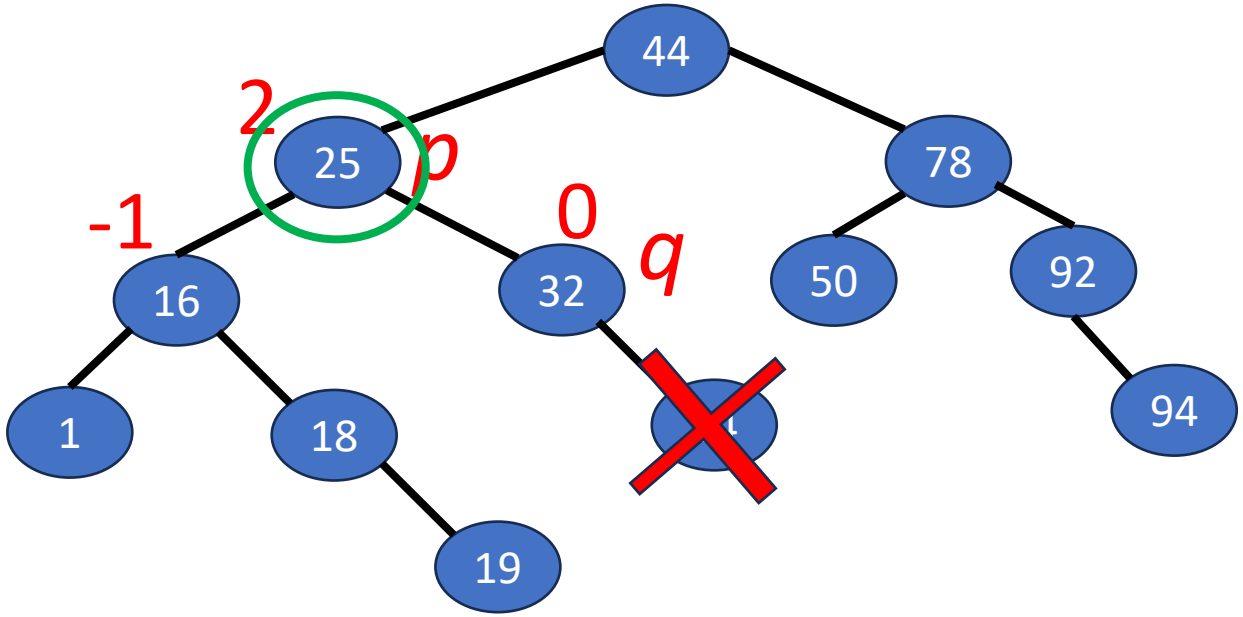
AVL tree

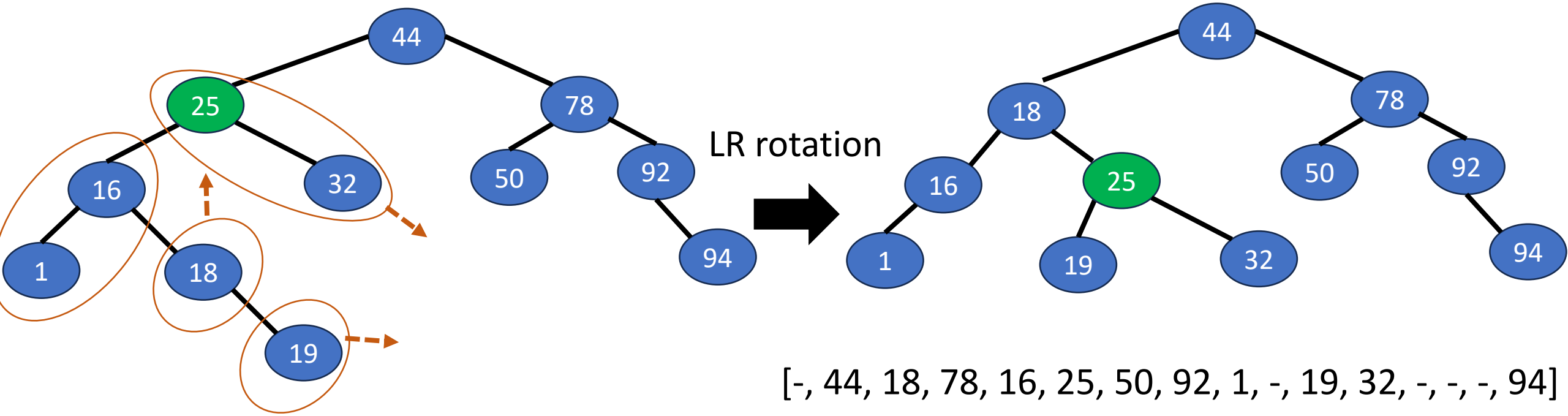
- Q1: Please write out the result after delete 34 from the following AVL tree.



- BF(q) is changed from -1 to 0 → Case III
- BF(q's parent p) is changed from 1 to 2 → Case II
- BF(p's left child) == -1 → R-1 rotation (Similar to LR)

AVL tree

- Q1: Please write out the result after delete 34 from the following AVL tree.

