1. Two Sum

Given an array of integers `nums` and an integer `target`, return *indices of the two numbers such that they add up to* `target`.

You may assume that each input would have ***exactly* one solution**, and you may not use the *same* element twice.

You can return the answer in any order.

Example 1:

```
Input: nums = [2,7,11,15], target = 9
Output: [0,1]
Explanation: Because nums[0] + nums[1] == 9, we return [0, 1].
```

Example 2:

```
Input: nums = [3,2,4], target = 6
Output: [1,2]
```

Example 3:

```
Input: nums = [3,3], target = 6
Output: [0,1]
```

Constraints:

- $2 \le \texttt{nums.length} \le 10^4$
- $-10^9 \le \texttt{nums[i]} \le 10^9$
- $-10^9 \le \texttt{target} \le 10^9$
- **Only one valid answer exists.**

Follow-up: Can you come up with an algorithm that is less than $O(n^2)$ time complexity?

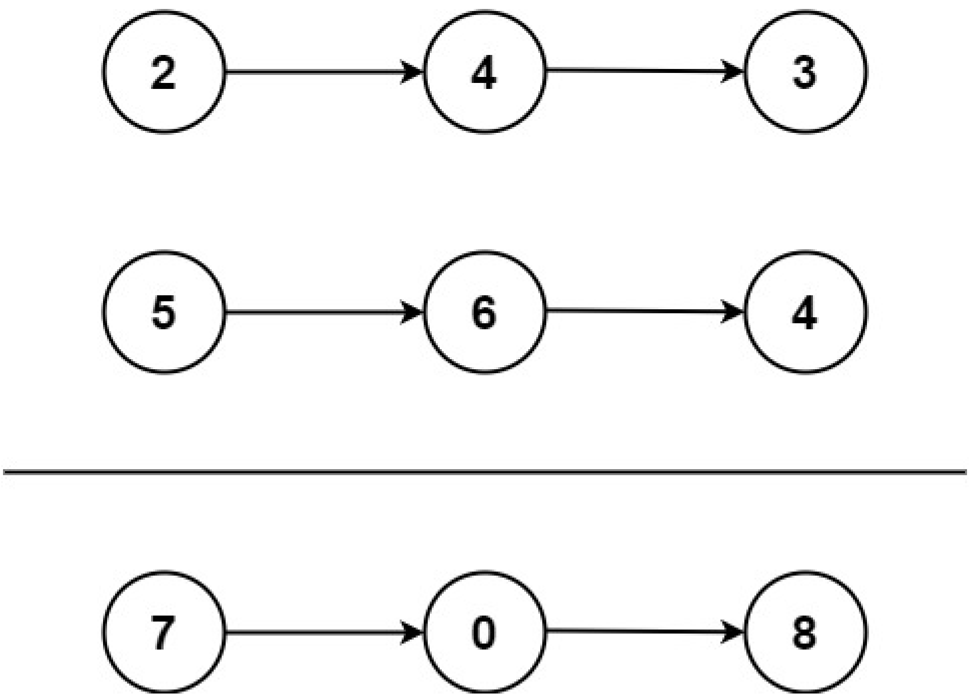
```
class Solution {
    public int[] twoSum(int[] nums, int target) {
        HashMap<Integer,Integer> hm=new HashMap<>();
        int [] arr=new int[2];
        for(int i=0;i<nums.length;i++)
        {
            if(hm.containsKey(target-nums[i]))
            {
                arr[0]=hm.get(target-nums[i]);
                arr[1]=i;
            }
            else
            {
                hm.put(nums[i],i);
            }
        }
        return arr;
    }
}
```

2. Add Two Numbers

You are given two **non-empty** linked lists representing two non-negative integers. The digits are stored in **reverse order**, and each of their nodes contains a single digit. Add the two numbers and return the sum as a linked list.

You may assume the two numbers do not contain any leading zero, except the number 0 itself.

Example 1:



```
Input: l1 = [2,4,3], l2 = [5,6,4]
Output: [7,0,8]
Explanation: 342 + 465 = 807.
```

Example 2:

```
Input: l1 = [0], l2 = [0]
Output: [0]
```

Example 3:

```
Input: l1 = [9,9,9,9,9,9,9], l2 = [9,9,9,9]
Output: [8,9,9,9,0,0,0,1]
```

Constraints:

- The number of nodes in each linked list is in the range `[1, 100]`.
- `0 <= Node.val <= 9`
- It is guaranteed that the list represents a number that does not have leading zeros.

```java
/*
    Name - Add Two Numbers
    Link - https://leetcode.com/problems/add-two-numbers/
    Time Complexity - O(m + n)
    Space Complexity - o(1)
    Note - make use of modulo (get remainder) and division (get quotient)
*/

class Solution {

    public ListNode addTwoNumbers(ListNode first, ListNode second) {
        int q = 0;
        int r = 0;
        int sum = 0;
        ListNode head = null;
        ListNode temp = null;
        while (first != null || second != null) {
            sum =
                q +
                (
                    ((first != null) ? first.val : 0) +
                    ((second != null) ? second.val : 0)
                );
            r = sum % 10;
            q = sum / 10;
            ListNode newNode = new ListNode(r);
            if (head == null) {
                head = newNode;
            } else {
                temp = head;
                while (temp.next != null) {
                    temp = temp.next;
                }
                temp.next = newNode;
                newNode.next = null;
            }
            if (first != null) {
                first = first.next;
            }
            if (second != null) {
                second = second.next;
            }
        }
        if (q > 0) {
            ListNode newNode = new ListNode(q);
            temp = head;
            while (temp.next != null) {
                temp = temp.next;
            }
            temp.next = newNode;
            newNode.next = null;
```

```
        }
        return head;
    }
}
```

3. Longest Substring Without Repeating Characters

Given a string s , find the length of the **longest substring** without repeating characters.

Example 1:

```
Input: s = "abcabcbb"
Output: 3
Explanation: The answer is "abc", with the length of 3.
```

Example 2:

```
Input: s = "bbbbb"
Output: 1
Explanation: The answer is "b", with the length of 1.
```

Example 3:

```
Input: s = "pwwkew"
Output: 3
Explanation: The answer is "wke", with the length of 3.
Notice that the answer must be a substring, "pwke" is a subsequence and not a
```

Constraints:

- 0 <= s.length <= 5 * 10^4
- s consists of English letters, digits, symbols and spaces.

