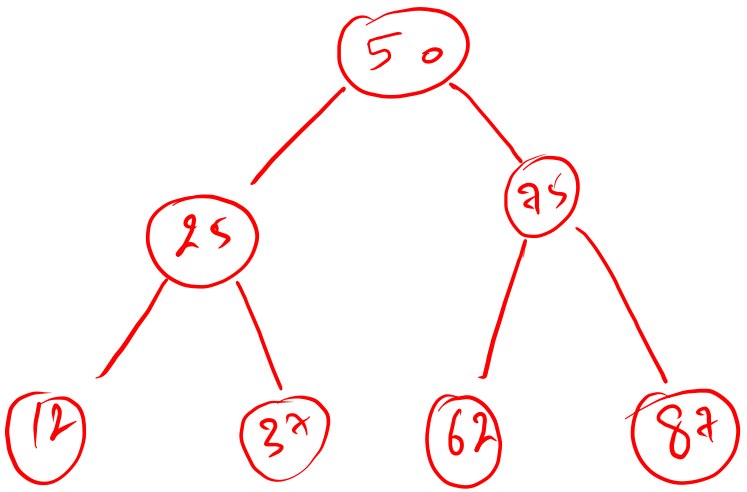
- Transform To Left-cloned Tree
- Transform To Normal From Left-cloned Tree
- Print Single Child Nodes
- Remove Leaves In Binary Tree
- Diameter Of A Binary Tree
- Tilt Of Binary Tree
- Is A Binary Search Tree
- Is Balanced Tree
- Largest Bst Subtree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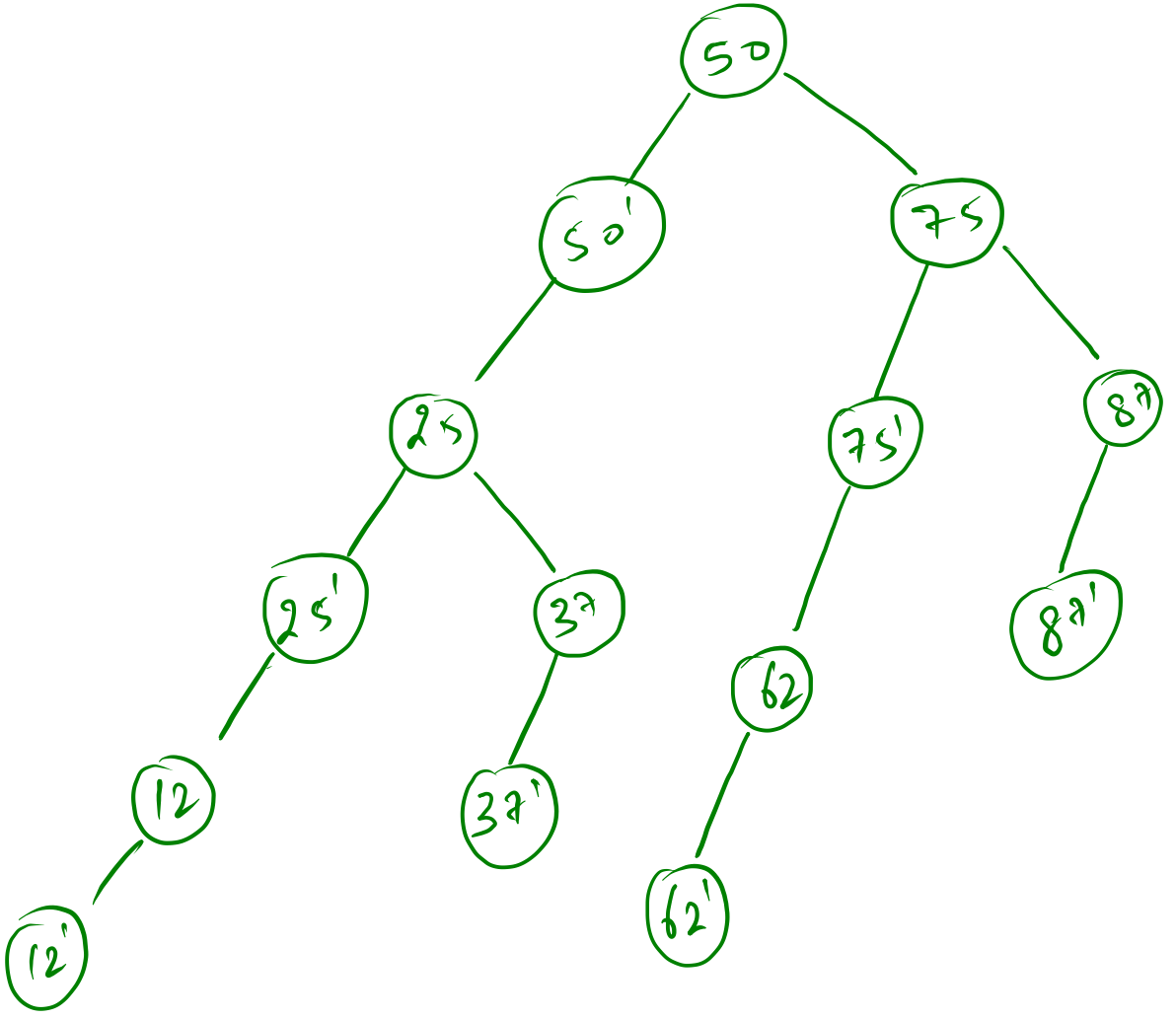