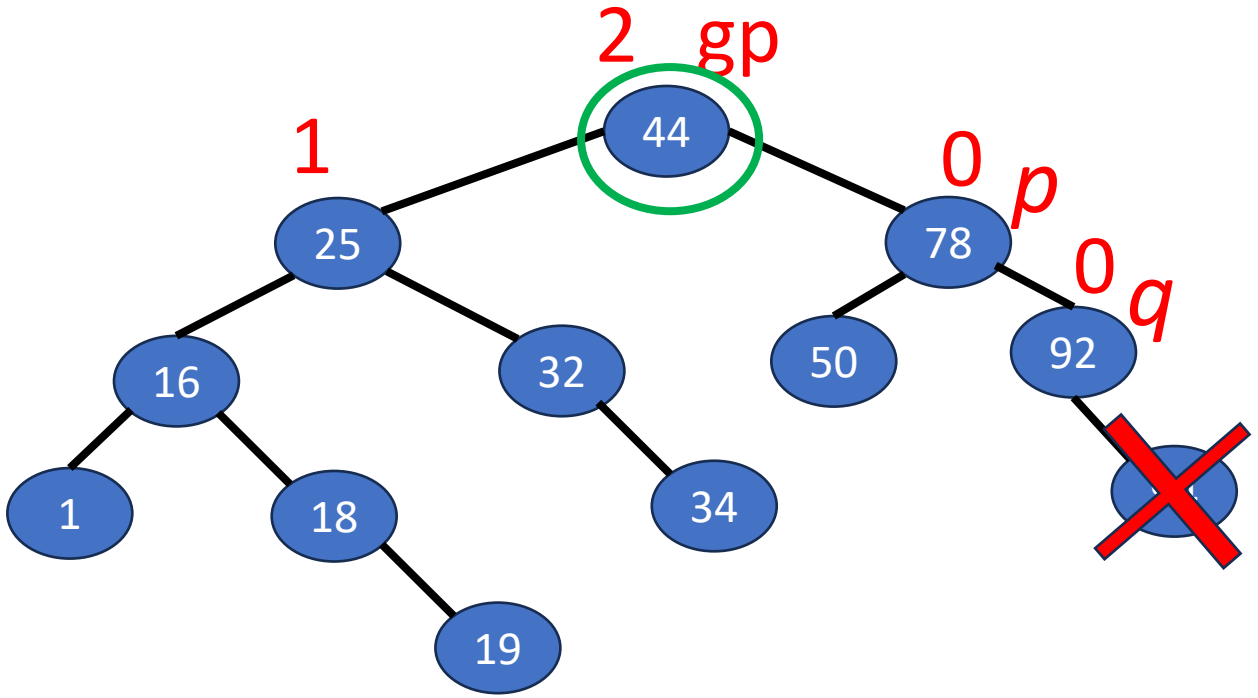


[-, 44, 18, 78, 16, 25, 50, 92, 1, -, 19, 32, -, -, -, 94]

- Adjust along path to root.
- New BF of the parent is from 1 to 0 → Case III
- But the root has no parent → finish

AVL tree

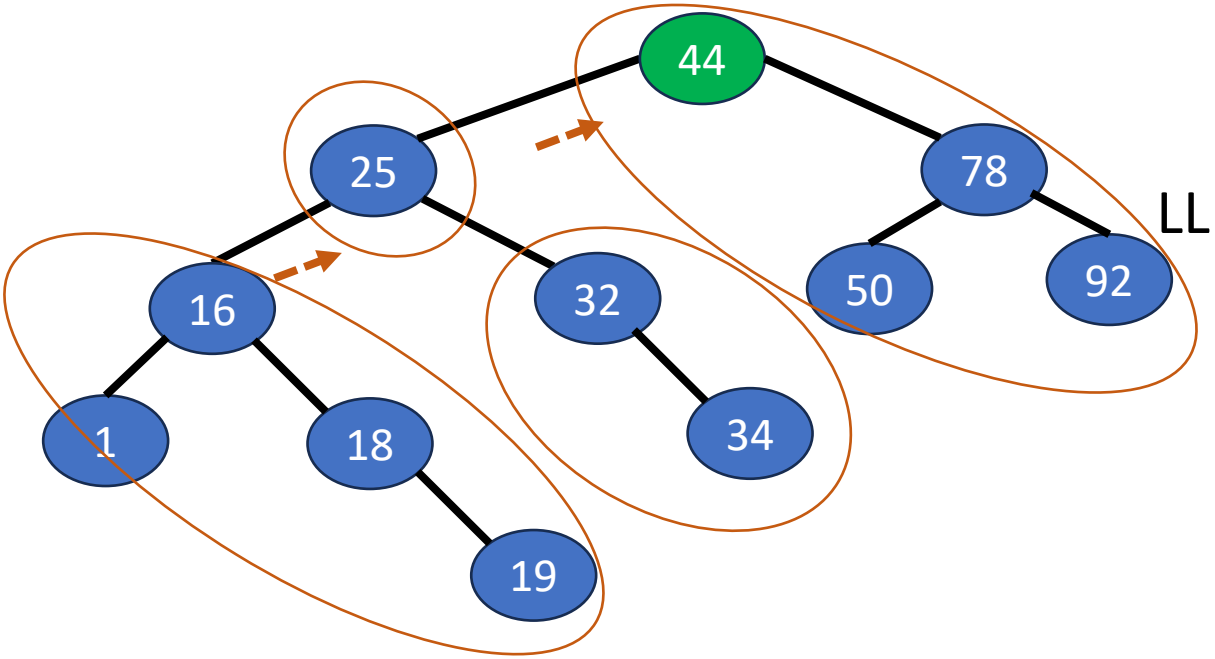
- Q2: Please write out the result after delete 94 from the following AVL tree.



