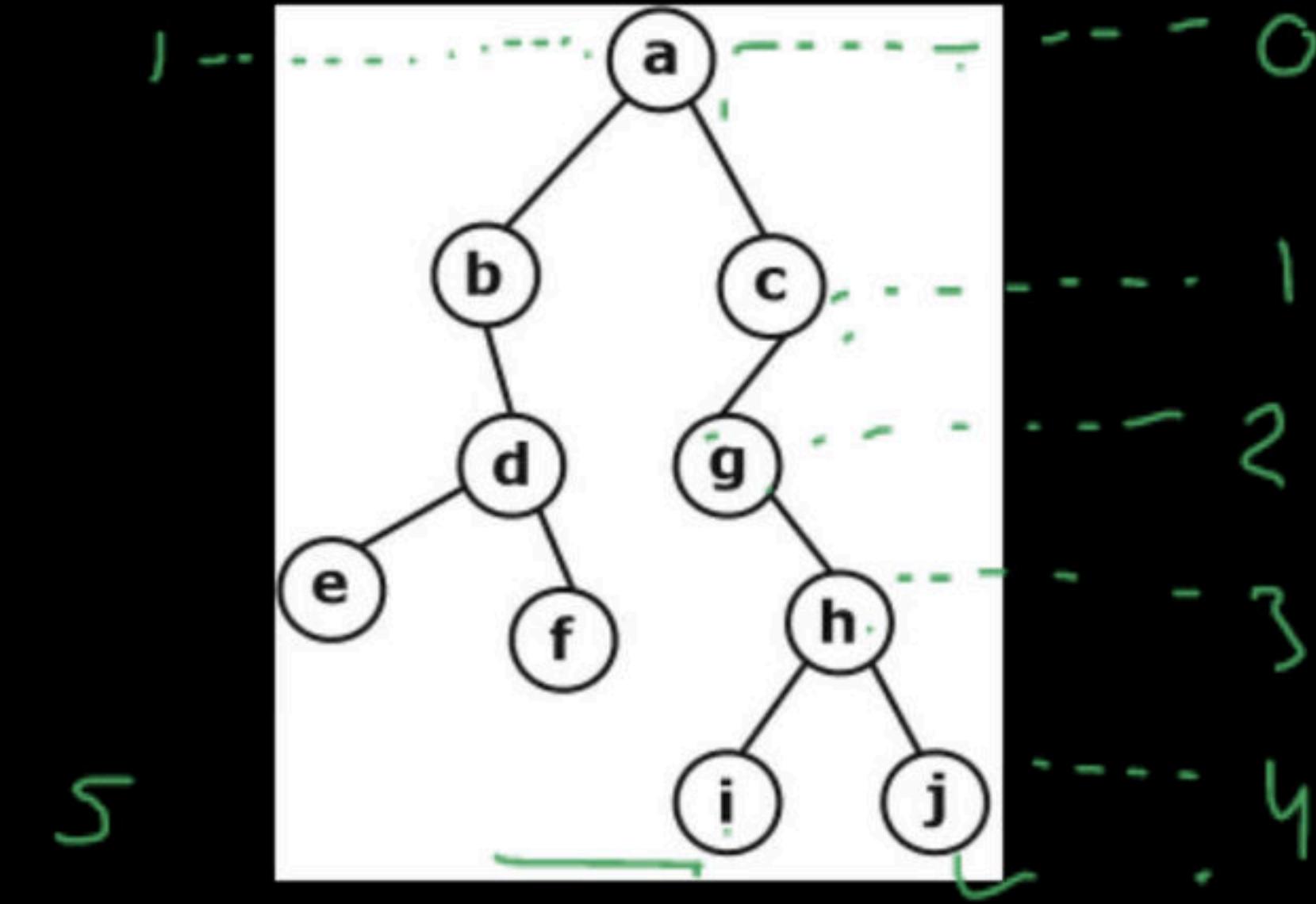
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Height of Tree

(a)



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TO GET
MAX DISCOUNT on



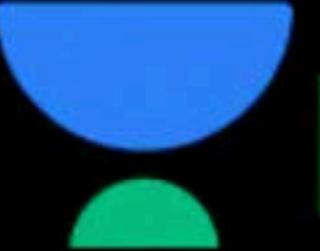
Height of Tree

No	Definition 1	Definition 2
1.	Height(tree) = max level no.	Height(tree) = max level no.+1
2.		
3.		
4.		

Use Code

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TO GET
MAX DISCOUNT on

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Height of Tree

No	Definition 1	Definition 2
1.	Height(tree) = max level no.	Height(tree) = max level no.+1
2.	Height(tree) with 1 node = 0 ↗ 4	Height(tree) with 1 node = 1 ↗ 5
3.		
4.		

Use Code

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TO GET
MAX DISCOUNT on

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Height of Tree

No	Definition 1	Definition 2
1.	Height(tree) = max level no.	Height(tree) = max level no.+1
2.	Height(tree) with 1 node = 0	Height(tree) with 1 node = 1
3.	Height of empty tree = -1 ✓	Height(tree) of empty tree = 0 ✓
4.		

Use Code

VDEEPLIVE

TO GET

MAX DISCOUNT on



Height of Tree

No	Definition 1 ✓	Definition 2 ✓
1.	Height(tree) = max level no.	Height(tree) = max level no.+1
2.	Height(tree) with 1 node = 0	Height(tree) with 1 node = 1
3.	Height of empty tree = -1	Height(tree) of empty tree = 0
4.	Height of a tree is the number of edges in the path from root to the farthest leaf node Or Height of a tree is the <u>distance</u> of the farthest leaf node from <u>root</u>	Height of a tree is the number of <u>nodes</u> in the path from root to the farthest leaf node

Use Code

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TO GET

MAX DISCOUNT on



Question

Minimum and maximum number of nodes in a binary of height h are?

