# Data Structures
# Chapter 5 Tree

1. introduction
2. Binary tree
   - Definition and Properties
   - Traversal
   - **Coding - Quizzes**
3. Binary search tree
4. Tree balancing

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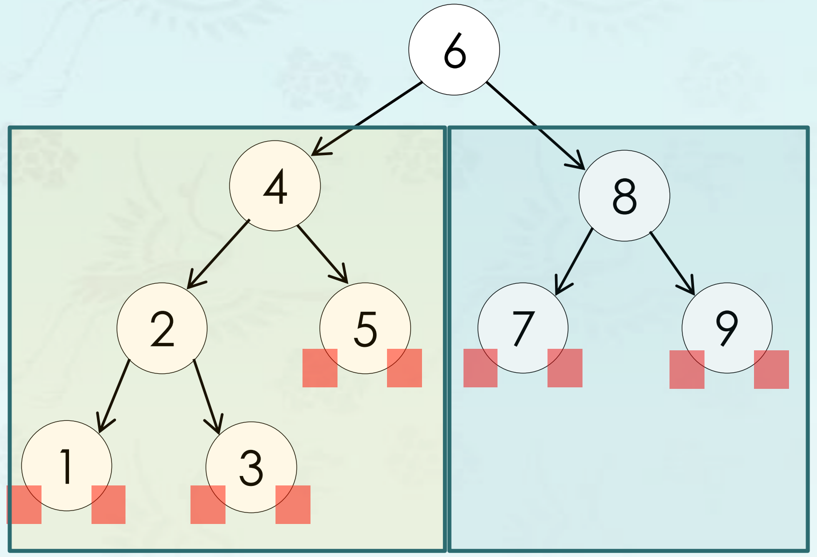
## Operations: size()

```
// returns the number of nodes in the binary tree
int size(tree node) {
  if (empty(node)) return 0;
  return size(node->left) + size(node->right) + 1;
}
```

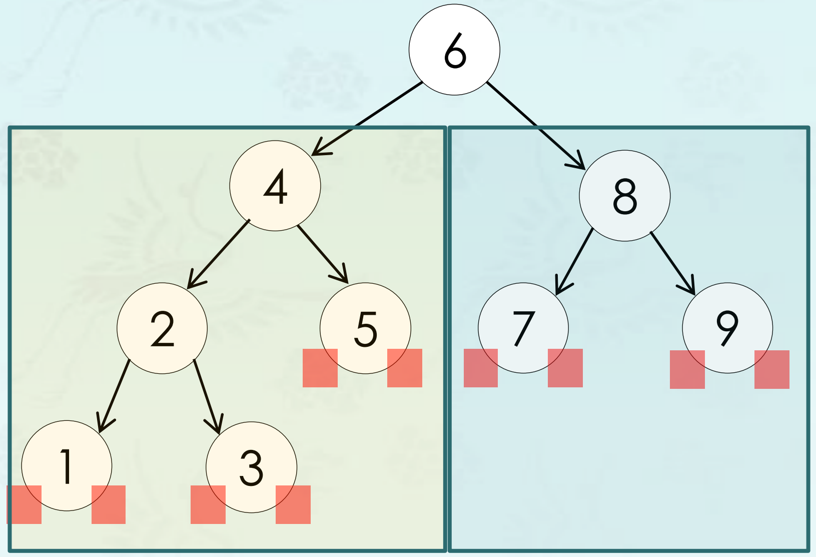
- Q1. What is the total number of the function calls to complete with the tree and how many returns each side from the root 6?
- Q2. Which node invokes the last function call?
- Q3. Which node finishes its size function call and returns size = 1 for the first time?



## Operations: height()

```
// returns the max depth of a tree.
// height = -1 for empty tree, 0 for root only tree
int height(tree node) {
  if (empty(node)) return -1;
  int left  = height(node->left);
  int right = height(node->right);
  return max(left, right) + 1;
}
```

- Q1. What is the total number of the function call to complete with the tree below?
- Q2. What is the return value of the 10th and 12th function call?
- Q3. What is the return value of the node 2?



# Operations: containsBT(), findBT()

```
// returns true if key is in a given binary tree, false otherwise.
bool containsBT(tree root, int key) {
  if (empty(root)) return false;
  if (key == root->key) return true;

  return containsBT(root->left, key) || containsBT(root->right, key);
}
```

- Q1: Which node invokes **`containsBT(root->right, key)`** for the first time?
- Q2: Which node will invoke **`return false`** for the first time?
- Q3: How many function calls are made to reach the node **`key=5`**?
- Q4: How many function calls still remain in the system stack to finish after key=5 is found and what are they?