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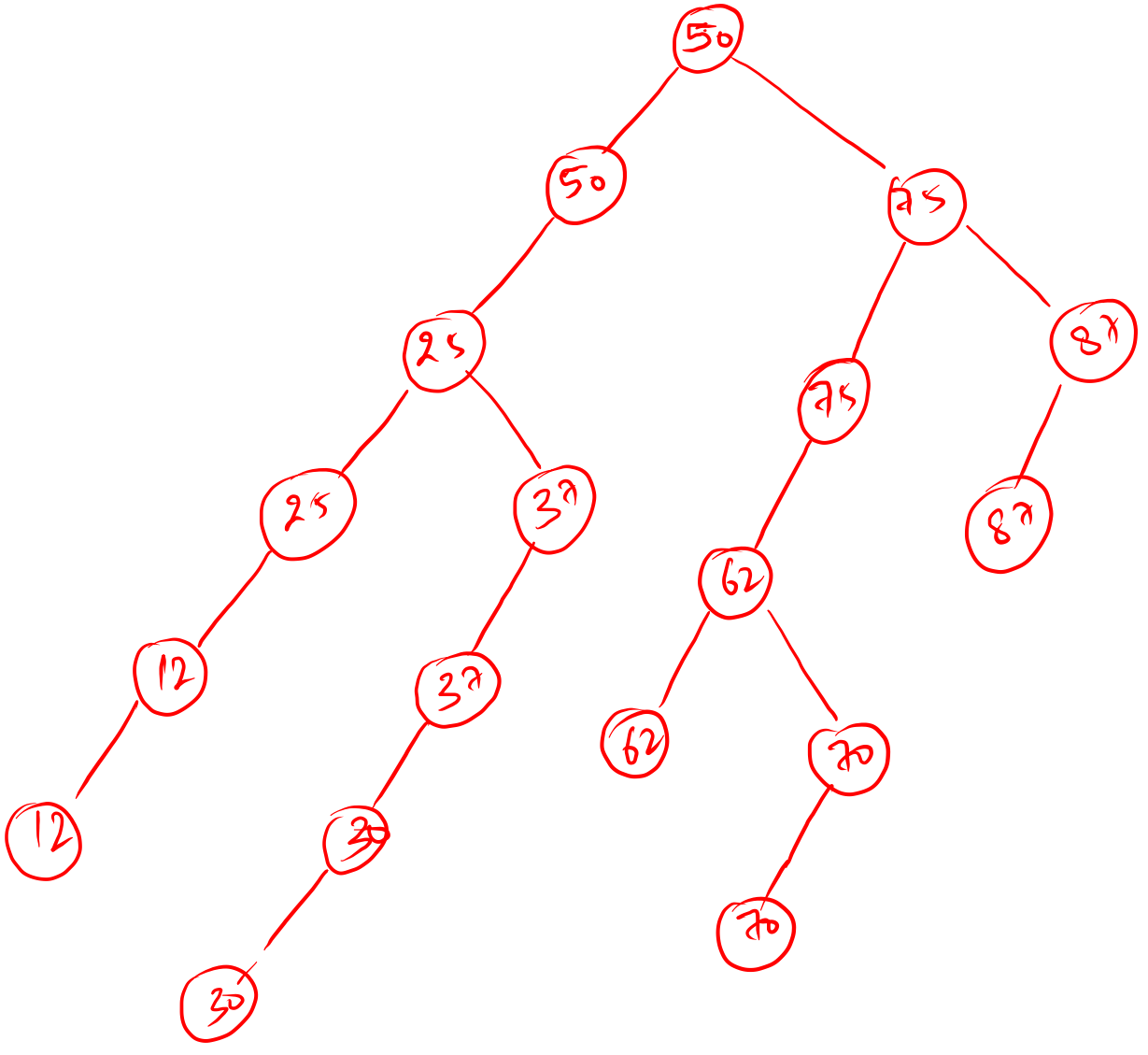
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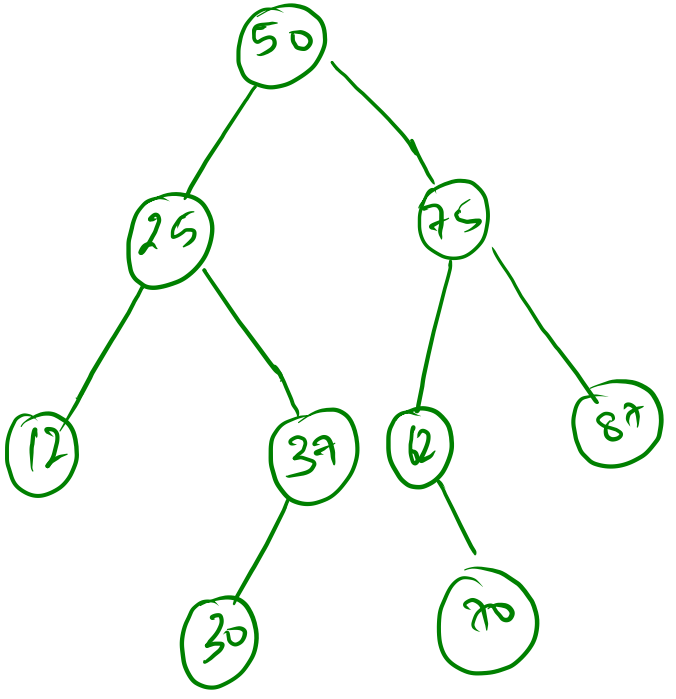
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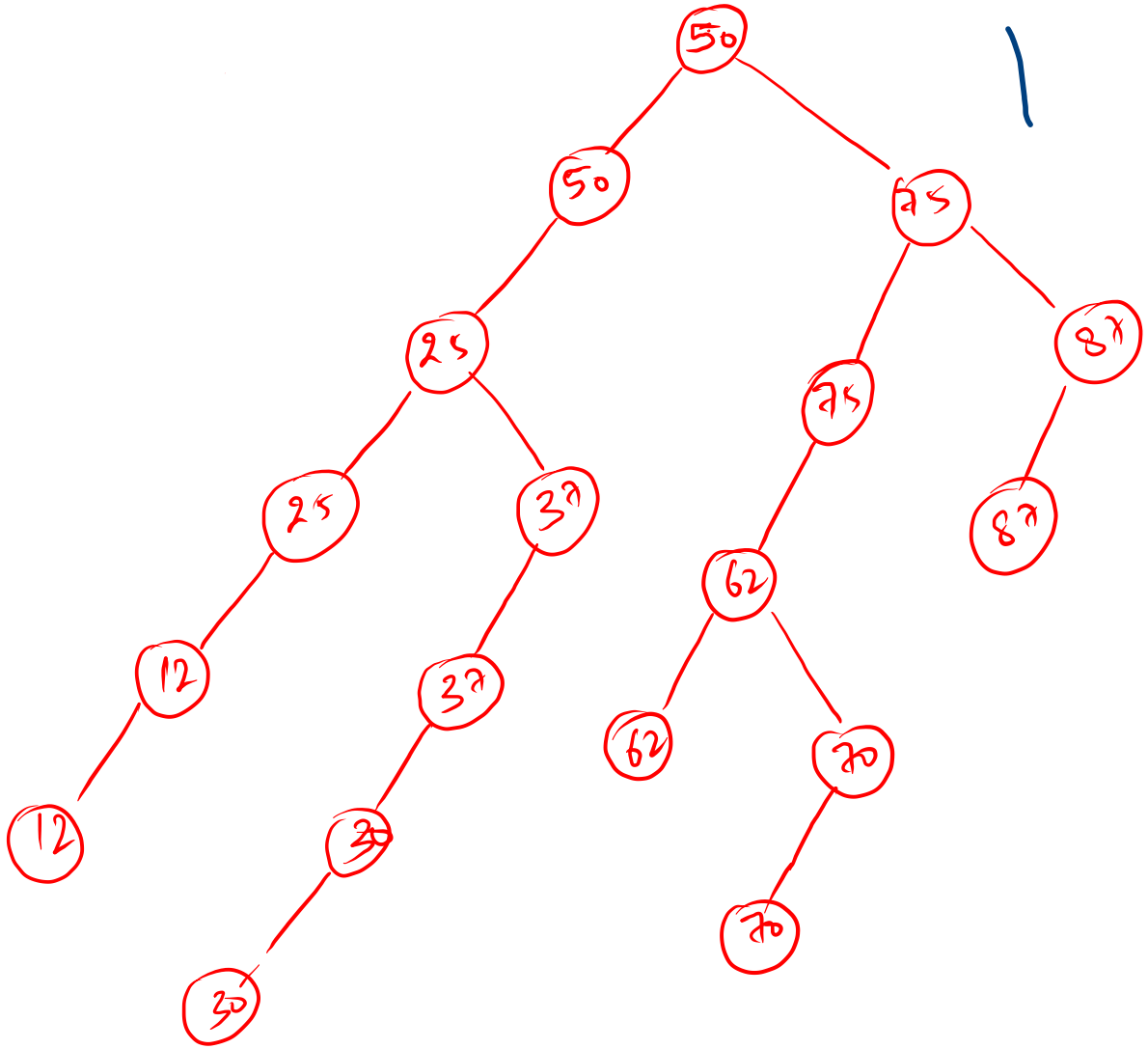
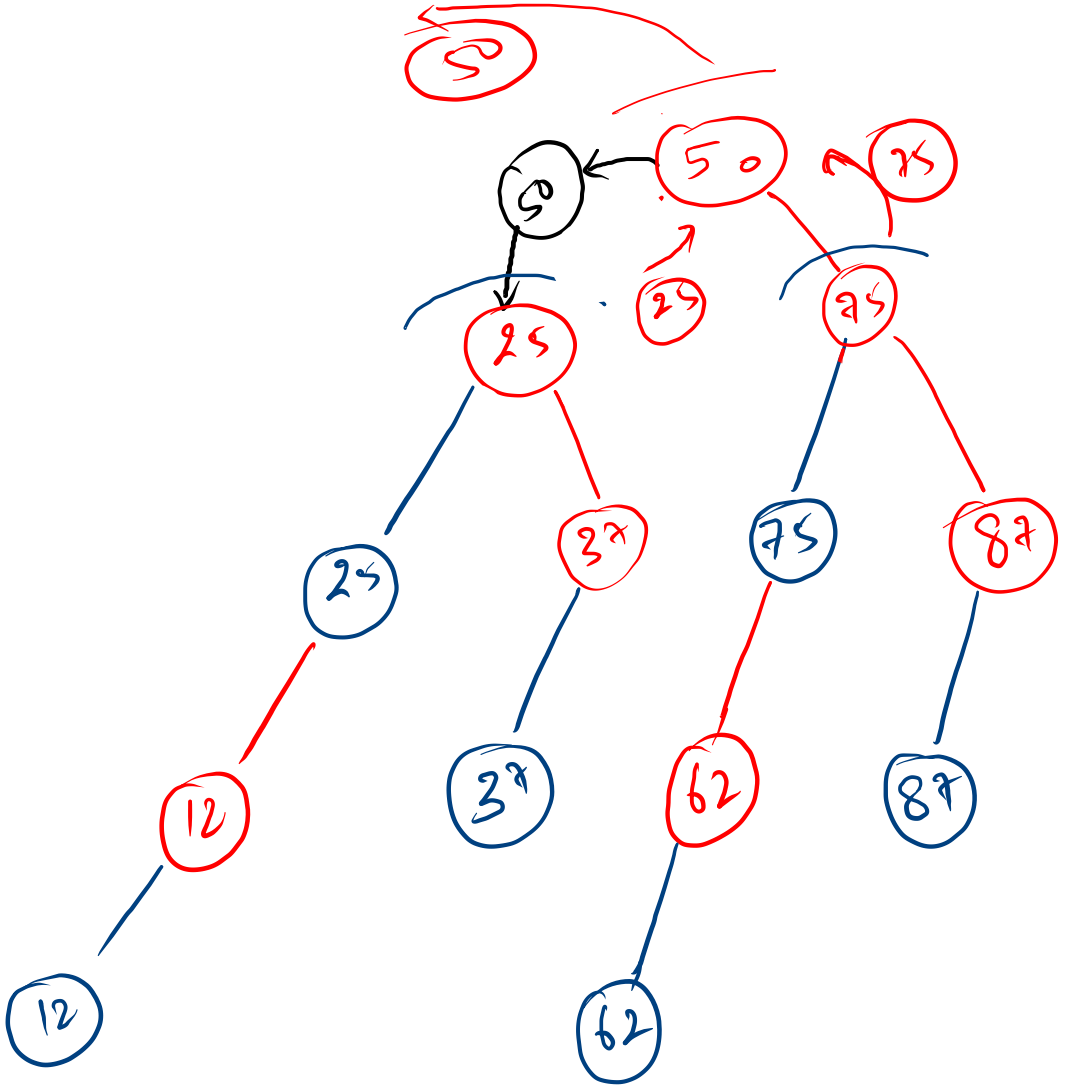
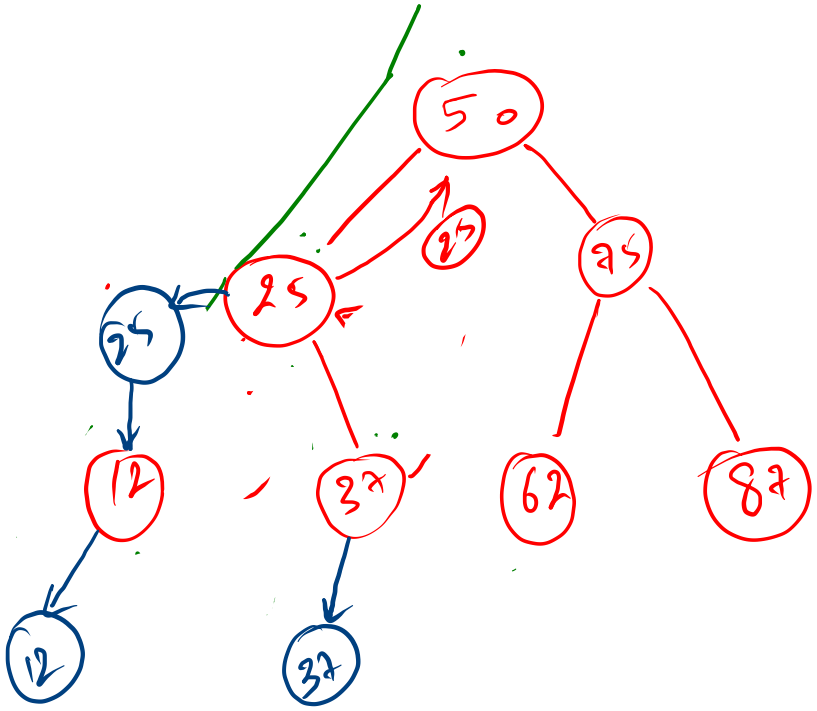