---

1. Note : j=> In short, when we see a duplicate character in the current substring, move the left pointer past the first occurrence of this character recorded in the map. (This cuts out unnecessary steps

```
public class Solution {
    public int lengthOfLongestSubstring(String s) {
        int result = 0;
        int[] cache = new int[256];
        for (int i = 0, j = 0; i < s.length(); i++) {
            j = (cache[s.charAt(i)] > 0) ? Math.max(j, cache[s.charAt(i)])
: j;
            cache[s.charAt(i)] = i + 1;
            result = Math.max(result, i - j + 1);
        }
        return result;
    }
}
```

2.

```
   public int lengthOfLongestSubstring(String s) {
        if (s.length()==0) return 0;
        HashMap<Character, Integer> map = new HashMap<Character, Integer>
();
        int max=0;
        for (int i=0, j=0; i<s.length(); ++i){
            if (map.containsKey(s.charAt(i))){
                j = Math.max(j,map.get(s.charAt(i))+1);// just updating val
ue of j to new char index
            }
            map.put(s.charAt(i),i);
            max = Math.max(max,i-j+1);
        }
        return max;
    }
```

11. Container With Most Water

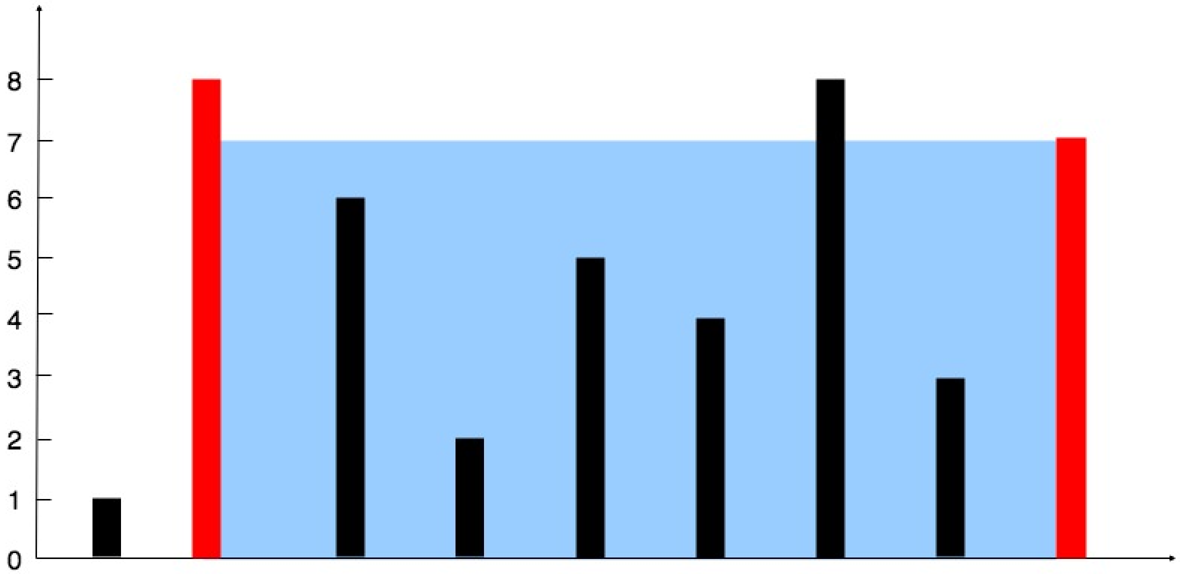
You are given an integer array `height` of length `n`. There are `n` vertical lines drawn such that the two endpoints of the i^{th} line are `(i, 0)` and `(i, height[i])`.

Find two lines that together with the x-axis form a container, such that the container contains the most water.

Return *the maximum amount of water a container can store*.

Notice that you may not slant the container.

Example 1:




```
Input: height = [1,8,6,2,5,4,8,3,7]
Output: 49
Explanation: The above vertical lines are represented by array [1,8,6,2,5,4,8
```

Example 2:

```
Input: height = [1,1]
Output: 1
```

Constraints:

- `n == height.length`
- `2 <= n <= 10`^{5}
- `0 <= height[i] <= 10`^{4}

---

1. O(N)

```
class Solution {
 public int maxArea(int[] height) {
     int right=height.length-1;
     int left=0;
     int maxVolume=Integer.MIN_VALUE;
     while(left<right)
     {
         int width=right-left;
         int heightAtIndex=(height[left]<height[right])?height[left]:h
eight[right];
         if((width*heightAtIndex)>maxVolume)
         {
             maxVolume=width*heightAtIndex;
         }
         else if(height[left]<height[right])
         {
             left++;
         }
         else
         {
             right--;
         }
     }

     return maxVolume;
 }
}
```

2. O(N^2)

```
class Solution {
 public int maxArea(int[] height) {
     int n=height.length;

     int maxVolume=Integer.MIN_VALUE;
     for(int i=0;i<n;i++)
     {
         for(int j=i+1;j<n;j++)
         {
         int minHeight=(height[i]<height[j])?height[i]:height[j];
         int volume=minHeight*(j-i);
         if(volume>maxVolume)
         maxVolume=volume;

         }
     }
     return maxVolume;
 }
}
```

15. 3Sum

Given an integer array nums, return all the triplets `[nums[i], nums[j], nums[k]]` such that `i != j`, `i != k`, and `j != k`, and `nums[i] + nums[j] + nums[k] == 0`.

Notice that the solution set must not contain duplicate triplets.