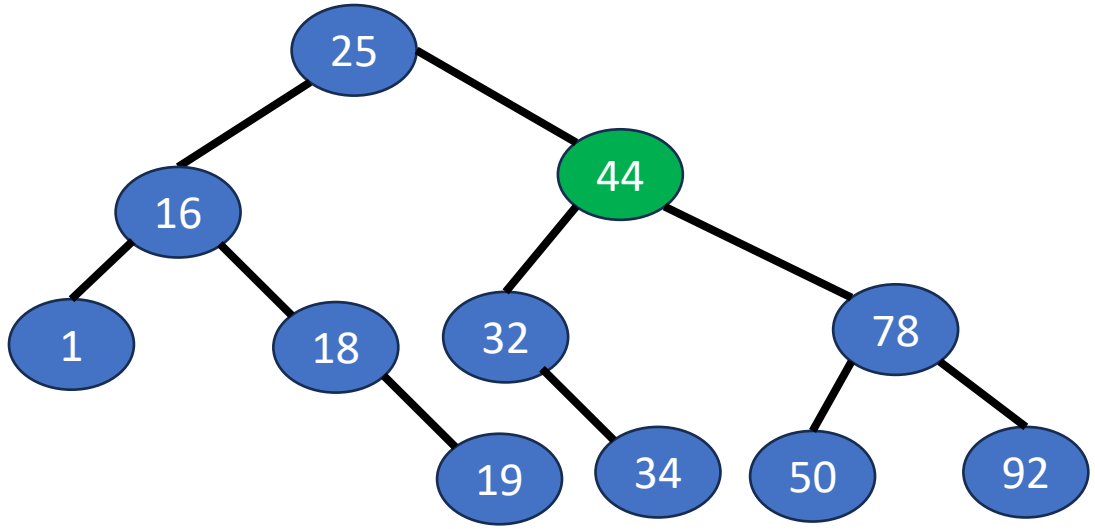
- BF(q) is changed from -1 to 0 → Case III
- BF(q's parent p) is changed from -1 to 0 → Case III
- BF(p's parent gp) is changed from 1 to 2 → Case II
- BF(gp's left child) == 1→ R1 rotation (Similar to LL)

AVL tree

- Q2: Please write out the result after delete 94 from the following AVL tree.



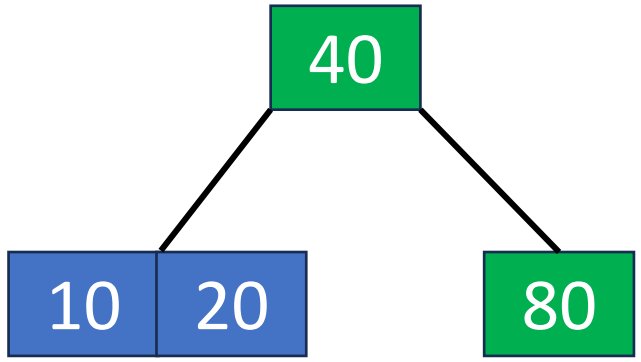
LL rotation



[-, 25, 16, 44, 1, 18, 32, 78, -, -, -, 19, -, 34, 50, 92]