H.W.

```
public static void fun(Node node){
  if(node == null){
    return null;
  }
  Node lns = fun(node.lft.lft);
  Node rns = fun(node.right)
  Node clone = node.lft;
  clone.lft = null
  node.lft = lns;
  return node;
}
```

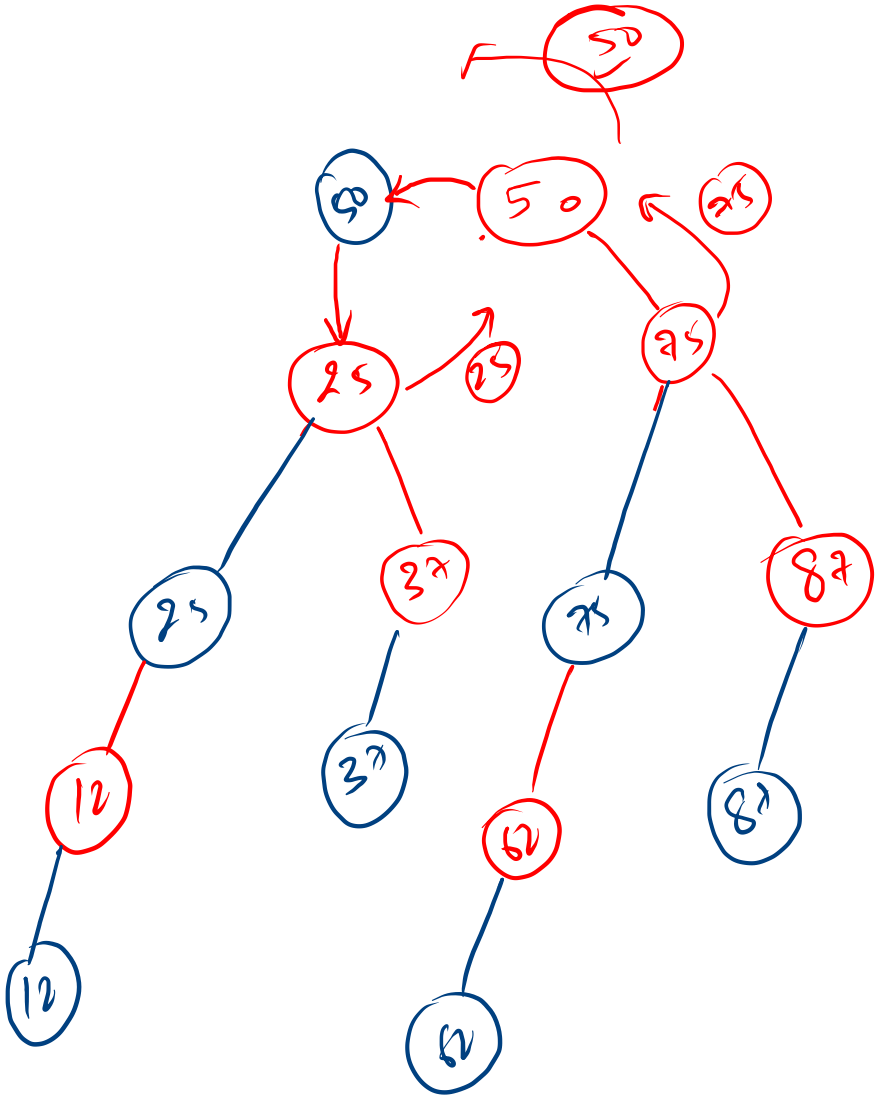





```java
public static Node createLeftCloneTree(Node node){
  if(node == null){
      return null;
  }
  Node lres = createLeftCloneTree(node.left);
  Node rres = createLeftCloneTree(node.right);

  Node clone = new Node(node.data,null,null);
  clone.left = lres;
  node.left = clone;

  return node;
}
```



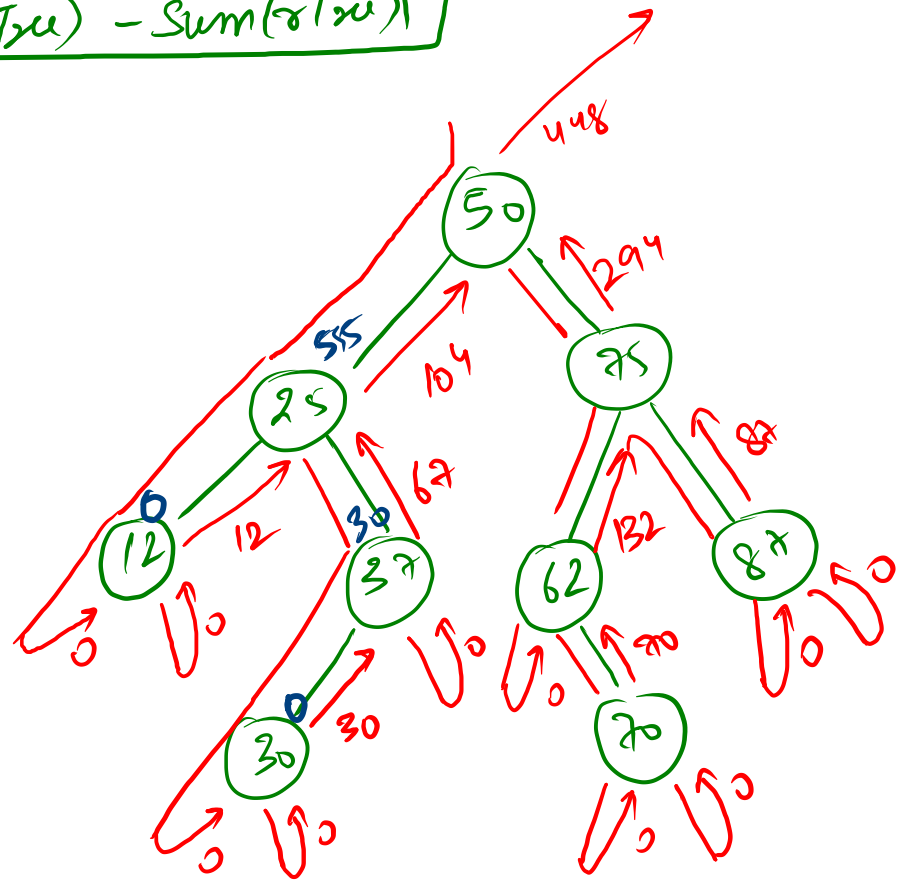
```java
public static Node createLeftCloneTree(Node node){
  if(node == null){
      return null;
  }
  Node lres = createLeftCloneTree(node.left);
  Node rres = createLeftCloneTree(node.right);

  Node clone = new Node(node.data,null,null);
  clone.left = lres;
  node.left = clone;

  return node;
}
```

Tilt of ~~left~~ Tree = Sum ( Tilt of ~~left~~ every node )

Tilt of a node = |Sum(LTree) − Sum(RTree)|

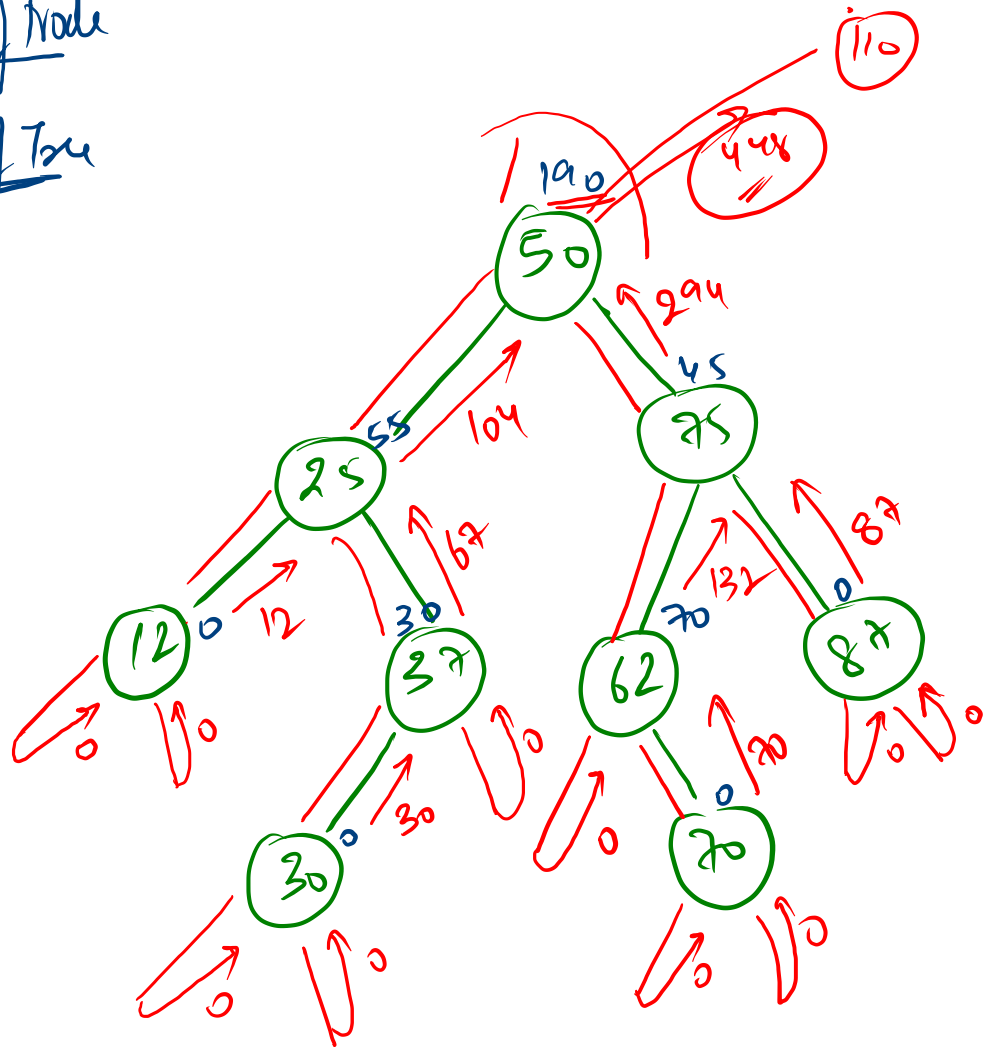



(Global variable hai)

