CS & IT ENGINEERING

Data Structure & Programming

Tree

Lec - 03

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TOPICS TO BE COVERED

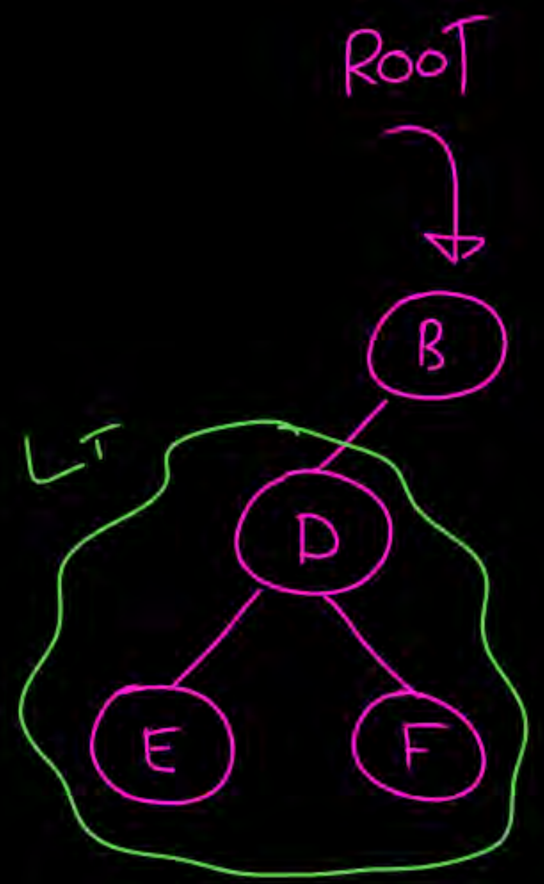
Tree-3

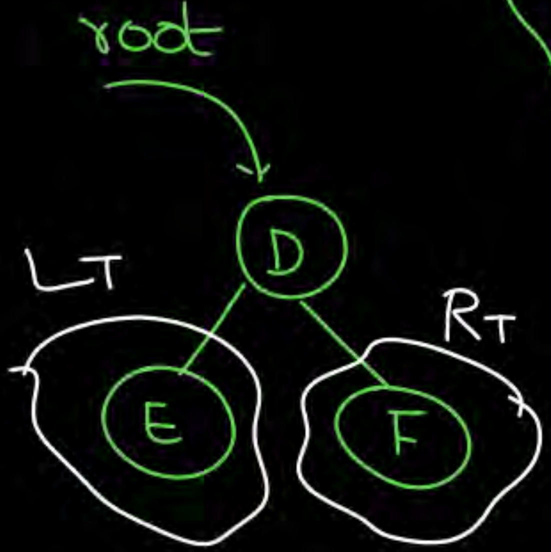
In-Order Traversal

1.) Traverse L_T of the root node in In-order.

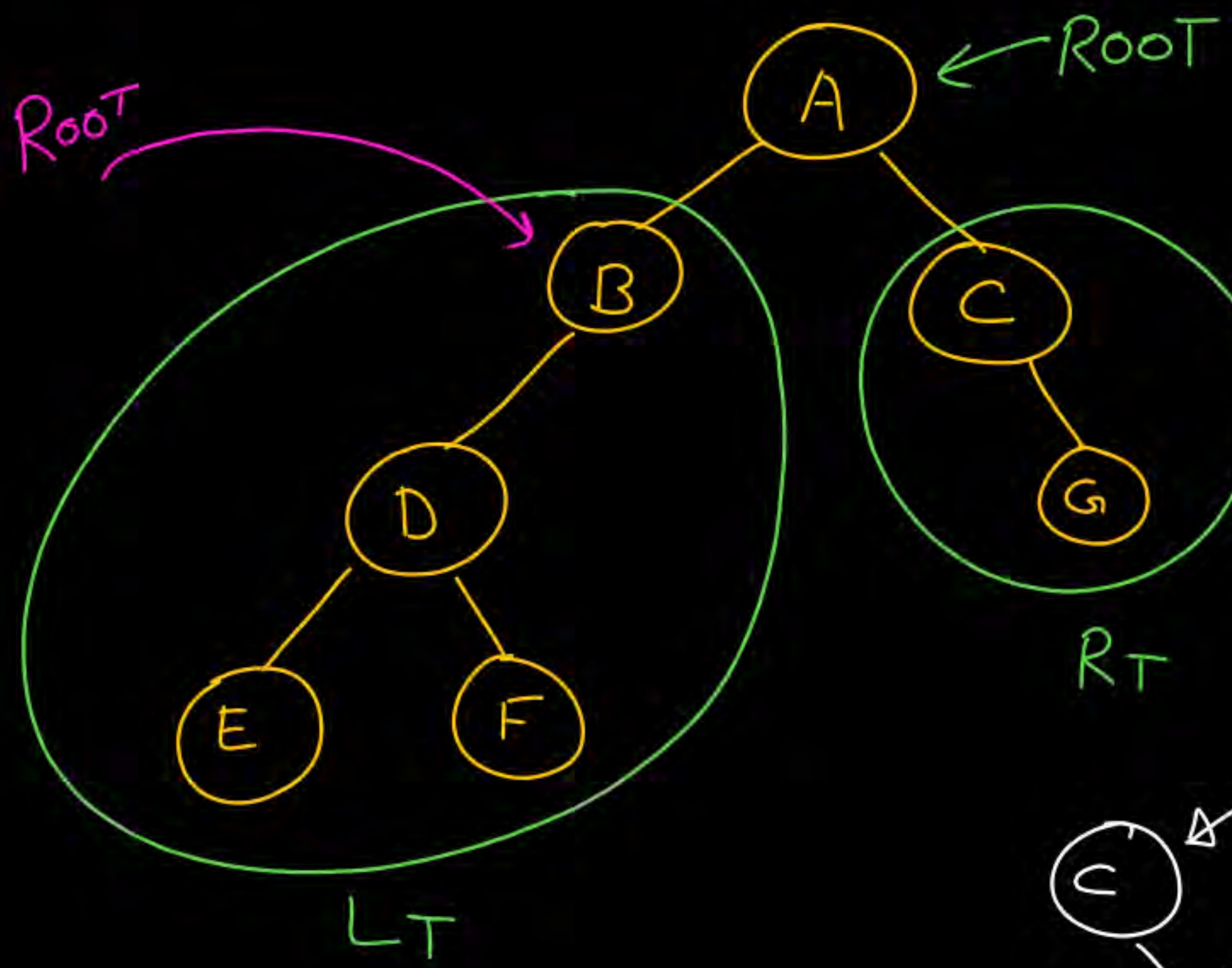
2.) Print/visit/Process root node

3.) Traverse R_T of root node in In-order.

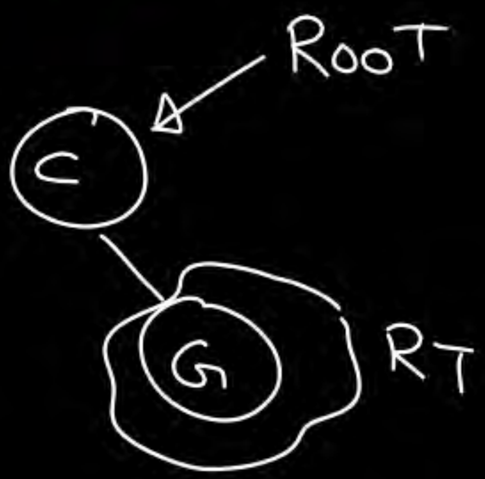




EDF B



EDFBACG

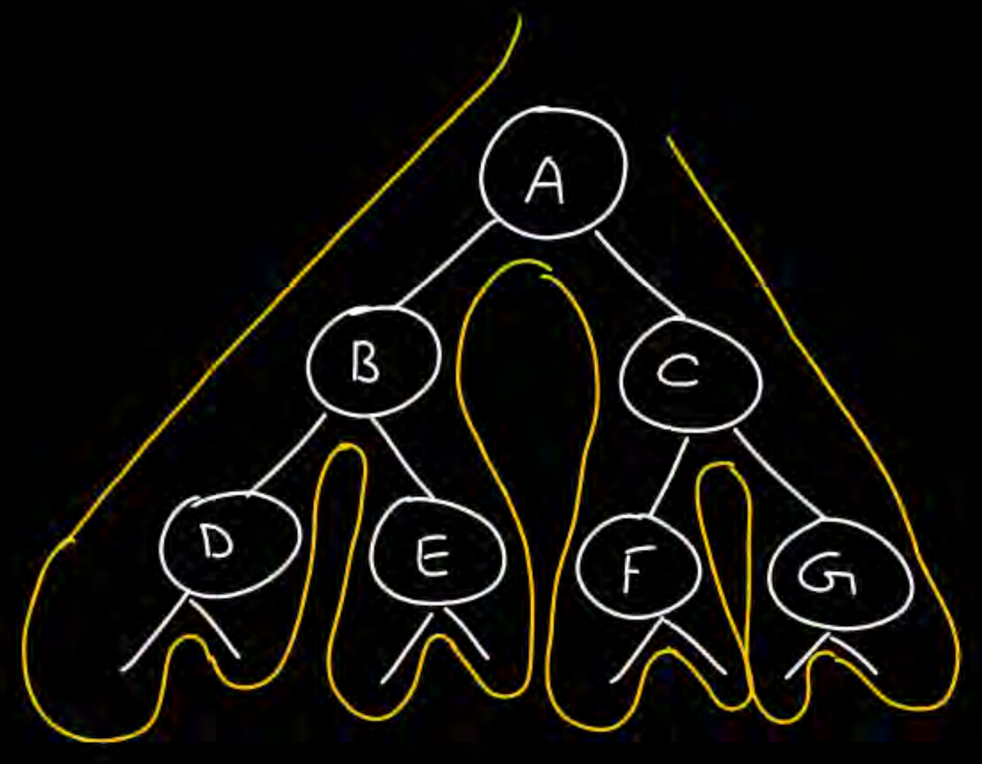


```
void InOrder( struct Node *Ptr)
    {
        if ( Ptr) {

            Inorder(Ptr→Left);
            printf("%d", Ptr→data);
            Inorder(Ptr→Right);

        }

    }
```