Note :- h (tree) with single node = 0

min:-

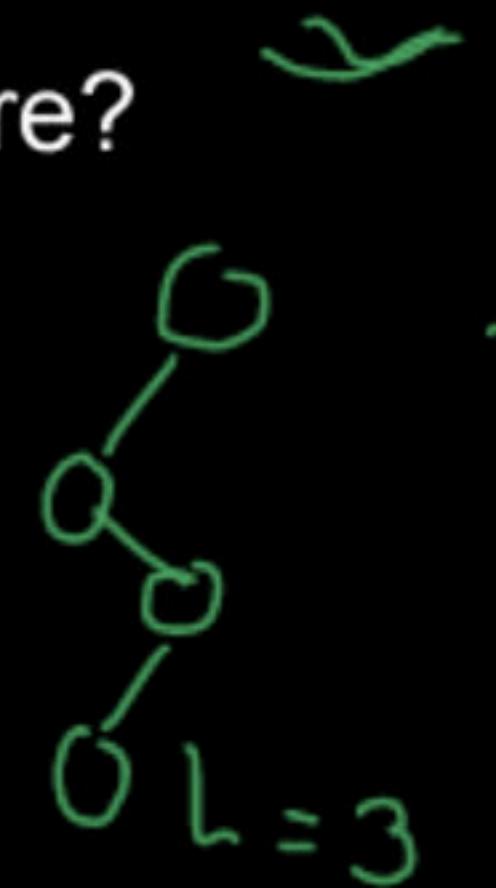
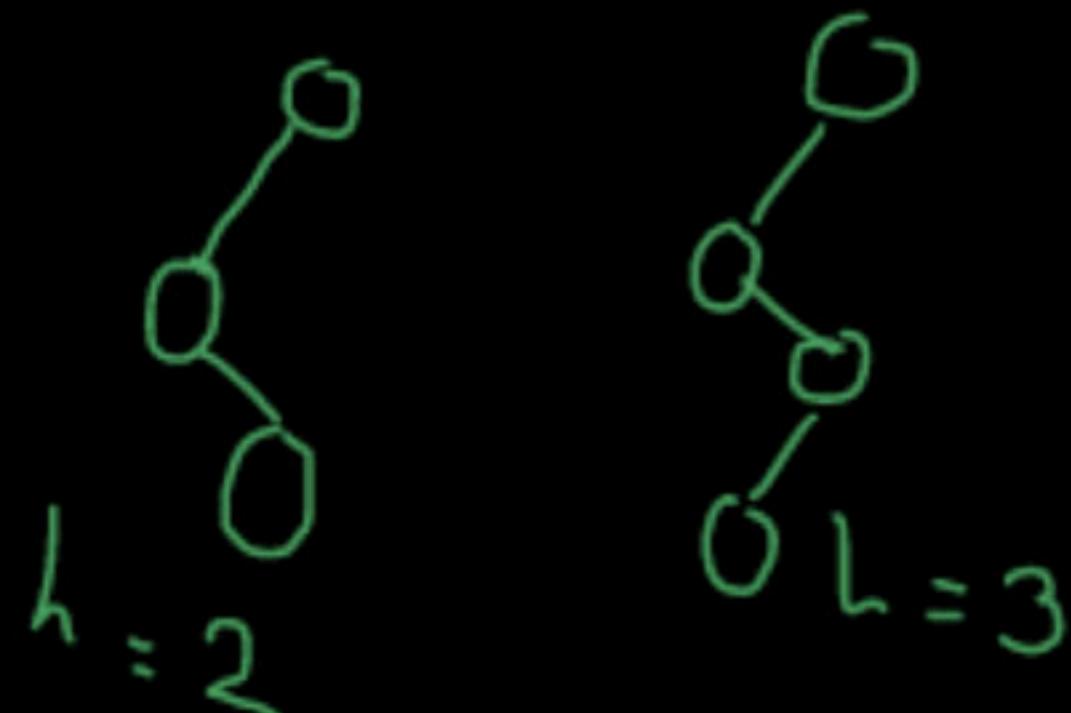


h	0	1	2	3
n_{\min}	1	2	3	4



$h = 1$

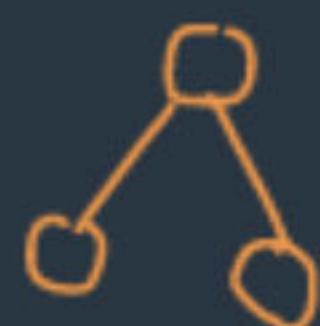
$$n_{\min} = h + 1$$



max

0

$h=0$



$h=1$



$L=2$



$L=3$

$$h_{\max} = 2^h - 1$$

h	0	1	2	3	
h_{\max}	1	3	7	15	

Tree Traversals ✓

- Preorder
- Inorder
- Postorder

Use Code

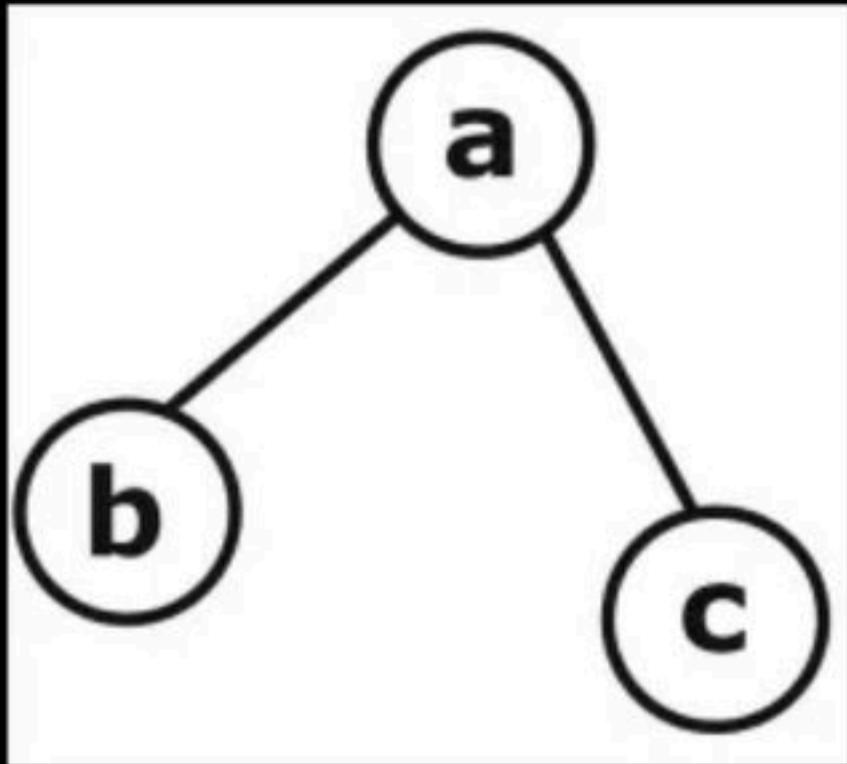
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Tree Traversals