Tilt = 0 + 0 + 0 + 30 + 55

Tilt of Node

Tilt of Tree




tiltOfTree = 0 + 0 + 0 + 30 + 55 + 0 + 70 + 0 + 45 + 190

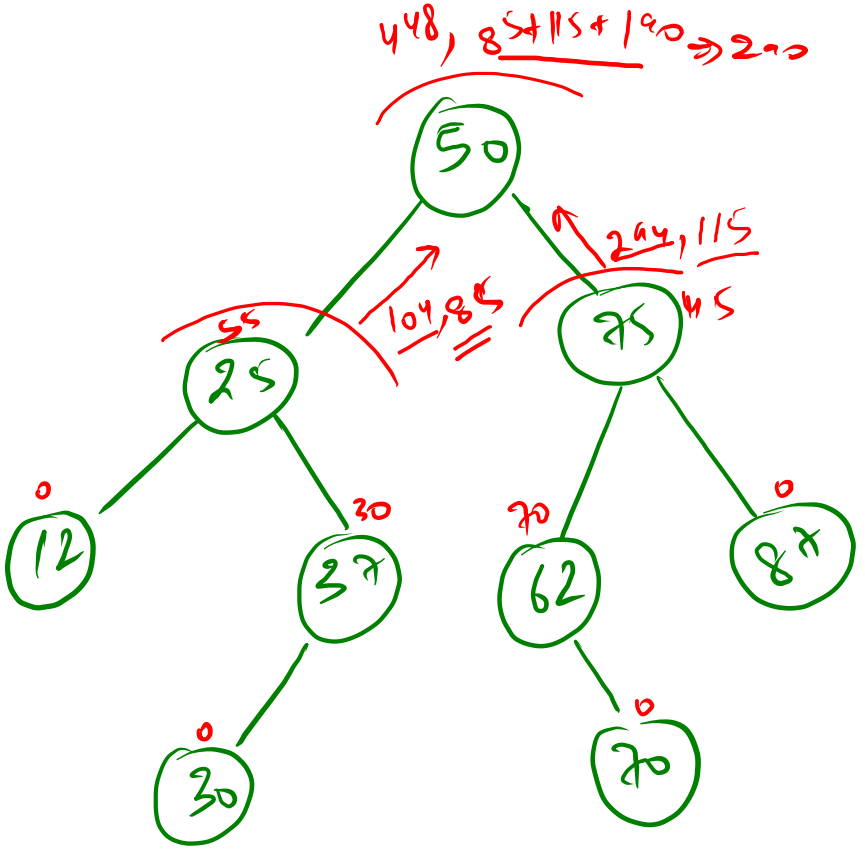
→ 390

```
static int tiltOfTree = 0;
public static int tilt(Node node){
    if(node == null){
        return 0;
    }

    int lSum = tilt(node.left);
    int rSum = tilt(node.right);

    int tiltOfNode = Math.abs(lSum-rSum);
    tiltOfTree += tiltOfNode;

    return lSum+rSum+node.data;
}
```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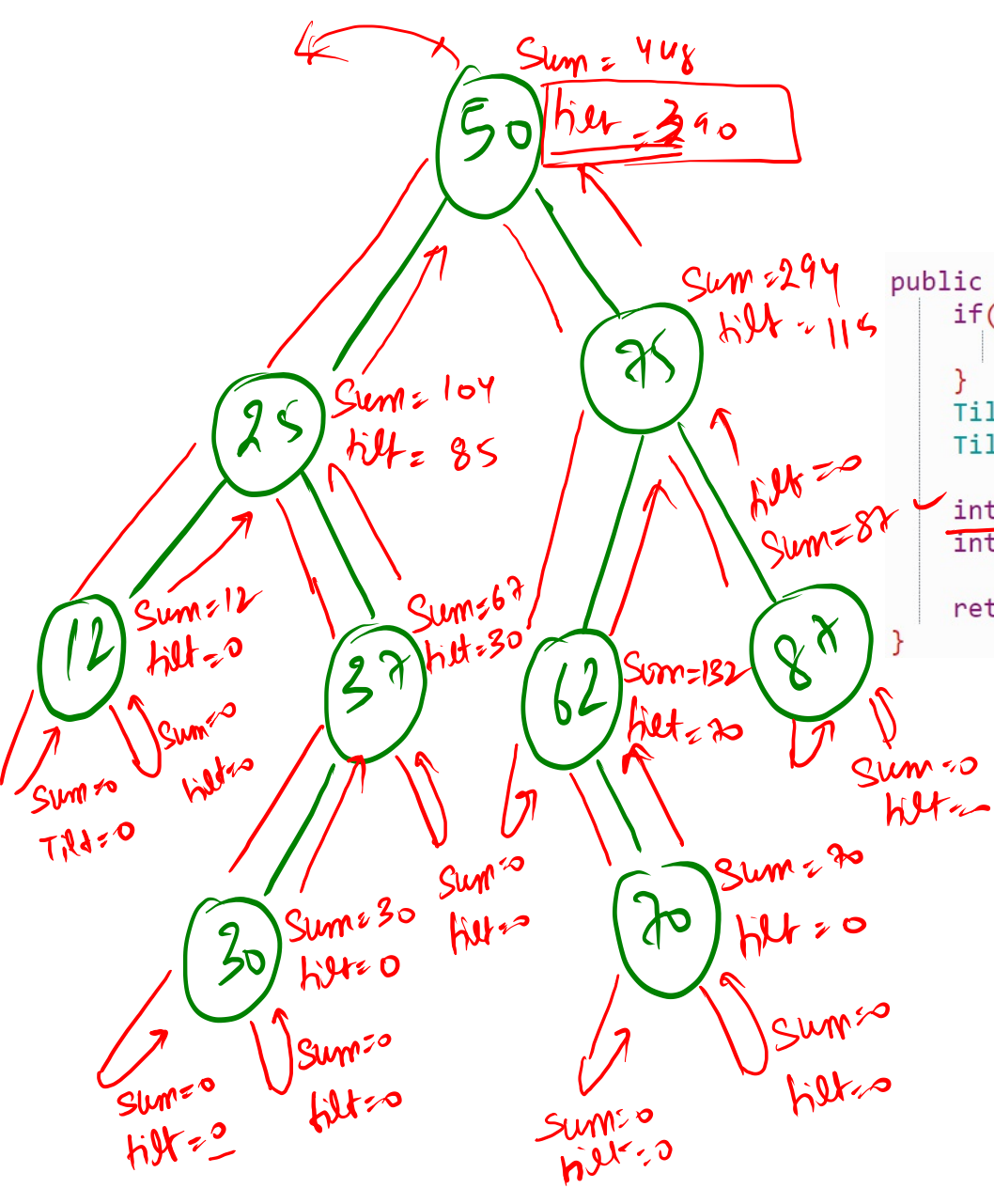
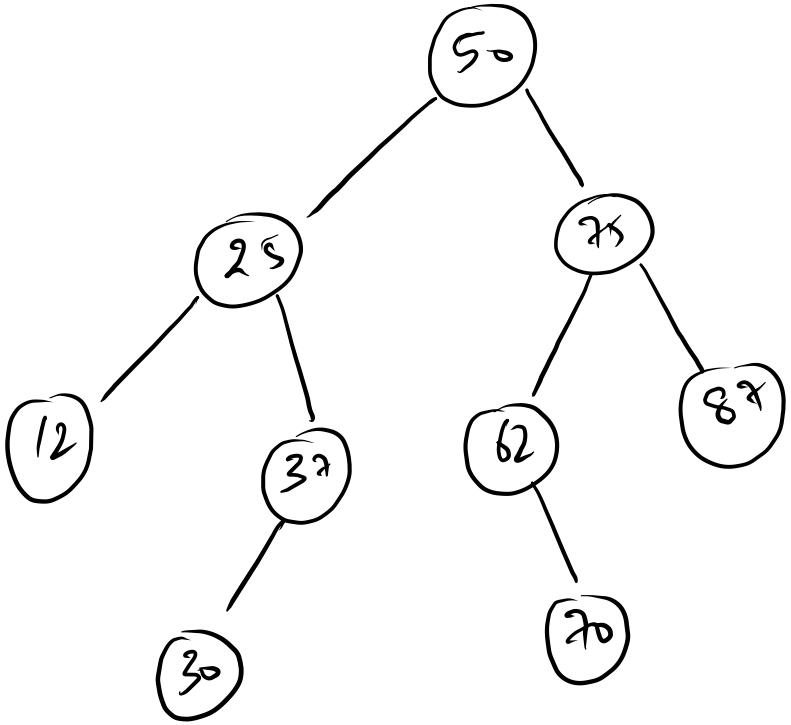


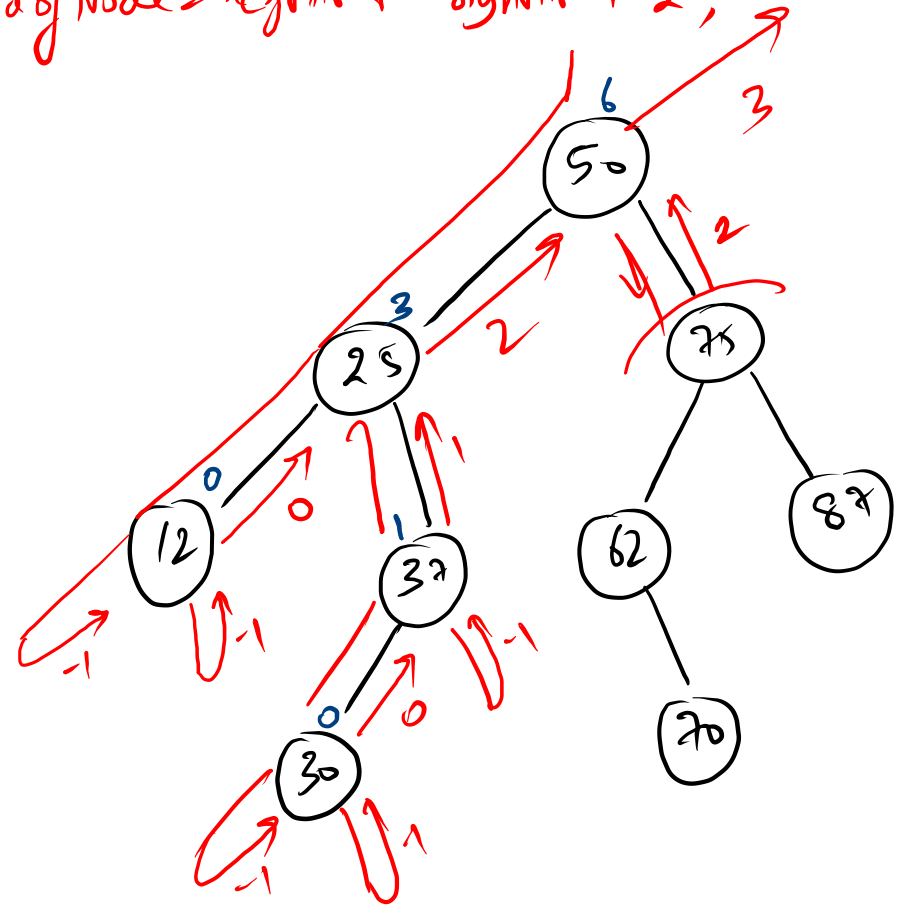

```
public static TiltSolver tilt1(Node node){
    if(node == null){
        return new TiltSolver(0,0);
    }
    TiltSolver lres = tilt1(node.left);
    TiltSolver rres = tilt1(node.right);

    int mySum = lres.sum+rres.sum+node.data;
    int tiltOfTree = lres.tiltOfTree+rres.tiltOfTree+Math.abs(lres.sum-rres.sum);

    return new TiltSolver(tiltOfTree,mySum);
}
```

Diameter → Max distance (on the basis of edges) b/w any two nodes in a binary Tree.

