

BINARY SEARCH TREE

Problem Solving with Computers-II

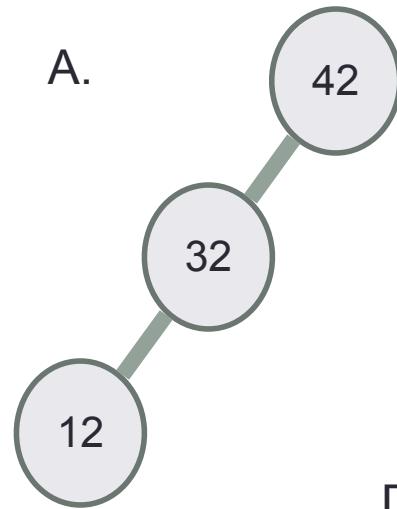
C++

```
#include <iostream>
using namespace std;

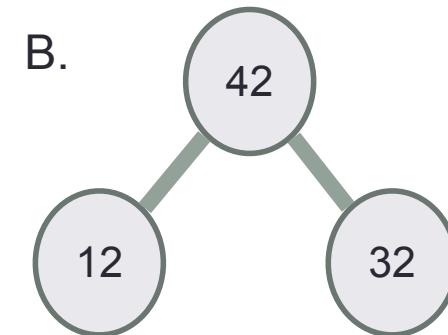
int main(){
    cout<<"Hola Facebook\n";
    return 0;
}
```

Which of the following is/are a binary search tree?

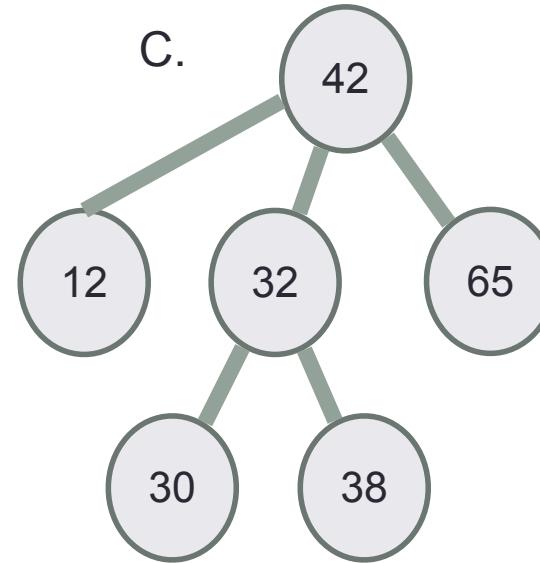
A.



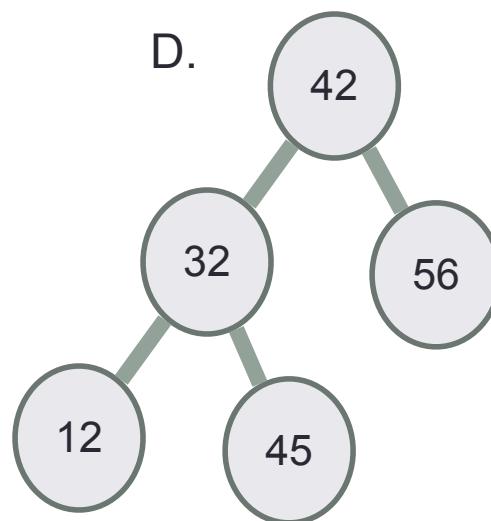
B.



C.



D.



E. More than one of these



Goal: To articulate the algorithm for inserting a key into a BST

Insert keys: 41, 45, 32, 42, 12

Traversal algo	BST	Output
<pre data-bbox="0 195 788 606">inorder(r: pointer to current node): if r is null: return inorder(r->left) process r (e.g., print r->val) inorder(r->right)</pre>		
<pre data-bbox="0 606 788 1031">postorder(r: pointer to current node): if r is null: return postorder(r->left) postorder(r->right) process r (e.g., print r->val)</pre>		
<pre data-bbox="0 1031 788 1440">preorder(r: pointer to current node): if r is null: return process r (e.g., print r->val) postorder(r->left) postorder(r->right)</pre>		

When would you use each traversal and why?

Pre-order traversal Game!

1. **Draw a BST:** Individually, draw a BST with 6 distinct keys (e.g., integers 1–10). Your
Your BST (draw secretly):

2. **Trace Preorder Sequence:** Trace the preorder traversal (root, left, right) of your BST
and write the sequence of node values.

Your Preorder sequence:

(read the sequence to your partner, don't show them your BST diagram!)

Pre-order traversal Game!