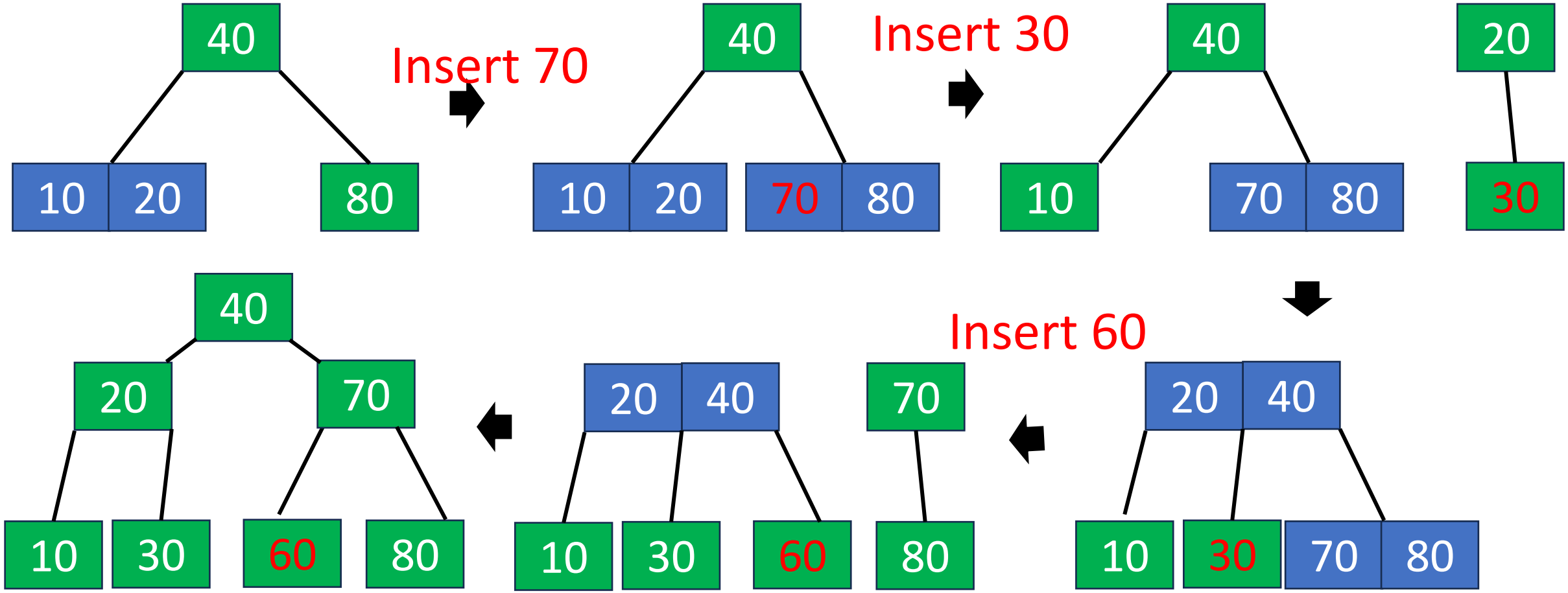
B-tree

- Given the following 2-3 tree.
  - Q3: Please insert 70. What will be the keys of data pairs of node at index 3?
  - Q4: (Continue Q3) Then further insert 30. How many nodes are in level 2?
  - Q5: (Continue Q4) Finally, insert 60. How many nodes are in the tree?



B-tree

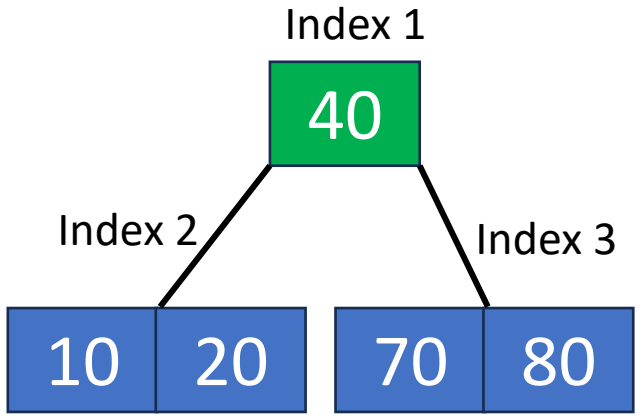
- Q3: Insert 70.
- Q4: (Continue Q3) Then further insert 30.
- Q5: (Continue Q4) Finally, insert 60.

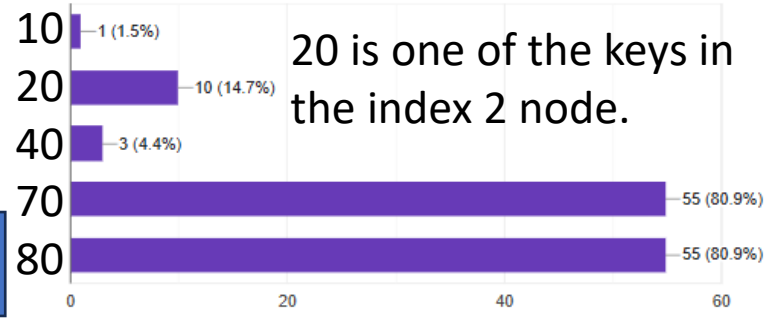


B-tree

- Q3: Insert 70. For the node at index 3, please select the keys in this node.