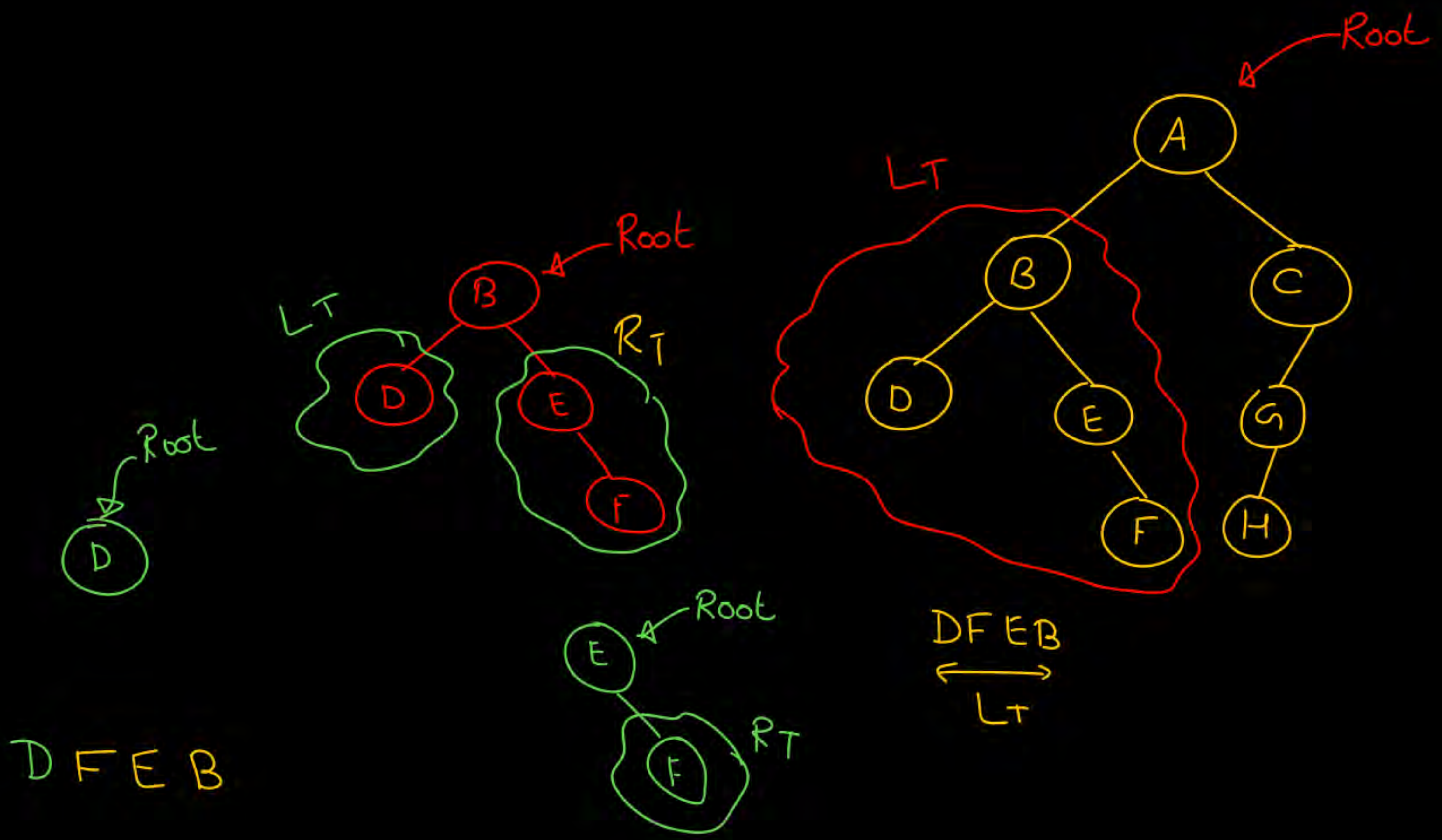


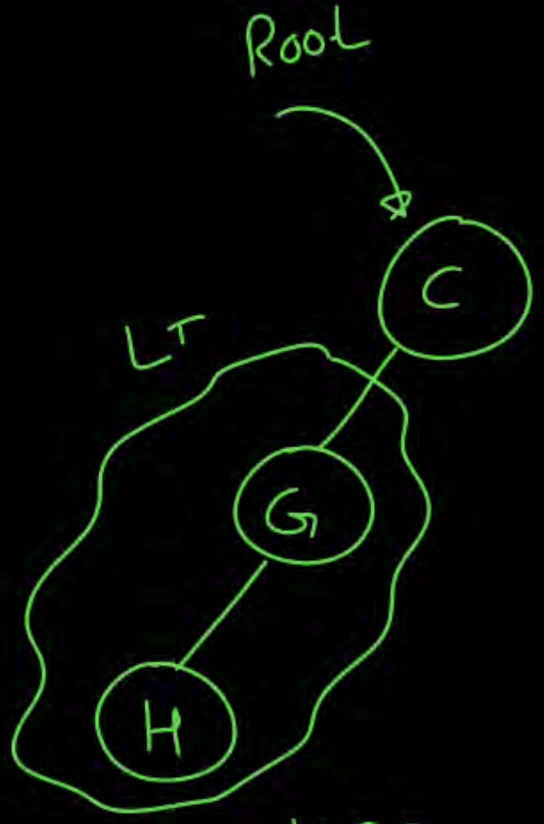
DBEAFCG

Post-Order Traversal

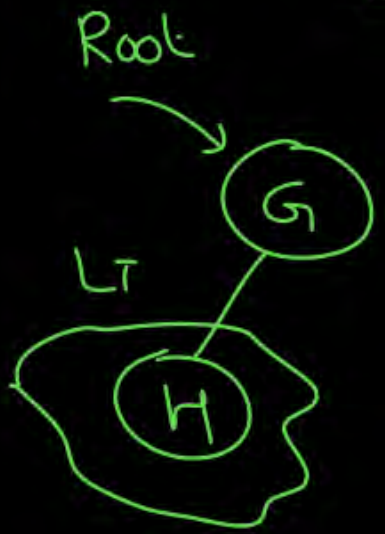
$L_T, R_T, Root$

1. Traverse L_T of root node in Post-Order.
2. Traverse R_T Of root node in Post-Order.
3. Print/visit/Process Root node.