Dia = left ht + right ht + 2



dia of Node = leftHt + rightHt + 2;

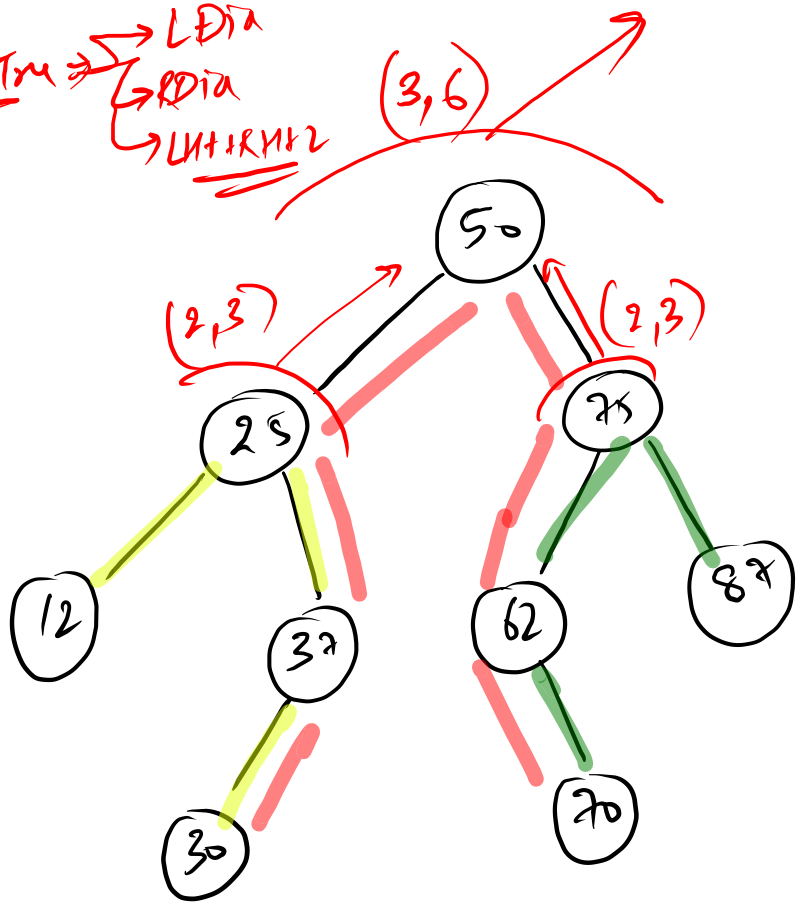



diaOfTree = ~~0~~ 6

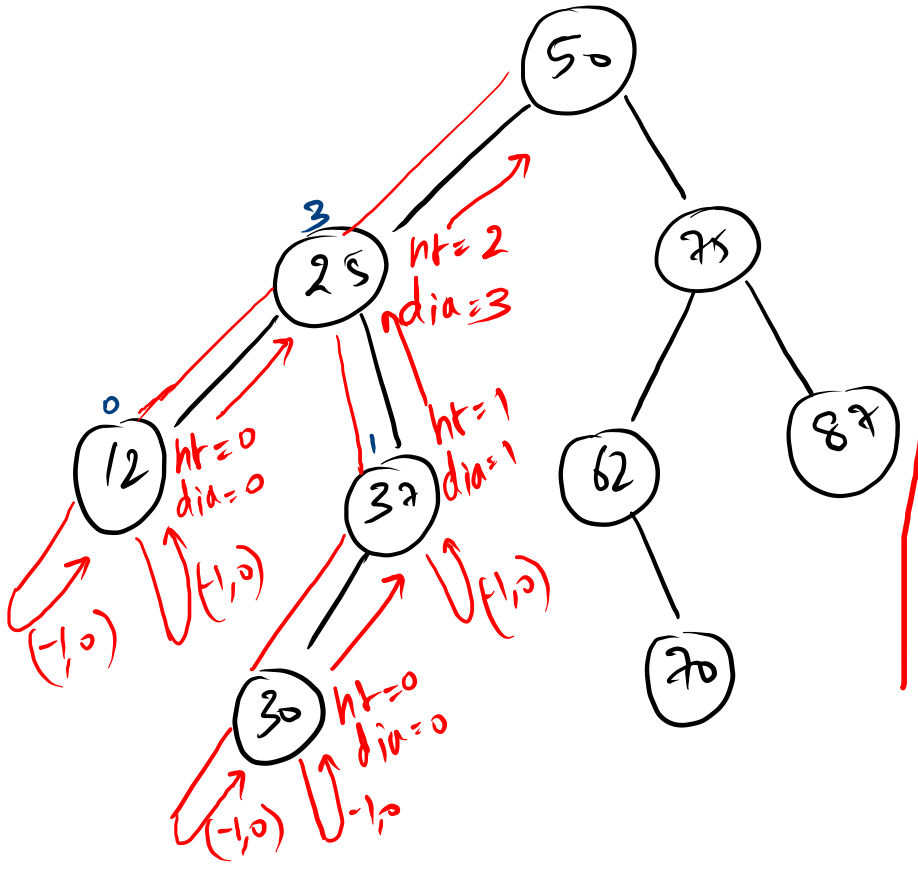
```
Node root = construct(arr);
diaOfTree = 0;
diameter1(root);
System.out.println(diaOfTree);
```

```
static int diaOfTree;
public static int diameter1(Node node) {
 if(node == null){
     return -1;
 }
 int leftHt = diameter1(node.left);
 int rightHt = diameter1(node.right);

 int diaOfNode = leftHt + rightHt + 2;
 if(diaOfNode > diaOfTree){
     diaOfTree = diaOfNode;
 }

 return Math.max(leftHt,rightHt)+1;
}
```

1. Hr
2. diaofTree ⇒ LDia, RDia, LHt+RHt+2




Diaofroot ⇒ 6




```java
public static DiaSolver diameter2(Node node){
    if(node == null){
        return new DiaSolver(-1,0);
    }
    DiaSolver lres = diameter2(node.left);
    DiaSolver rres = diameter2(node.right);

    int ht  = Math.max(lres.ht,rres.ht)+1;
    int diaOfNode = lres.ht+rres.ht+2;
    int diaOfTree = Math.max(diaOfNode,Math.max(lres.diaOfTree,rres.diaOfTree));

    return new DiaSolver(ht,diaOfTree);
}
```