Example 1:

```
Input: nums = [-1,0,1,2,-1,-4]
Output: [[-1,-1,2],[-1,0,1]]
Explanation:
nums[0] + nums[1] + nums[2] = (-1) + 0 + 1 = 0.
nums[1] + nums[2] + nums[4] = 0 + 1 + (-1) = 0.
nums[0] + nums[3] + nums[4] = (-1) + 2 + (-1) = 0.
The distinct triplets are [-1,0,1] and [-1,-1,2].
Notice that the order of the output and the order of the triplets does not ma
```

Example 2:

```
Input: nums = [0,1,1]
Output: []
Explanation: The only possible triplet does not sum up to 0.
```

Example 3:

```
Input: nums = [0,0,0]
Output: [[0,0,0]]
Explanation: The only possible triplet sums up to 0.
```

Constraints:

- `3 <= nums.length <= 3000`
- -10^5 `<= nums[i] <=` 10^5

---

1. time: O(N^2), space: O(N)

```
public List<List<Integer>> threeSum(int[] nums) {
 Arrays.sort(nums);
 List<List<Integer>> list = new ArrayList<List<Integer>>();
 for(int i = 0; i < nums.length-2; i++) {
     if(i > 0 && (nums[i] == nums[i-1])) continue; // avoid duplicates
     for(int j = i+1, k = nums.length-1; j<k;) {
         if(nums[i] + nums[j] + nums[k] == 0) {
             list.add(Arrays.asList(nums[i],nums[j],nums[k]));
             j++;k--;
             while((j < k) && (nums[j] == nums[j-1]))j++;// avoid dupl
icates
             while((j < k) && (nums[k] == nums[k+1]))k--;// avoid dupl
icates
         }else if(nums[i] + nums[j] + nums[k] > 0) k--;
         else j++;
     }
 }
 return list;
}
```

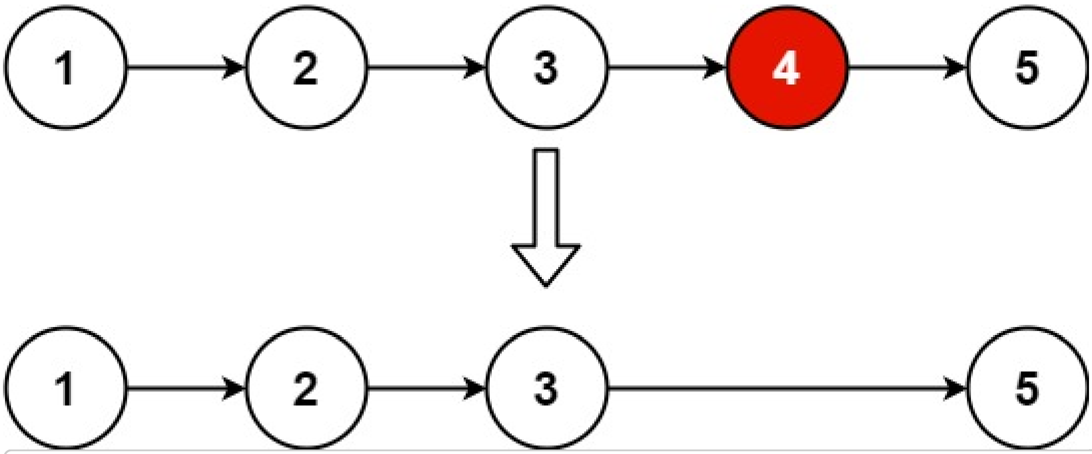
2. time: O(N^3) , space:O(N)

```
class Solution {
 public List<List<Integer>> threeSum(int[] nums) {
     Arrays.sort(nums);
     ArrayList<List<Integer>> al=new ArrayList<>();
     HashSet<List<Integer>> hs=new HashSet<>();
     for(int i=0;i<nums.length;i++)
     {
         for(int j=i+1;j<nums.length;j++)
         {
             for(int k=j+1;k<nums.length;k++)
             {
             if(nums[i]+nums[j]+nums[k]==0)
             {
                 hs.add(new ArrayList<>(List.of(nums[i],nums[j],nums
[k])));
             }
             }
         }
     }
     hs.stream().forEach(i->al.add(i));
     return al;
 }
}
```

19. Remove Nth Node From End of List

Given the head of a linked list, remove the n^{th} node from the end of the list and return its head.

Example 1:




```
Input: head = [1,2,3,4,5], n = 2
Output: [1,2,3,5]
```

Example 2:

```
Input: head = [1], n = 1
Output: []
```

Example 3:

```
Input: head = [1,2], n = 1
Output: [1]
```

Constraints:

- The number of nodes in the list is `sz`.
- `1 <= sz <= 30`
- `0 <= Node.val <= 100`
- `1 <= n <= sz`

Follow up: Could you do this in one pass?

```
class Solution {

    public ListNode removeNthFromEnd(ListNode head, int n) {
        if (head == null || head.next == null) return null;

        ListNode temp = new ListNode(0);
        temp.next = head;
        ListNode first = temp, second = temp;

        while (n > 0) {
            second = second.next;
            n--;
        }

        while (second.next != null) {
            second = second.next;
            first = first.next;
        }

        first.next = first.next.next;
        return temp.next;
    }
}
```

20. Valid Parentheses

Given a string `s` containing just the characters `'('`, `')'`, `'{'`, `'}'`, `'['` and `']'`, determine if the input string is valid.

An input string is valid if:

1. Open brackets must be closed by the same type of brackets.
2. Open brackets must be closed in the correct order.
3. Every close bracket has a corresponding open bracket of the same type.

Example 1:

```
Input: s = "()"
Output: true
```

Example 2:

```
Input: s = "()[]{}"
Output: true
```

Example 3:

```
Input: s = "(]"
Output: false
```

Constraints:

- `1 <= s.length <= 10`^{4}
- `s` consists of parentheses only `'()[]{}'`.

```
class Solution {
    public boolean isValid(String s) {
    Stack<Character> stack = new Stack<Character>();
    for (char c : s.toCharArray()) {
        if (c == '(')
            stack.push(')');
        else if (c == '{')
            stack.push('}');
        else if (c == '[')
            stack.push(']');
        else if (stack.isEmpty() || stack.pop() != c)
            return false;
    }
    return stack.isEmpty();
}
}
```