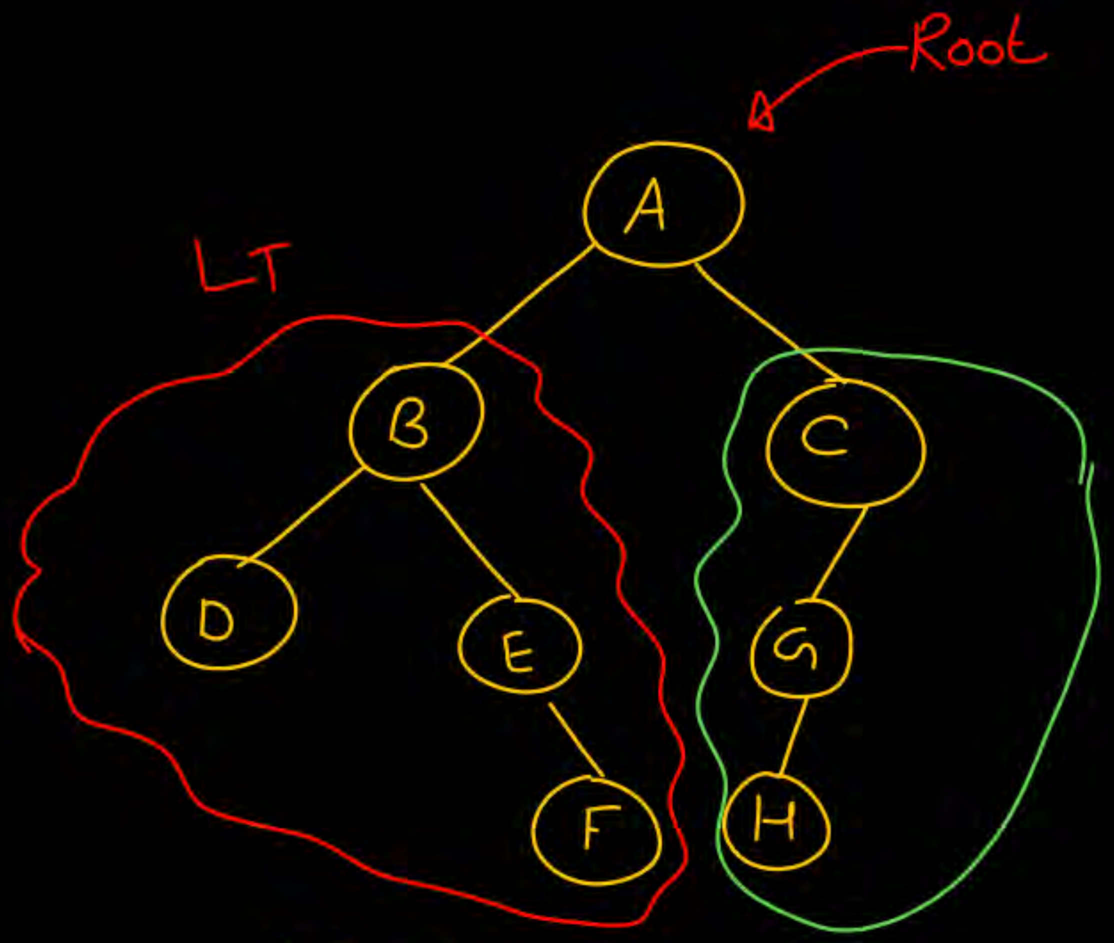

Root
A
LT
B
C
D
E
G
F
H
DFEB
LT
Root
B
LT
RT
D
E
F
Root
D
Root
E
RT
F
DFEB



HGC



HGC



DFEB — LT

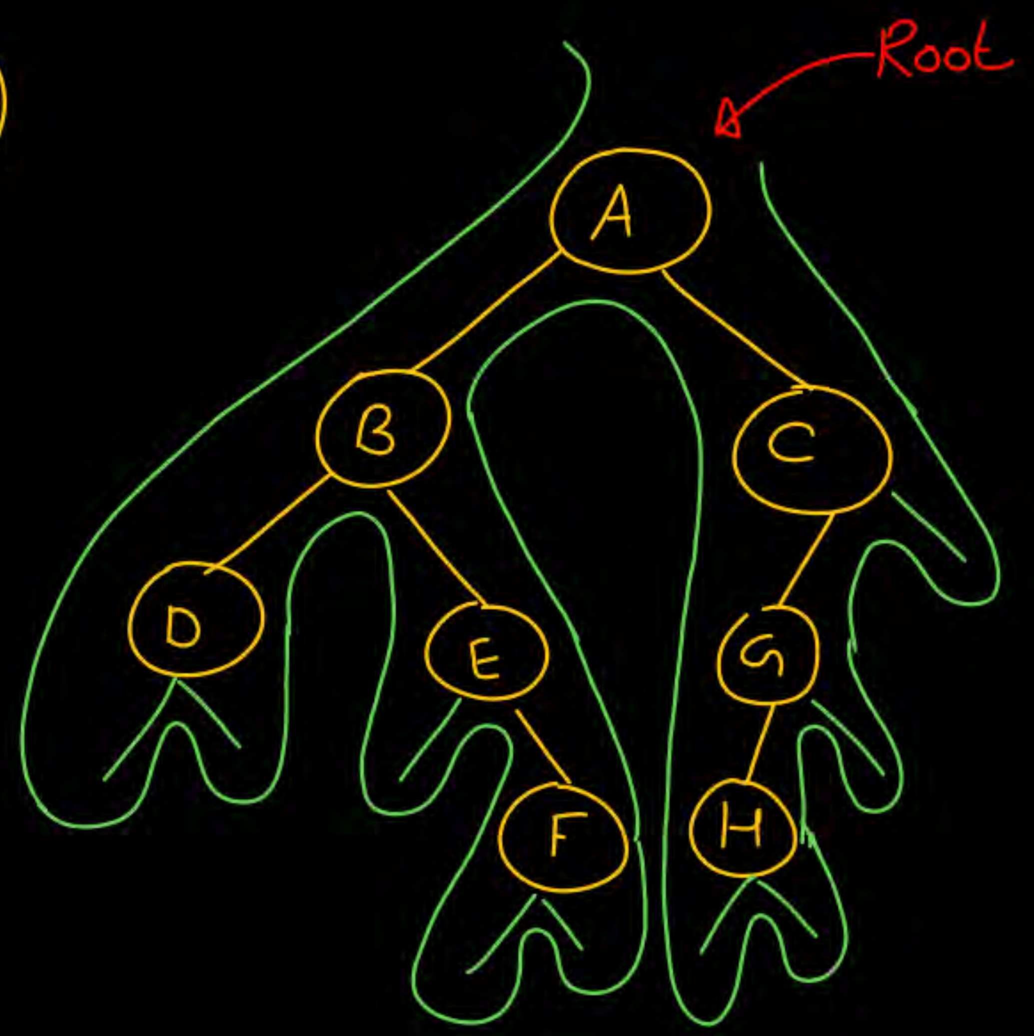
HGC — RT

A

DFEBHGCA

```
void Postorder(struct Node* Ptr)
{
    if(Ptr){                          → if(Ptr != NULL)

        Postorder(Ptr → Left);
        Postorder(Ptr → Right);
        printf("%d", Ptr → data);
    }
}
```

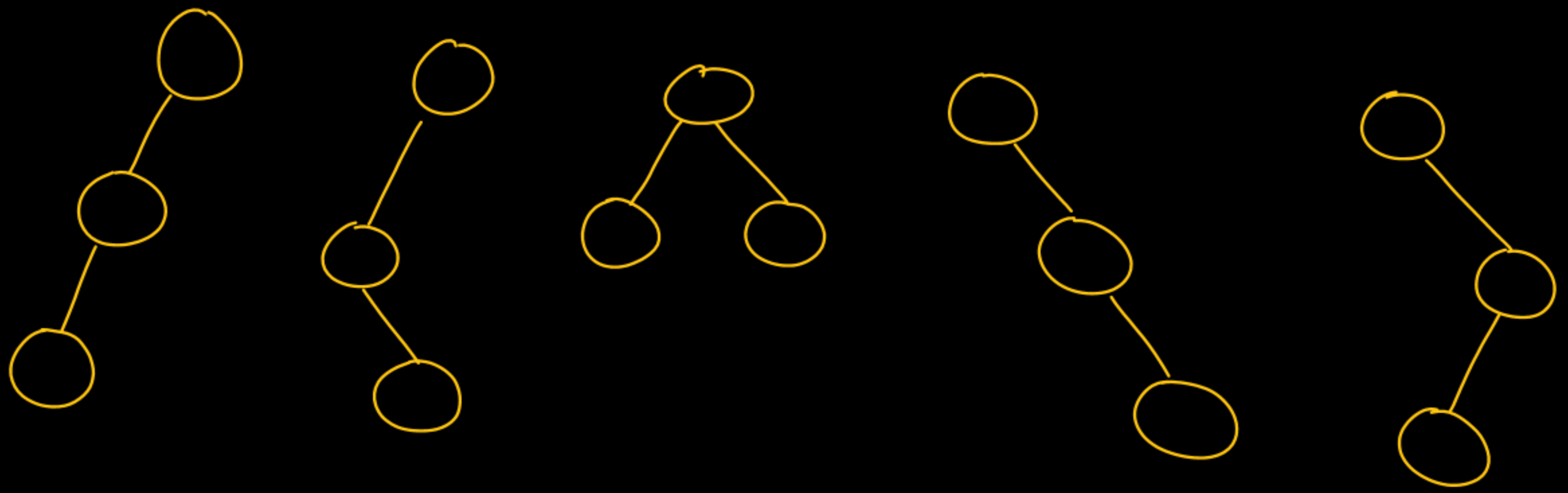


$$\underbrace{D\,F\,E\,B}_{L_T}\;\underbrace{H\,G\,C}_{R_T}\;\underbrace{A}_{Root}$$

No. of unlabelled binary tree (shape/Geometry) with 1 node

$n = 2$

$n = 3$



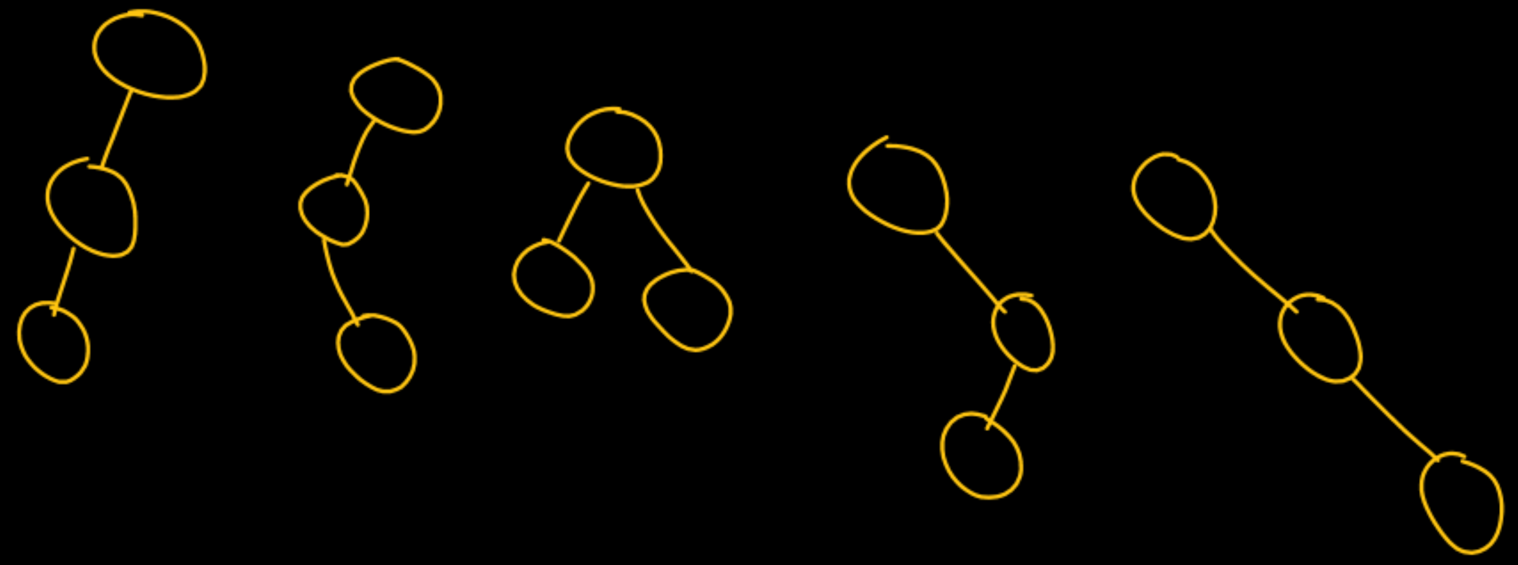
No. of unlabelled binary trees with n nodes

(shape/structure/Geometry)

$n = 1 \Rightarrow 1$

$n = 2 \Rightarrow 2$

$n = 3 \Rightarrow 5$



$$\boxed{\text{No. of unlabelled binary trees with } n \text{ nodes} = \frac{{}^{2n}C_n}{n+1}}$$

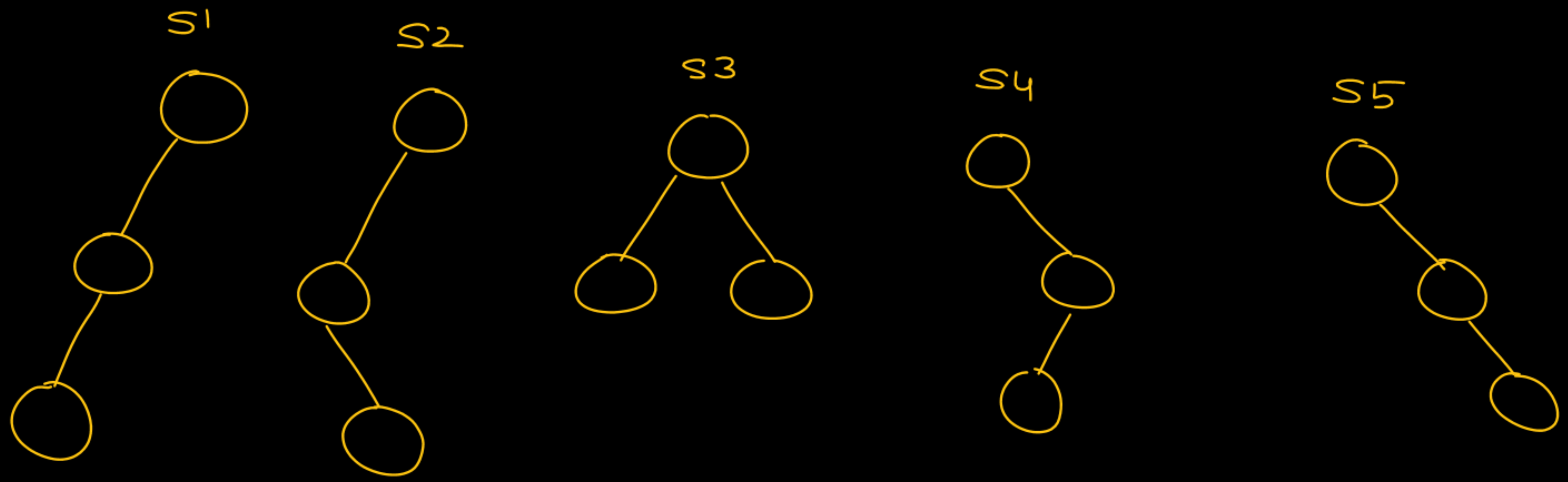
$n = 1 \Rightarrow \dfrac{{}^{2}C_1}{1+1} = \dfrac{2}{2} = 1$ ✓

$n = 2 \quad \dfrac{{}^{4}C_2}{3} = \dfrac{1}{3} \times \dfrac{4!}{2! \times 2!} = \dfrac{24}{3 \times 2 \times 2} = 2$ ✓

$n = 3 \quad \dfrac{{}^{6}C_3}{4} = \dfrac{1}{4} \times \dfrac{6!}{3! \times 3!} = \dfrac{\cancel{6} \times 5 \times \cancel{4} \times \cancel{3!}}{\cancel{4} \times \cancel{3!} \times \cancel{3!}} = 5$ ✓