# Binary Search Tree

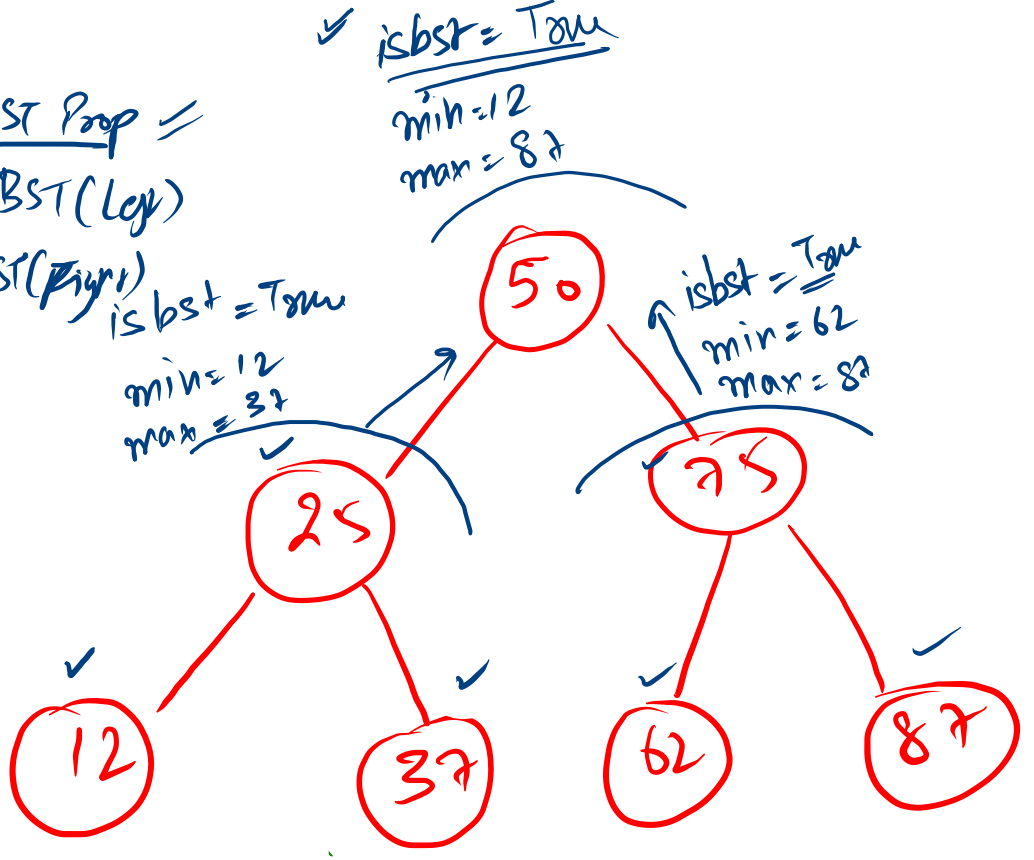
↳ all nods follow BST Poop

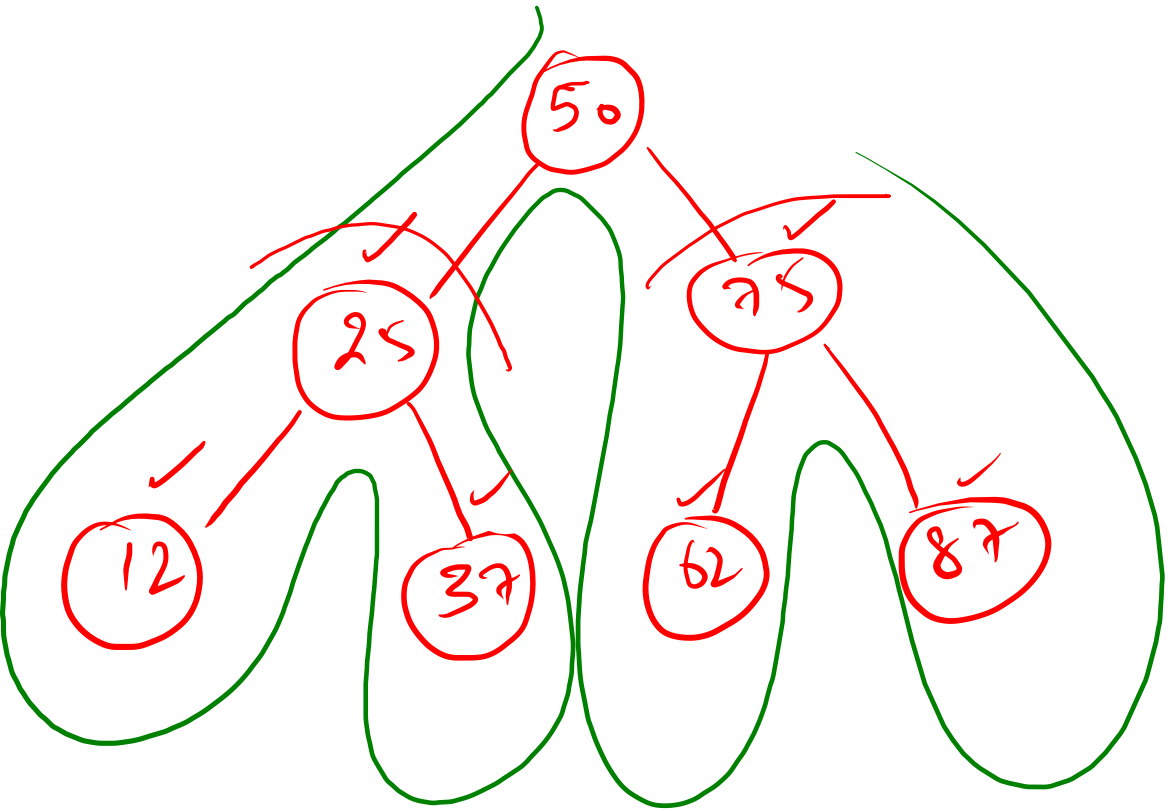
isBST() → BST Poop ✓
- isBST(left)
- isBST(right)

BST Poop:

left < n.data < right

Max(left) ≤ n.data < Min(right)

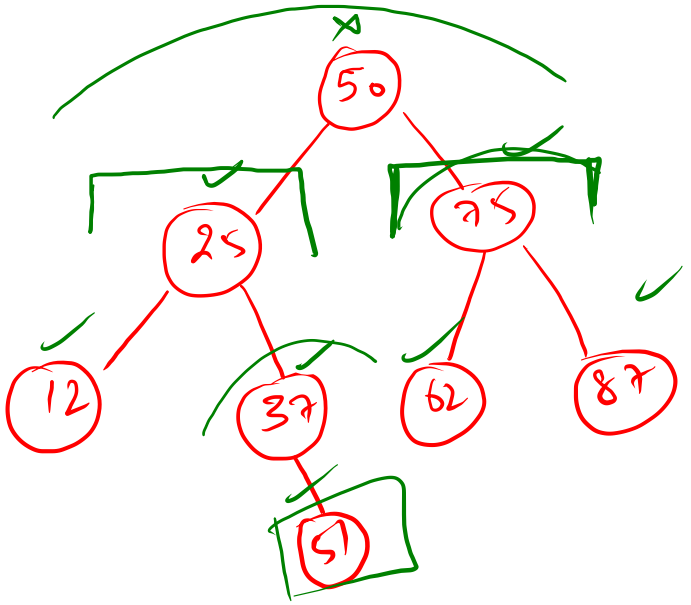





| | | Min | Max | isbst |
|---|---|---|---|---|
| | null | $+\infty$ | $-\infty$ | true |
| | 12 | 12 | 12 | true |
| | 37 | 37 | 37 | true |
| l | 25 | 12 | 37 | true |
| | 62 | 62 | 62 | true |
| | 87 | 87 | 87 | true |
| r | 75 | 62 | 87 | true |
| | 50 | 12 | 87 | true |

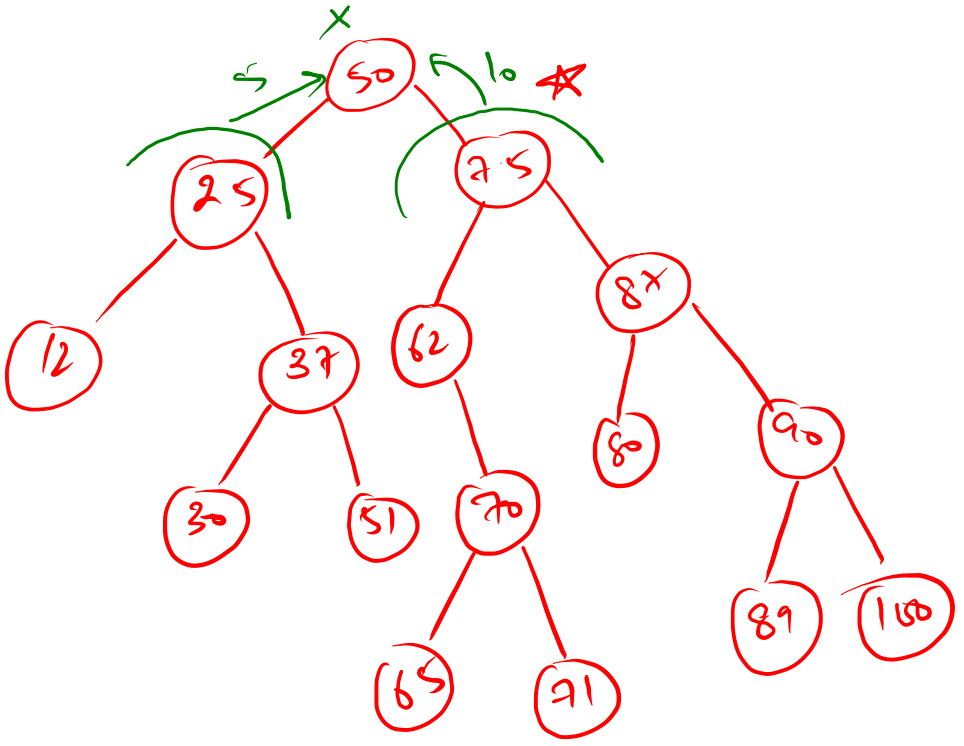
isbst (node)

- isbst (left)
- isbst (right)
- Max(left) < n.data < Min(right)




| | Node | Min | Max | isBst |
|---|---|---|---|---|
| | null | +∞ | -∞ | true |
| | 12 | 12 | 12 | true |
| | 51 | 51 | 51 | true |
| | 37 | 37 | 51 | true |
| l | 25 | 12 | 51 | true |
| | 62 | 62 | 62 | true |
| | 87 | 87 | 87 | true |
| r | 75 | 62 | 87 | true |
| | 50 | 12 | 87 | false |

```java
public static IsBSTSolver checkBst(Node node){
    if(node == null){
        return new IsBSTSolver(Integer.MAX_VALUE,Integer.MIN_VALUE,true);
    }
    IsBSTSolver lres = checkBst(node.left);
    IsBSTSolver rres = checkBst(node.right);

    int min = Math.min(node.data,Math.min(lres.min,rres.min));
    int max = Math.max(node.data,Math.max(lres.max,rres.max));
    boolean isbst = lres.isbst && rres.isbst && node.data > lres.max && node.data < rres.min;
    return new IsBSTSolver(min,max,isbst);
}
```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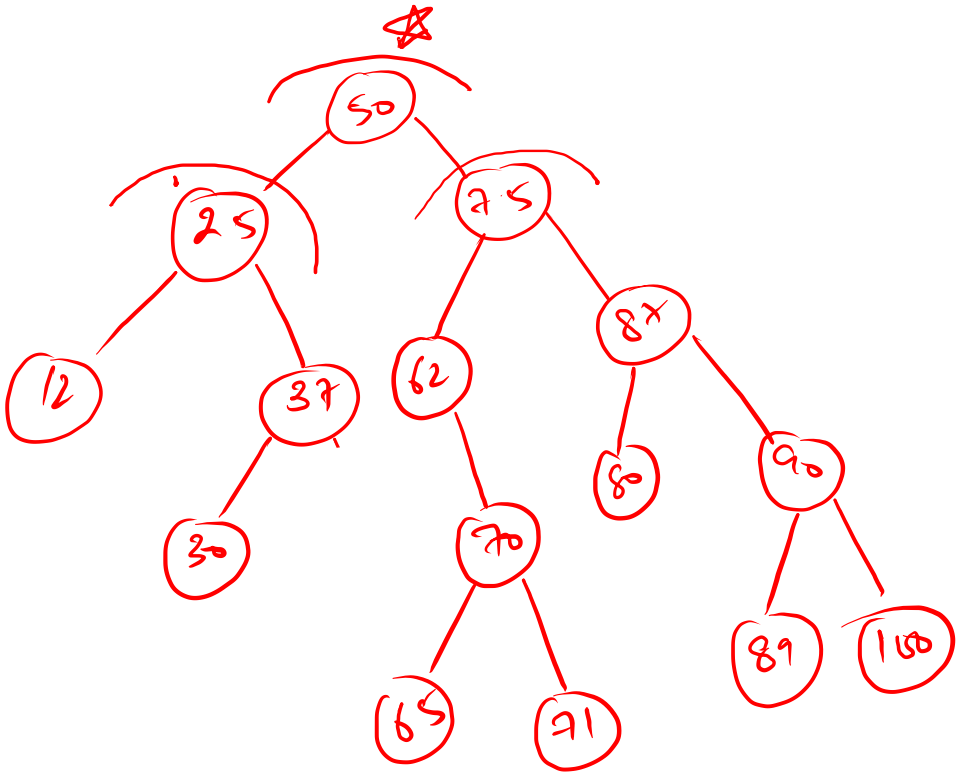
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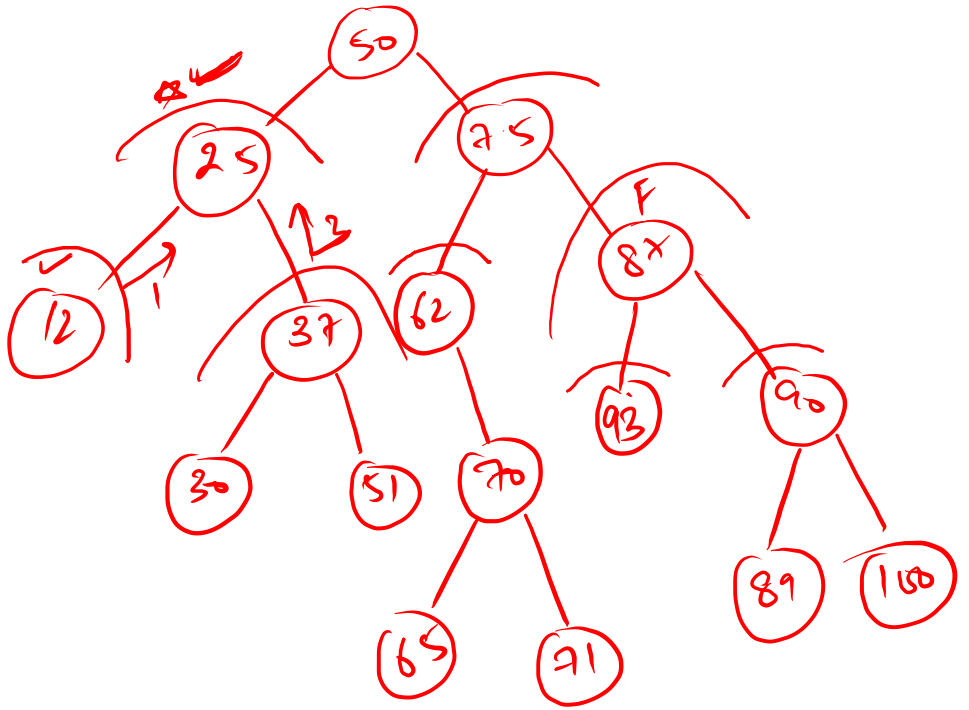