3. Write the PreOrder sequence you received:

4. **Reconstruct the BST:** Using your partner's sequence, rebuild their BST by inserting nodes in the given order, respecting BST properties.

5. Compare trees

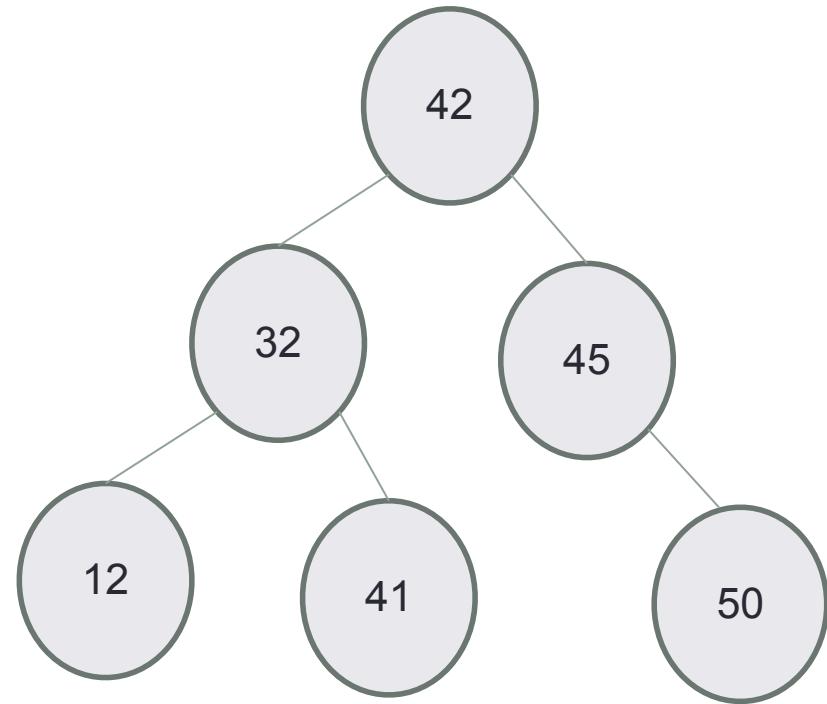
Leetcode problem

Given the root of a binary tree, return the preorder traversal of its nodes' values in a vector.

```
class Solution {  
public:  
    vector<int> preorderTraversal(TreeNode* root) {}  
};
```

<https://leetcode.com/problems/binary-tree-preorder-traversal/description/?envType=problem-list-v2&envId=depth-first-search>

Interview question: Write a function to extract BST keys into a vector. The extraction order must allow reconstructing the exact same tree structure by sequential insertion.



<https://leetcode.com/problems/binary-tree-preorder-traversal/description/?envType=problem-list-v2&envId=depth-first-search>

Post-order traversal: use to recursively clear the tree!

postorder(r : pointer to current node):

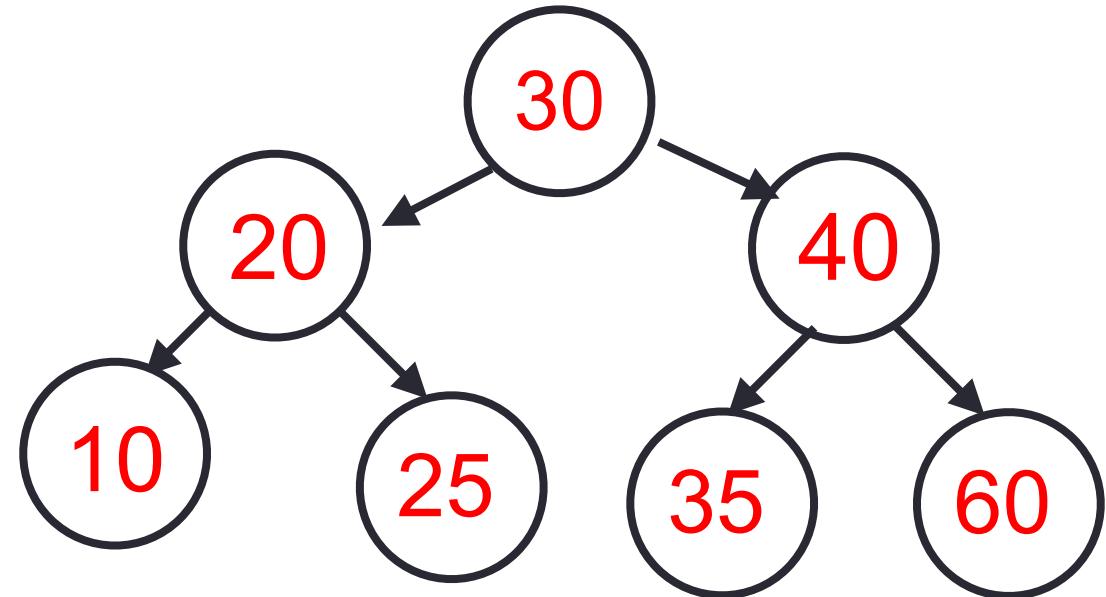
```
if r is null, return  
postorder(r->left)  
postorder(r->right)  
process r (e.g., print r->val)
```

```
int bst::getHeight(Node *r) const{  
    if (!r)  
        return -1;  
    int hleft = getHeight(r->left);  
    int hright = getHeight(r->right);  
    return max(hleft, hright) + 1;  
}
```

```
void bst::clear(Node *r){  
    if (!r)  
        return;  
    clear(r->left);  
    clear(r->right);  
    delete r;  
}
```