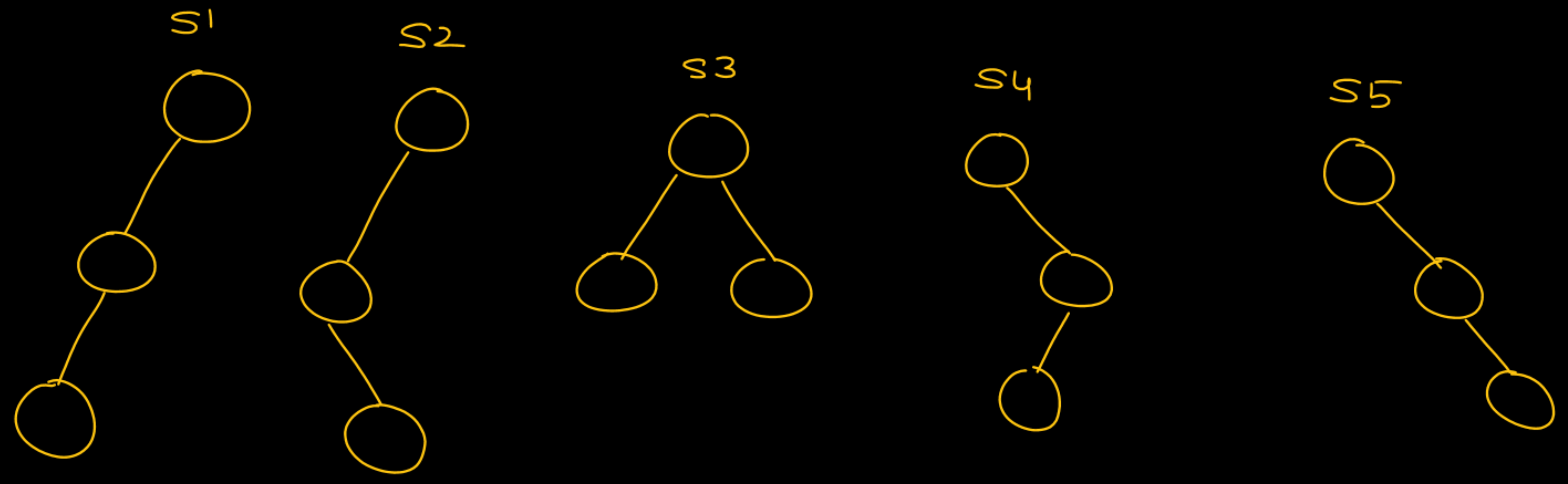
$n = 3$

$\Rightarrow$ 5 binary tree structure are possible



$n = 3$

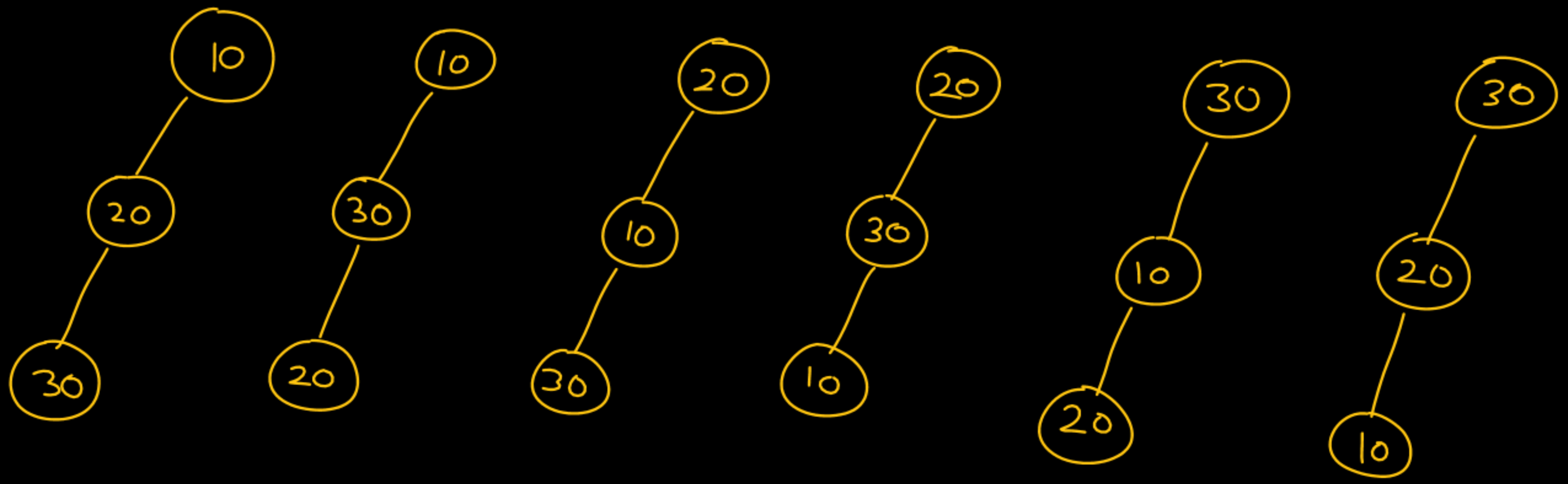
$\Rightarrow$ 5 binary tree structure are possible



Keys : 10, 20, 30

we are interested in labelled binary trees

10, 20, 30



For Each unlabelled structure $\Rightarrow$ 3! possible ways to label

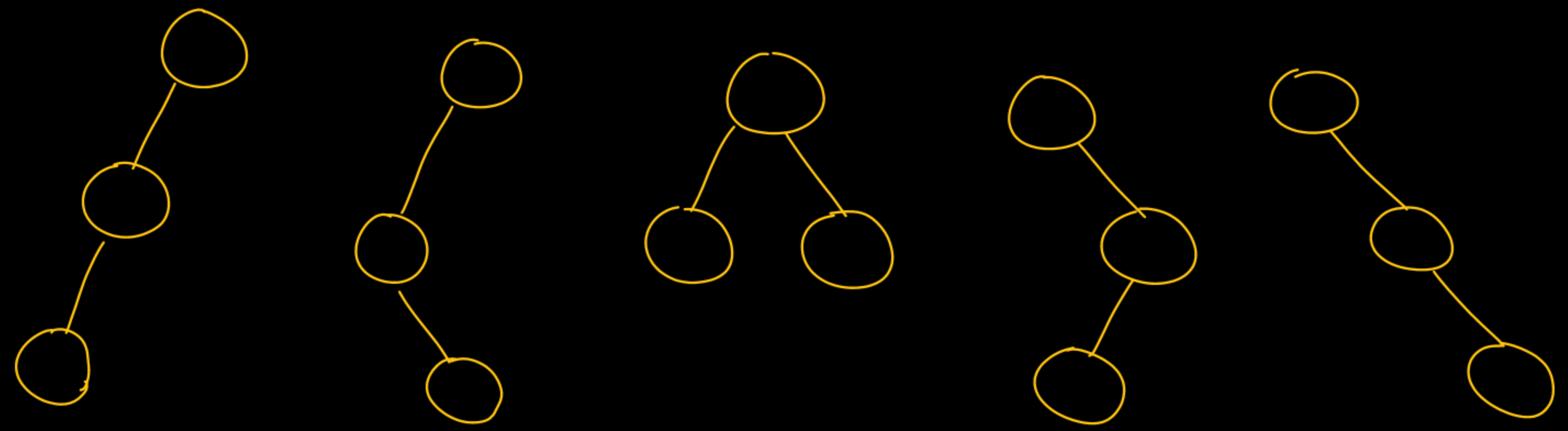
Labelled binary trees with 3 nodes = No. of structure with 3 nodes × 3!

