

Binary Search Tree

Course on C-Programming & Data Structures: GATE - 2024 & 2025

Data Structure

Tree 6 (B.S.T.)

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Hello!

I am Vishvadeep Gothi

I am here because I love to teach

Searching so far

① array → Linear \Rightarrow R.T.C. $\Rightarrow O(n)$

array → Binary \Rightarrow R.T.C. $\Rightarrow O(\log n)$

↳ applicable on only sorted array

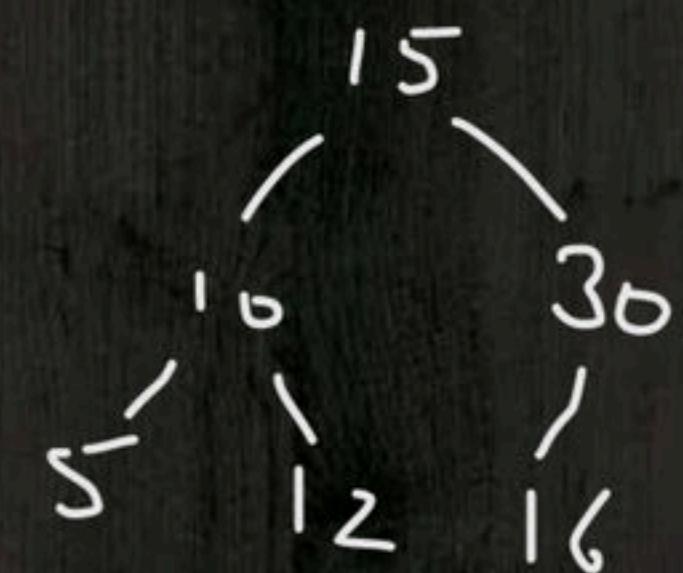
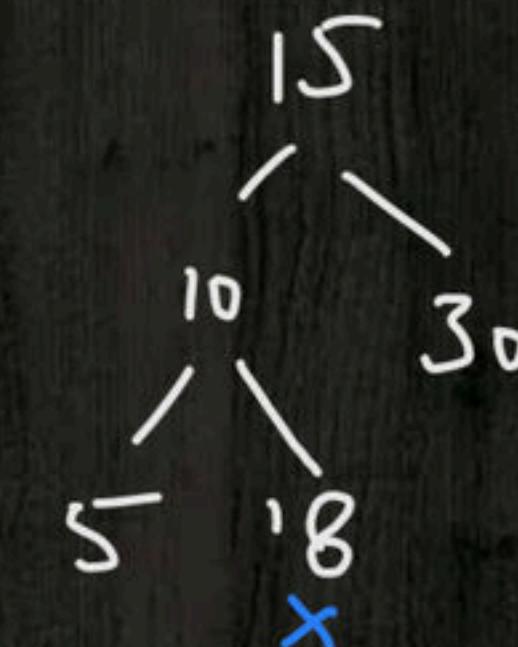
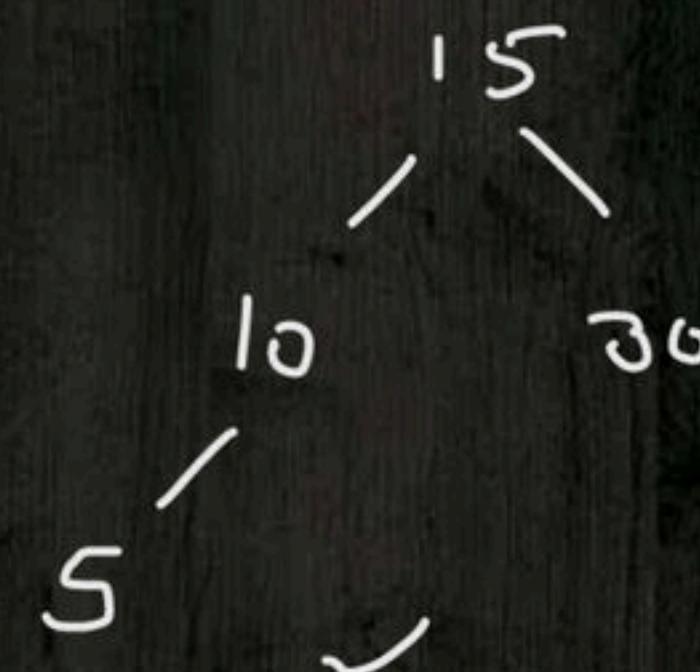
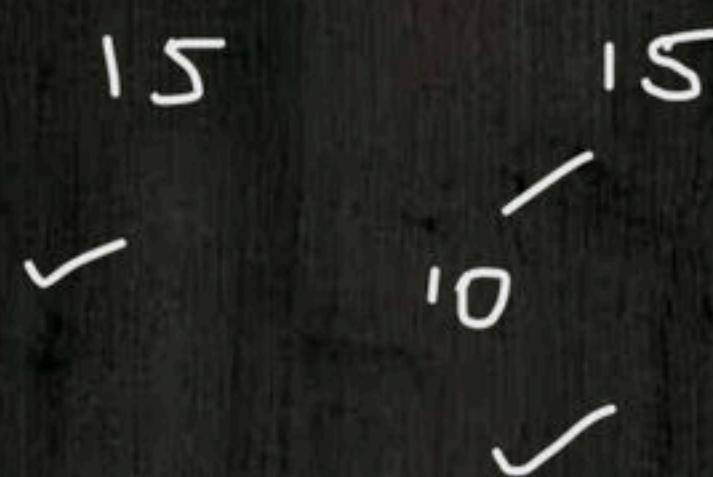
hence to maintain sorted