- Preorder
- Inorder
- Postorder



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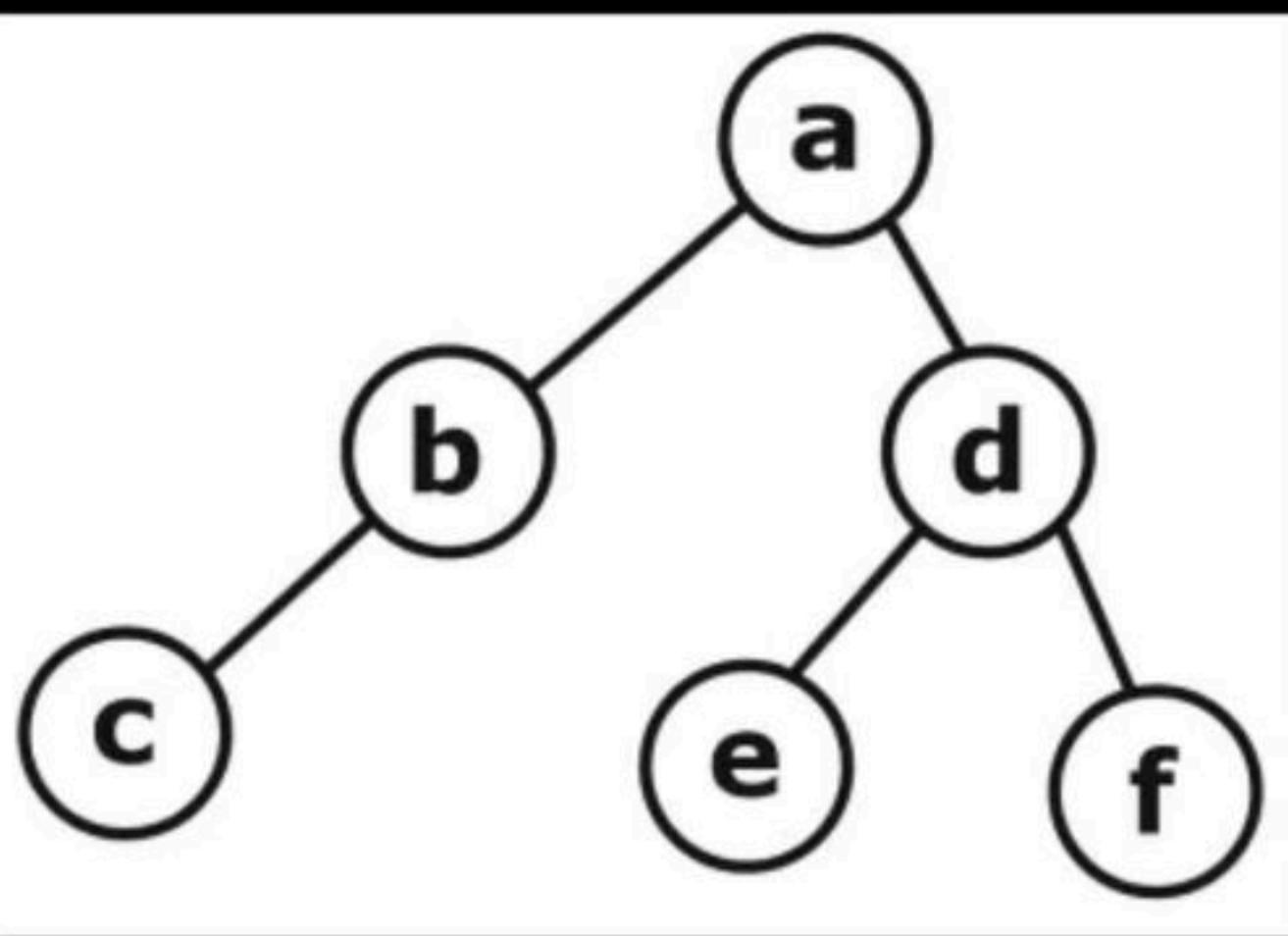
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Tree Traversals

