- Today's Content

Invert Binary Tree

Equal tree partition

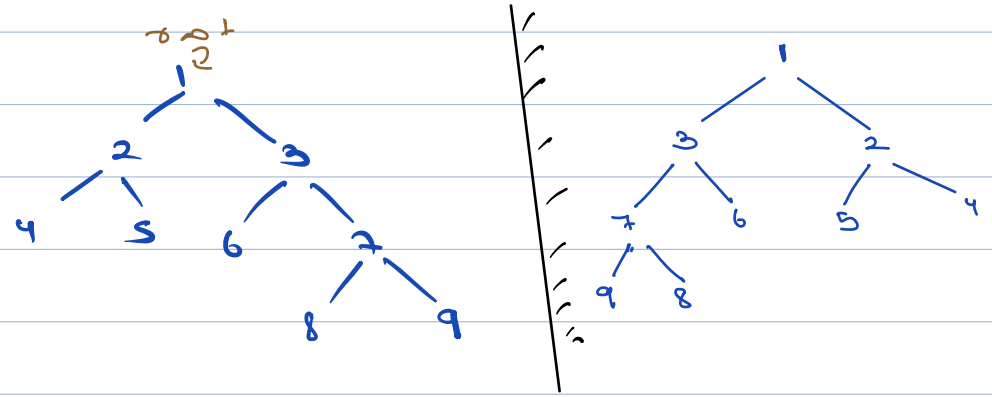
Next pointer B.T.

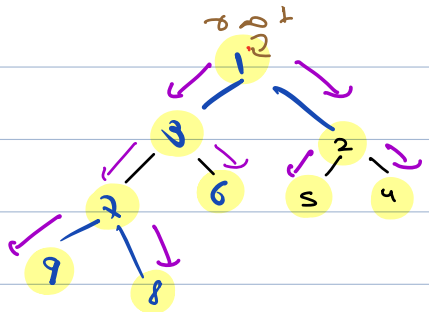
Root to leaf path sum = k.

Diameter of B.T.

Ques) Invert a B.T.

I/P →





Sol:- At, nodes swap L & R child.

T.C → O(n)
S.C → O(H)

```
void invert (root) {
    if (root == null) { return }
    temp = root.left;
    root.left = root.right
    root.right = temp
    invert (root.left);
    invert (root.right);
}
```

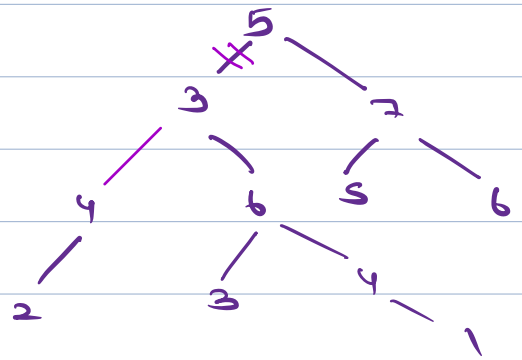
} swap left & right child

Equal Tree Partition

Ques) Check if it is possible to remove an edge from b.t, s.t, the sum of resultant two trees is equal.

sum = 46.

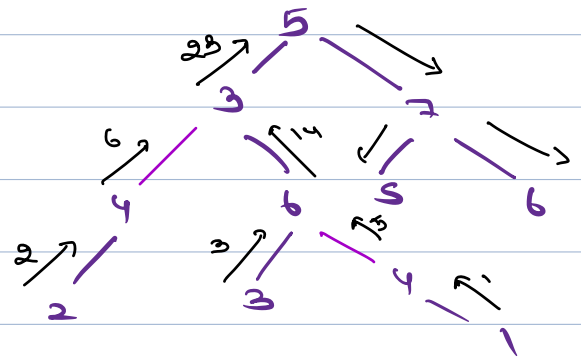
Ans → True.



Obs - 1 :- If total sum of the Tree is S, both the subtrees would have sum $S/2$.

Obs 2 :- If total sum is odd, return false.

> check if there's a subtree with sum = $S/2$.