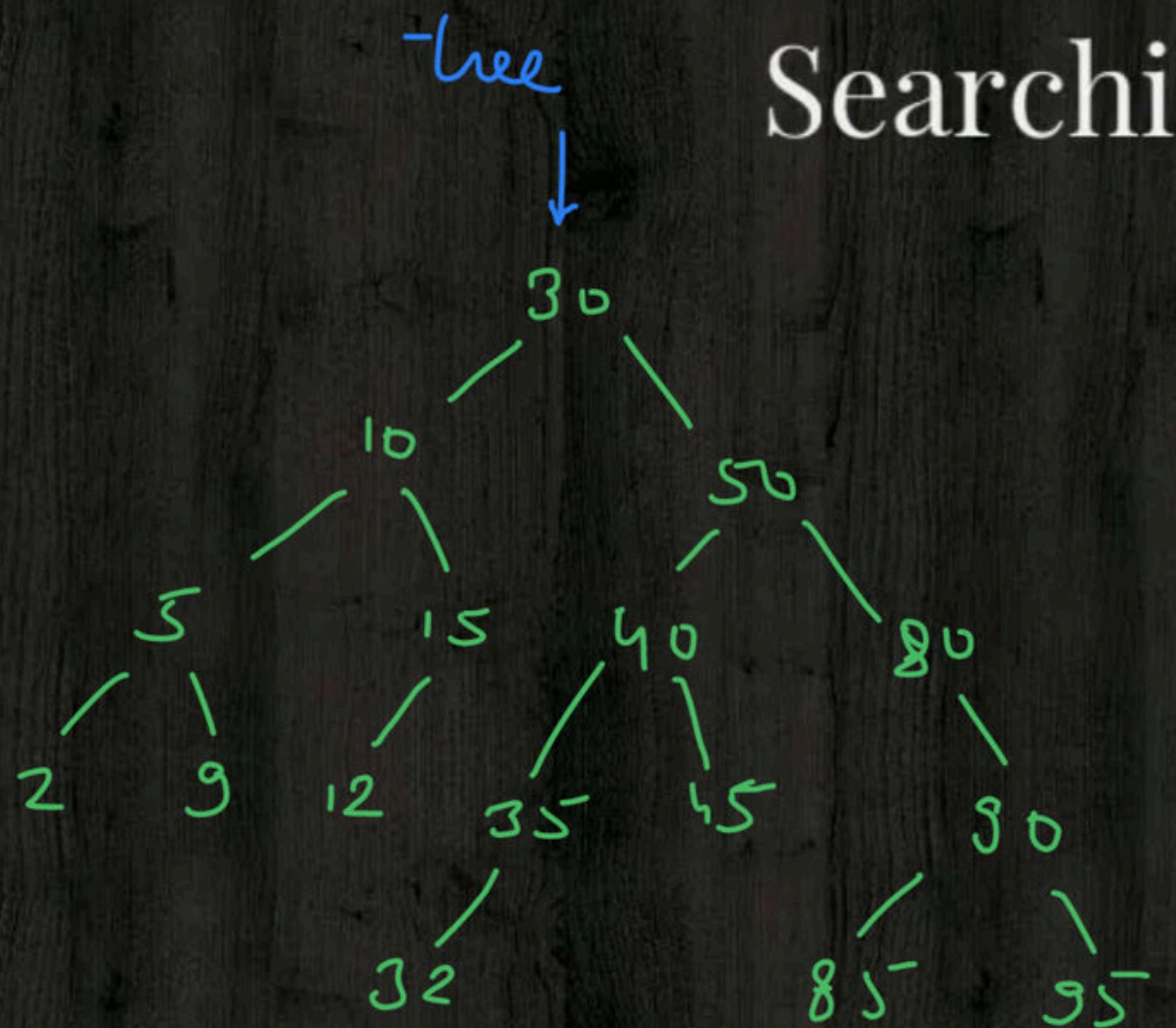
array $\xrightarrow{\text{Insert}} \xrightarrow{\text{Delete}} \{O(n)\}$

② Linked-List \rightarrow linear \Rightarrow R.T.C. $\Rightarrow O(n)$

Binary Search Tree (BST)

A B.T. in which for every node, its left subtree contains smaller (lesser) values and right subtree contains greater value.





Searching in BST

search \Rightarrow 12

searching sequence $\Rightarrow 30, 10, 15, 12$
 (elements compared with 12)