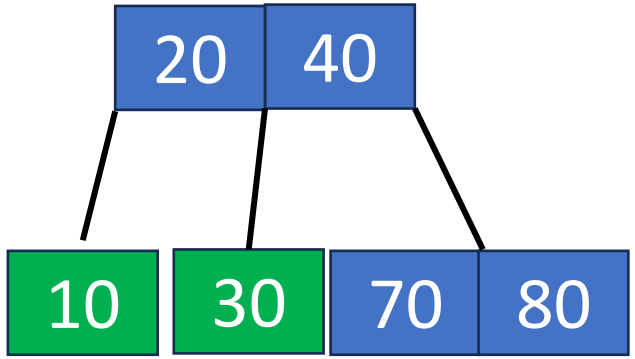
  70, 80

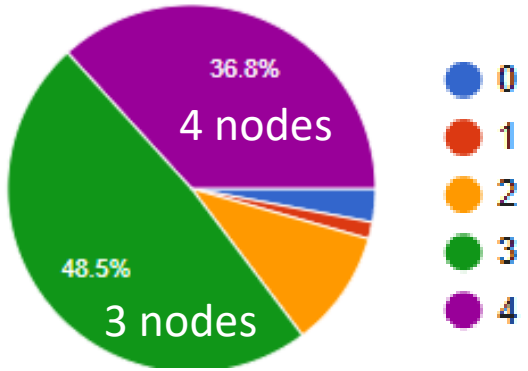




- Q4: (Continue Q3) Then further insert 30. How many nodes are in level 2?

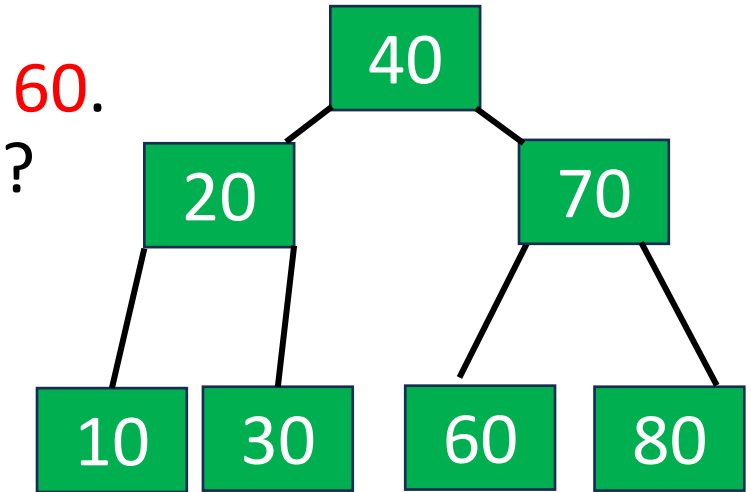
  3 nodes

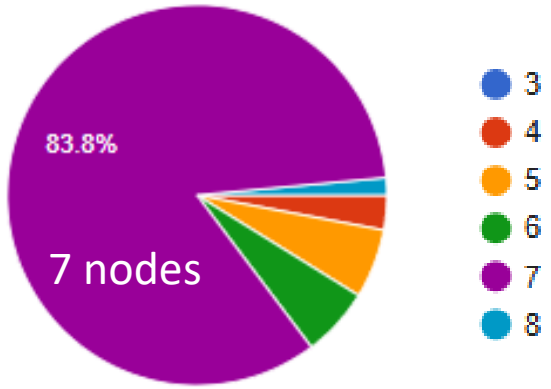




- Q5: (Continue Q4) Finally, insert 60. How many nodes are in the tree?