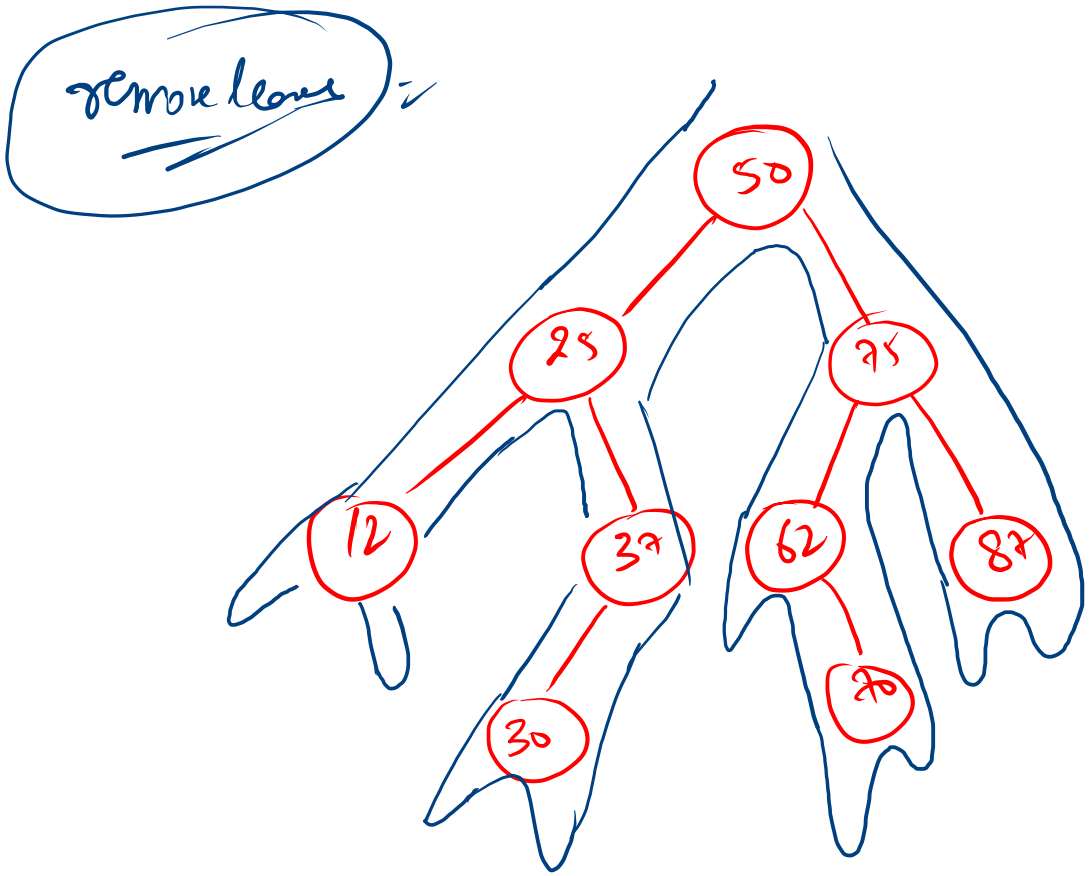

| | | Min | Max | isbst | lBSTNode | lBSTSize |
|---|---|---|---|---|---|---|
| | null | +∞ | -∞ | true | null | 0 |
| | 12 | 12 | 12 | true | 12 | 1 |
| | 30 | 30 | 30 | true | 30 | 1 |
| | 51 | 51 | 51 | true | 51 | 1 |
| | 37 | 30 | 51 | true | 37 | 3 |
| l | 25 | 12 | 51 | true | 12 51 | 5 |
| | 65 | 65 | 65 | true | 65 | 1 |
| | 71 | 71 | 71 | true | 71 | 1 |
| → | 70 | 65 | 71 | true | 70 | 3 |
| → | 62 | 62 | 71 | true | 62 | 4 |
| → | 80 | 80 | 80 | true | 80 | 1 |
| → | 89 | 89 | 89 | true | 89 | 1 |
| → | 100 | 100 | 100 | true | 100 | 1 |
| → | 90 | 89 | 100 | true | 90 | 3 |
| | 87 | 80 | 100 | true | 90 | 3 |
| r | 75 | 62 | 100 | true | 62 | 4 |
| | 50 | 12 | 100 | false | 25 | 5 |

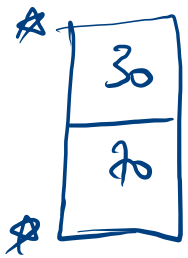
```
if (isbst){

lbstNode = node;

lbst size = lres.size + r.size + 1;

}
```

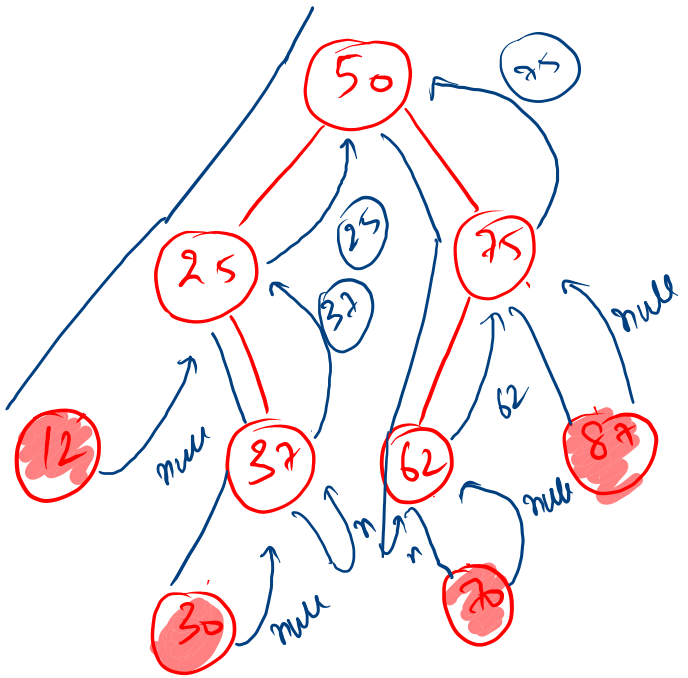



```java
public static void printSingleChildNodes(Node node){
    if(node == null){
        return;
    }

    if(node.right == null && node.left != null){
        System.out.println(node.left.data);
    }else if(node.right != null && node.left == null){
        System.out.println(node.right.data);
    }

    printSingleChildNodes(node.left);
    printSingleChildNodes(node.right);
}
```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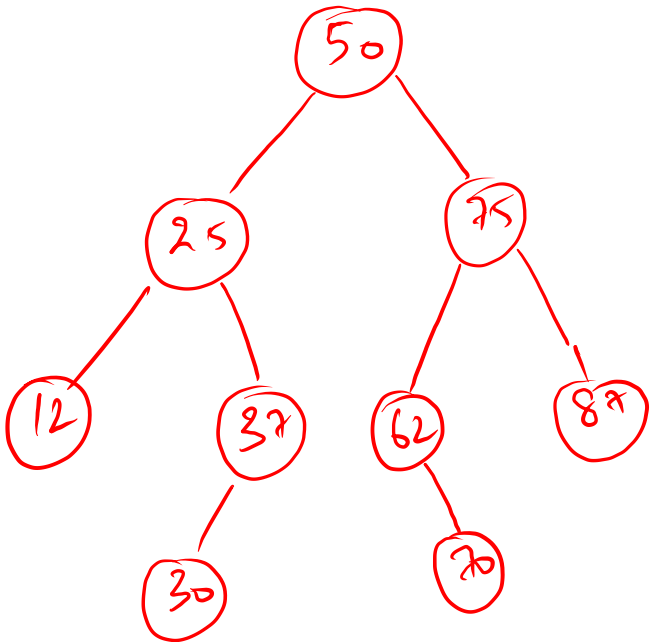
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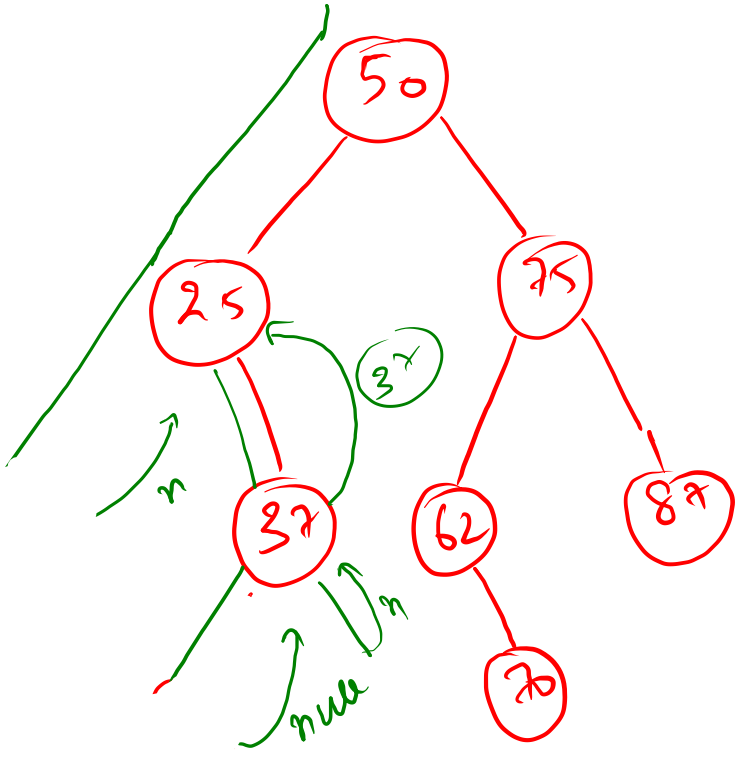
→ largest bst subtree