Search \Rightarrow 85-

seq :- 30, 50, 80, 90, 85-

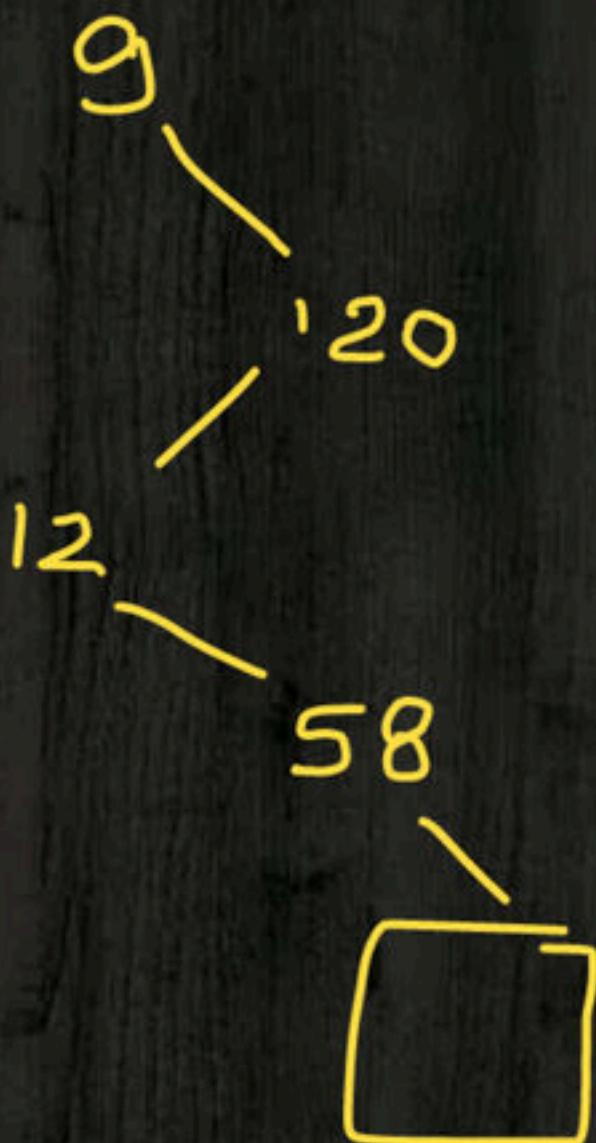
Search \Rightarrow 34

seq:- 30, 50, 40, 35, 32

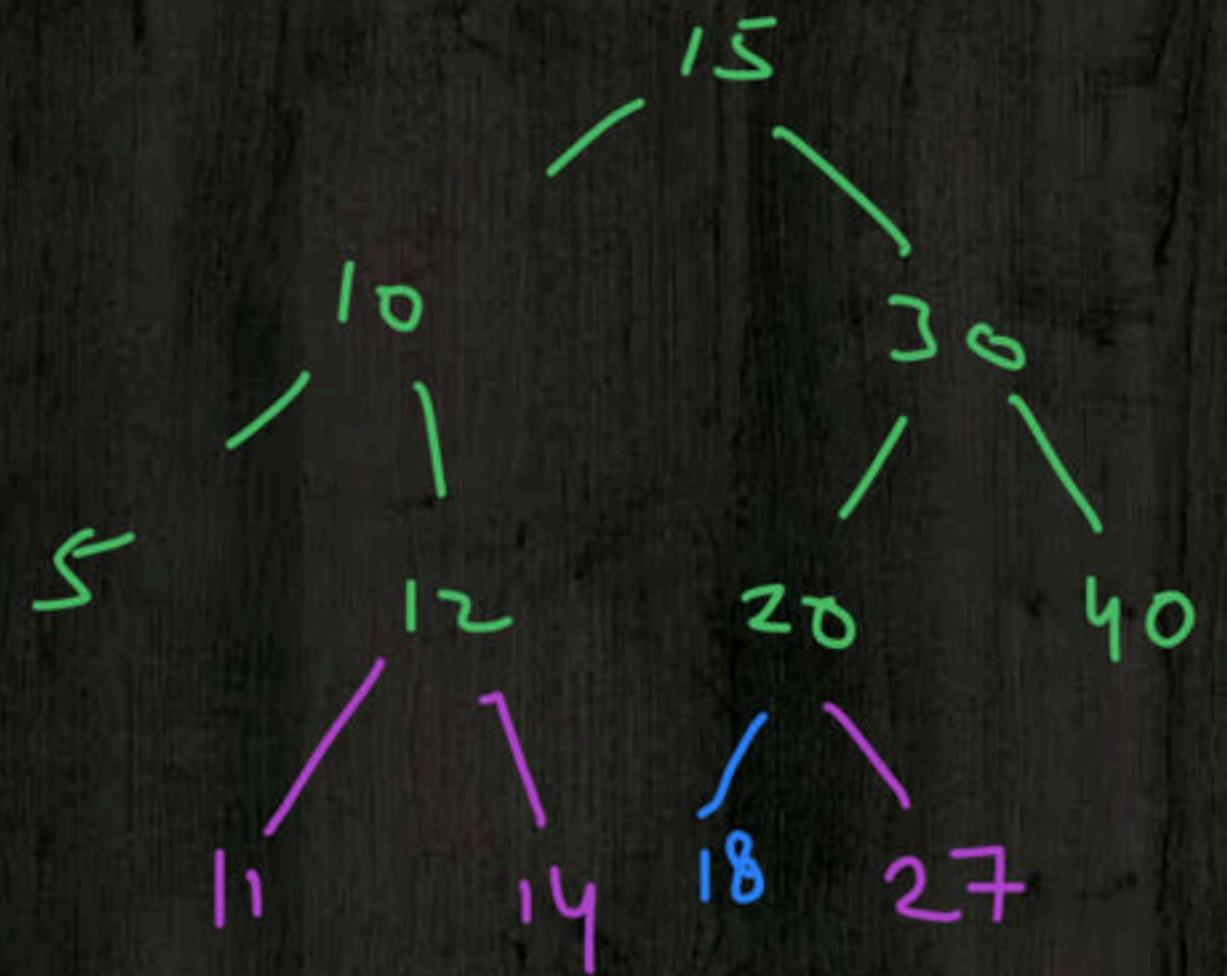
Question

Q. Identify the correct/wrong sequences for searching 80 in a BST?

- a) 9, 120, 12, 58, 88, 81, 86, 50, 84 → 80 in right subtree of 58.
- b) 198, 47, 111, 58, 71, 90, 65, 75, 54, 89
- c) 15, 33, 46, 109, 94, 80, 
- d) 17, 37, 49, 117, 96, 85, 15, 56, 80
- e) 20, 40, 90, 48, 68, 79, 81

