

Lowest Common Ancestor of BST

● MEDIUM

■ Introduction

The Lowest Common Ancestor (LCA) of two nodes p and q is the deepest node that has both p and q as descendants. For a generic binary tree, this requires $O(n)$. But for a BST, the BST property gives us a shortcut: we can find LCA in $O(h)$!

■ Core Intuition

The Fork Intuition

- Walk from root. At some node, p and q go in different directions $\rightarrow$ THAT node is LCA.
- If both p and q are less than current node $\rightarrow$ LCA is in LEFT subtree.
- If both p and q are greater $\rightarrow$ LCA is in RIGHT subtree.
- If they diverge (one left, one right) OR $\text{current} == p$ or $q \rightarrow$ current IS the LCA.

■ Visual

LCA Visualization

```

10
 / \
5 15 LCA(3,7) = 5 (3<5, 7>5  $\rightarrow$  diverge at 5)
 / \ \ LCA(3,5) = 5 (5 is p itself  $\rightarrow$  LCA)
3 7 20 LCA(5,15) = 10 (5<10, 15>10  $\rightarrow$  diverge at 10)

At node 10: LCA(3,7)  $\rightarrow$  both < 10  $\rightarrow$  go LEFT
At node 5: LCA(3,7)  $\rightarrow$  3<5 and 7>5  $\rightarrow$  FORK! Return node 5
  
```

■ Java Implementation

Java

```

class Solution {
    // Iterative (O(1) space) – preferred
    public TreeNode lowestCommonAncestor(TreeNode root, TreeNode p, TreeNode q) {
        TreeNode curr = root;

        while (curr != null) {
            if (p.val < curr.val && q.val < curr.val) {
  
```

■ Time & Space Complexity

Case	Time	Space	Why
Iterative	$O(h)$	$O(1)$	h = tree height; no extra space
Recursive	$O(h)$	$O(h)$	Call stack depth = h

Common Mistakes

Watch Out For

- Using generic binary tree LCA algorithm — BST LCA is much faster, use BST property.
- Forgetting the case where p or q IS the ancestor of the other.
- Not handling equal values — if `curr.val == p.val` or `q.val`, it can be the LCA.

■ Practice Problems

Case	Time	Space	Why
Medium	LC 235	LCA of BST	Direct application
Medium	LC 236	LCA of Binary Tree (no BST)	Generic version, $O(n)$
Hard	LC 1123	LCA of Deepest Leaves	LCA generalization

■ Mental Model

Remember Forever

- "Walk down. The moment p and q stop agreeing on which direction to go — you've found their common ancestor."