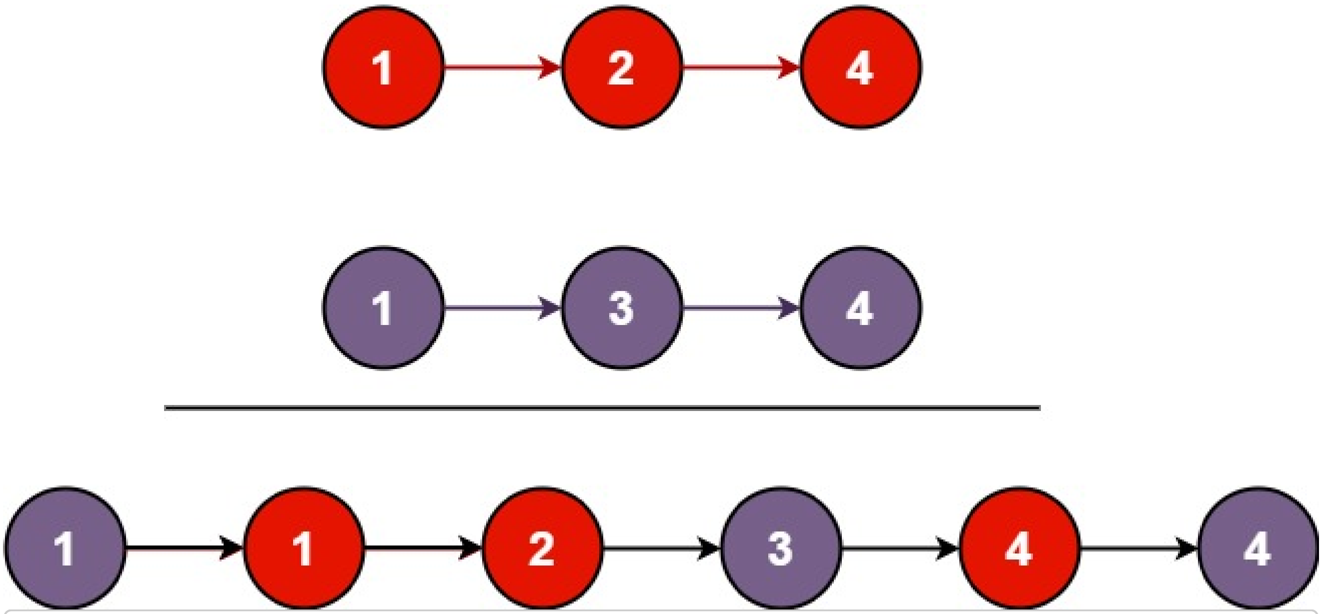
21. Merge Two Sorted Lists

You are given the heads of two sorted linked lists `list1` and `list2`.

Merge the two lists in a one **sorted** list. The list should be made by splicing together the nodes of the first two lists.

Return *the head of the merged linked list*.

Example 1:




```
Input: list1 = [1,2,4], list2 = [1,3,4]
Output: [1,1,2,3,4,4]
```

Example 2:

```
Input: list1 = [], list2 = []
Output: []
```

Example 3:

```
Input: list1 = [], list2 = [0]
Output: [0]
```

Constraints:

- The number of nodes in both lists is in the range `[0, 50]`.
- `-100 <= Node.val <= 100`
- Both `list1` and `list2` are sorted in **non-decreasing** order.

```
/**
 * Definition for singly-linked list.
 * public class ListNode {
 *     int val;
 *     ListNode next;
 *     ListNode() {}
 *     ListNode(int val) { this.val = val; }
 *     ListNode(int val, ListNode next) { this.val = val; this.next = next;
}
 * }
 */
class Solution {
    public ListNode mergeTwoLists(ListNode list1, ListNode list2) {
       if(list1 == null) return list2;
        if(list2 == null) return list1;
        if(list1.val < list2.val){
            list1.next = mergeTwoLists(list1.next, list2);
            return list1;
        } else{
            list2.next = mergeTwoLists(list1, list2.next);
            return list2;
        }
    }
}
```

33. Search in Rotated Sorted Array

There is an integer array `nums` sorted in ascending order (with **distinct** values).

Prior to being passed to your function, `nums` is **possibly rotated** at an unknown pivot index `k` (`1 <= k < nums.length`) such that the resulting array is `[nums[k], nums[k+1], ..., nums[n-1], nums[0], nums[1], ..., nums[k-1]]` (**0-indexed**). For example, `[0,1,2,4,5,6,7]` might be rotated at pivot index `3` and become `[4,5,6,7,0,1,2]`.

Given the array `nums` **after** the possible rotation and an integer `target`, return *the index of* `target` *if it is in* `nums`*, or* `-1` *if it is not in* `nums`.

You must write an algorithm with `O(log n)` runtime complexity.

Example 1:

```
Input: nums = [4,5,6,7,0,1,2], target = 0
Output: 4
```

Example 2:

```
Input: nums = [4,5,6,7,0,1,2], target = 3
Output: -1
```

Example 3:

```
Input: nums = [1], target = 0
Output: -1
```

Constraints:

- `1 <= nums.length <= 5000`
- -10^4 `<= nums[i] <=` 10^4
- All values of `nums` are **unique**.
- `nums` is an ascending array that is possibly rotated.
- -10^4 `<= target <=` 10^4

Do note the conditions used

```
public class Solution {
    public int search(int[] nums, int target) {
        int start = 0;
        int end = nums.length - 1;
        while (start <= end){
            int mid = (start + end) / 2;
            if (nums[mid] == target)
                return mid;

            if (nums[start] <= nums[mid]){
                 if (target < nums[mid] && target >= nums[start])
                    end = mid - 1;
                 else
                    start = mid + 1;
            }

            if (nums[mid] <= nums[end]){
                if (target > nums[mid] && target <= nums[end])
                    start = mid + 1;
                 else
                    end = mid - 1;
            }
        }
        return -1;
    }
}
```

49. Group Anagrams

Given an array of strings `strs`, group **the anagrams** together. You can return the answer in **any order**.

An **Anagram** is a word or phrase formed by rearranging the letters of a different word or phrase, typically using all the original letters exactly once.