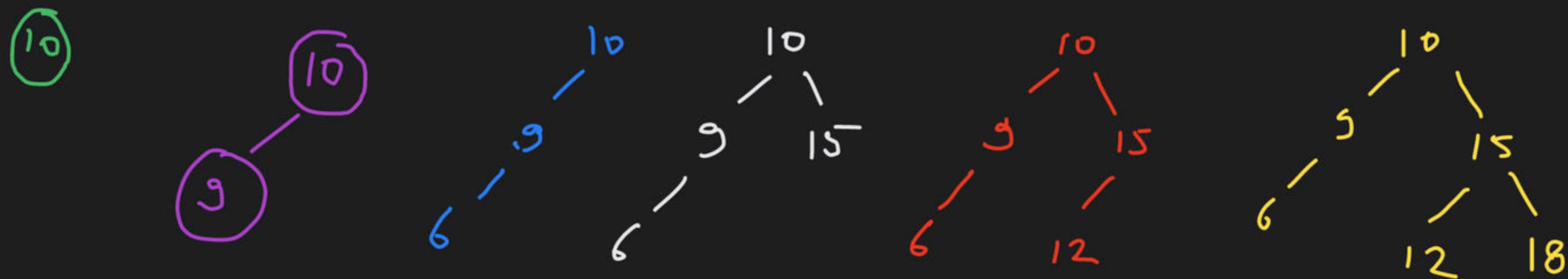


Insertion in BST



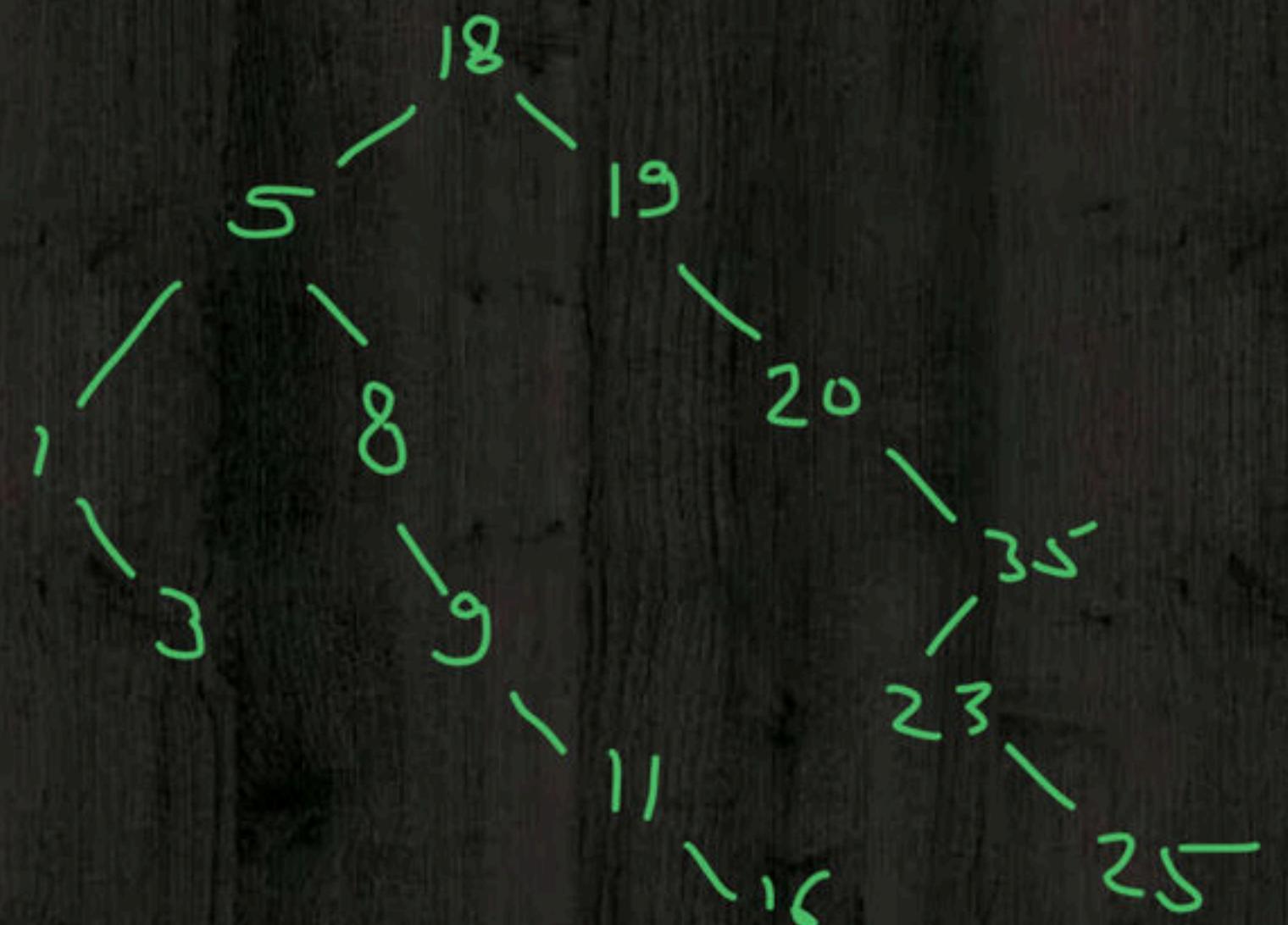
Insert => 27, 14, 11, 18

Construct BST using given keys:- 10, 9, 6, 15-, 12, 18



Question

Construct BST using keys: 18, 5, 8, 19, 20, 35, 23, 9, 11, 16, 1, 3, 25



Finding Minimum

```
int find-min (struct BTnode *t)
{
    if (t == NULL) return;
    while (t->Lchild != NULL)
    {
        t = t->Lchild;
    }
    return t->data;
}
```

```
int find-min (struct BTnode *t)
{
    if (!t) return;
    if (!t->Lc) return t->data;
    return find-min (t->Lc);
}
```

Finding Maximum

```
int find_max ( struct BTree *t ) {  
    if (!t) return;  
    while (t->RC != NULL)  
    {  
        t = t->RC;  
    }  
    return t->data;  
}
```

```
int find_max ( struct BTree *t ) {  
    if (!t) return;  
    if (!t->RC) return t->data;  
    return find_max (t->RC);  
}
```

Inorder of BST

Inorder traversal of a BST is a sorted seq. in ascending order.

Converse inorder traversal of BST
is a sorted seq. in descending order

Ques) Consider a pre-order traversal seq. of a BST:-

15, 10, 9, 12, 19, 17, 20

Inorder traversal of tree is ?