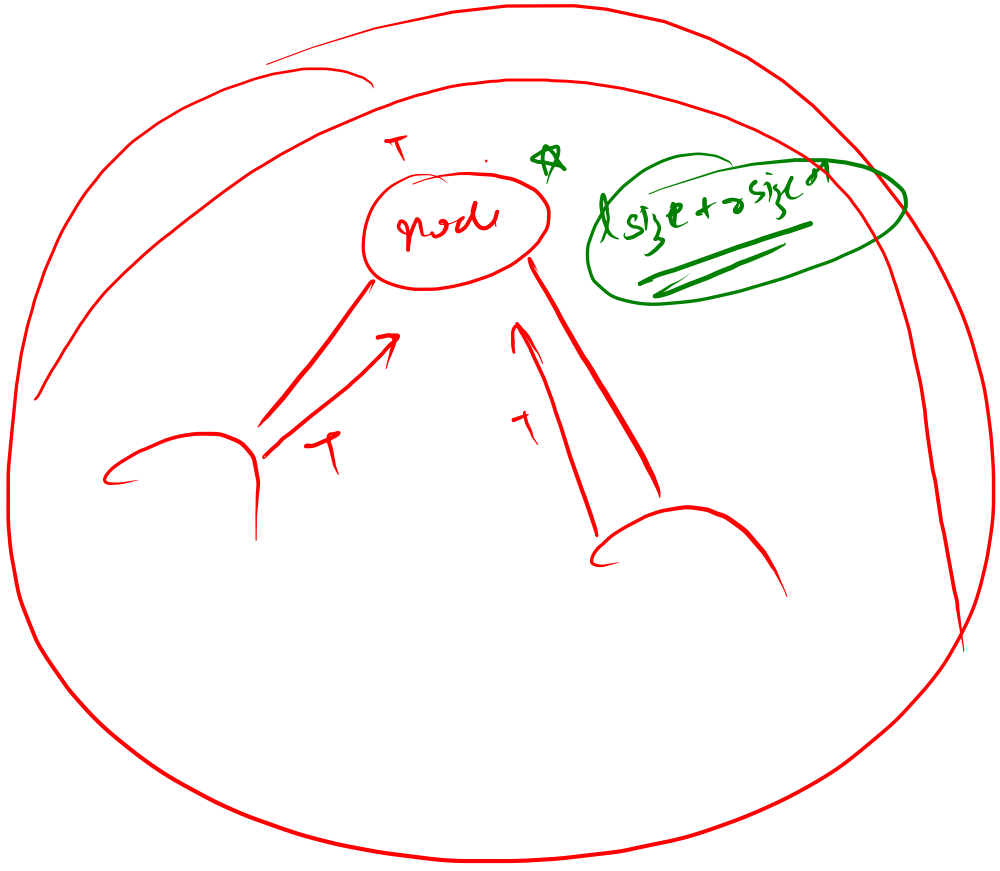



```java
public static Node removeLeaves(Node node){
  if(node == null){
      return null;
  }

  if(node.left == null && node.right == null){
      return null;
  }

  node.left = removeLeaves(node.left);
  node.right = removeLeaves(node.right);

  return node;
}
```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node
size+size
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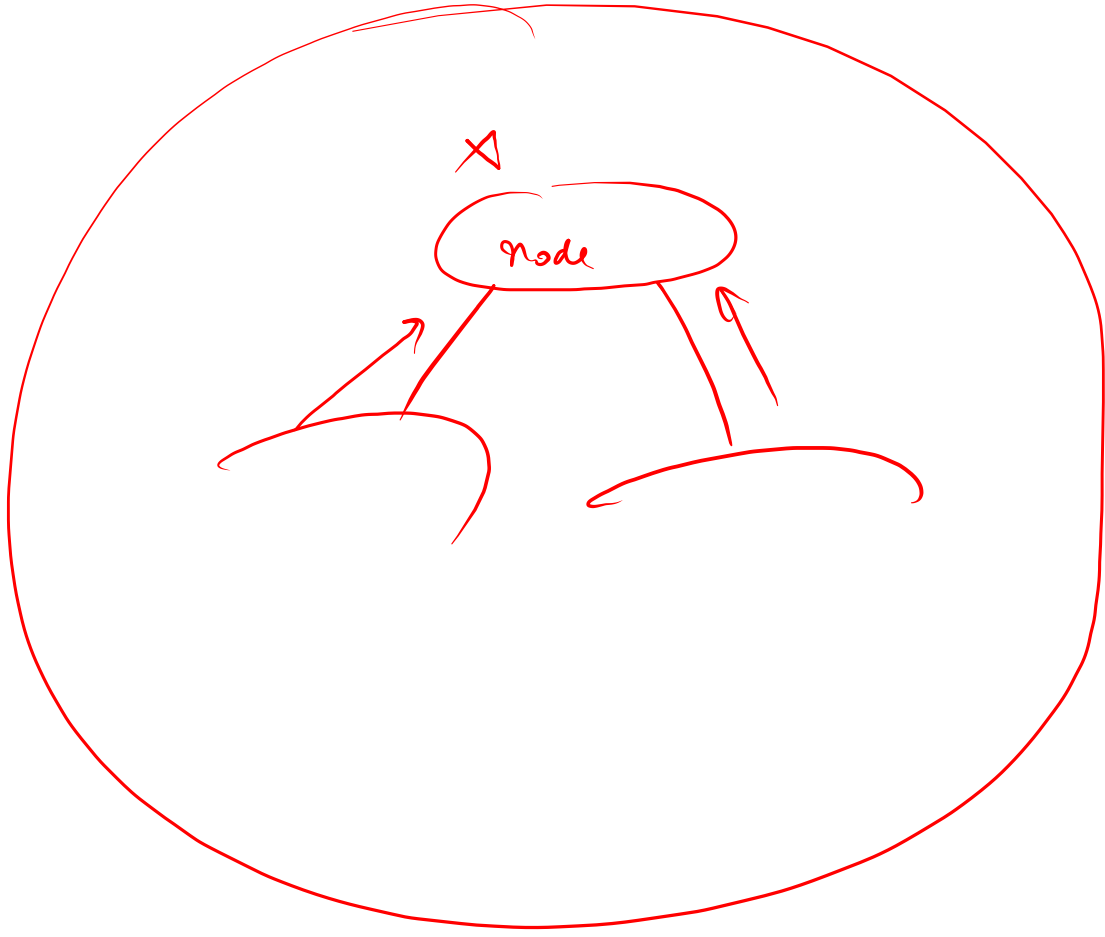
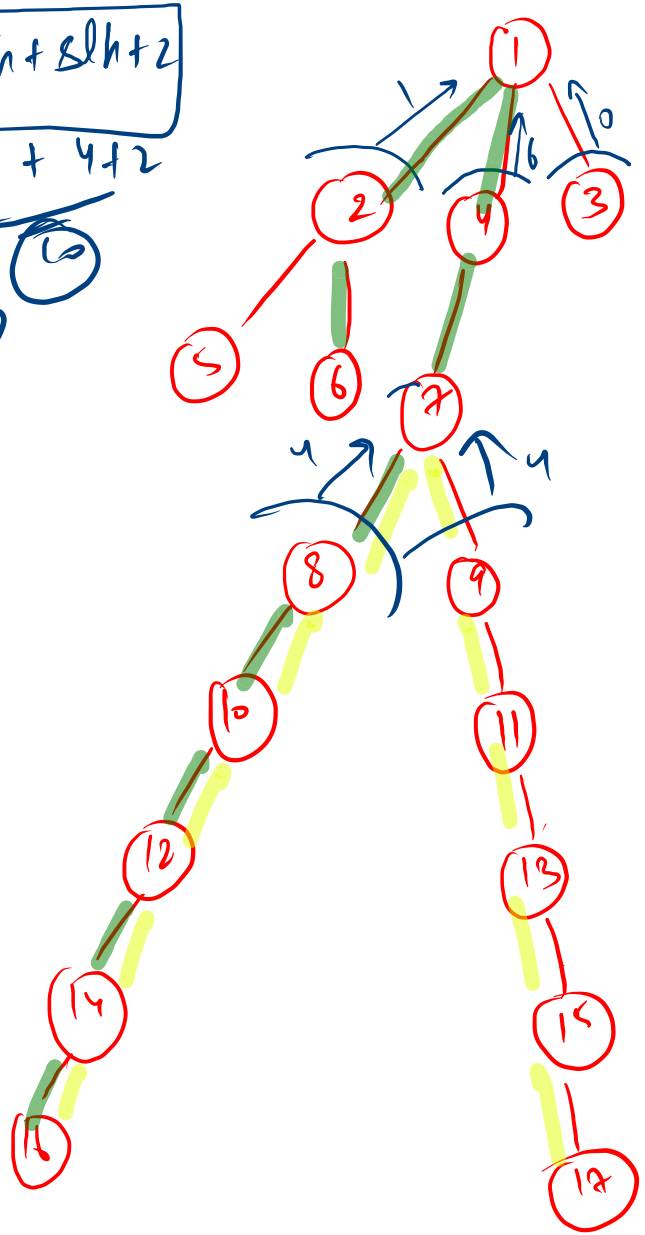

node

Dia ⇒ lh + slh + 2

4 + 4 + 2

10




**Dia**

↳ Maximum distance b/w any two nodes.

6 - 16 ⇒ ?

16 - 17 ⇒ 10

Dia = lh + slh + 2

Dia mein ⇒ 10