TotalSum = 46

```
S = sum(root);
if (S%2 == 1) { return false }
```

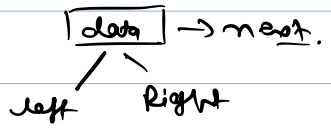
T.C → O(n)
S.C → O(H)

```
boolean ans = false;
int check(root) {
    if (root == null) { return 0 }
    L = check(root.left);
    R = check(root.right);
    if (L == S/2 || R == S/2) {
        ans = true;
    }
    return L + R + root.val;
}
```

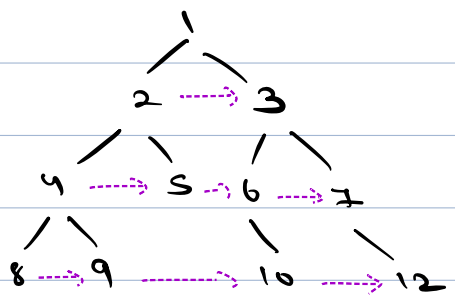
```
class node {
    int data;
    node left;
    node right;
    node next;
}
```

Ques). [Next pointer in B.T]

Initially each node's next pointer points to null.



update each node's next pointer to point to the next node in same level.




```
void levelOrder(Node root){
    Queue<Node> q;
    q.add(root);
    while(q.size()>0){
        n = q.size();
        for(i=1; i<=n; i++){
            Node front = q.peek();
            q.remove();
            print(front.data);
            if(front.left!=null){
                q.add(front.left);
            }
            if(front.right!=null){
                q.add(front.right);
            }
            if(i!=n){
                front.next = q.peek();
            }
        }
        print("\n");
    }
}
```

T.C → O(n)

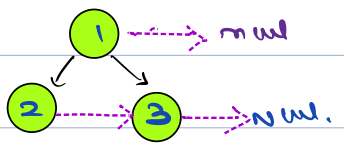
S.C → O(n)

Ques Fill next in Perfect Binary Tree.

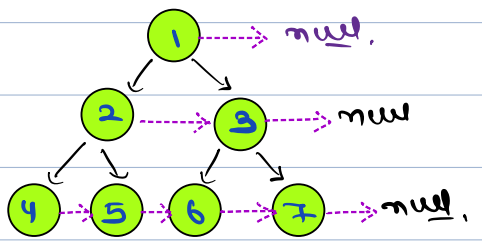
Expected S.C → O(1).

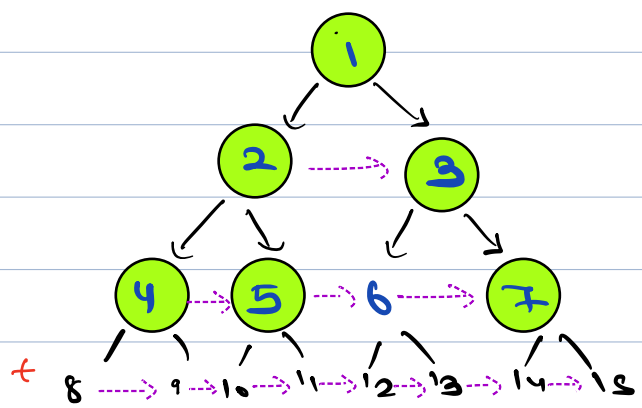
```
class Node {
    int data;
    Node left, right, next;
    Node(x) {
        data = x
        left = null
        right = null
        next = null
    }
}
```

Ex1:-



Ex2:-





T.C → O(n)

S.C → O(1).

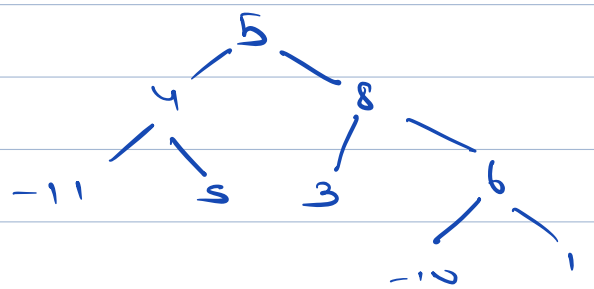
```
t = root;
while (t.left != null) {
    Node s = t;
    while (t != null) {
        t.left.next = t.right
        if (t.next != null) {
            t.right.next = t.next.left
        }
        t = t.next;
    }
    t = s.left
}
```