Ans:-

9, 10, 12, 15, 17, 19, 20

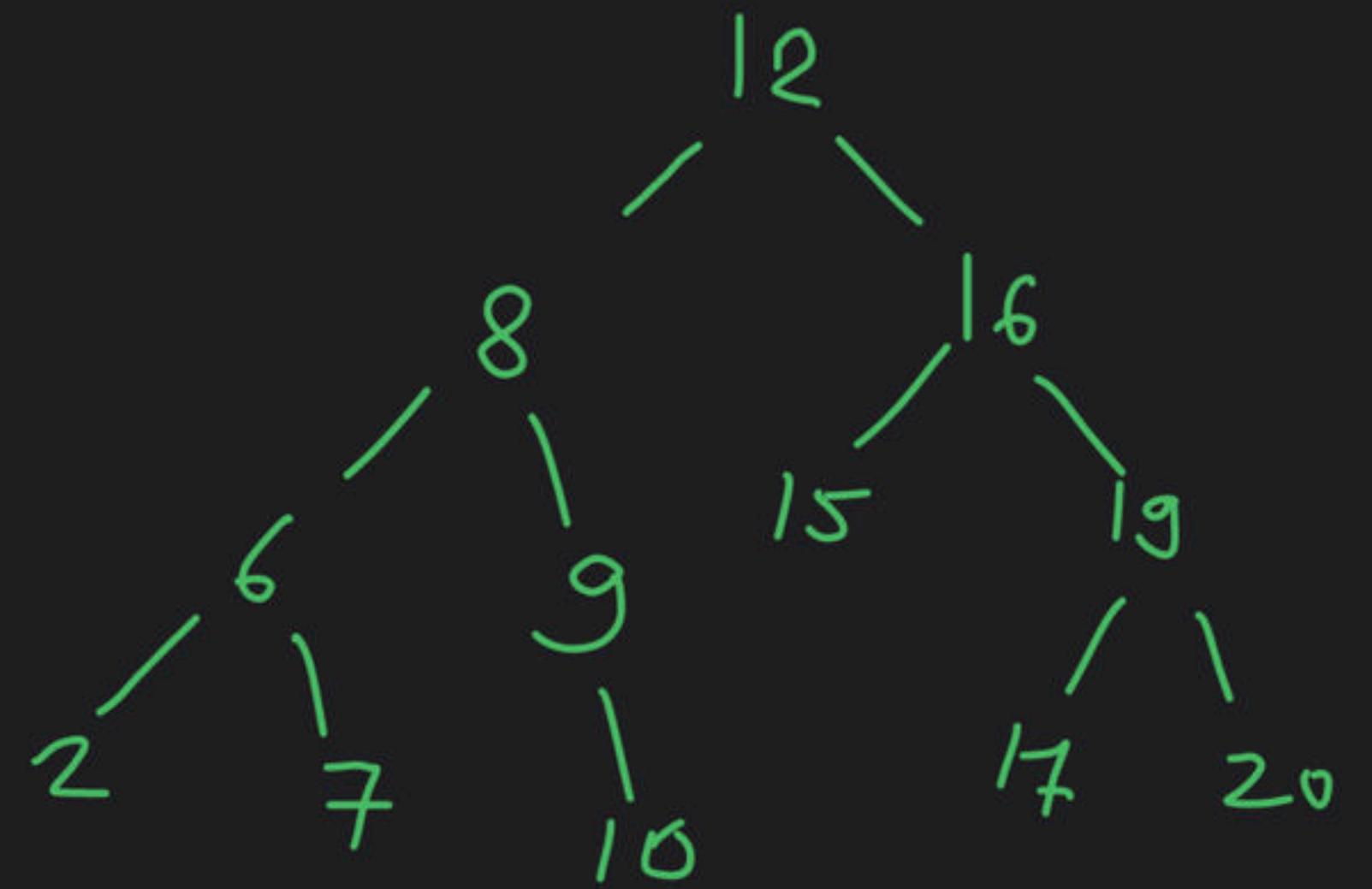
Question GATE-2017

The pre-order traversal of a binary search tree is given by 12, 8, 6, 2, 7, 9, 10, 16, 15, 19, 17, 20.

Then the post-order traversal of this tree is:

- (A) 2, 6, 7, 8, 9, 10, 12, 15, 16, 17, 19, 20
- (B) 2, 7, 6, 10, 9, 8, 15, 17, 20, 19, 16, 12
- (C) 7, 2, 6, 8, 9, 10, 20, 17, 19, 15, 16, 12
- (D) 7, 6, 2, 10, 9, 8, 15, 16, 17, 20, 19, 12

Inorder of BST \Rightarrow construct BST using keys
by inserting from left-to-right.