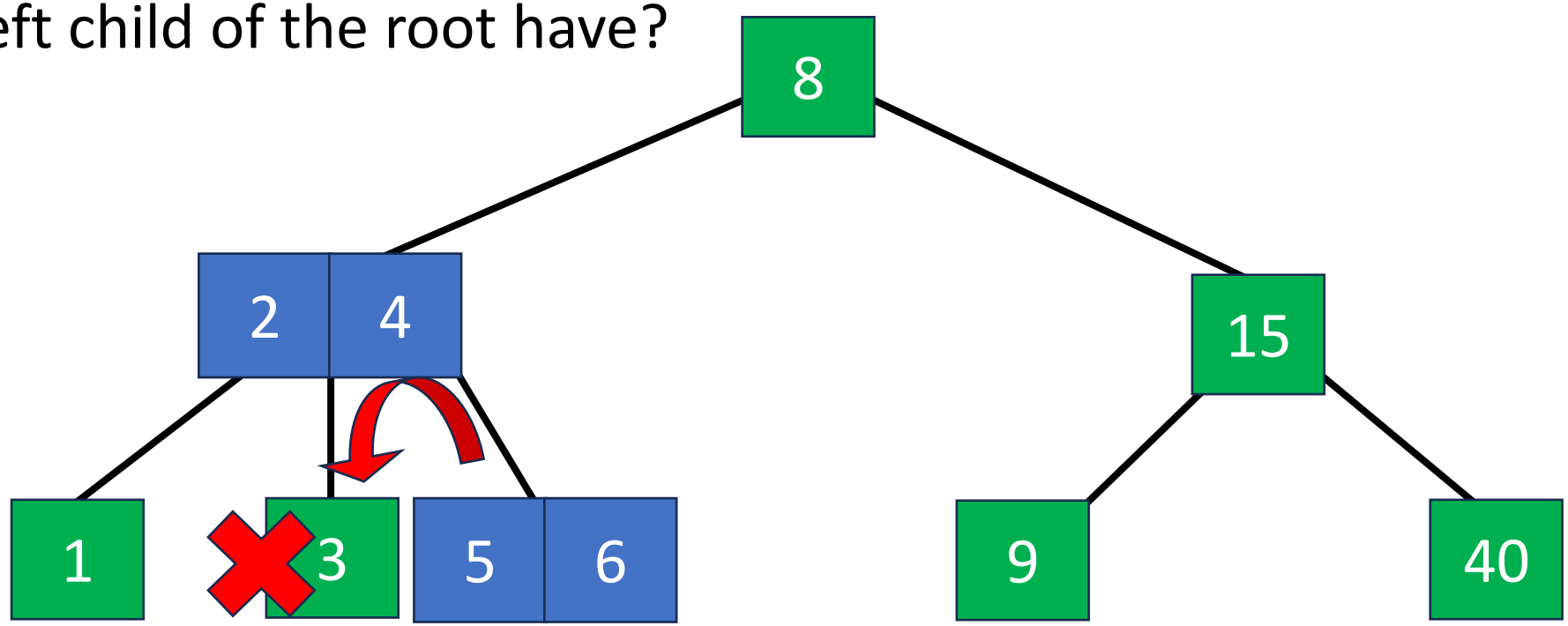
  7 nodes





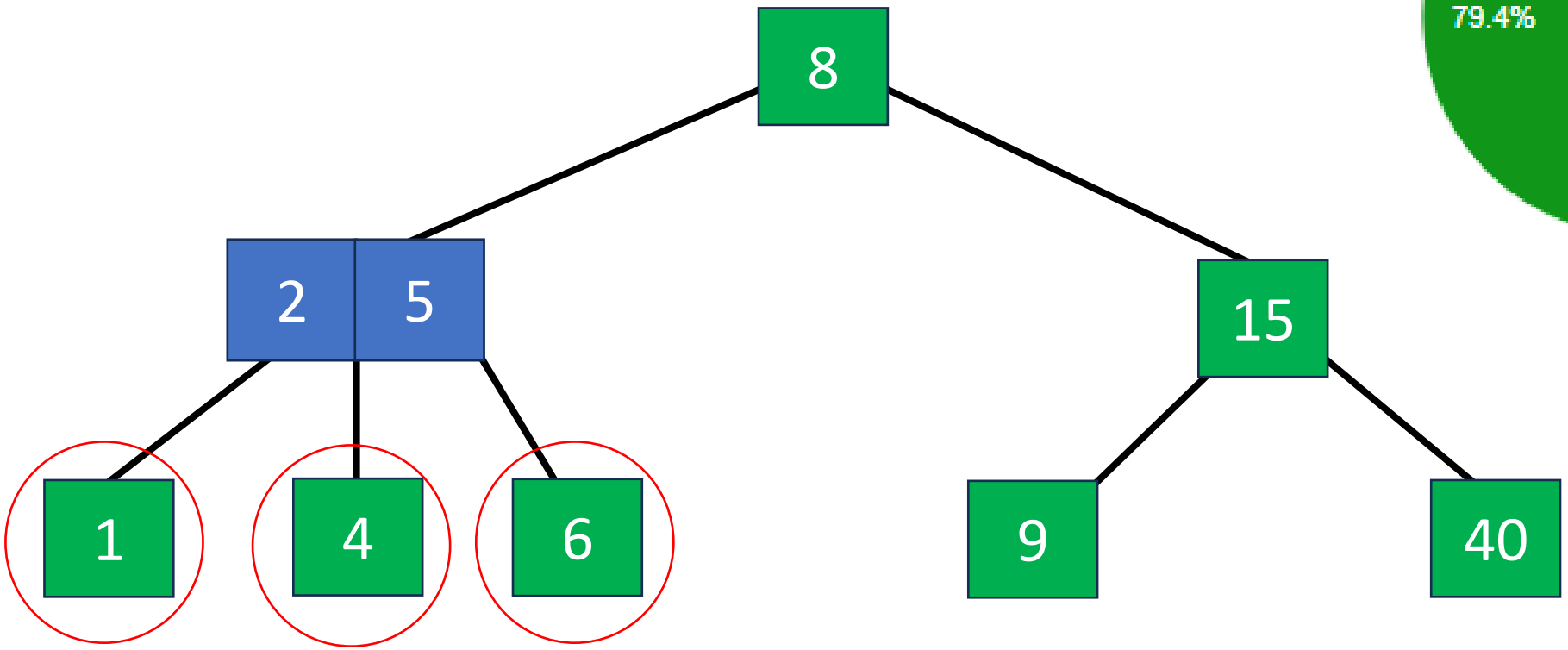
B-tree

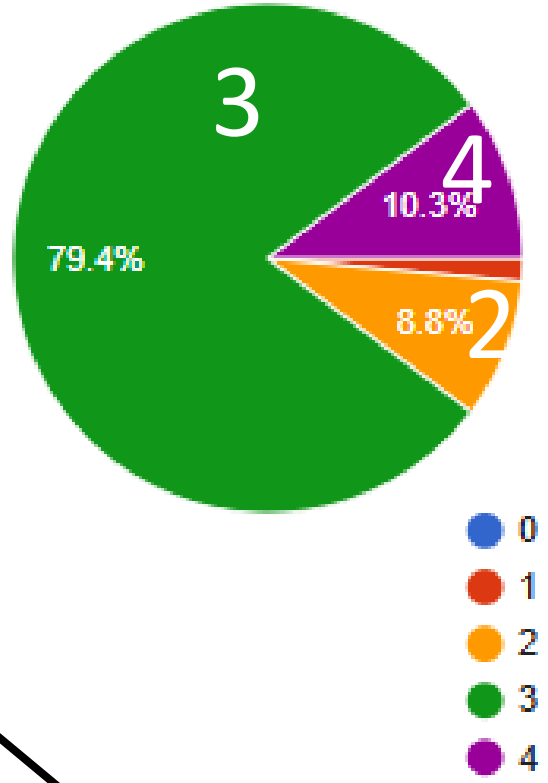
- Given the following 2-3 tree.
  - Q6: Please delete the pair with key = 3. How many children do the left child of the root have?



- Deletion from a 2-node.
- Check the nearest sibling and determine if it is a 3-node.
- If so borrow a pair and a subtree via parent node. (Rotation)