- Preorder
- Inorder
- Postorder



Use Code

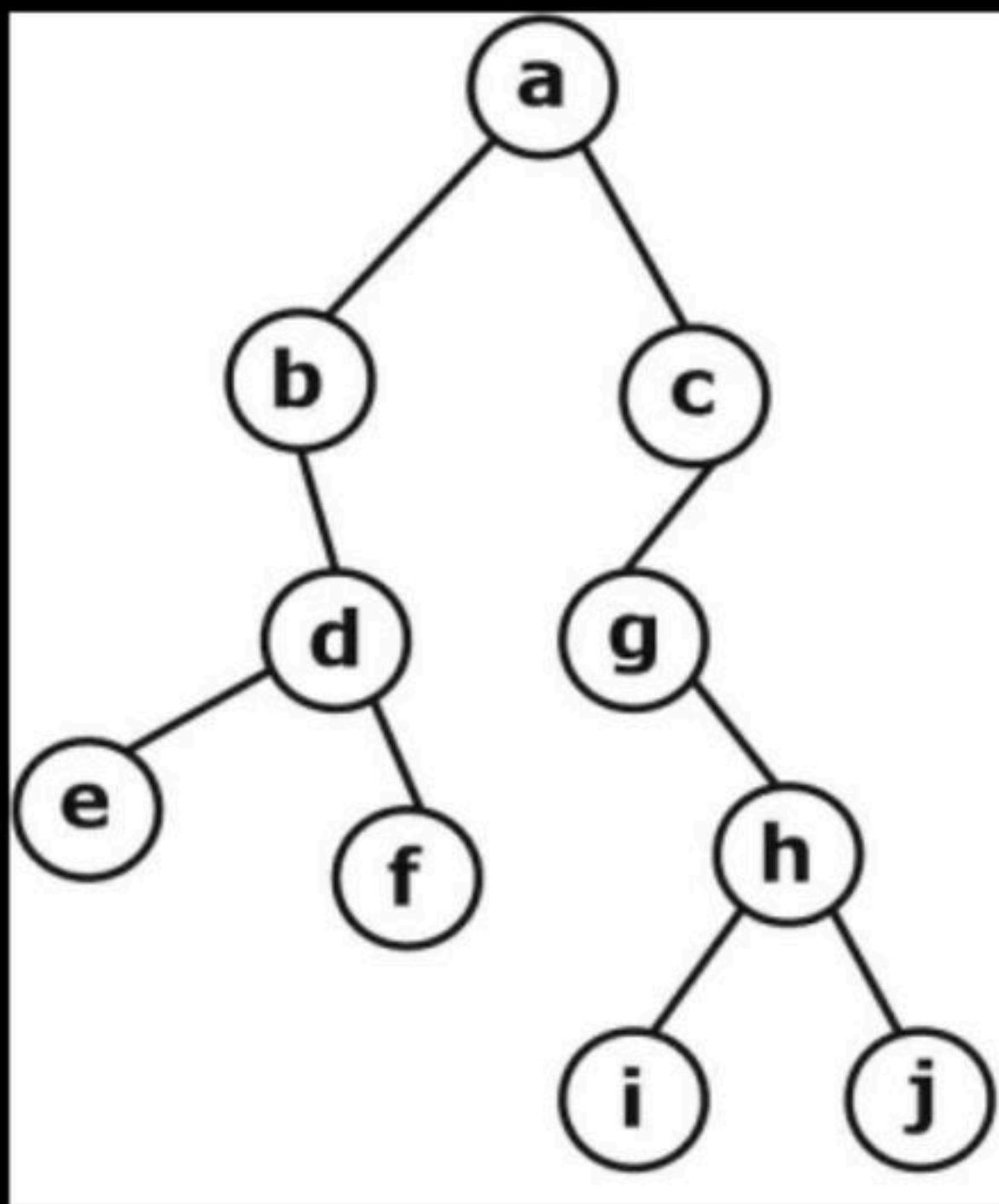
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Tree Traversals

- Preorder
- Inorder
- Postorder

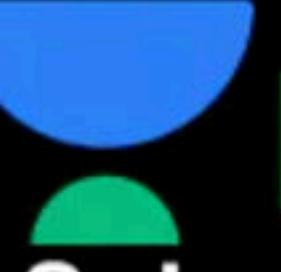


Use Code

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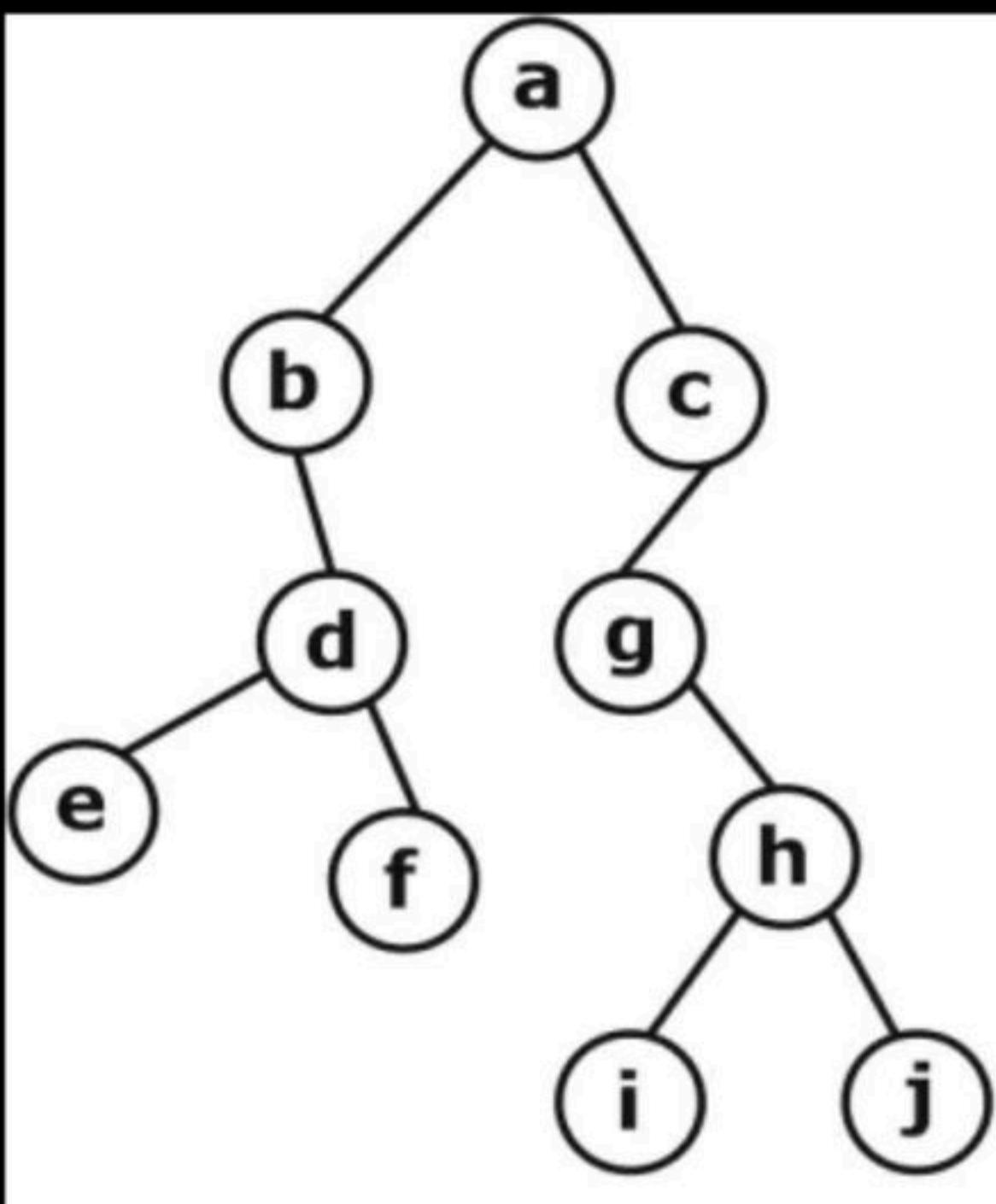
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Tree Traversals