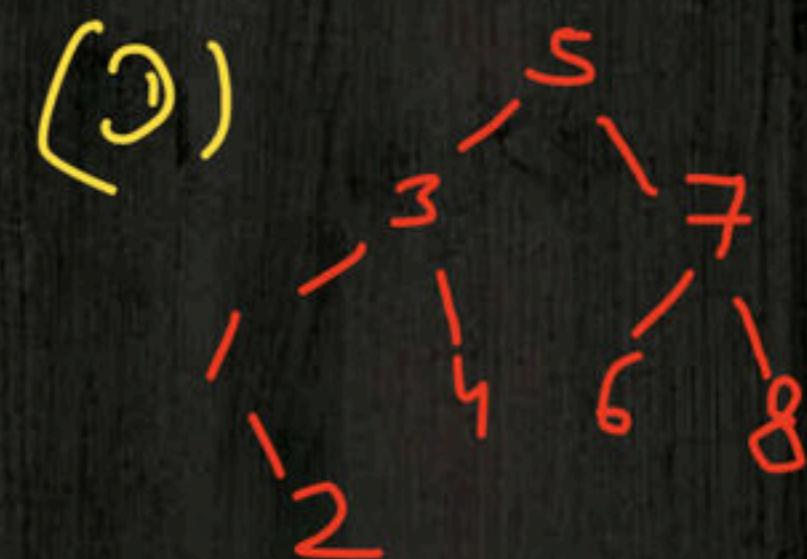
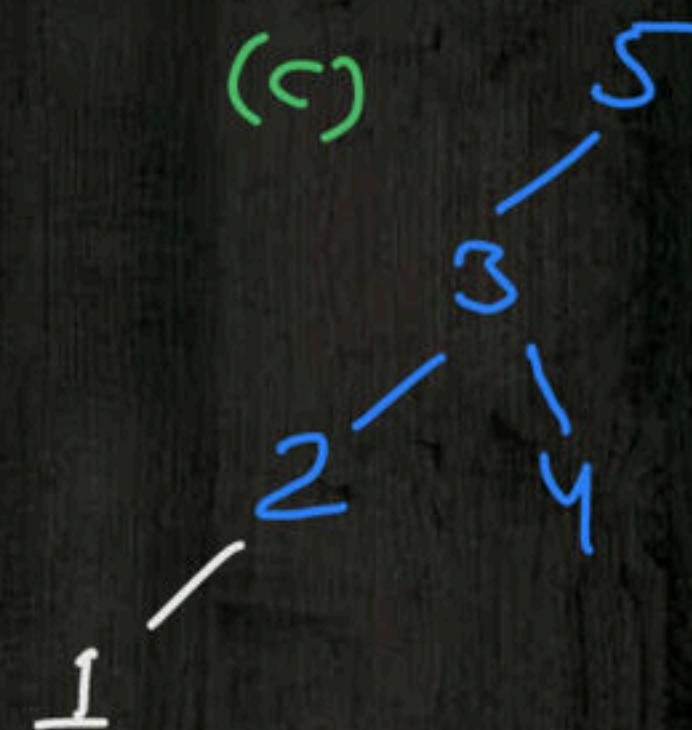
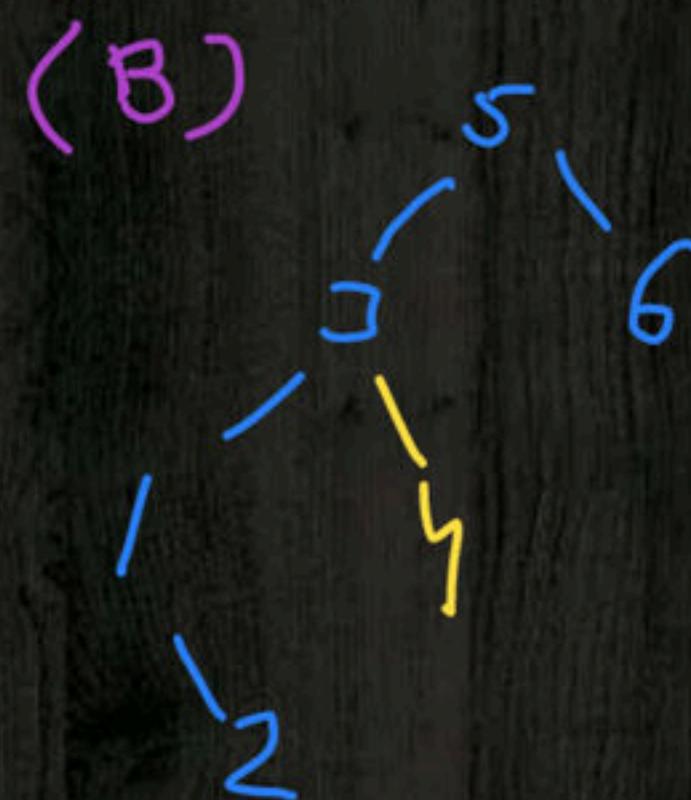
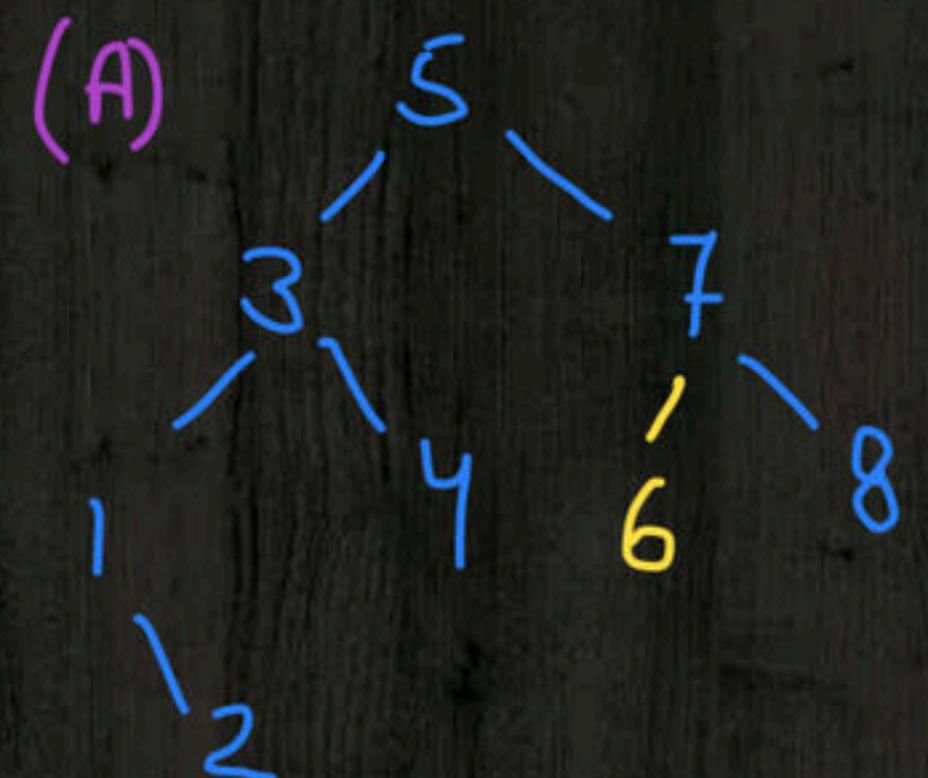


Post :- 2, 7, 6, 10, 9, 8, 15, 17, 20, 19, 16, 12

Question GATE-1997

A binary search tree contains the value 1,2,3,4,5,6,7,8. The tree is traversed in pre-order and the values are printed out. Which of the following sequences is a valid output?

