极客时间

树、二叉树、二叉搜索树

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本节内容

1. Tree, Binary Tree, Binary Search Tree
2. Graph

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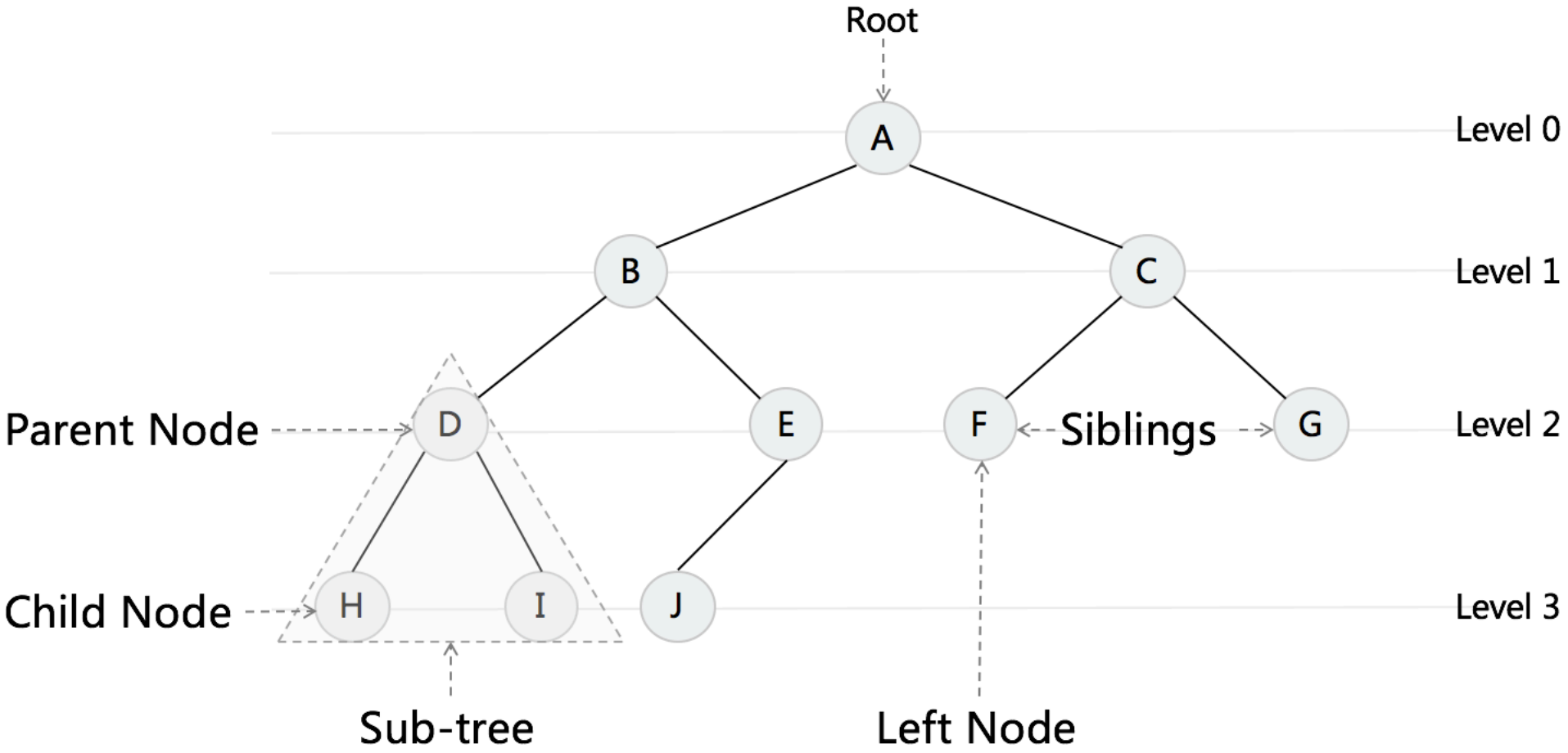
Tree


Root
A
B
C
D
E
F
G
H
I
J
Level 0
Level 1
Level 2
Level 3
Parent Node
Siblings
Child Node
Sub-tree
Left Node