- Preorder
- Inorder
- Postorder

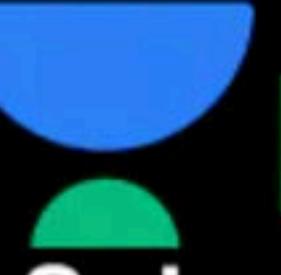


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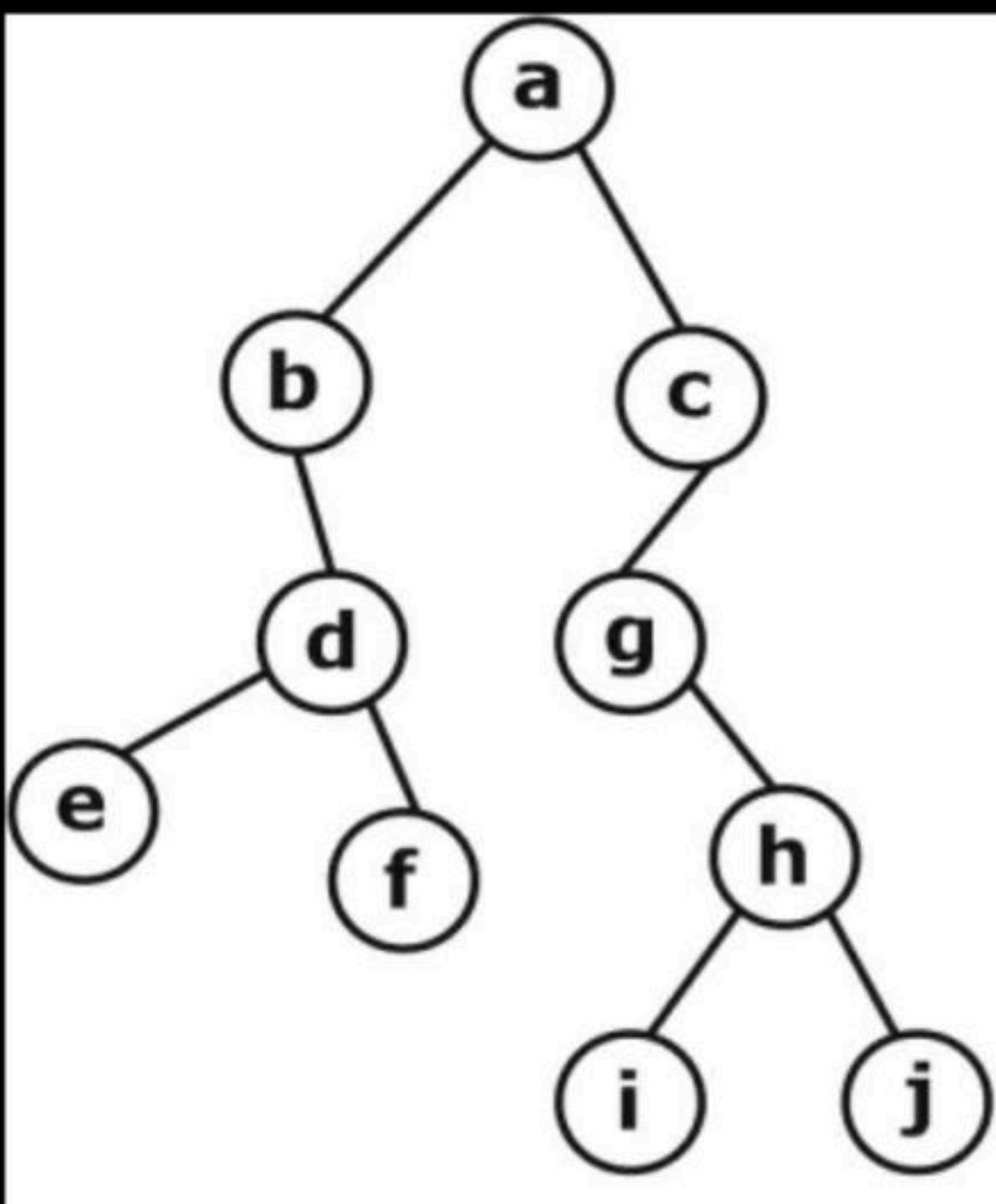
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Tree Traversals

- Preorder
- Inorder
- Postorder

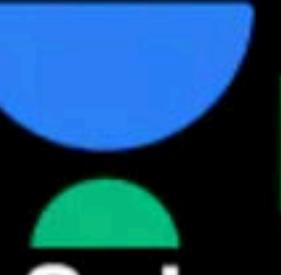


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Observation From Traversals

Use Code

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Question GATE-2008

The following three are known to be the preorder, inorder and postorder sequences of a binary tree. But it is not known which is which.

MBCAFHPYK

KAMCBYPFH

MABCKYFPH

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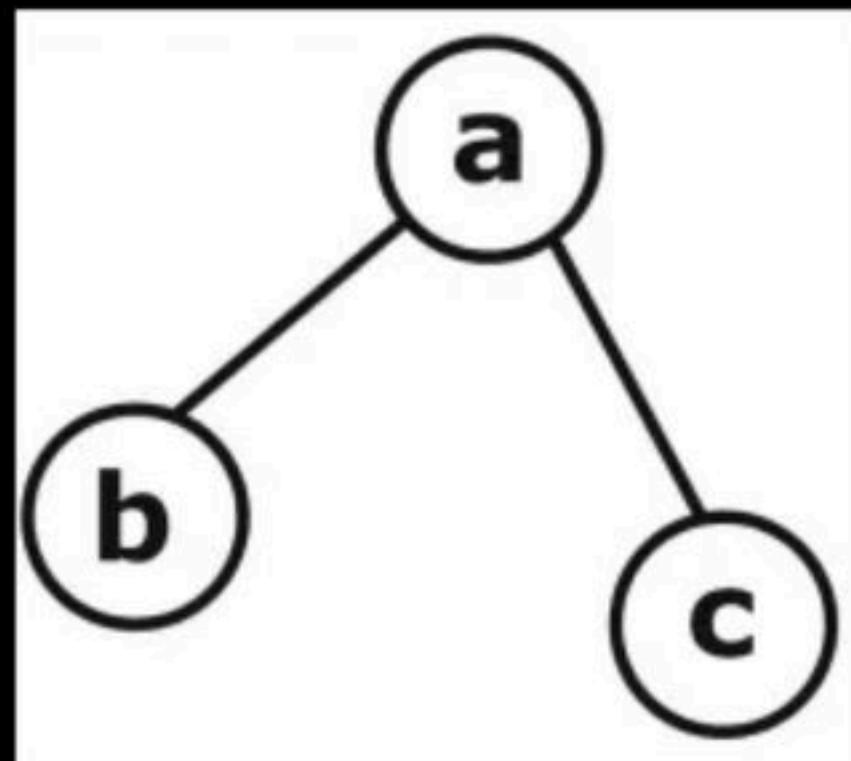
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Converse Order Traversal