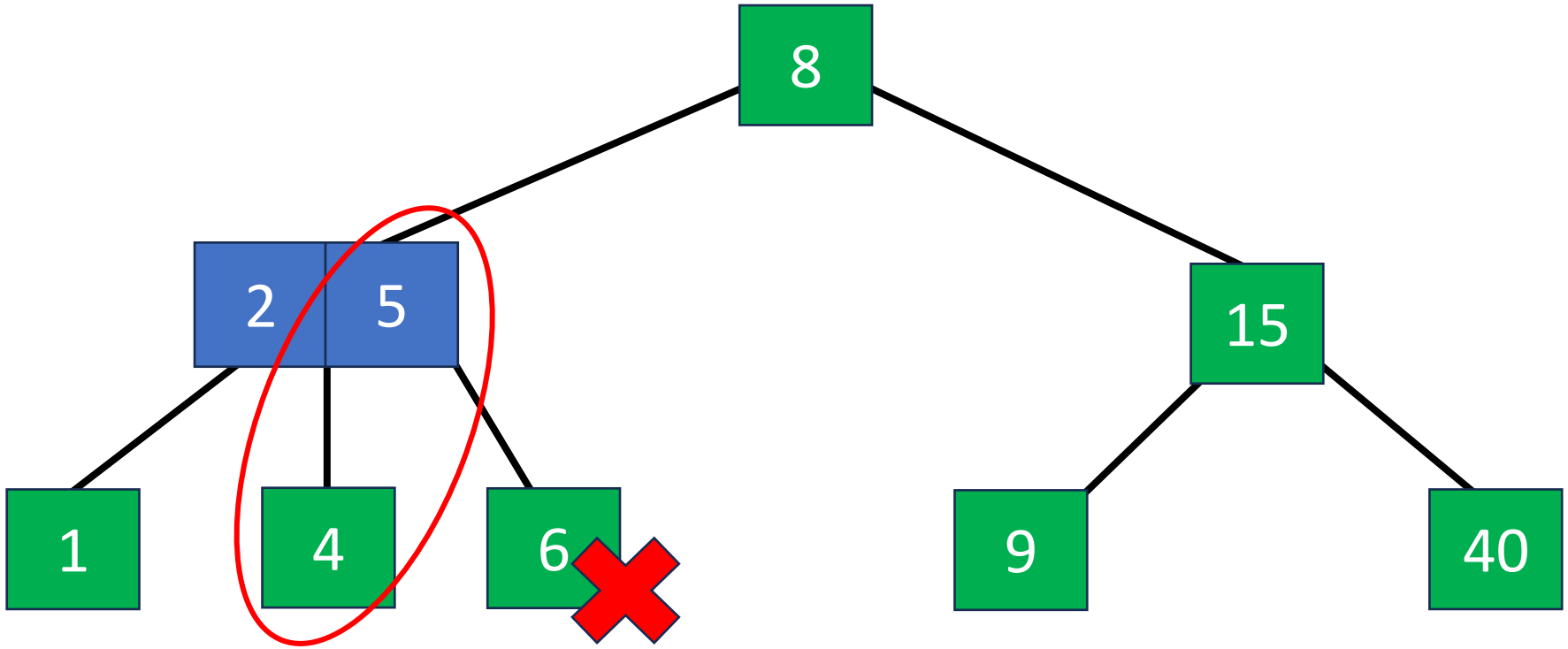
After deletion of the pair with key 3





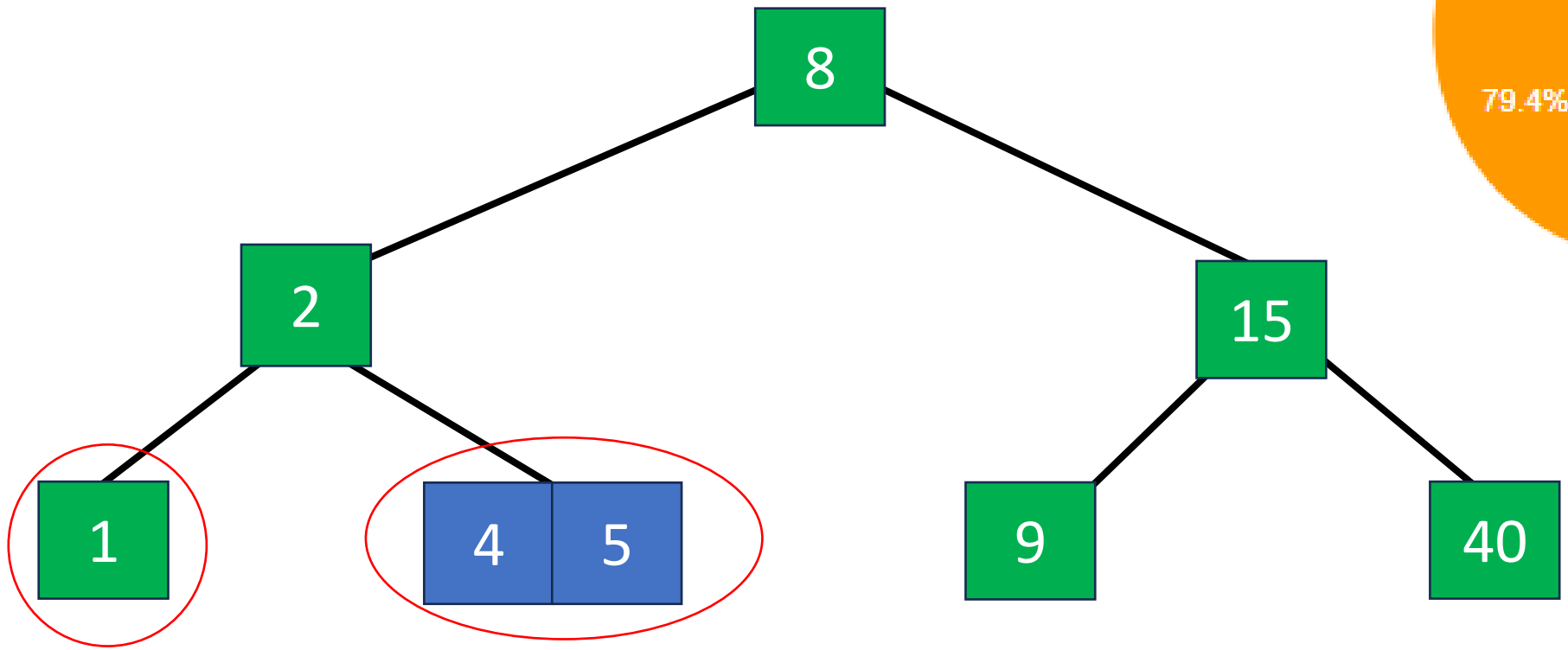
How many children does the left child of the root have? 3

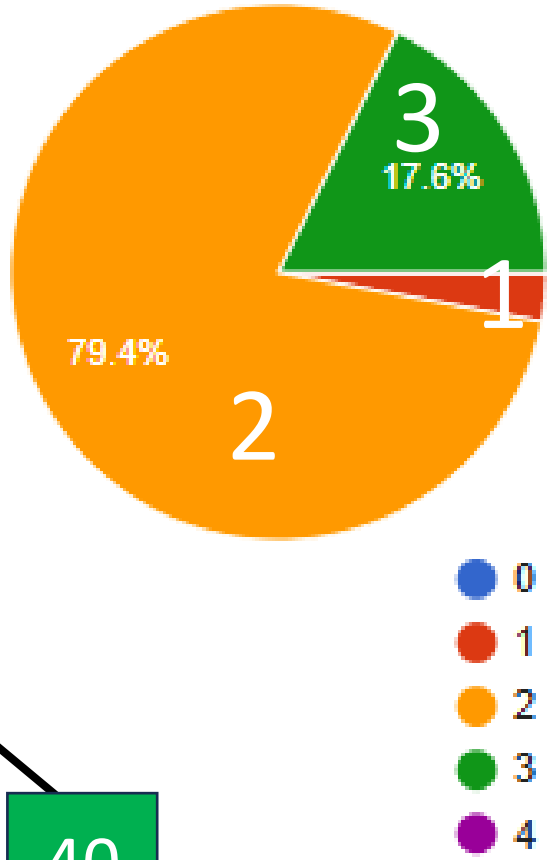
Q7: (Continue Q6) Please delete the pair with key = 6. How many children do the left child of the root have?



- Deletion from a 2-node.
- Check the nearest sibling and determine if it is a 3-node.
- If not, combine with one nearest sibling and a parent pair.

After deletion of the pair with key 6





How many children does the left child of the root have? 2