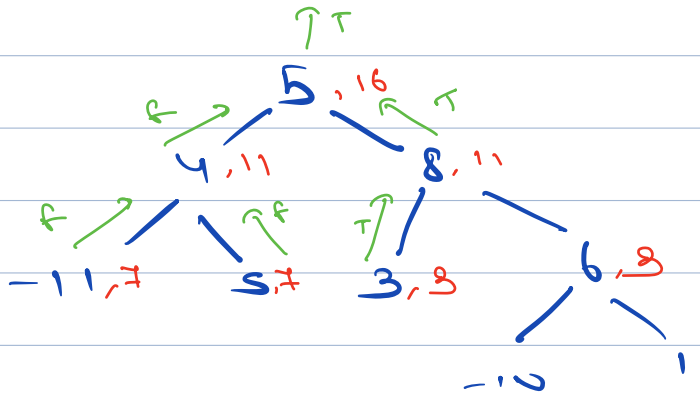
Ques. check if given binary Tree, has any one root to leaf path sum = k.

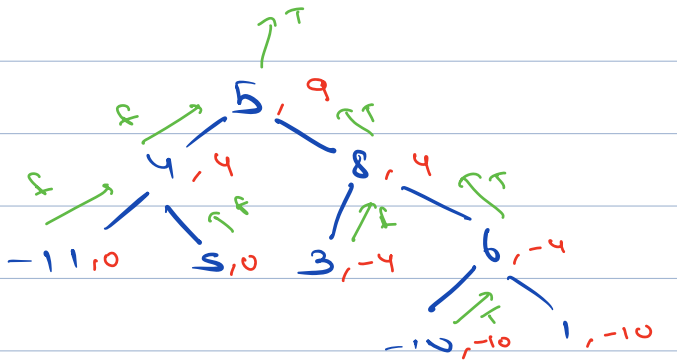
k = 16 → True.

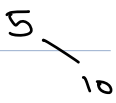
k = -2 → True

k = 9 → True.

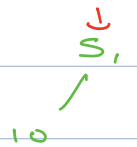






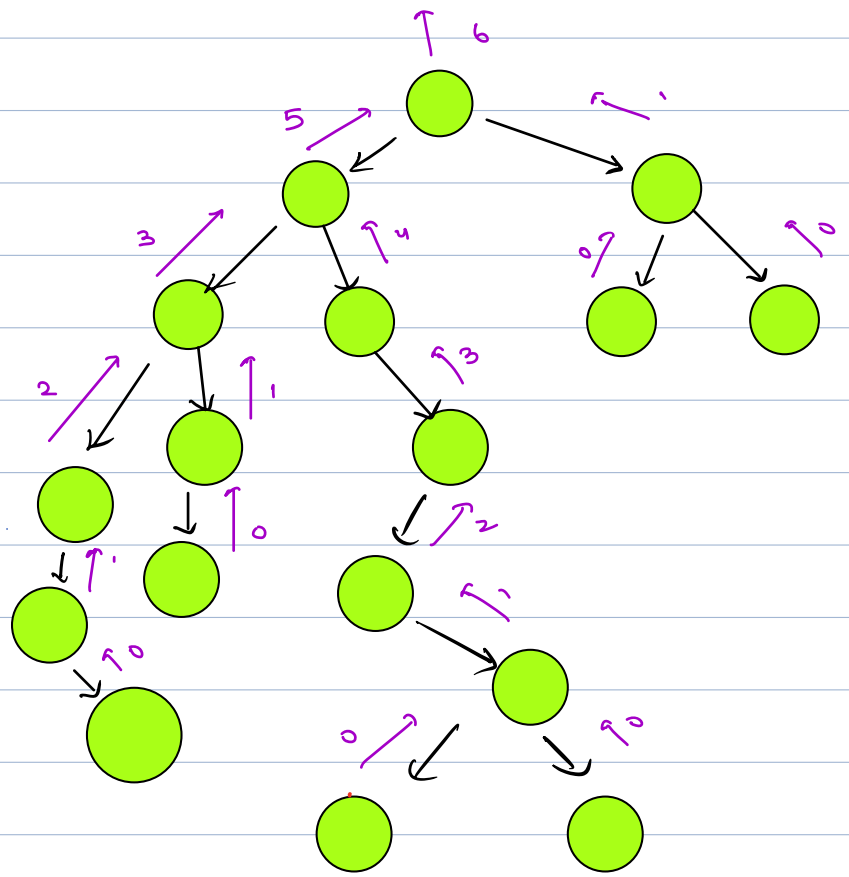


T.C → O(n)
S.C → O(h)




```
Boolean check (Node root, k)
    if (root == null) { return false }

        if (root.left == null && root.right == null){
            return (root.data == k)
        }

    return check (root.left, k-root.data) ||
           check (root.right, k-root.data);
```