- Converse Preorder
- Converse Inorder
- Converse Postorder

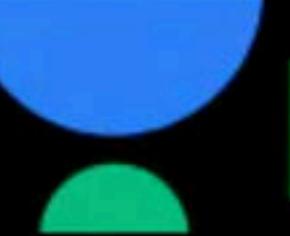


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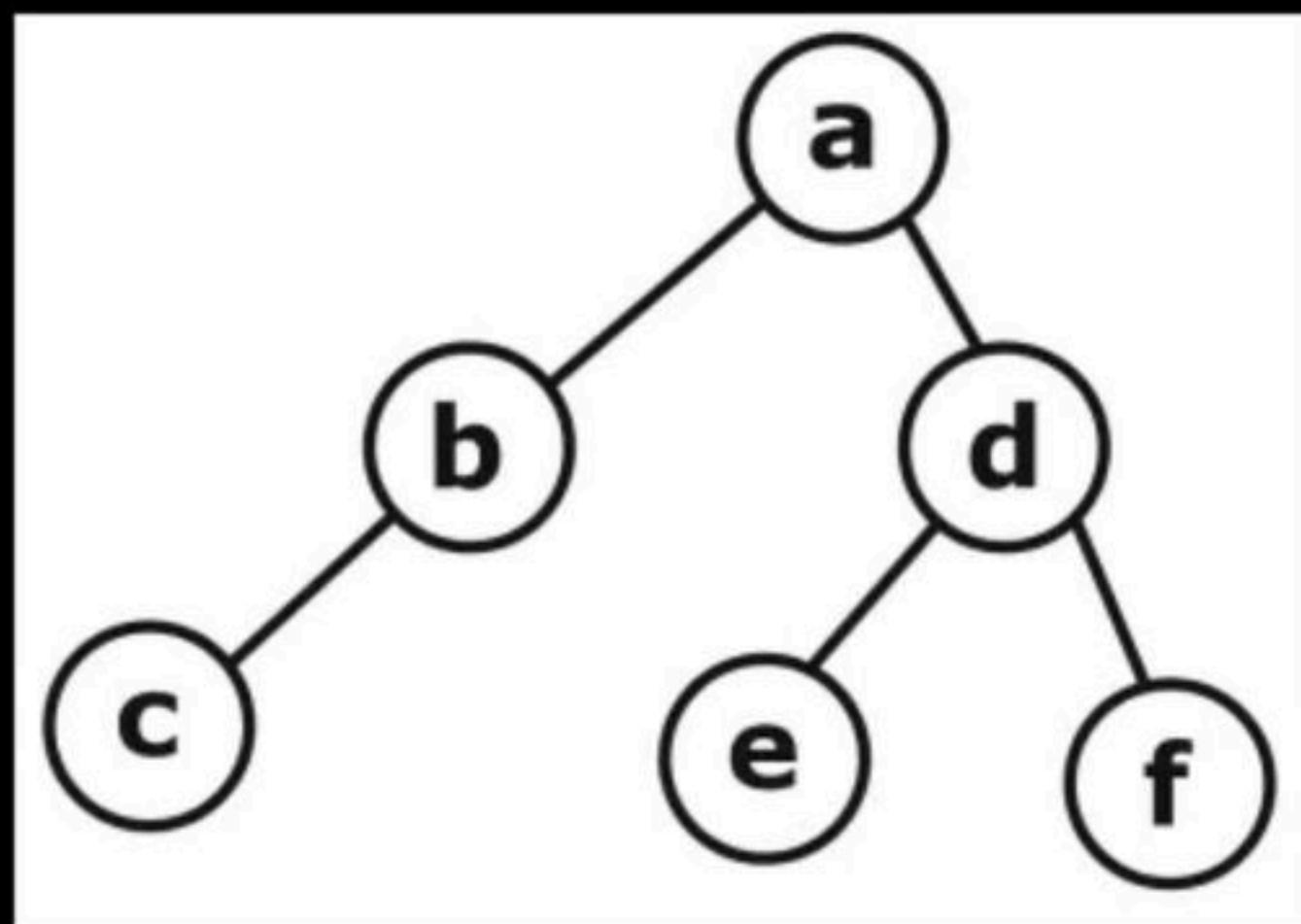
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Converse Order Traversal