Example 1:

```
Input: strs = ["eat","tea","tan","ate","nat","bat"]
Output: [["bat"],["nat","tan"],["ate","eat","tea"]]
```

Example 2:

```
Input: strs = [""]
Output: [[""]]
```

Example 3:

```
Input: strs = ["a"]
Output: [["a"]]
```

Constraints:

- `1 <= strs.length <= ` 10^4
- `0 <= strs[i].length <= 100`
- `strs[i]` consists of lowercase English letters.

1.
```
public List<List<String>> groupAnagrams(String[] strs) {
    if (strs == null || strs.length == 0) return new ArrayList<>();
    Map<String, List<String>> map = new HashMap<>();
    for (String s : strs) {
        char[] ca = s.toCharArray();
        Arrays.sort(ca);
        String keyStr = String.valueOf(ca);
        if (!map.containsKey(keyStr)) map.put(keyStr, new ArrayList<>
());
        map.get(keyStr).add(s);
    }
    return new ArrayList<>(map.values());
}
```

2.

```
import java.util.*;
class Solution {
    public List<List<String>> groupAnagrams(String[] strs) {
       HashMap<String,ArrayList<String>> hm=new HashMap<>();
       for(int i=0;i<strs.length;i++)
       {
        //each string in array
        //key is sorted string
        String sortedStringChar=sortString(strs[i]);
        if(!hm.containsKey(sortedStringChar))
        {
            ArrayList<String> alString=new ArrayList<>();
            alString.add(strs[i]);
            hm.put(sortedStringChar,alString);
        }
        else
        {
            ArrayList<String> al=hm.get(sortedStringChar);
            al.add(strs[i]);
            hm.put(sortedStringChar,al);
        }
       }
       System.out.println(hm);
       Collection<ArrayList<String>> valuesCollection =hm.values();
       ArrayList<List<String>> result=new ArrayList<List<String>>();
       valuesCollection.stream().forEach(i->{result.add(i);});
       return result;
    }
    public static String sortString(String inputString)
    {
        // Converting input string to character array
        char tempArray[] = inputString.toCharArray();

        // Sorting temp array using
        Arrays.sort(tempArray);

        // Returning new sorted string
        return new String(tempArray);
    }
}
```

70. Climbing Stairs

You are climbing a staircase. It takes `n` steps to reach the top.

Each time you can either climb `1` or `2` steps. In how many distinct ways can you climb to the top?

Example 1:

```
Input: n = 2
Output: 2
Explanation: There are two ways to climb to the top.
1. 1 step + 1 step
2. 2 steps
```

Example 2:

```
Input: n = 3
Output: 3
Explanation: There are three ways to climb to the top.
1. 1 step + 1 step + 1 step
2. 1 step + 2 steps
3. 2 steps + 1 step
```

Constraints:

- `1 <= n <= 45`

Recursion

Does it implement recusrion ?

If asking for total possible steps, min/max possible value.

How to implement recursion?

- think in terms of indexes
- set the base condition
- apply possible operations on the indexes
- for total: add all operations
- for min/max: min/max of the operation values

Dynamic Programing (DP)

Optimise the recursion problem with

1. Memoization: storing values in array in top down (recurssion tree) for quick access.
2. Tabulation: use the bottom-up approach which is to save the base condition value in the array and then apply the for loop till the n, compute the value of next by prev calculated and stored value of array.
3. Optimise space complexity on top of Tabulation: if there is condition that refers to previous values then no need of array, instead use the variables to store prev (two generally) values and update it's prev with next in every loop.

Memoization: top down approach. Store values in array to avoid repeated calculation.

```
class Solution {
    public int fun(int n,int []dpArray)
    {
        if(n==0 || n==1) return 1;
        if(dpArray[n]!=-1) return dpArray[n];

        int singleStep= fun(n-1,dpArray);
        int twoStep= fun(n-2,dpArray);
        return dpArray[n]=singleStep+twoStep;
    }
    public int climbStairs(int n) {
        int []dpArray=new int [n+1];
        for(int i=0;i<=n;i++)
        {
            dpArray[i]=-1;
        }
        return fun(n,dpArray);
    }
}
```

Tabulation:

```
class Solution {

    public int climbStairs(int n) {
        int []dpArray=new int [n+1];
        dpArray[0]=1;
        dpArray[1]=1;
        for(int i=2;i<=n;i++)
        {
            dpArray[i]=dpArray[i-1]+dpArray[i-2];
        }
        return dpArray[n];
    }
}
```

Optimised space in tabulation:

```
class Solution {

    public int climbStairs(int n) {
        int prev2=1;
        int prev1=1;
        for(int i=2;i<=n;i++)
        {
           int output=prev1+prev2;
           prev2=prev1;
           prev1=output;
        }
        return prev1;
    }
}
```

74. Search a 2D Matrix

You are given an `m x n` integer matrix `matrix` with the following two properties:

- Each row is sorted in non-decreasing order.
- The first integer of each row is greater than the last integer of the previous row.

Given an integer `target`, return `true` *if* `target` *is in* `matrix` *or* `false` *otherwise*.

You must write a solution in `O(log(m * n))` time complexity.

Example 1:

1	3	5	7
10	11	16	20
23	30	34	60

```
Input: matrix = [[1,3,5,7],[10,11,16,20],[23,30,34,60]], target = 3
Output: true
```

Example 2:

1	3	5	7
10	11	16	20
23	30	34	60

```
Input: matrix = [[1,3,5,7],[10,11,16,20],[23,30,34,60]], target = 13
Output: false
```

Constraints:

- `m == matrix.length`
- `n == matrix[i].length`
- `1 <= m, n <= 100`
- `-10`^{4} `<= matrix[i][j], target <= 10`^{4}

```
class Solution {
    public boolean searchMatrix(int[][] matrix, int target) {
        for(int i=0;i<matrix.length;i++)
        {
            if(matrix[i][matrix[0].length-1]>=target && matrix[i][0]<=targe
t)
            {
                if(Arrays.binarySearch(matrix[i],target)>=0)
                return true;
            }
        }

        return false;

    }
}
```

76. Minimum Window Substring

Given two strings `s` and `t` of lengths `m` and `n` respectively, return *the* ***minimum window substring*** *of* `s` *such that every character in* `t` *(**including duplicates**) is included in the window*. If there is no such substring, return *the empty string* `""`.