Height of a B.T. → In terms of Edges

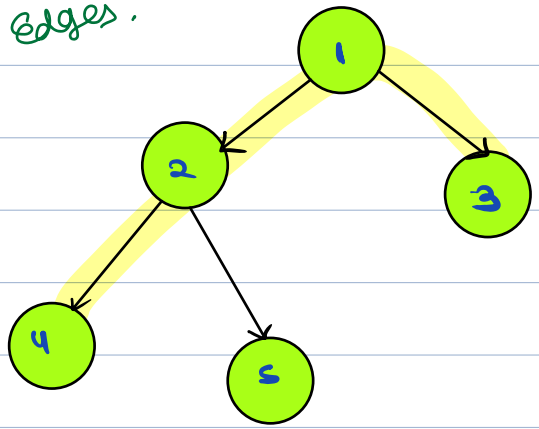


T.C → O(n)
S.C → O(h)

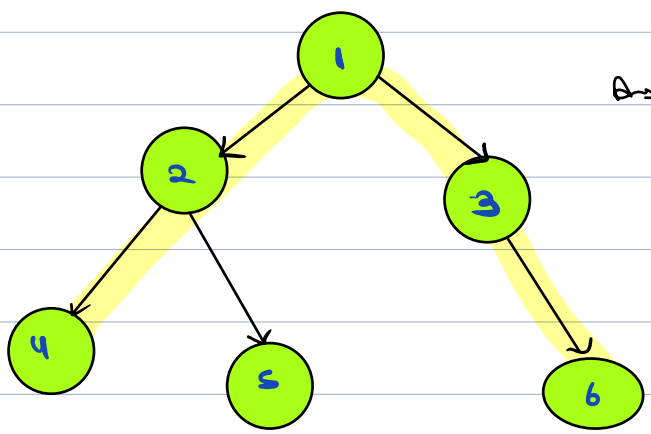
```
int height(root) {
    if (root == null) {return -1;}
    lh = height(root.left);
    rh = height(root.right);
    return Max(lh, rh) + 1;
}
```

Diameter :- It is no. of edges on longest path b/w two nodes in a binary tree.

diameter in terms of edges.