$$= 5 \times 3!$$

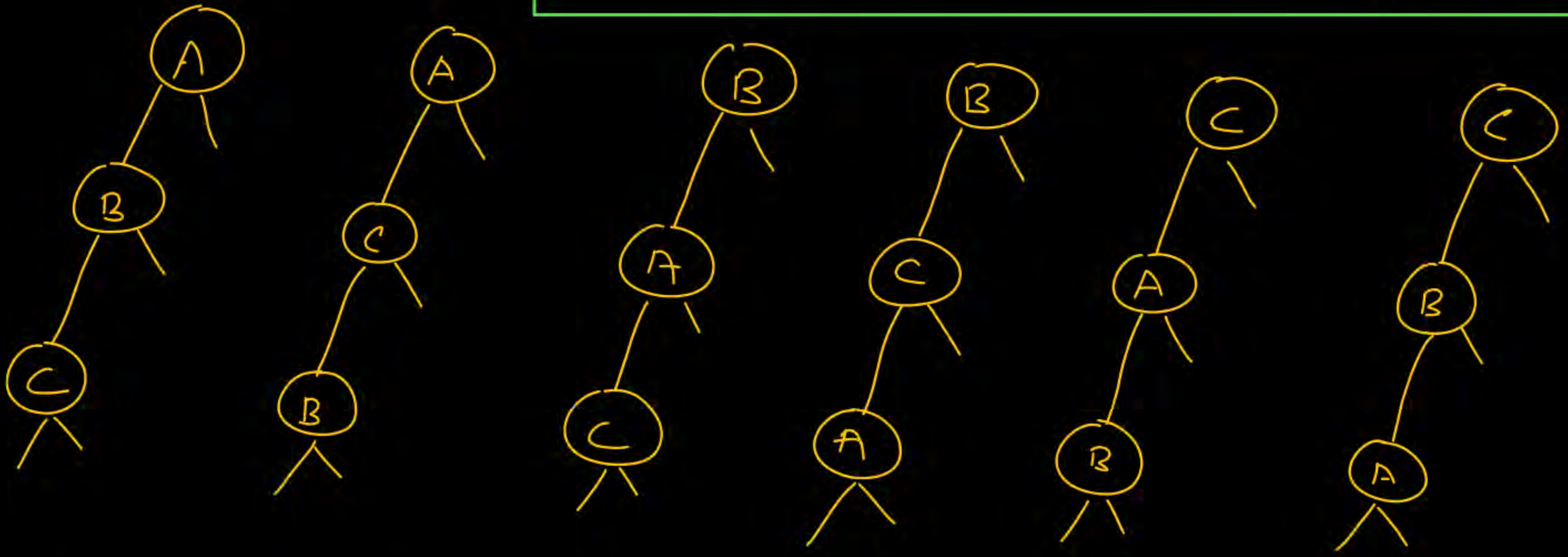
$$= 30$$

No. of Labelled binary trees with n nodes $= \dfrac{{}^{2n}C_n}{n+1} \times n!$

Q) How many binary trees are possible with preorder ABC



Every structure — Only 1 binary tree with preorder as ABC



Pre : ABC ✓

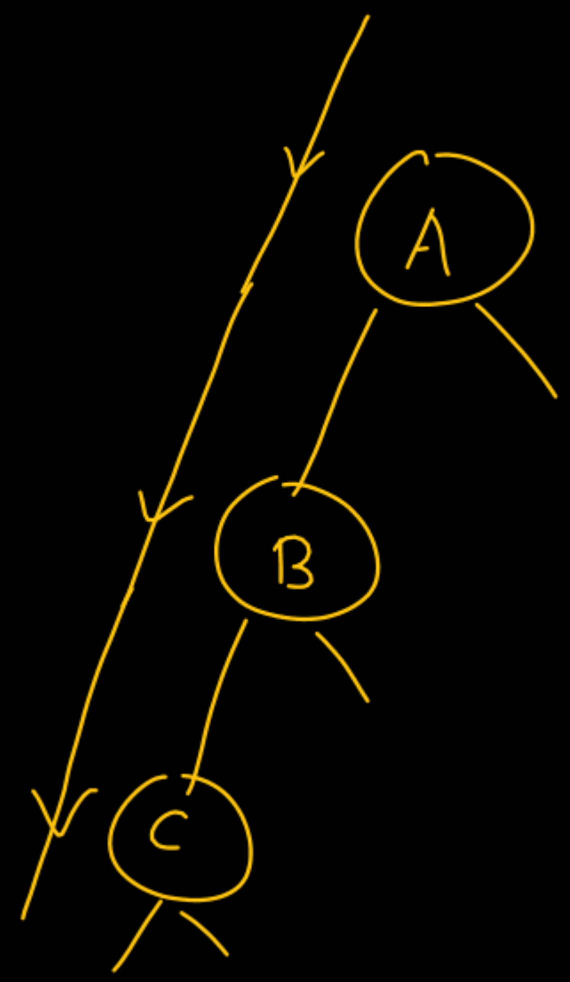
Pre : ACB ✗

Pre : BAC ✗

Pre : BCA ✗

Pre : CAB ✗

Pre : CBA ✗



Pre : ABC

$n=3$

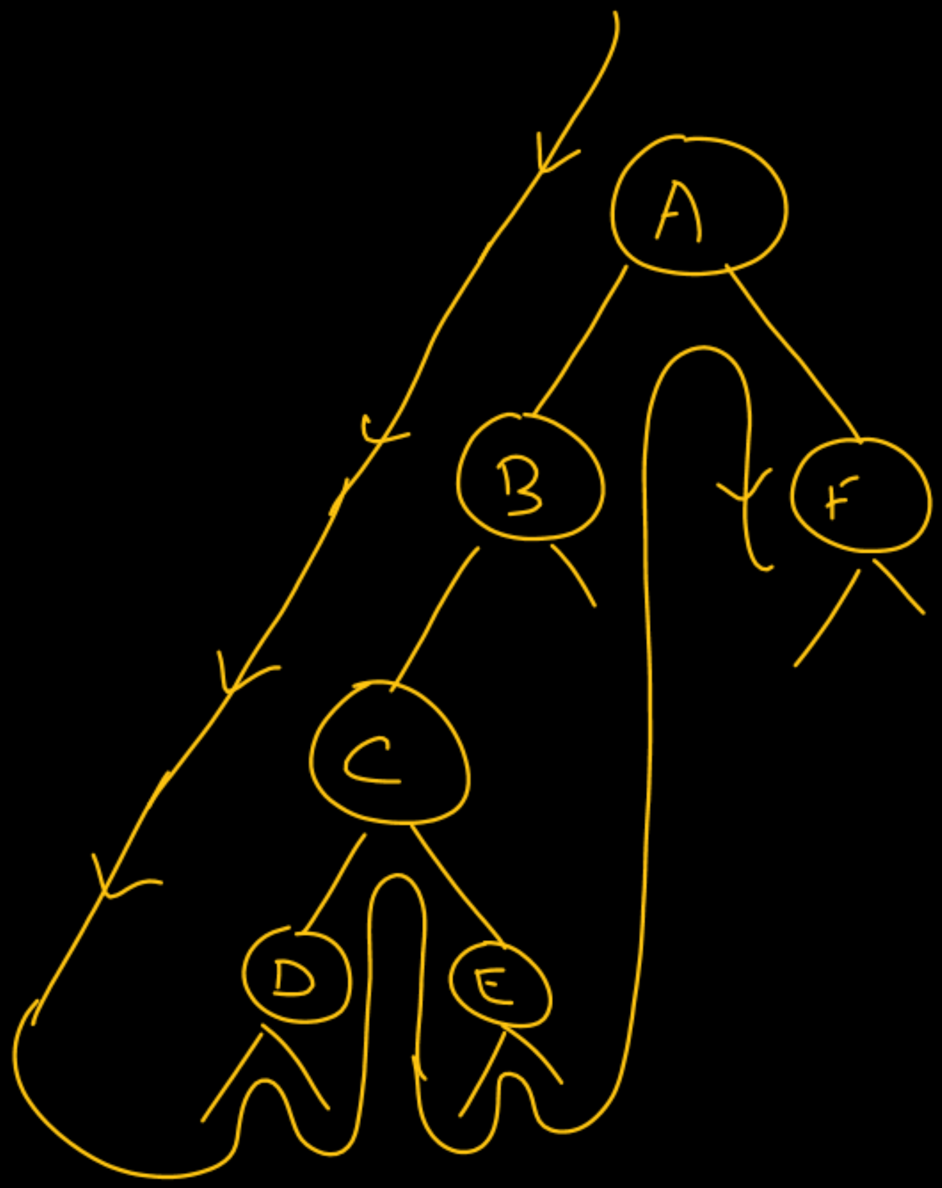
No. of binary trees with preorder ABC $= \frac{{}^{2n}C_n}{n+1}$