- (A) A. 5 3 1 2 4 7 8 6
- B. 5 3 1 2 6 4 8 7
- C. 5 3 2 4 1 6 7 8
- D. 5 3 1 2 4 7 6 8



If "postorder of BST" is given

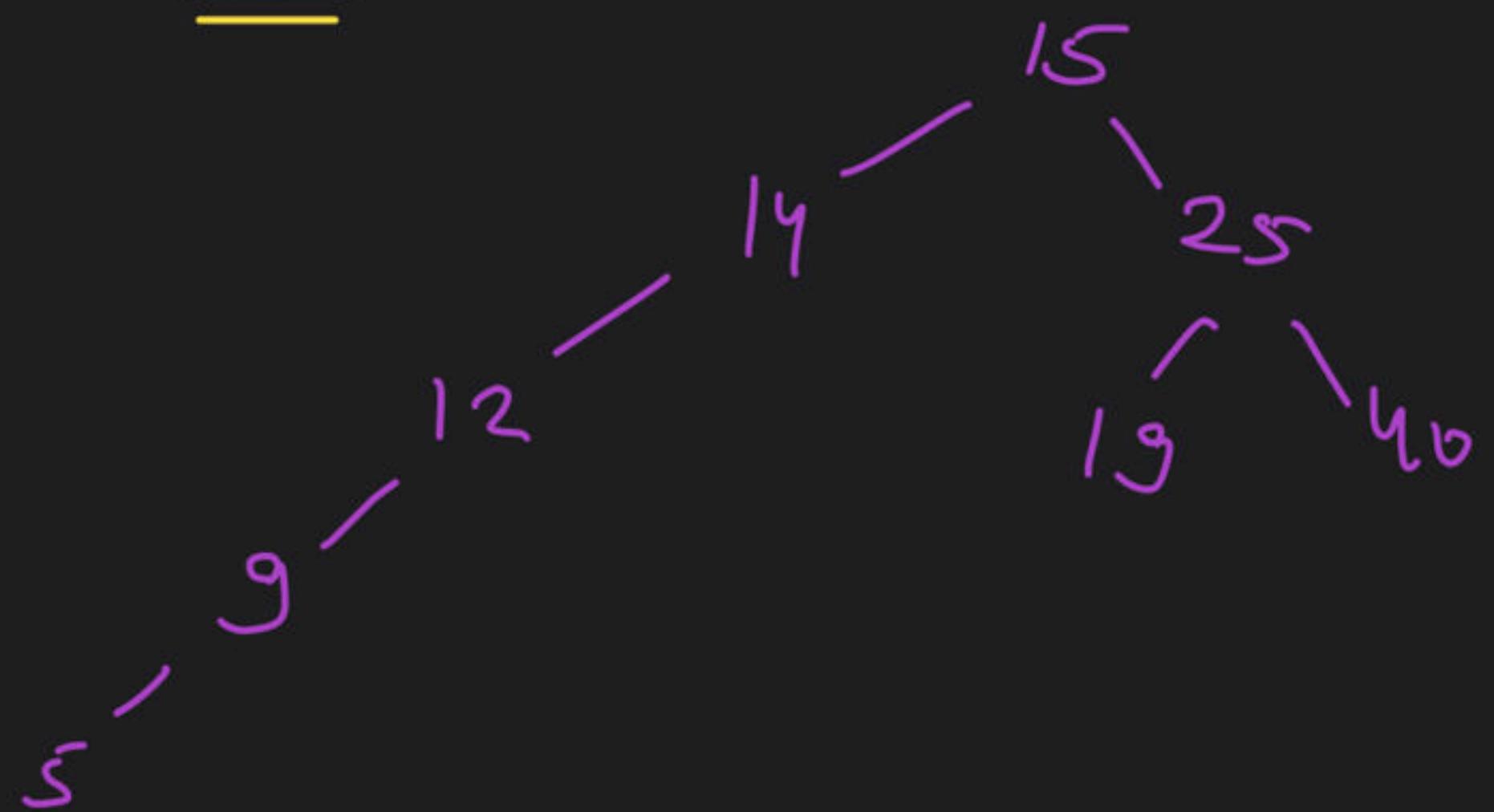


construct BST by inserting keys from
right to left

Ques] Post order :-

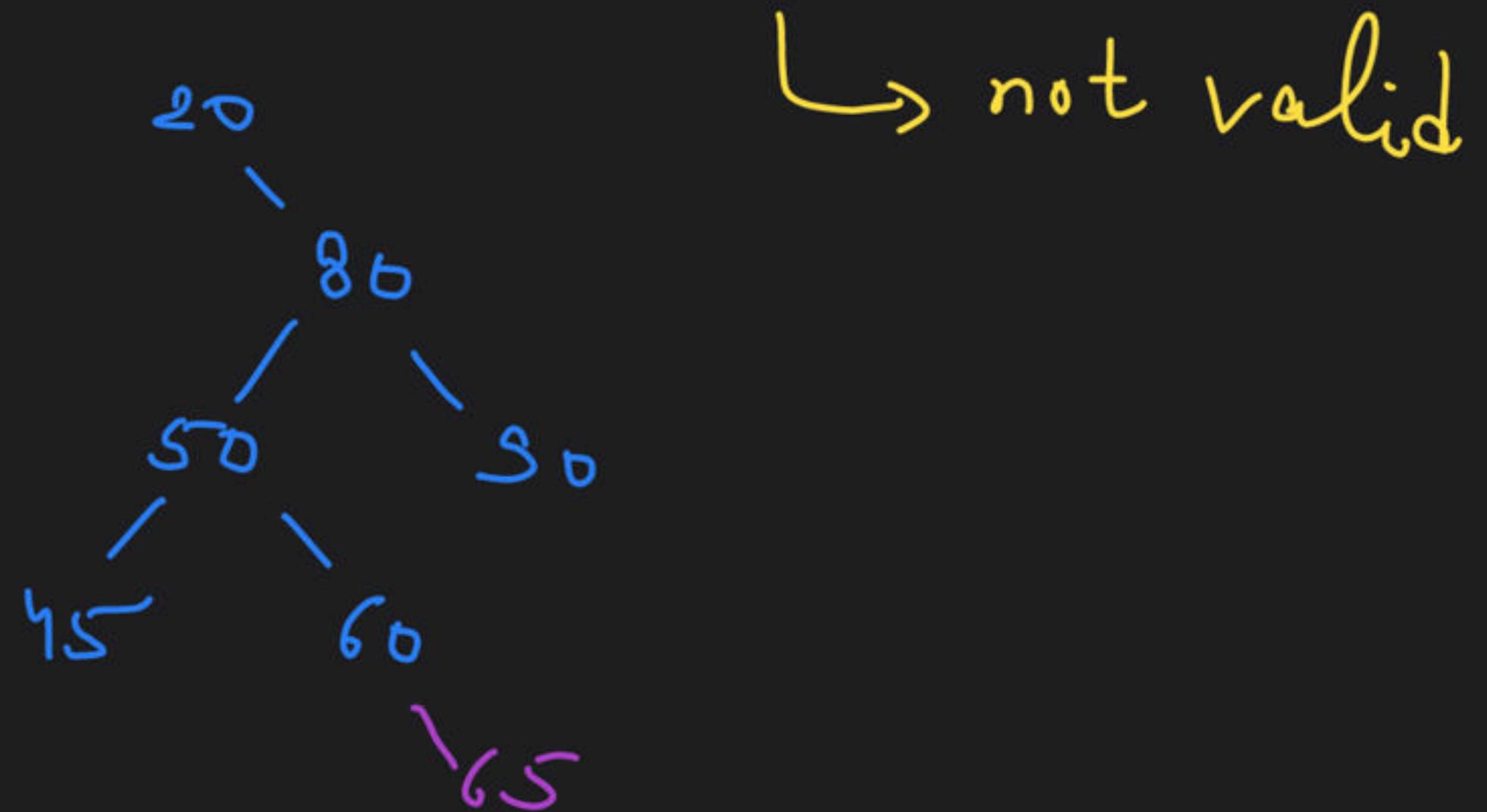
5, 9, 12, 14, 19, 40, 25, 15

Tree :-



Ques) Check validity of given postorder traversal of BST {

15, 65, 45, 60, 50, 90, 80, 20



Question GATE-2011

We are given a set of n distinct elements and an unlabeled binary tree with n nodes. In how many ways we can populate the tree with the given set so that it becomes a BST?

- A. 0
- B. 1
- C. $n!$
- D. $\frac{c(2n,n)}{n+1}$

Number of BSTs Using n-distinct Keys

Question GATE-2007

When searching for a key value 60 in a BST, nodes containing the key values 10, 20, 40, 50, 70, 80, 90 are traversed, not necessarily in the same order given. How many different orders are possible in which these key values can occur on the search path from the root to the node containing the value 60?

Deletion in BST





DPP

✓Question

A Binary search Tree (BST) store value in the range 37 to 573.
Consider the following sequences of keys.

- I. 81, 537, 102, 439, 285, 376, 305
- II. 52, 97, 121, 195, 242, 381, 472
- III. 142, 248, 520, 386, 345, 270, 307
- IV. 550, 149, 507, 395, 463, 402, 270

Suppose the BST has been unsuccessfully searched for key 273.
Which all of the above sequences list nodes in the order in which we
could have encountered them in the search

Question

Identify correct or wrong searching sequence for searching 50.

1. 80, 73, 65, 45, 57, 49, 71, 82, 50
2. 40, 45, 90, 80, 70, 60, 63, 36, 50
3. 24, 33, 46, 98, 47, 80, 75, 61, 48, 50
4. 28, 95, 29, 94, 37, 85, 39, 71, 43, 50