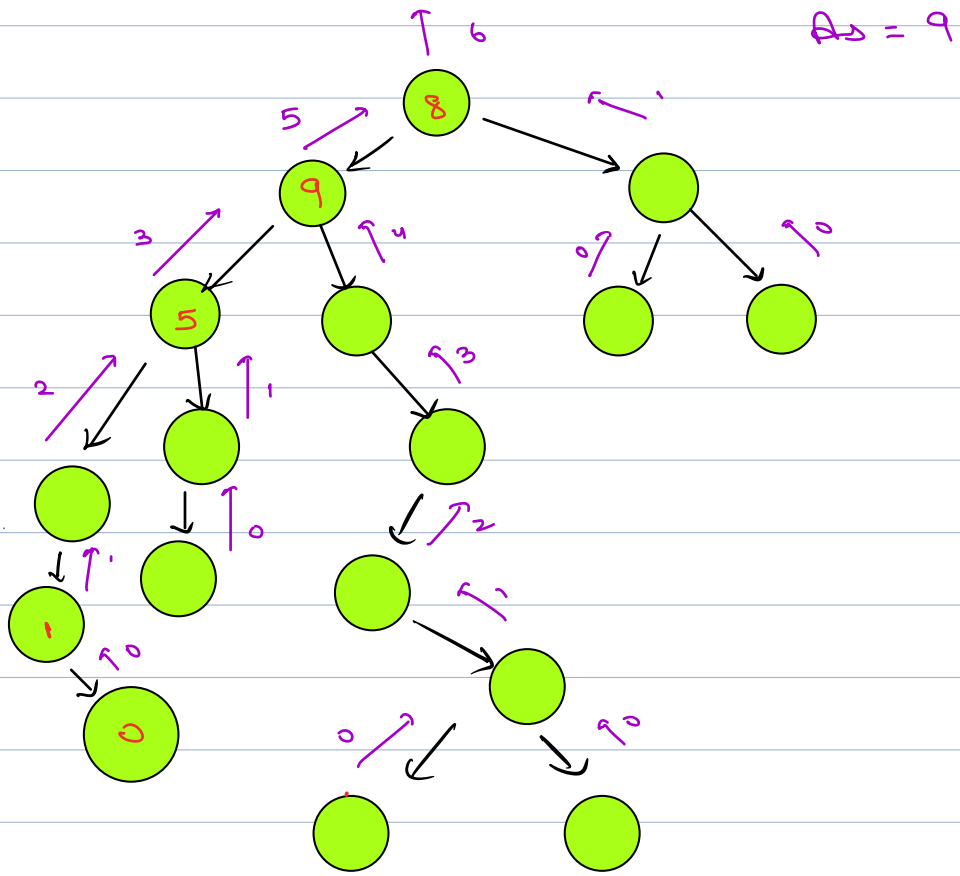


Ans = 3.



Ans = 4.

diameter = $lh + rh + 2$



Ans = 9

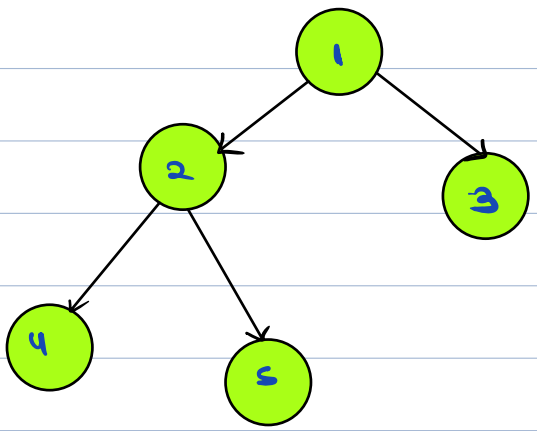
```
int diameter = 0;
```

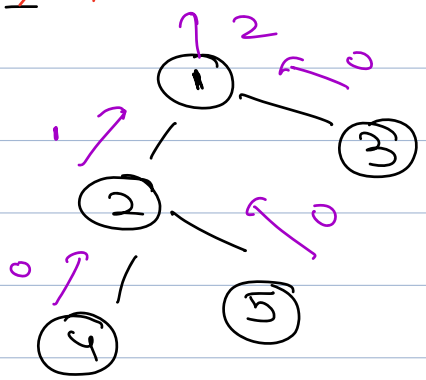
T.C → O(n)

S.C → O(H)

```
int height(root) {
    if (root == null) {return -1}
    lh = height(root.left);
    rh = height(root.right);
    diameter = max(diameter, lh+rh+2);
    return max(lh,rh) + 1
}
```