- Converse Preorder
- Converse Inorder
- Converse Postorder



Use Code

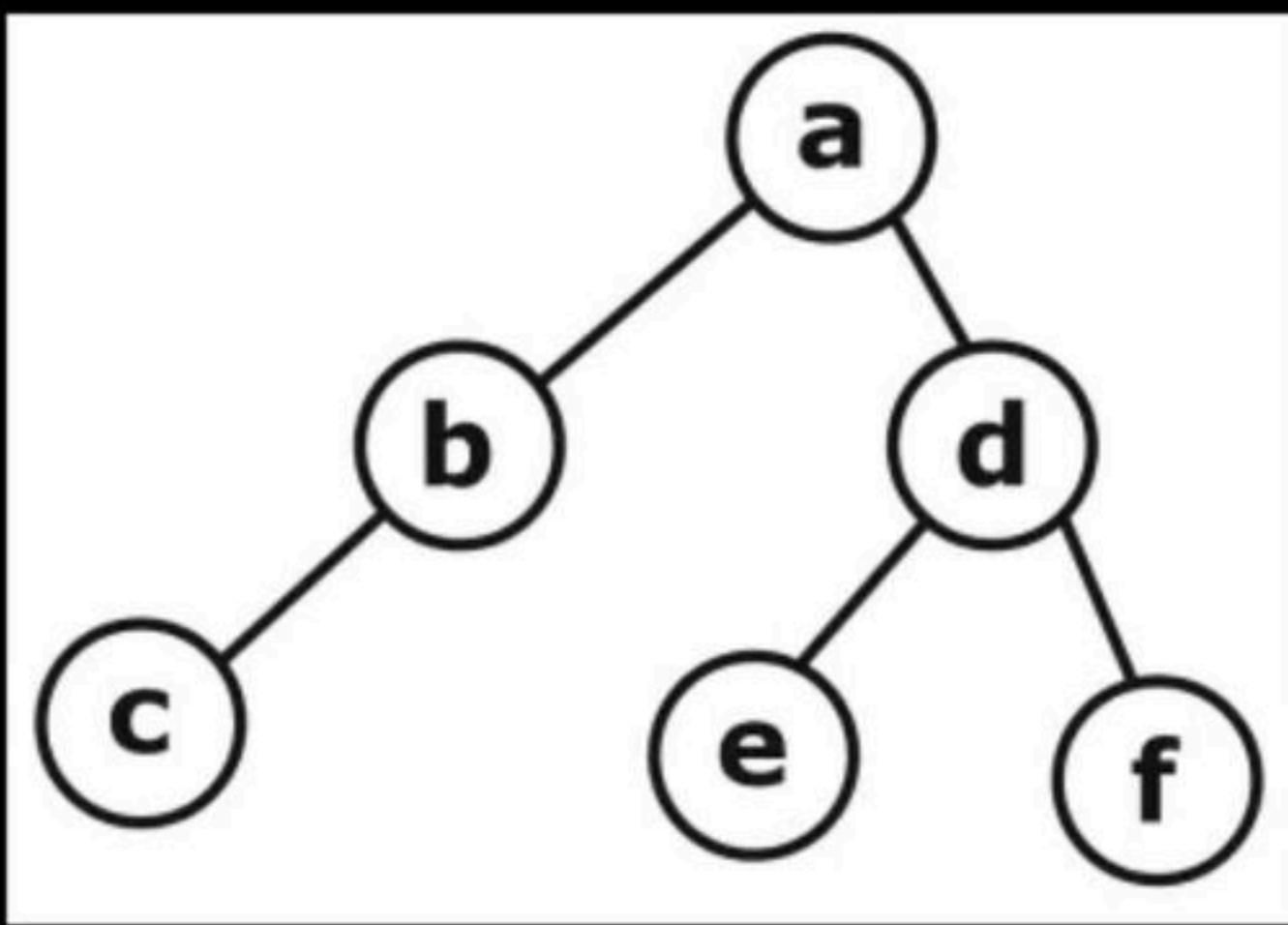
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Converse Order Traversal

- Converse Preorder
- Converse Inorder
- Converse Postorder



Use Code

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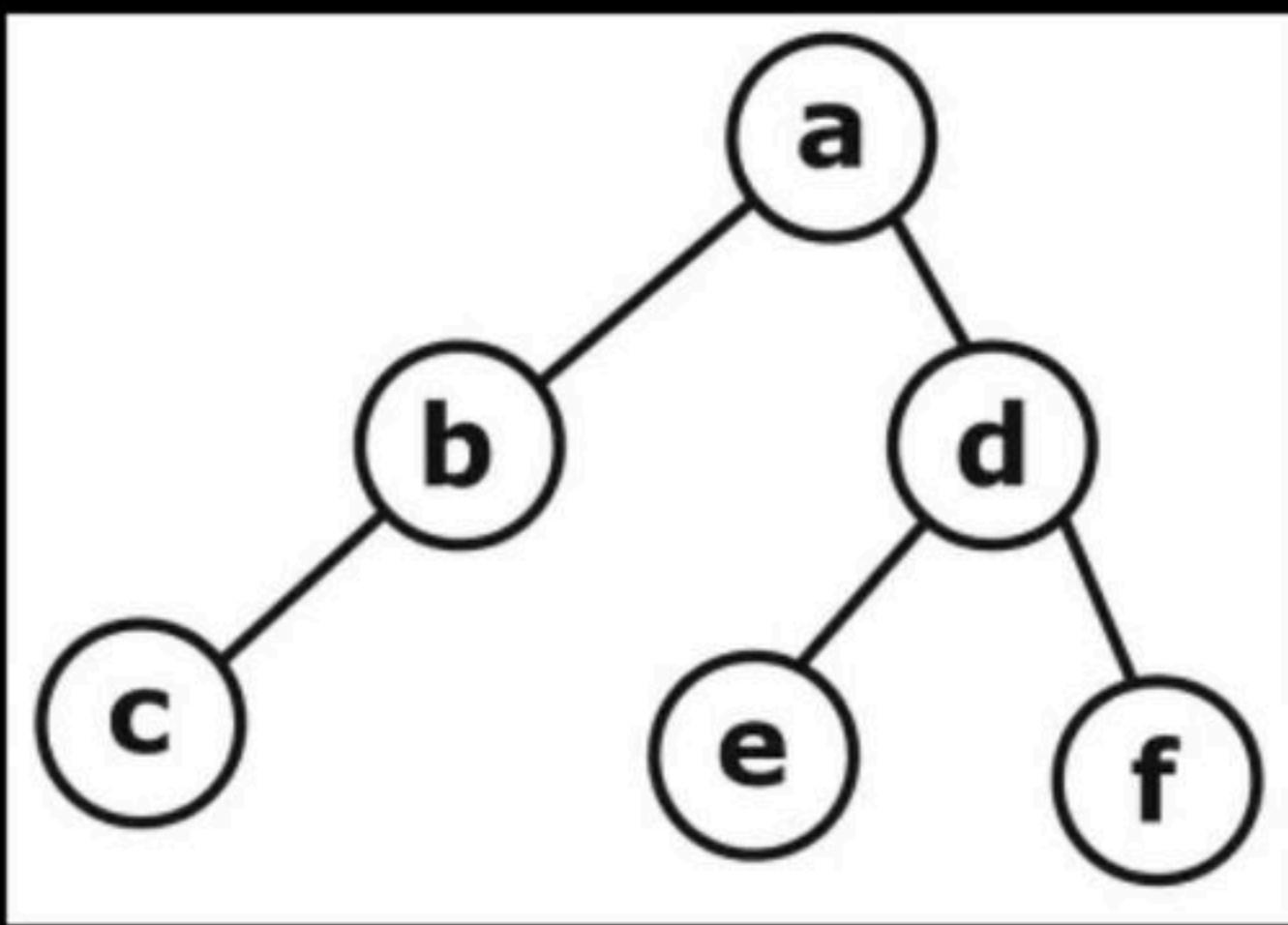
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Converse Order Traversal