The testcases will be generated such that the answer is **unique**.

Example 1:

```
Input: s = "ADOBECODEBANC", t = "ABC"
Output: "BANC"
Explanation: The minimum window substring "BANC" includes 'A', 'B', and 'C' f
```

Example 2:

```
Input: s = "a", t = "a"
Output: "a"
Explanation: The entire string s is the minimum window.
```

Example 3:

```
Input: s = "a", t = "aa"
Output: ""
Explanation: Both 'a's from t must be included in the window.
Since the largest window of s only has one 'a', return empty string.
```

Constraints:

- `m == s.length`
- `n == t.length`
- `1 <= m, n <= 10`^{5}
- `s` and `t` consist of uppercase and lowercase English letters.

Follow up: Could you find an algorithm that runs in `O(m + n)` time?

```
class Solution {

    //sliding window
    public String minWindow(String s, String t) {
        HashMap<Character, Integer> map = new HashMap<>();

        for (char x : t.toCharArray()) {
            map.put(x, map.getOrDefault(x, 0) + 1);
        }

        int matched = 0;
        int start = 0;
        int minLen = s.length() + 1;
        int subStr = 0;
        for (int endWindow = 0; endWindow < s.length(); endWindow++) {
            char right = s.charAt(endWindow);
            if (map.containsKey(right)) {
                map.put(right, map.get(right) - 1);
                if (map.get(right) == 0) matched++;
            }

            while (matched == map.size()) {
                if (minLen > endWindow - start + 1) {
                    minLen = endWindow - start + 1;
                    subStr = start;
                }
                char deleted = s.charAt(start++);
                if (map.containsKey(deleted)) {
                    if (map.get(deleted) == 0) matched--;
                    map.put(deleted, map.get(deleted) + 1);
                }
            }
        }
        return minLen > s.length() ? "" : s.substring(subStr, subStr + minL
en);
    }
}
```

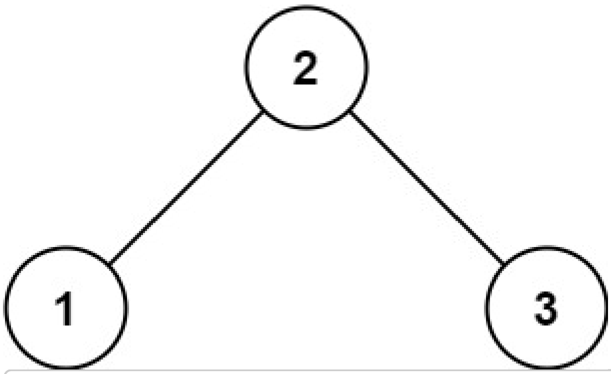
98. Validate Binary Search Tree

Given the `root` of a binary tree, *determine if it is a valid binary search tree (BST)*.

A **valid BST** is defined as follows:

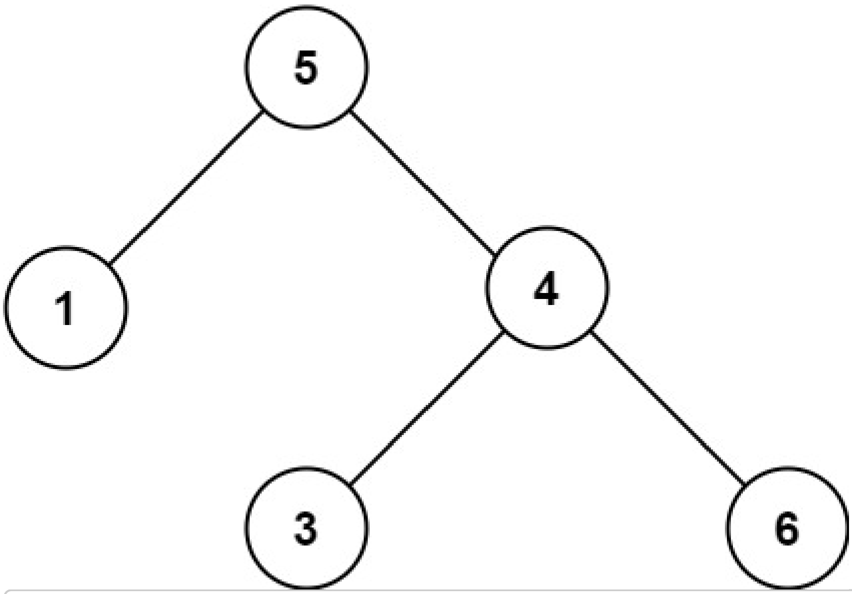
- The left subtree of a node contains only nodes with keys **less than** the node's key.
- The right subtree of a node contains only nodes with keys **greater than** the node's key.
- Both the left and right subtrees must also be binary search trees.

Example 1:




```
Input: root = [2,1,3]
Output: true
```

Example 2:




```
Input: root = [5,1,4,null,null,3,6]
Output: false
Explanation: The root node's value is 5 but its right child's value is 4.
```

Constraints:

- The number of nodes in the tree is in the range $[1, 10^4]$.
- $-2^{31} <= Node.val <= 2^{31} - 1$