dia = 2 ~~2~~ 3

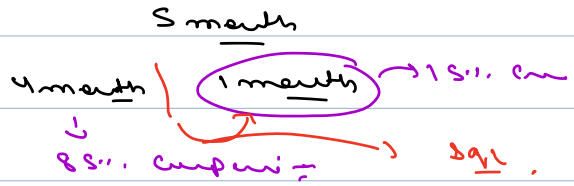




DSA len by 1 month

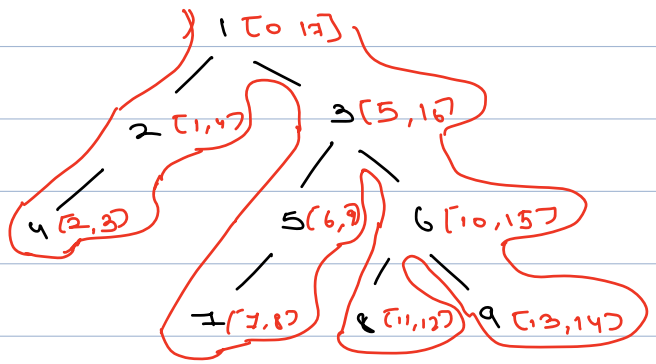
Adv. DSA

Tried,



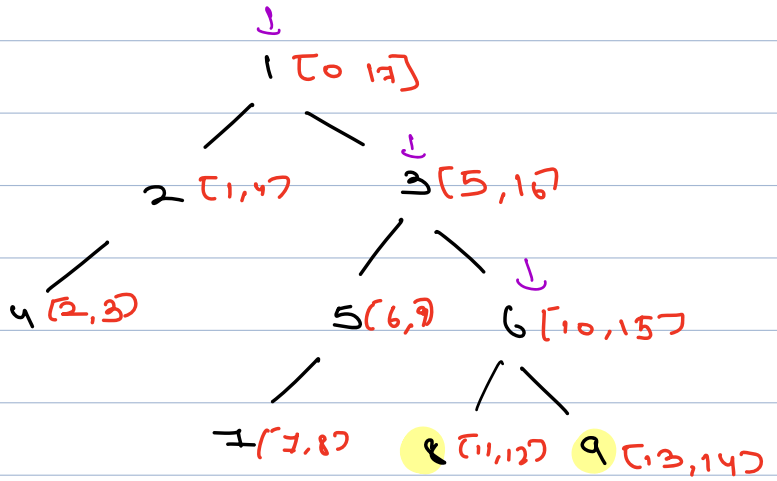
In time - Out time Concept

t = 0 1 2 3 4 5 6 7 8




```
T=0;
void Traversal (root) {
    if (root == null) {return;}
    in(root) = T;
    T++;
    Traversal (root.left);
    Traversal (root.right);
    out(root) = T
    T++;
}
```

T.C -> O(n)



in(x) < in(y)
out(x) > out(y)
} x is ancestor of y.

T.C → O(H)

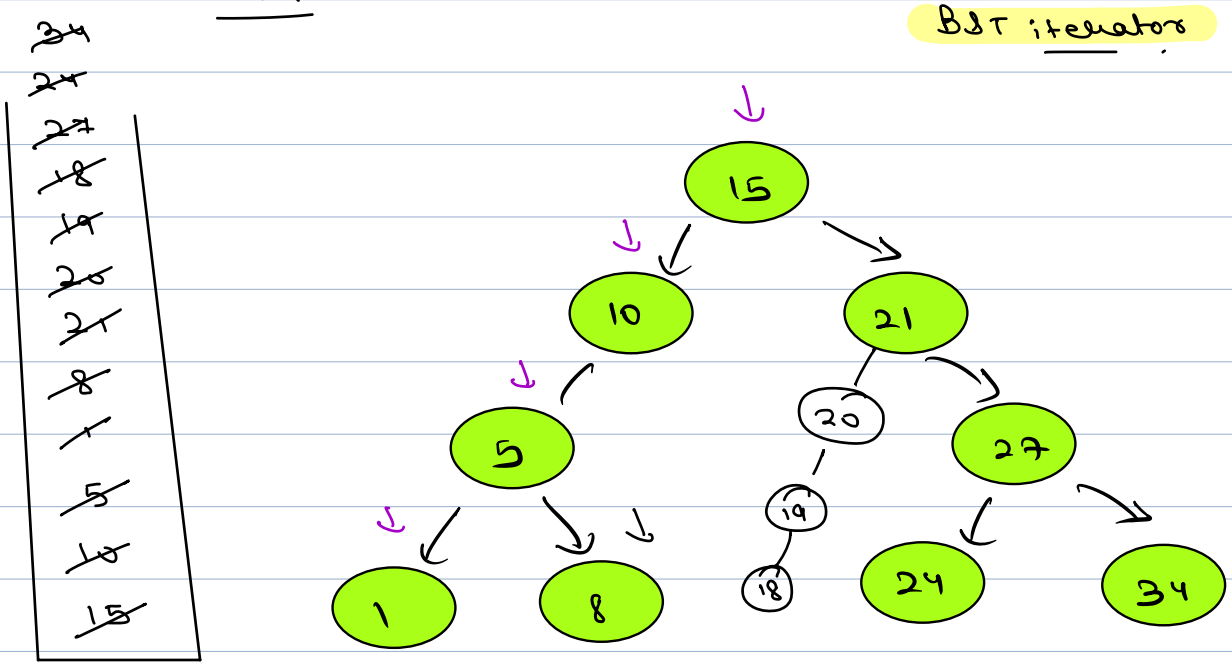
```
curr = root;
while (curr != null) {
    if (curr.left is ancestor of x & y) {
        curr = curr.left;
    }
    else if (curr.right is ancestor of x & y) {
        curr = curr.right;
    }
    else {
        return curr;
    }
}
```

Q queries :-

O(n) + O(h) * Q
for Queries.