With a given preorder (n length), no. of binary trees possible

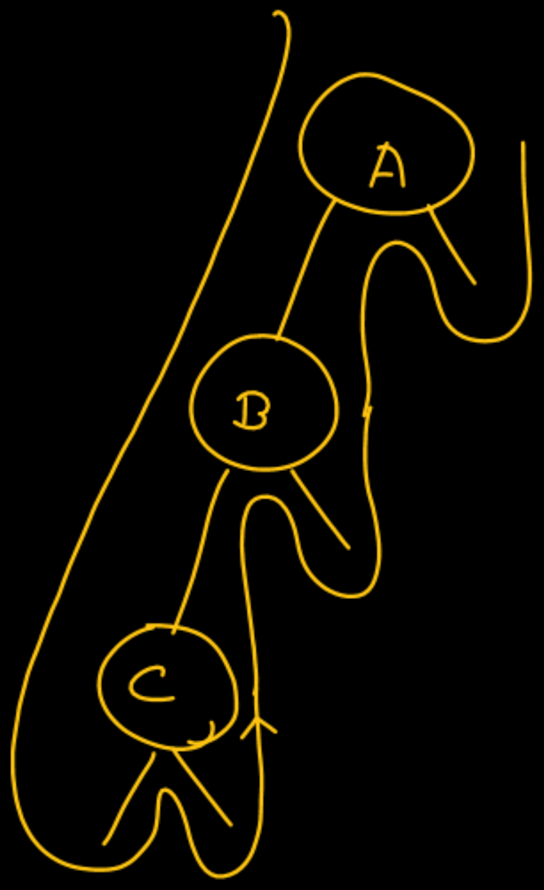
$$= \frac{{}^{2n}C_n}{n+1}$$

Pre : A B C D E F

Shivansh



Q No. of binary trees possible with postorder : CBA



with a given postorder (n length),

no. of binary trees

$$= \frac{{}^{2n}C_n}{n+1}$$

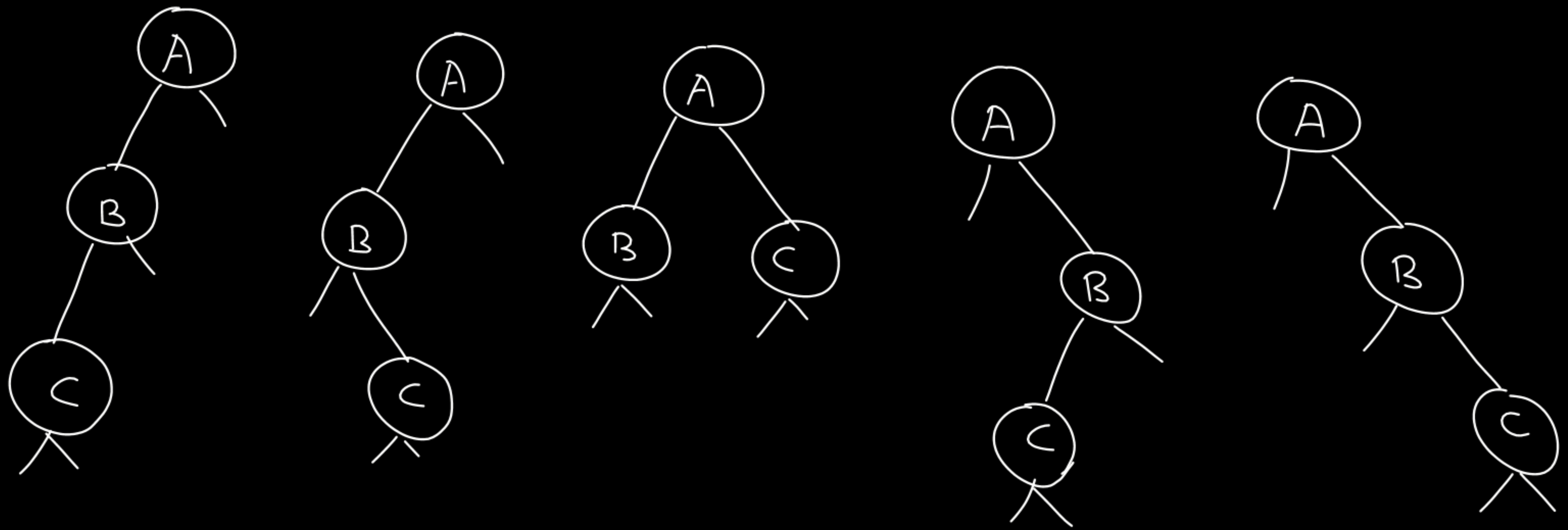
Exactly 1 is given

* No. of binary trees with a given traversal (Pre/In/Post) of n length

$$= \frac{{}^{2n}C_n}{n+1}$$

No. of binary trees possible with Pre : ABC
Post : CBA

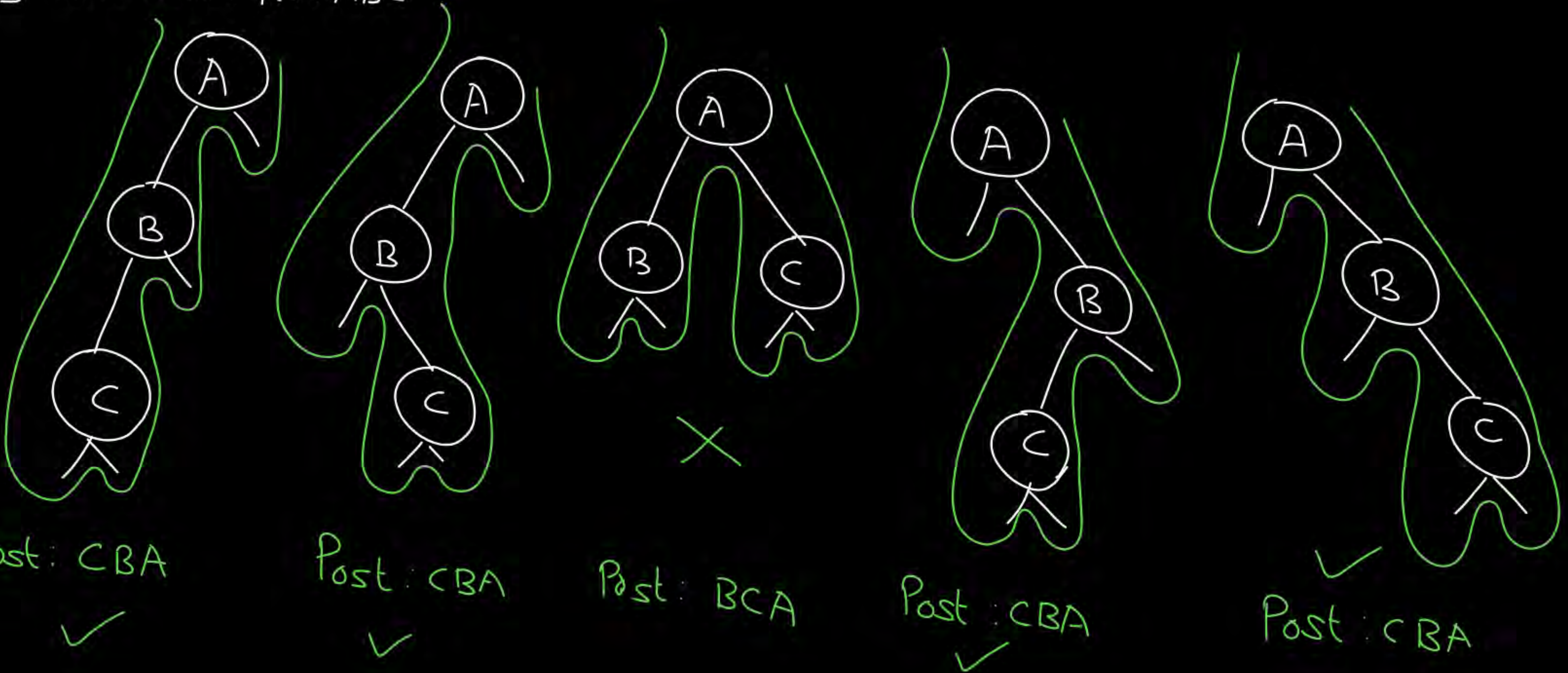
binary trees with Pre : ABC



No. of binary trees possible with Pre : ABC

Post : CBA

binary trees with Pre : ABC

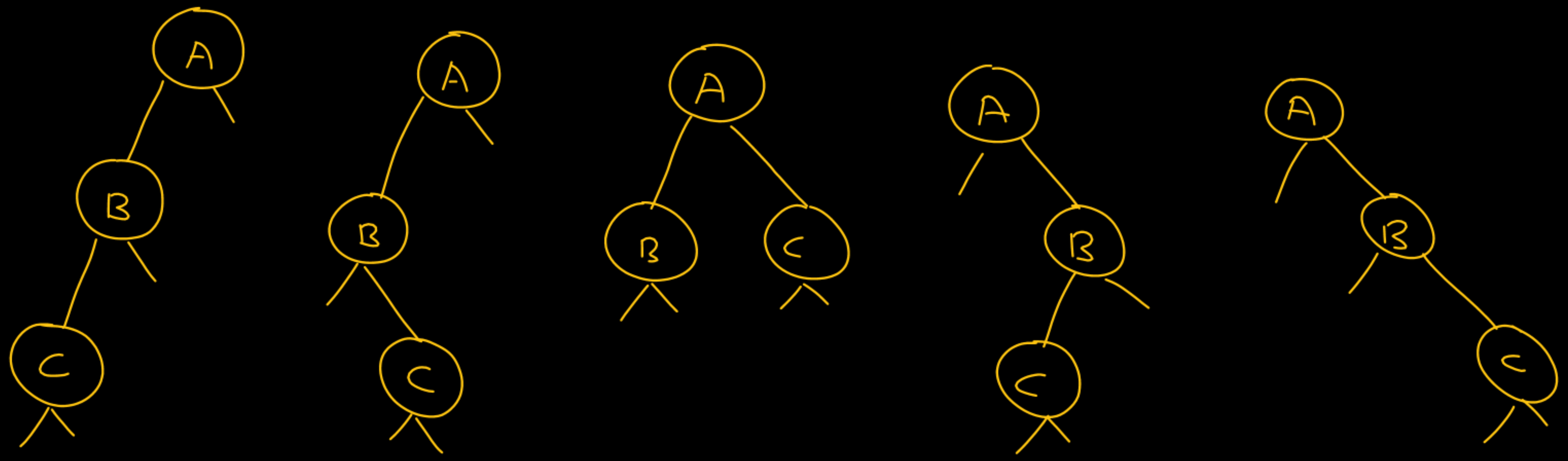


With a given pre and post-order , no. of binary tree $\Longrightarrow$ many

No. of binary trees with Pre : ABC

In : BAC

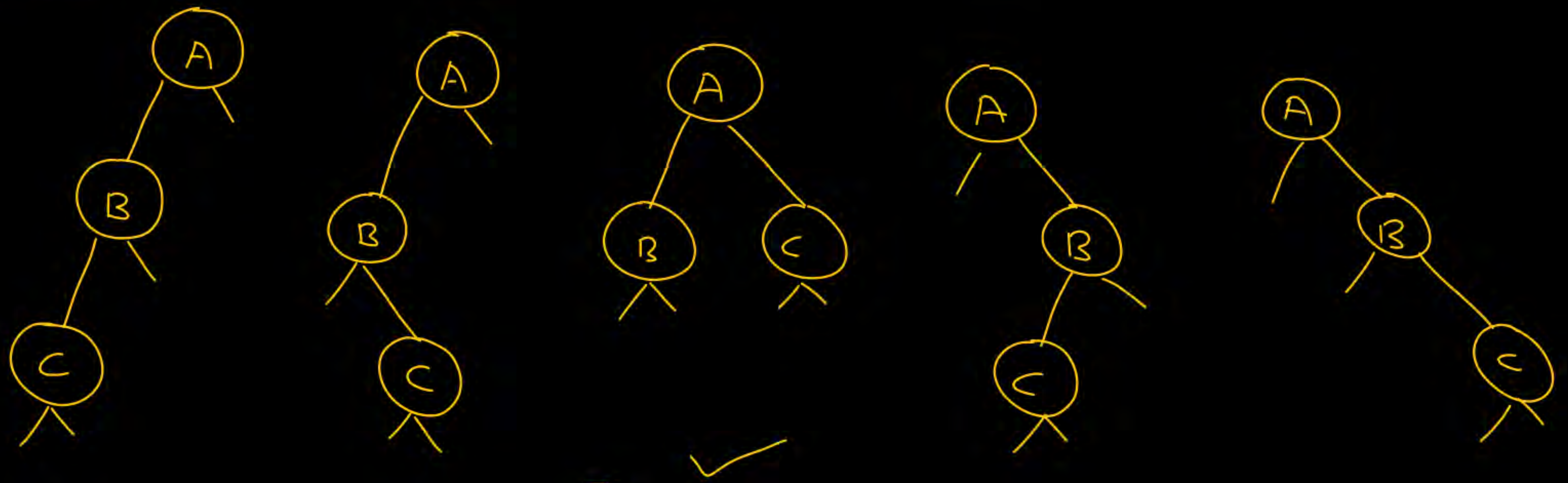
Pre : ABC



No. of binary trees with Pre: ABC

In: BAC

Pre: ABC



In: CBA

In: BCA

In: BAC

In: ACB

In: ABC

With a given pre-order & In-order, no. of binary trees = Atmost 1

= 1 (In general)

* No. of binary trees with given preorder (n length)

= No. of binary trees with given Inorder (n length)

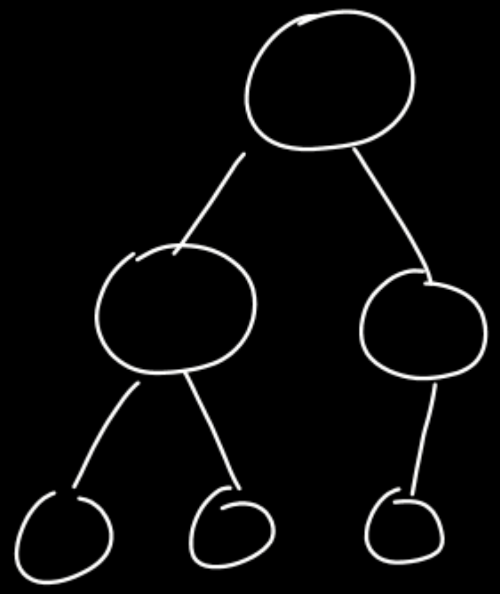
= No. of binary trees with given postorder (n length)

$$= \frac{{}^{2n}C_n}{n+1}$$

* No. of binary trees with given pre-order & post-order $\Rightarrow$ many

* No. " " " " pre-order & In-order $\Rightarrow$ 1

* " " " " " post-order & In-order $\Rightarrow$ 1



Pre-order

In-order

Given:

Pre :

In :

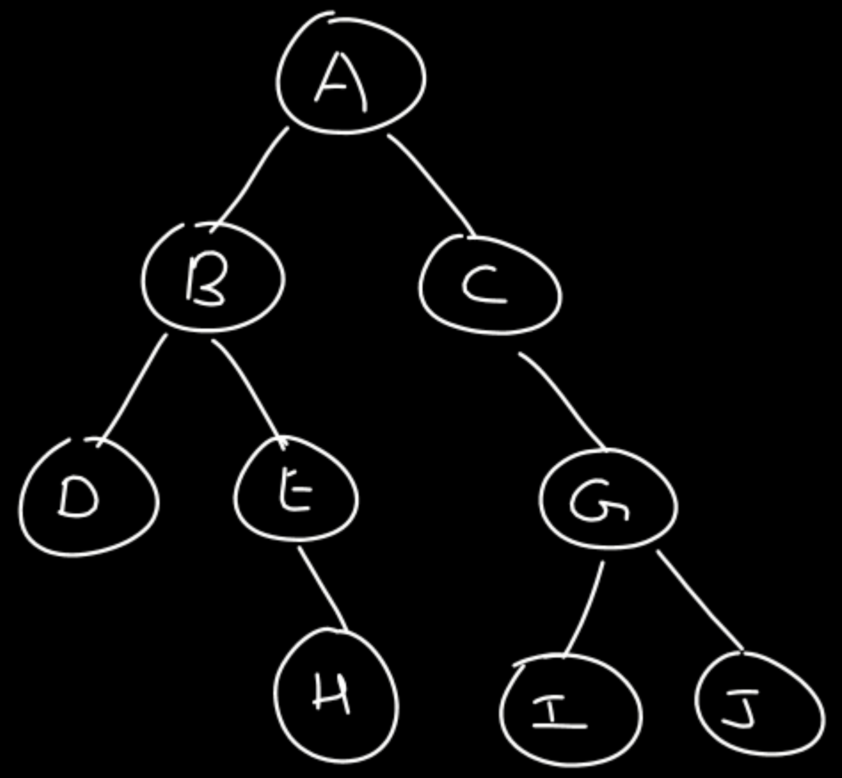
$\Rightarrow$ No. of binary trees = 1

Randomly

$$\left.\begin{array}{l} \text{Pre : ABC} \\ \text{In : CAB} \end{array}\right\} \Longrightarrow \text{Atmost 1}$$