What does this code do?

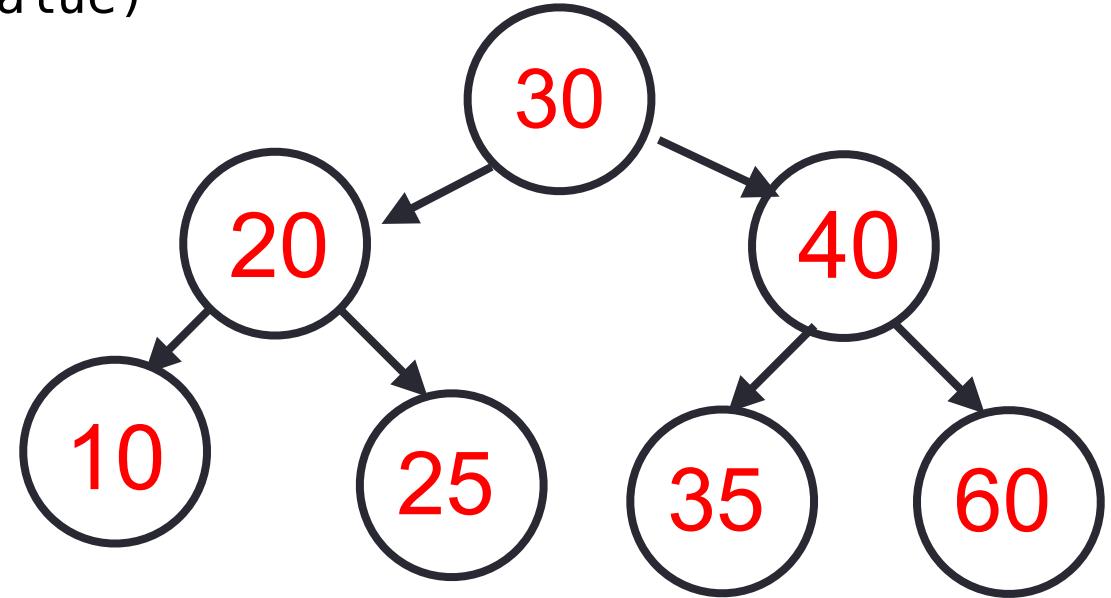
```
Node* r = b.min(root);  
while(r){  
    cout << r->data << " ";  
    r = b.successor(r);  
}
```



- What is the successor of 30?
- What is the successor of 25?