5. 36, 39, 84, 81, 73, 67, 45, 59, 35, 50

✓ Question

Construct BST using keys: Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday

Number of leaf nodes in the tree are?

✓ Question

Construct BST using keys: 4, 2, 6, 5, 1, 3, 7
What is the maximum level number in tree?

✓ Question GATE-2015

While inserting the elements 71, 65, 84, 69, 67, 83 in an empty binary search tree (BST) in the sequence shown, the element in the lowest level is

~~Question~~

While inserting the elements 56, 23, 78, 54, 53, 89, 74, 12, 5, 29, 34, 9, 6, 63, 70, 59, 80, 19, 35 in an empty binary search tree (BST) in the sequence shown, the maximum level number in the tree is?

Question

The Postorder traversal of a binary search tree is 2, 4, 3, 9, 13, 7, 6, 17, 20, 18, 15,. Which one of the following is the preorder traversal of the tree ?

~~Question~~ GATE-2020

The preorder traversal of a binary search tree is 15, 10, 12, 11, 20, 18, 16, 19. Which one of the following is the postorder traversal of the tree ?

- (A) 10, 11, 12, 15, 16, 18, 19, 20
- (B) 11, 12, 10, 16, 19, 18, 20, 15
- (C) 20, 19, 18, 16, 15, 12, 11, 10
- (D) 19, 16, 18, 20, 11, 12, 10, 15

Question

A binary search tree contains the value 1,2,3,4,5,6,7,8. The tree is traversed in pre-order and the values are printed out. Which of the following sequences is a valid output?

- A. 4 2 1 3 8 6 7 5
- B. 4 2 3 1 8 5 7 6
- C. 4 2 1 3 7 6 8 5
- D. 4 2 1 3 8 5 7 6

Question

A binary search tree contains the value 1,2,3,4,5,6,7,8. The tree is traversed in post-order and the values are printed out. Which of the following sequences is a valid output?

- A. 1 2 4 3 8 6 7 5
- B. 1 4 2 3 6 8 7 5
- C. 1 2 4 6 3 8 7 5
- D. 1 2 4 3 6 8 7 5

Happy Learning