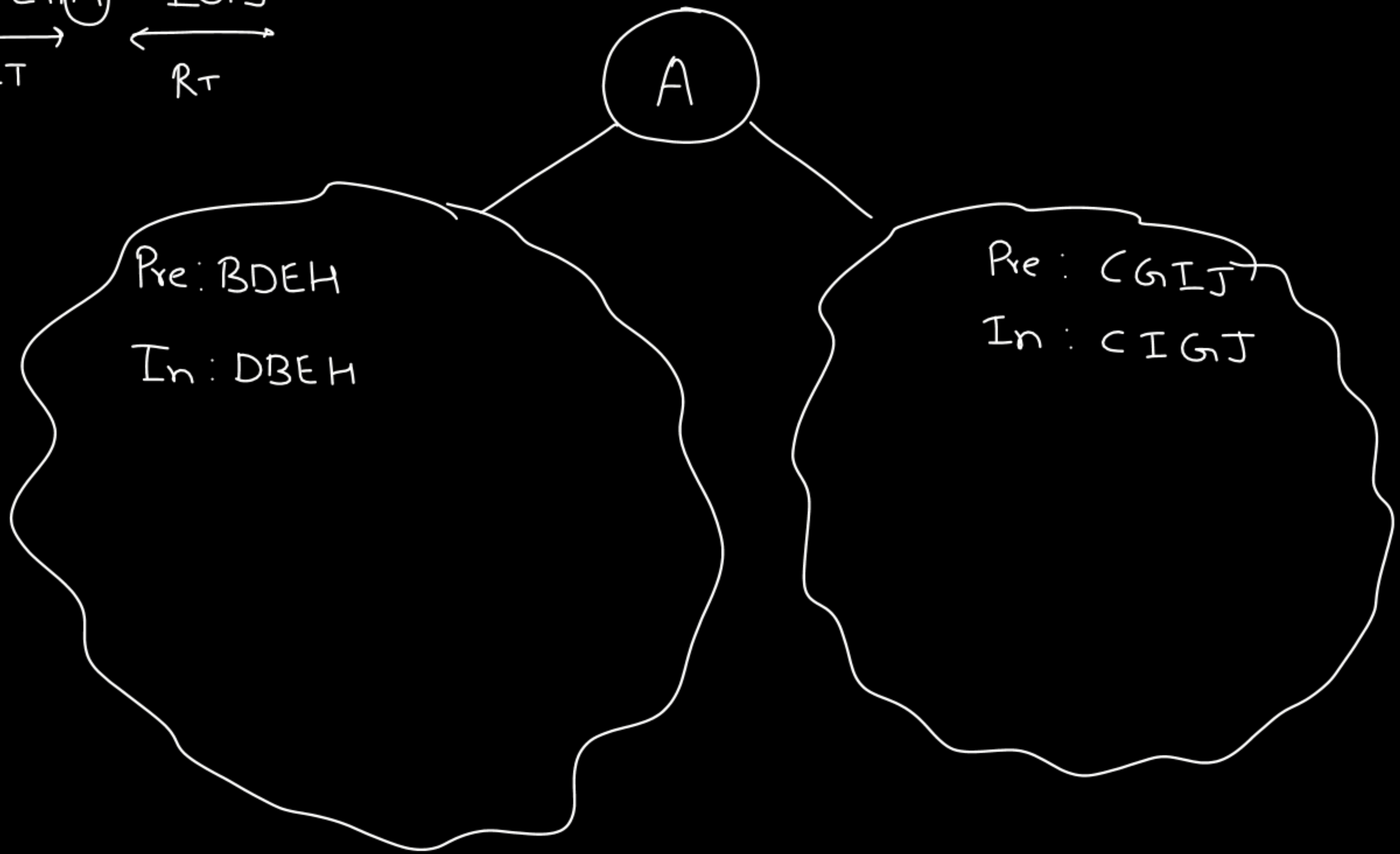
Pre : A B D E H C G I J

In : D B E H A C I G J



Pre : A$\underline{\text{BDEH}}$CGIJ

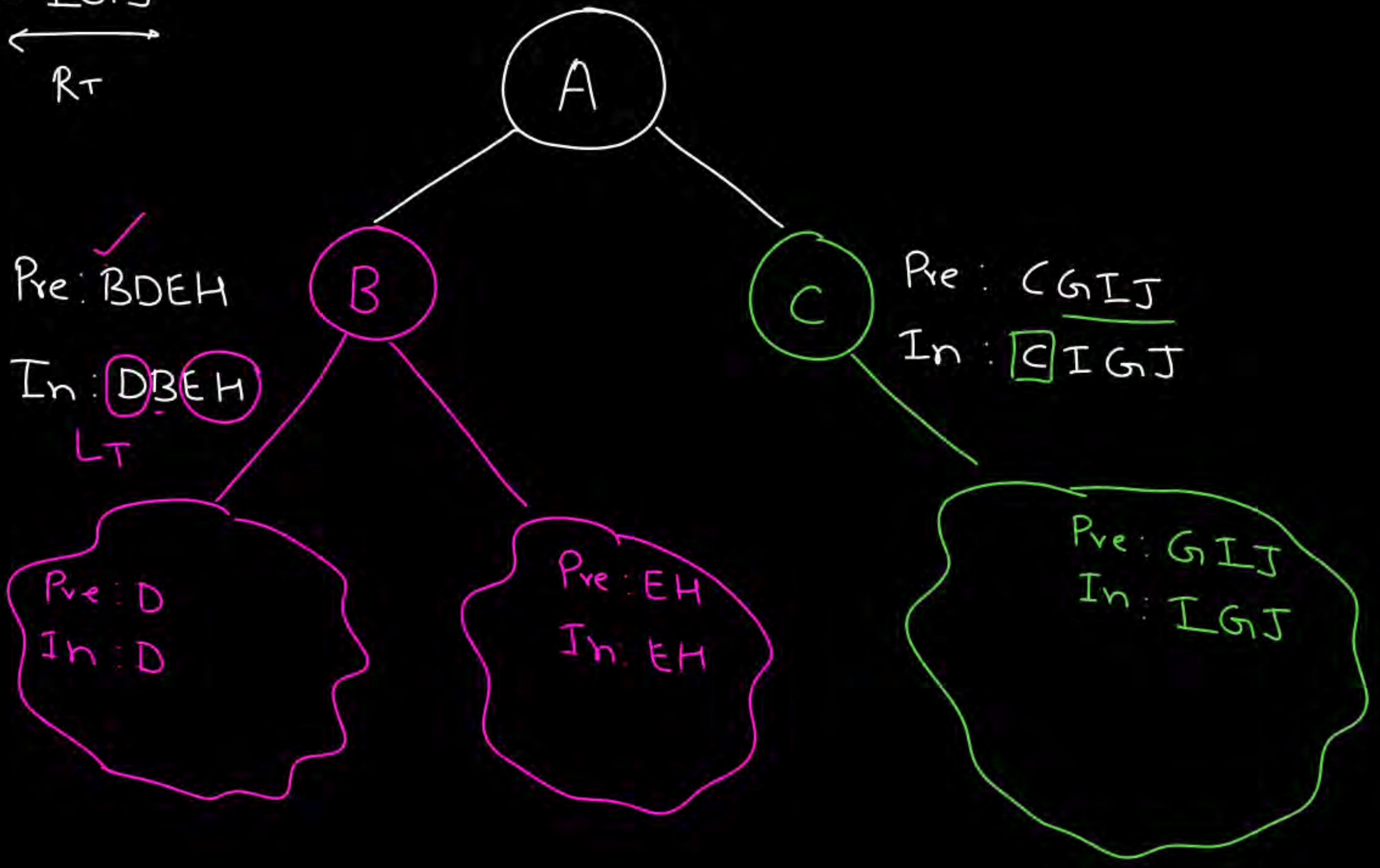
In : $\underbrace{\text{DBEH}}_{LT}$ A $\underbrace{\text{CIGJ}}_{RT}$