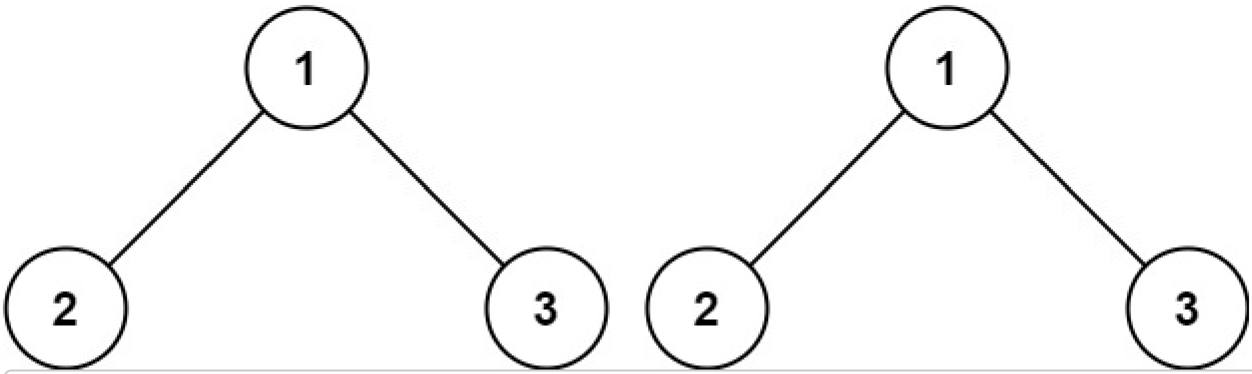
```
class Solution {

    public boolean isValidBST(TreeNode root) {
        if (root == null) return true;
        return dfs(root, null, null);
    }

    private boolean dfs(TreeNode root, Integer min, Integer max) {
        if (root == null) return true;

        if (
            (min != null && root.val <= min) || max != null && root.val >= 
max
        ) {
            return false;
        }

        return dfs(root.left, min, root.val) && dfs(root.right, root.val, m
ax);
    }
}
```

100. Same Tree

Given the roots of two binary trees `p` and `q`, write a function to check if they are the same or not.

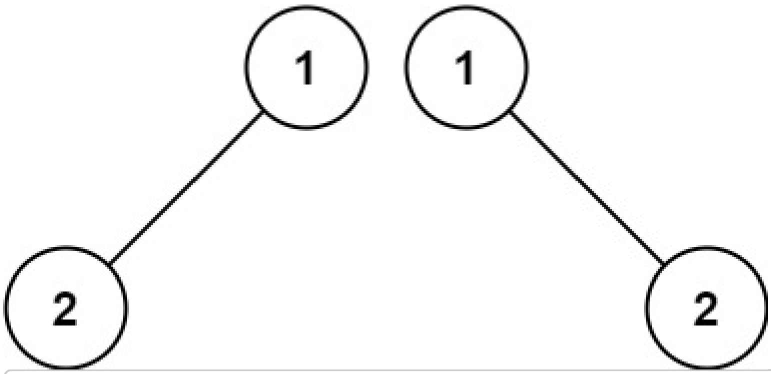
Two binary trees are considered the same if they are structurally identical, and the nodes have the same value.

Example 1:



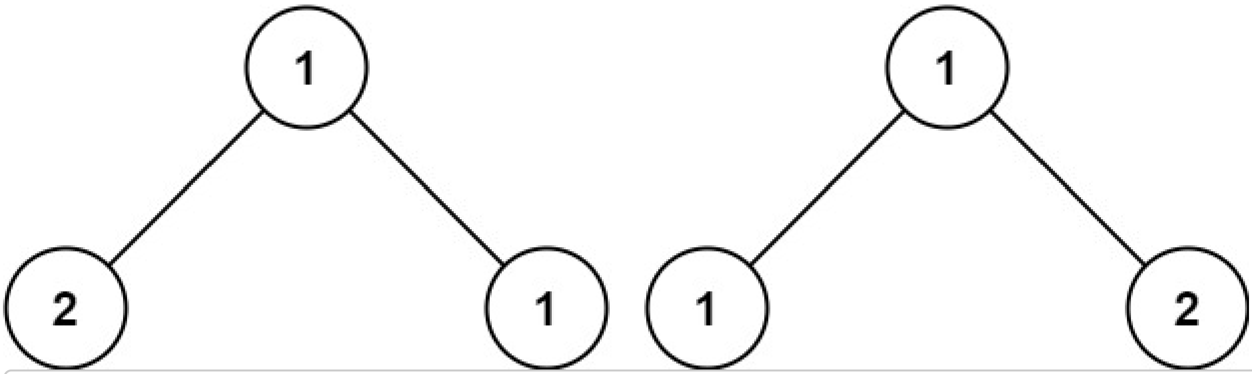

```
Input: p = [1,2,3], q = [1,2,3]
Output: true
```

Example 2:



```
Input: p = [1,2], q = [1,null,2]
Output: false
```

Example 3:



```
Input: p = [1,2,1], q = [1,1,2]
Output: false
```

Constraints:

- The number of nodes in both trees is in the range `[0, 100]`.
- -10^4 <= Node.val <= 10^4

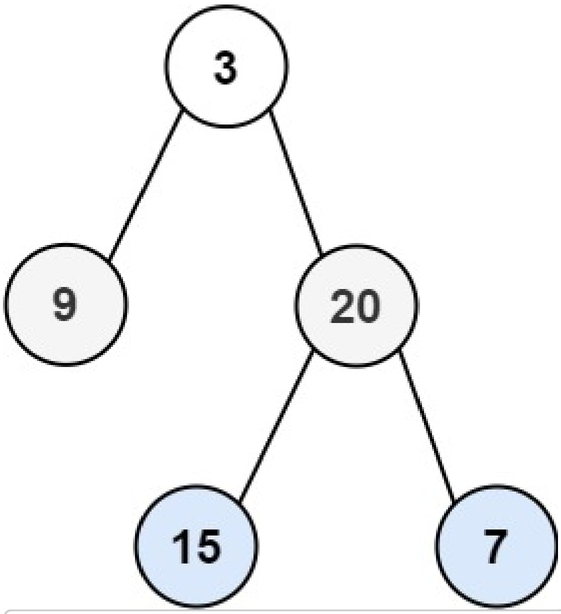
```java
class Solution {

    public boolean isSameTree(TreeNode p, TreeNode q) {
        return dfs(p, q);
    }

    private boolean dfs(TreeNode p, TreeNode q) {
        if (p == null && q == null) {
            return true;
        }

        if (p == null || q == null) {
            return false;
        }

        if (p.val != q.val) return false;

        boolean left = dfs(p.left, q.left);
        boolean right = dfs(p.right, q.right);

        return left && right;
    }
}
```

```
class Solution {
    int flag=0;
    public boolean isSameTree(TreeNode p, TreeNode q) {
       dfs(p,q);
       if(flag==0)
       return true;
       else
       return false;
    }
    public void dfs(TreeNode p,TreeNode q)
    {
        if((p==null && q!=null)||(p!=null && q==null))
        {
            flag=1;
            return;
        }

        if(p==null && q==null)
        {
            return;
        }
        if(flag==0 && p.val!=q.val)
        {
            flag=1;
            return;
        }
        dfs(p.left,q.left);
        dfs(p.right,q.right);


    }
}
```

102. Binary Tree Level Order Traversal

Given the `root` of a binary tree, return *the level order traversal of its nodes' values*. (i.e., from left to right, level by level).