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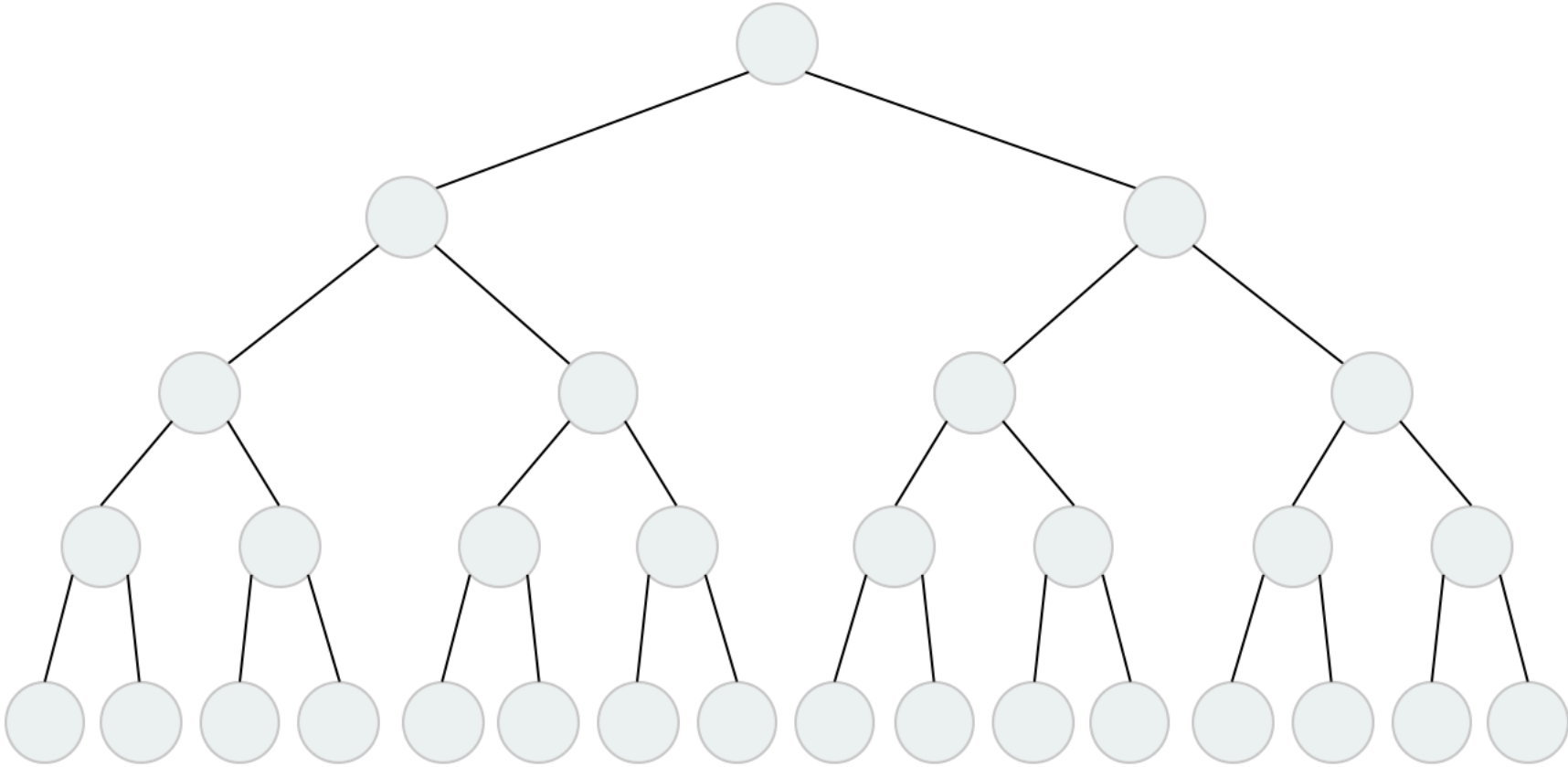
Binary Tree