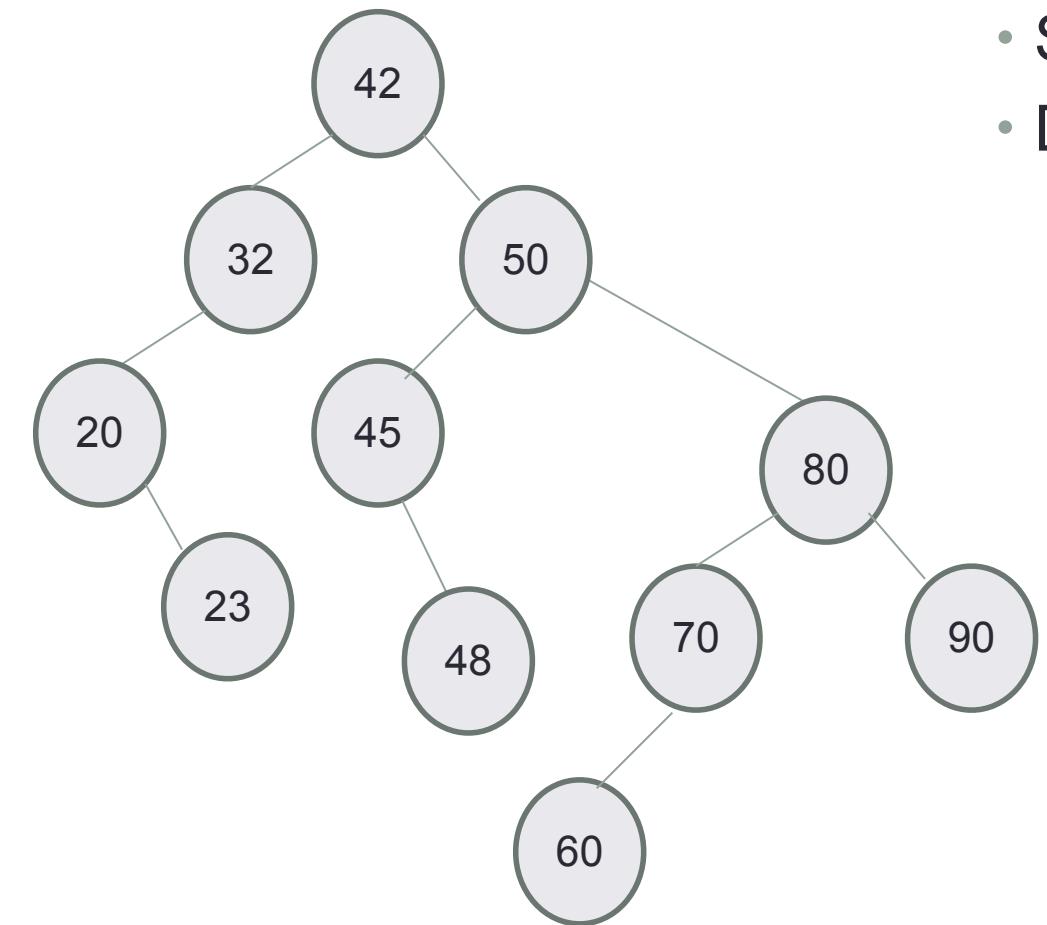
Successor: Next largest element

```
BSTNode* bst::successor(BSTNode* n, int value)
const{
    if(!n) return nullptr;
    if(n->right){
        //Case 1
    }
    else{
        //Case 2
    }
}
```



- What is the successor of 30?
- What is the predecessor of 25?