- Converse Preorder
- Converse Inorder
- Converse Postorder



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Observations

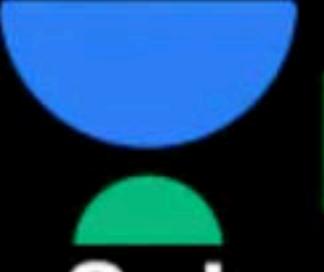
- Reverse of conventional preorder traversal is Converse postorder

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Observations

- Reverse of conventional postorder traversal is Converse preorder

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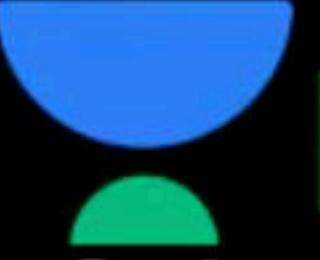
Observations

- Reverse of conventional inorder traversal is Converse inorder

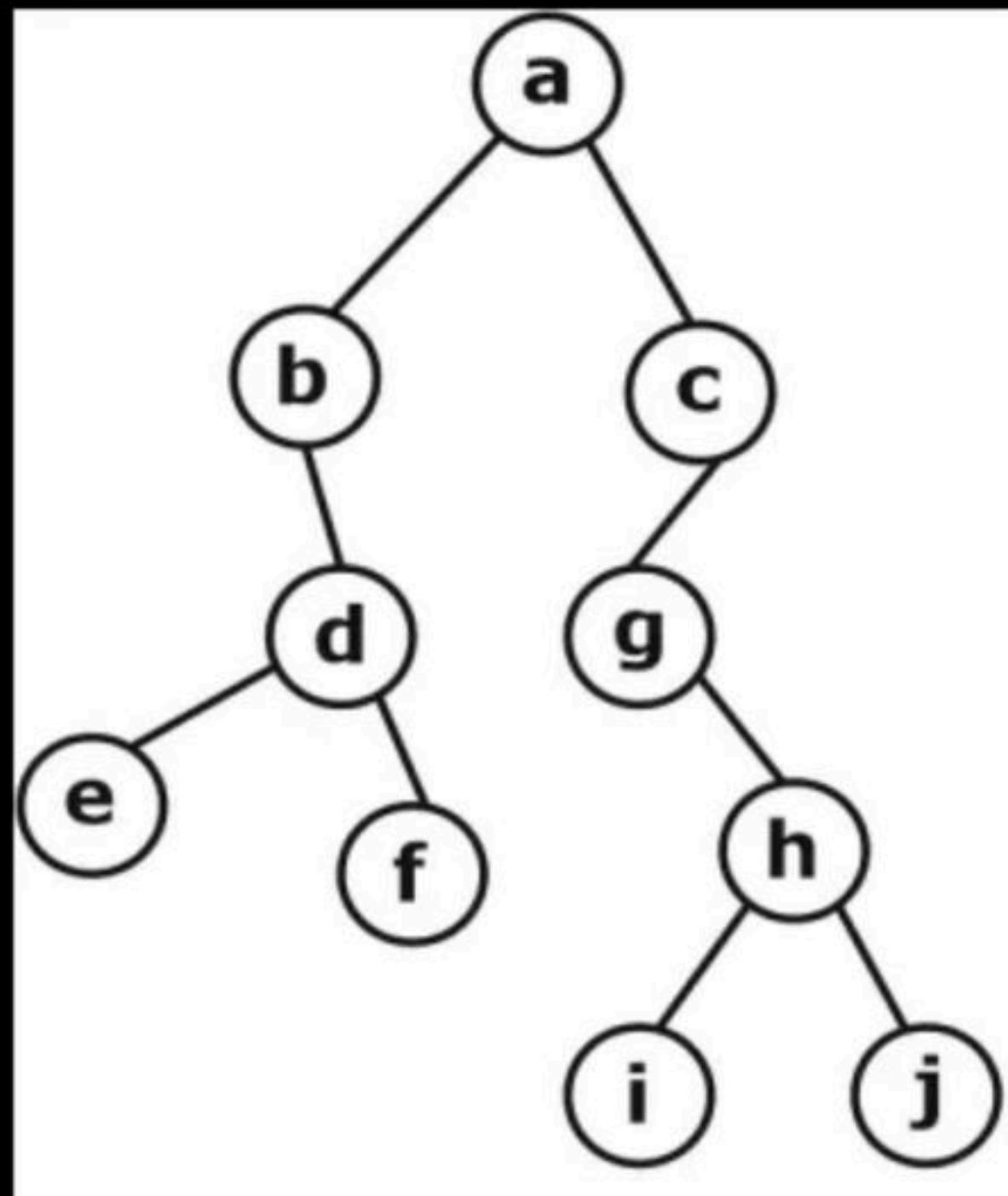
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Level Order Traversal



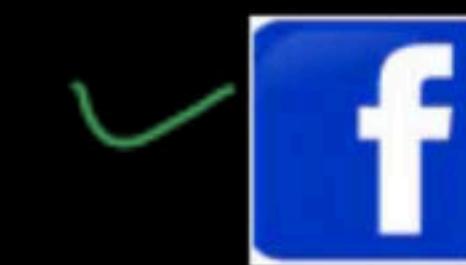
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vishvadeep.gothi



vd_gothi



CO with Vishvadeep

@vishvadeepG

Thank you



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