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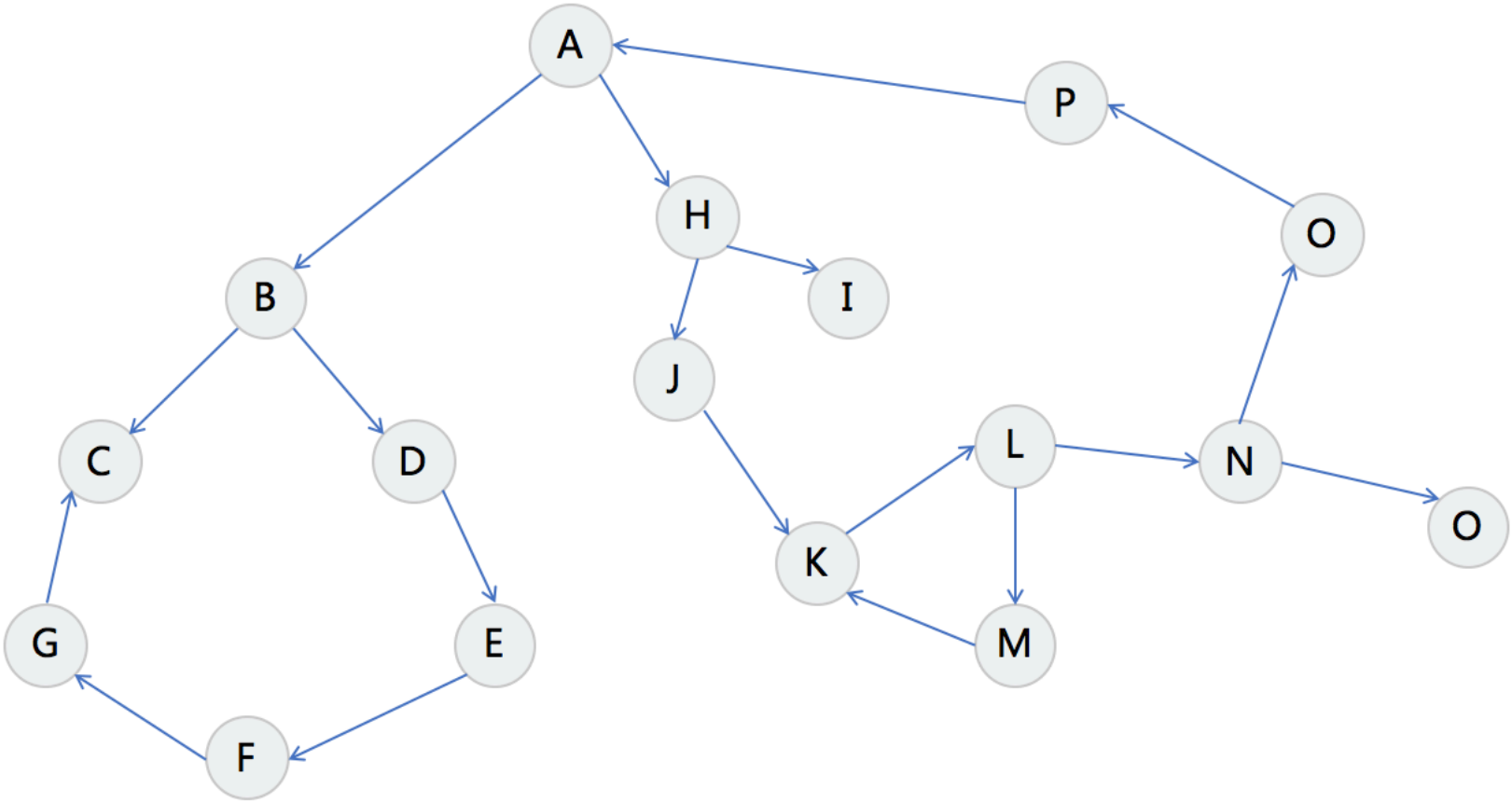
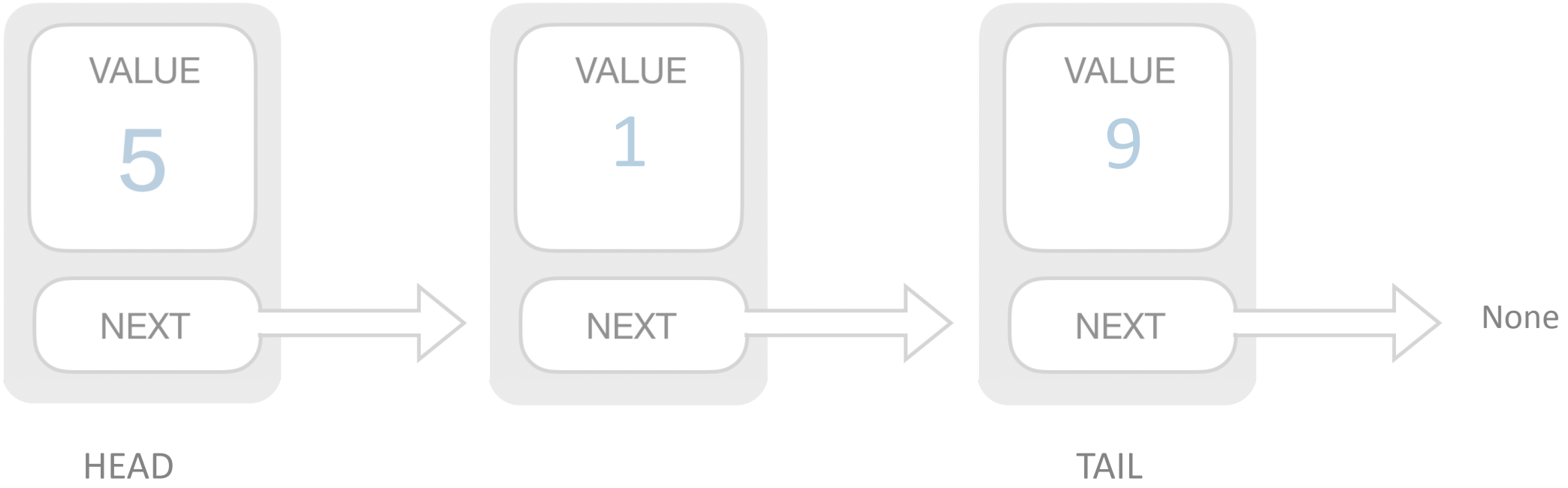
Graph