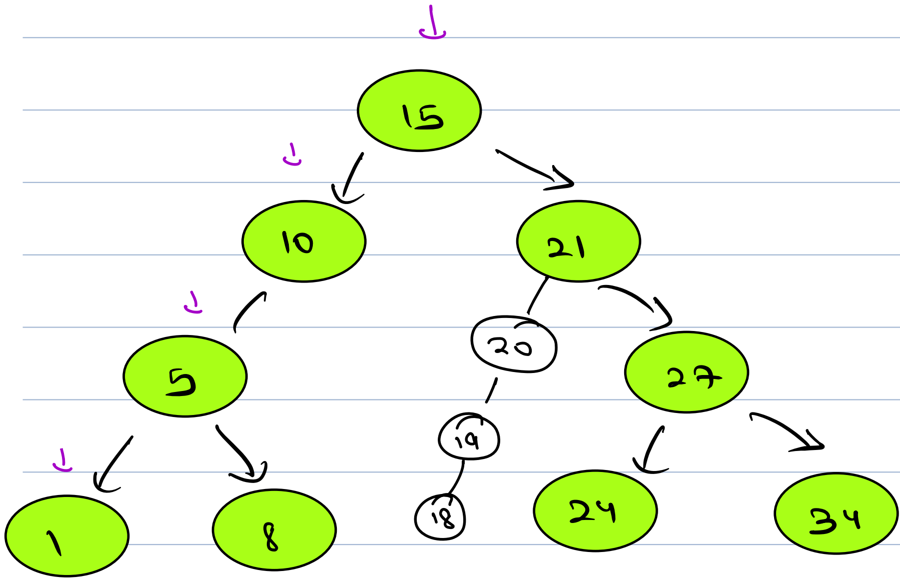
LDR

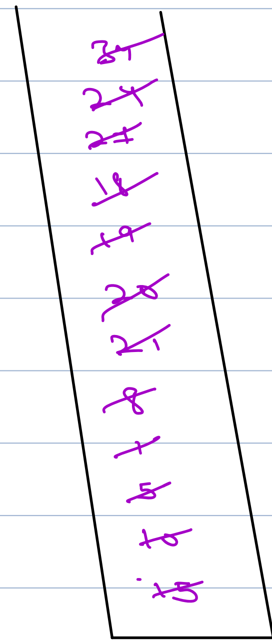
BST iterator



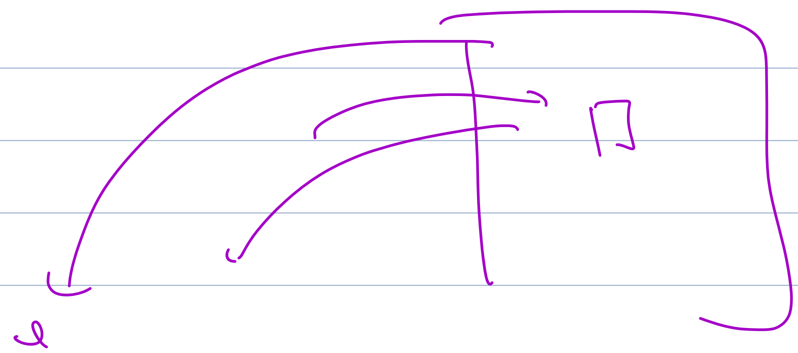
1 5 8 10 15 18 19 20 21 24 27 34

```
Next() {

    Stack <> ( );
    while ( curr != null ) { st.push(curr); curr = curr.left; }
    Node temp;
    while (st.size() > 0) {
        temp = st.top(); st.pop();
        if (temp.right != null) {
            ...
        }
    }
    return temp;

hasNext() {

}
```





1 5 8 10 15 18 19 20 21 24 27 34



l = next();

r = ReverseNext()

if l < r