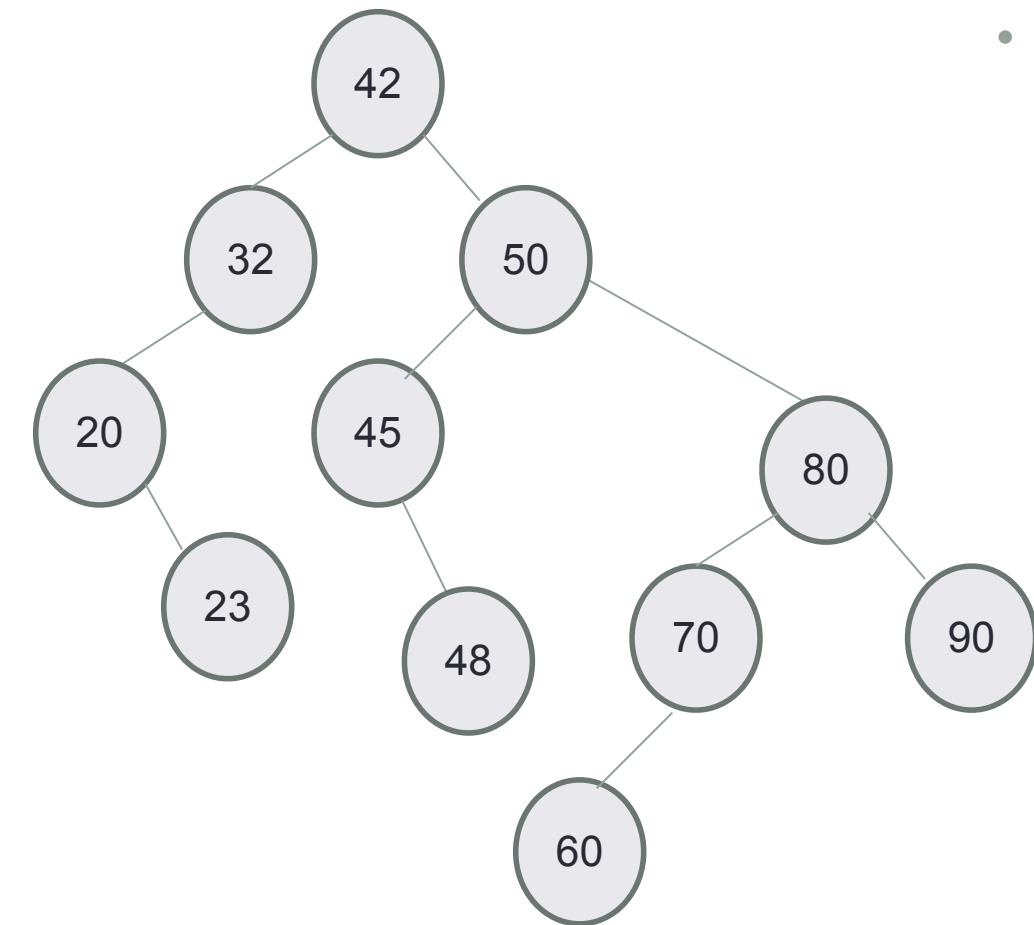
Delete: Case 1 - Node is a leaf node



- Set parent's (left/right) child pointer to null
- Delete the node

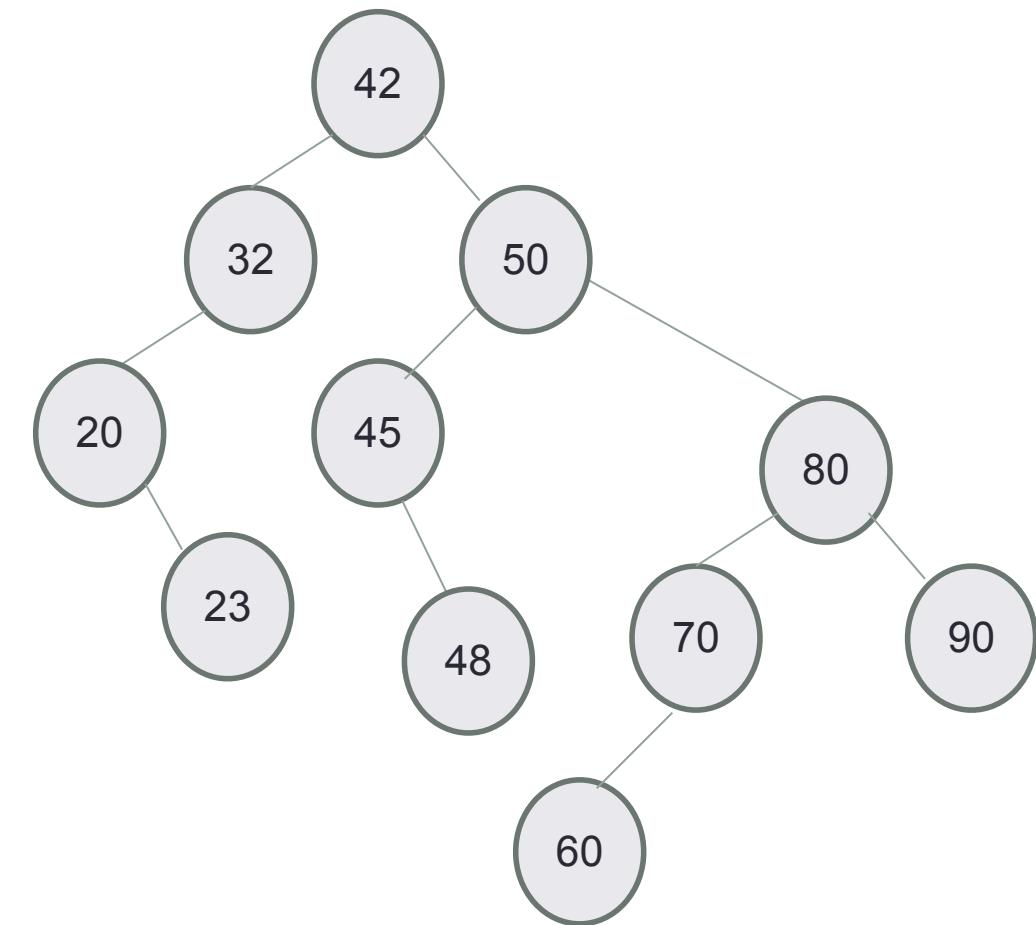
Delete: Case 2 - Node has only one child

- Replace the node by its only child



Delete: Case 3 - Node has two children

- Can we still replace the node by one of its children? Why or Why not?



BST ADT

Operations

Search

Insert

Min

Max

Successor

Predecessor

Delete

Print elements In order

Preorder,

Post order