Linked List



Linked List 就是特殊化的 Tree

Tree 就是特殊化的 Graph

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Python

```python
class TreeNode:
    def __init__(self, val):
        self.val = val
        self.left, self.right = None, None
```

C++

```cpp
struct TreeNode {
    int val;
    TreeNode *left;
    TreeNode *right;
    TreeNode(int x) : val(x), left(NULL), right(NULL) {}
}
```

Java

```java
public class TreeNode {
    public int val;
    public TreeNode left, right;
    public TreeNode(int val) {
      this.val = val;
      this.left = null;
      this.right = null;
    }
}
```

二叉搜索树（英语：Binary Search Tree），也称二叉搜索树、有序二叉树（英语：ordered binary tree），排序二叉树（英语：sorted binary tree），是指一棵空树或者具有下列性质的二叉树：

1. 若任意节点的左子树不空，则左子树上所有结点的值均小于它的根结点的值；
2. 若任意节点的右子树不空，则右子树上所有结点的值均大于它的根结点的值；
3. 任意节点的左、右子树也分别为二叉查找树。

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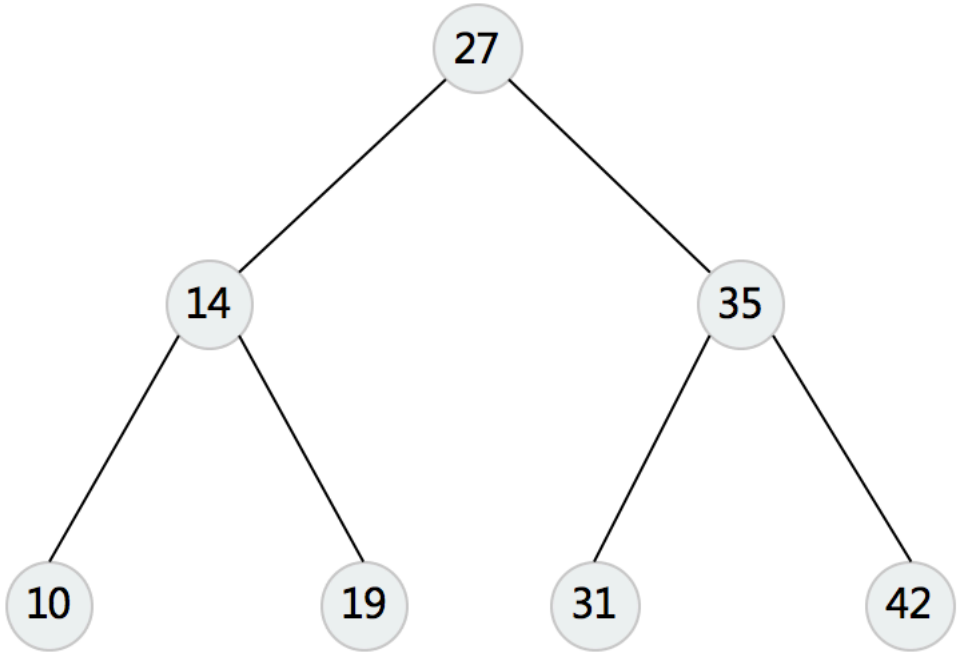
Binary Search Tree



Common Data Structure Operations

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Data Structure	Time Complexity								Space Complexity
	Average				Worst				Worst
	Access	Search	Insertion	Deletion	Access	Search	Insertion	Deletion	
Array	Θ(1)	Θ(n)	Θ(n)	Θ(n)	O(1)	O(n)	O(n)	O(n)	O(n)
Stack	Θ(n)	Θ(n)	Θ(1)	Θ(1)	O(n)	O(n)	O(1)	O(1)	O(n)
Queue	Θ(n)	Θ(n)	Θ(1)	Θ(1)	O(n)	O(n)	O(1)	O(1)	O(n)
Singly-Linked List	Θ(n)	Θ(n)	Θ(1)	Θ(1)	O(n)	O(n)	O(1)	O(1)	O(n)
Doubly-Linked List	Θ(n)	Θ(n)	Θ(1)	Θ(1)	O(n)	O(n)	O(1)	O(1)	O(n)
Skip List	Θ(log(n))	Θ(log(n))	Θ(log(n))	Θ(log(n))	O(n)	O(n)	O(n)	O(n)	O(n log(n))
Hash Table	N/A	Θ(1)	Θ(1)	Θ(1)	N/A	O(n)	O(n)	O(n)	O(n)
Binary Search Tree	Θ(log(n))	Θ(log(n))	Θ(log(n))	Θ(log(n))	O(n)	O(n)	O(n)	O(n)	O(n)
Cartesian Tree	N/A	Θ(log(n))	Θ(log(n))	Θ(log(n))	N/A	O(n)	O(n)	O(n)	O(n)
B-Tree	Θ(log(n))	Θ(log(n))	Θ(log(n))	Θ(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(n)
Red-Black Tree	Θ(log(n))	Θ(log(n))	Θ(log(n))	Θ(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(n)
Splay Tree	N/A	Θ(log(n))	Θ(log(n))	Θ(log(n))	N/A	O(log(n))	O(log(n))	O(log(n))	O(n)
AVL Tree	Θ(log(n))	Θ(log(n))	Θ(log(n))	Θ(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(n)
KD Tree	Θ(log(n))	Θ(log(n))	Θ(log(n))	Θ(log(n))	O(n)	O(n)	O(n)	O(n)	O(n)

图片来源：http://www.bigocheatsheet.com/

实战题目

1. https://leetcode.com/problems/validate-binary-search-tree
2. https://leetcode.com/problems/lowest-common-ancestor-of-a-binary-search-tree/
3. https://leetcode.com/problems/lowest-common-ancestor-of-a-binary-tree/

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