Pre : ABDEHCGIJ

In : DBEHACIGJ

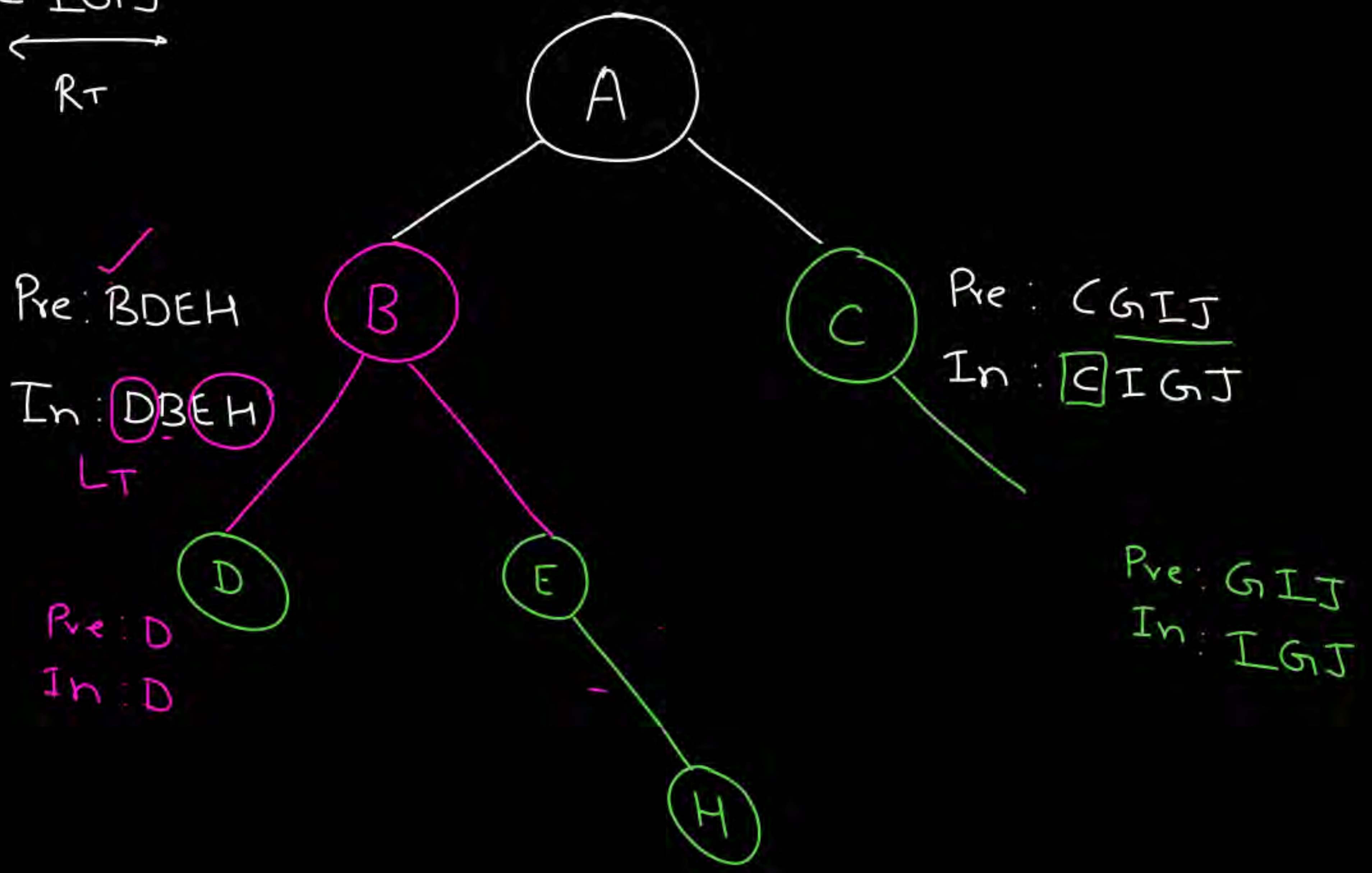
LT RT



Pre : ABDEHCGIJ

In : DBEHACIGJ

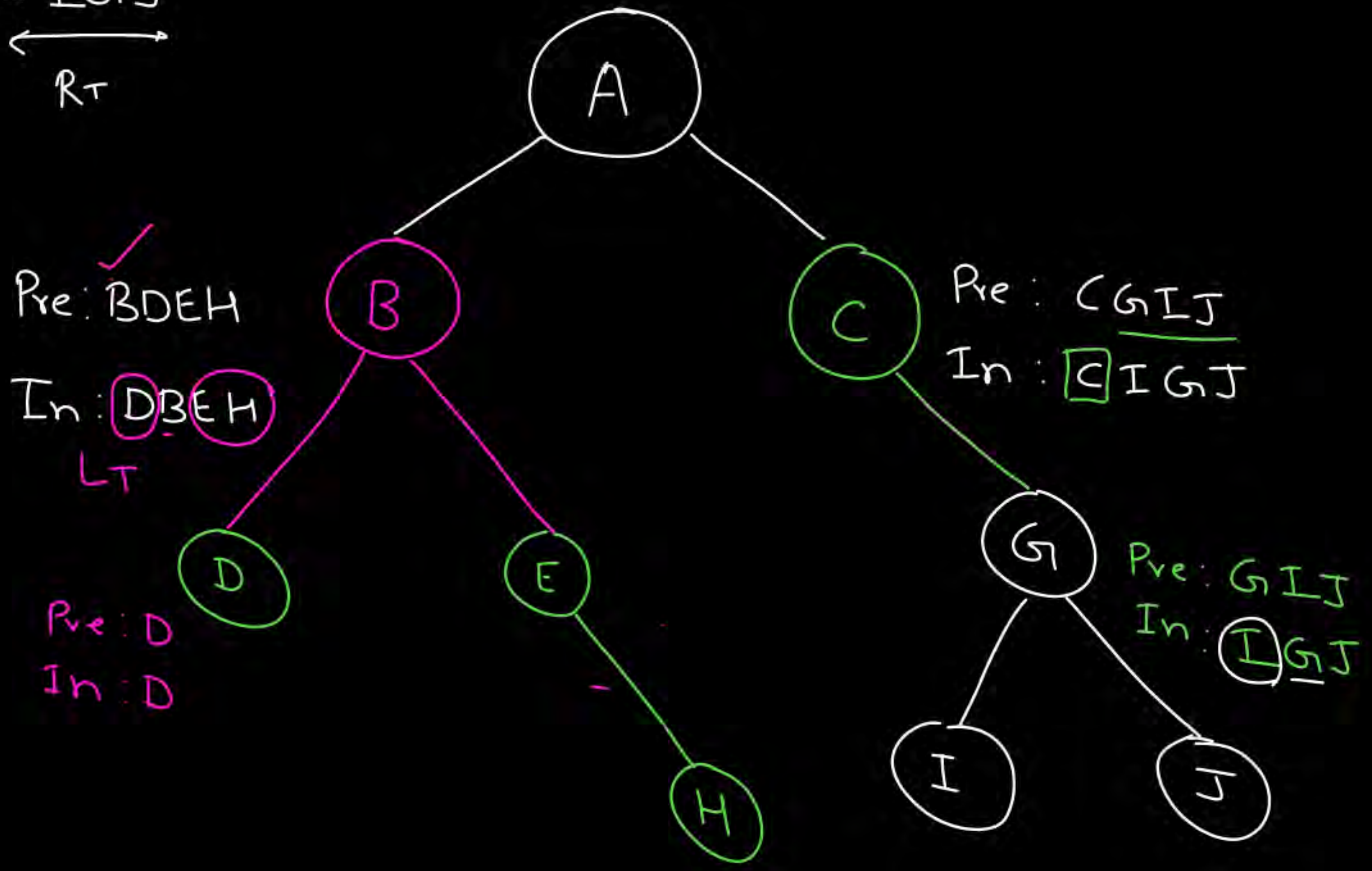
LT RT



Pre : ABDEHCGIJ

In : DBEHACIGJ

LT RT



Pre : ABDEHCGIJ

In : DBEH$\boxed{A}$CIGJ

Short-trick

A

Mark करो Inorder में

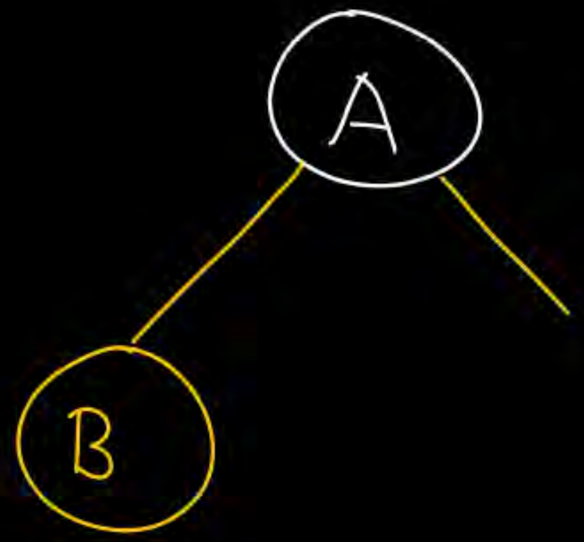
Short-trick

Pre : ABDEHCGIJ

In : DBEH $\boxed{A}$ CIGJ

is in the left of marked node

B A ⇒

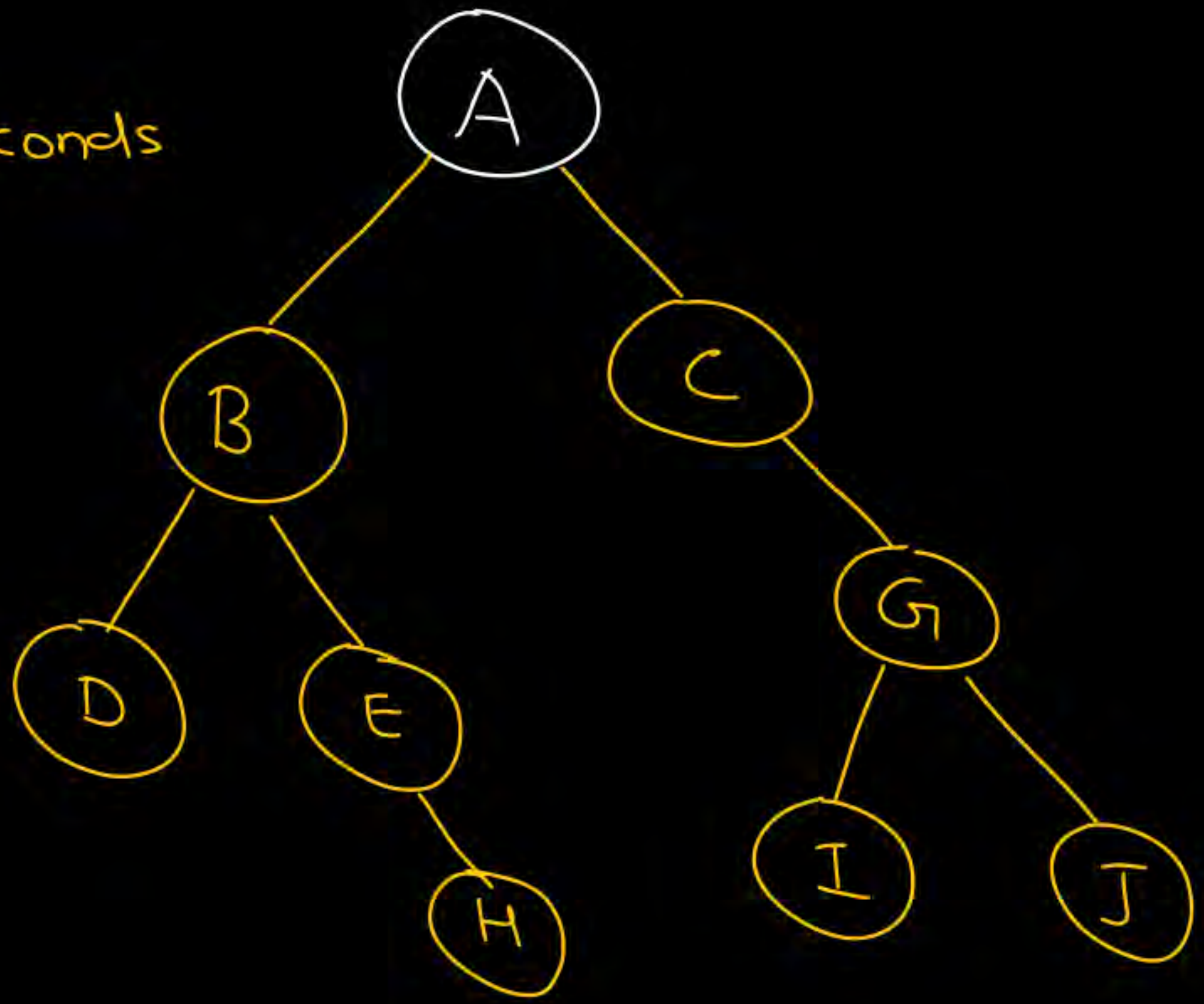


Short-trick

Pre : A B D E H C G I J

In : D B E H A C I G J

20 seconds




THANK YOU GW
SOLDIERS !