Example 1:




```
Input: root = [3,9,20,null,null,15,7]
Output: [[3],[9,20],[15,7]]
```

Example 2:

```
Input: root = [1]
Output: [[1]]
```

Example 3:

```
Input: root = []
Output: []
```

Constraints:

- The number of nodes in the tree is in the range `[0, 2000]`.
- `-1000 <= Node.val <= 1000`

```
class Solution {

    public List<List<Integer>> levelOrder(TreeNode root) {
        List<List<Integer>> res = new ArrayList<>();
        Queue<TreeNode> queue = new LinkedList<>();

        if (root == null) return res;

        queue.add(root);
        while (!queue.isEmpty()) {
            int len = queue.size();
            List<Integer> level = new ArrayList<>();
            for (int i = 0; i < len; i++) {
                TreeNode curr = queue.poll();
                level.add(curr.val);
                if (curr.left != null) {
                    queue.add(curr.left);
                }
                if (curr.right != null) {
                    queue.add(curr.right);
                }
            }
            res.add(level);
        }
        return res;
    }
}
```

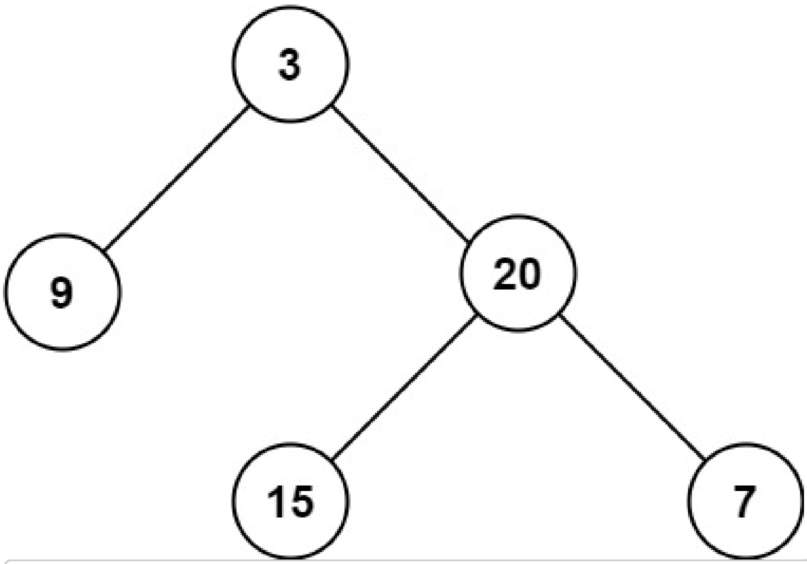
---

104. Maximum Depth of Binary Tree

Given the `root` of a binary tree, return *its maximum depth*.

A binary tree's **maximum depth** is the number of nodes along the longest path from the root node down to the farthest leaf node.

Example 1:




```
Input: root = [3,9,20,null,null,15,7]
Output: 3
```

Example 2:

```
Input: root = [1,null,2]
Output: 2
```

Constraints:

- The number of nodes in the tree is in the range `[0, 10^4]`.
- `-100 <= Node.val <= 100`

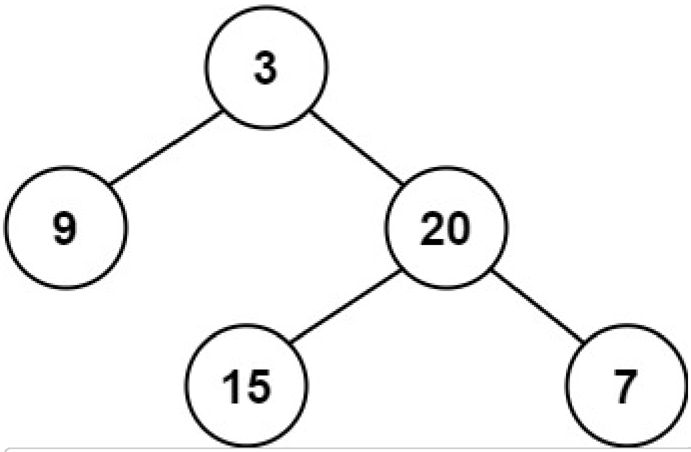
```java
/**
 * Definition for a binary tree node.
 * public class TreeNode {
 *     int val;
 *     TreeNode left;
 *     TreeNode right;
 *     TreeNode() {}
 *     TreeNode(int val) { this.val = val; }
 *     TreeNode(int val, TreeNode left, TreeNode right) {
 *         this.val = val;
 *         this.left = left;
 *         this.right = right;
 *     }
 * }
 */
class Solution {
    public int maxDepth(TreeNode root) {
//          if(root==null)
//              return 0;
//          int depth=0;
//          Queue<TreeNode> q= new LinkedList<>();
//          q.add(root);
//          while(q.size()!=0)
//          {
//              int initialSize=q.size();
//              for(int i=0;i<initialSize;i++)
//              {
//                  System.out.println("remove node:"+ q.peek().val);
//              TreeNode node=q.remove();
//              if(node.left!=null)
//              {
//                  q.add(node.left);
//                  System.out.println("left node:"+node.left.val);
//              }
//              if(node.right!=null)
//              {
//                  q.add(node.right);
//                  System.out.println("right node:"+node.right.val);
//              }
//              }
//              System.out.println("depth before=="+depth);

//              depth++;
//              System.out.println("depth after removed=="+depth);

//          }
//          return depth;
         // Base Condition
        if(root == null) return 0;
        // Hypothesis
        int left = maxDepth(root.left);
```

```
        int right = maxDepth(root.right);
        // Induction
        return Math.max(left, right) + 1;
    }
}
```

110. Balanced Binary Tree

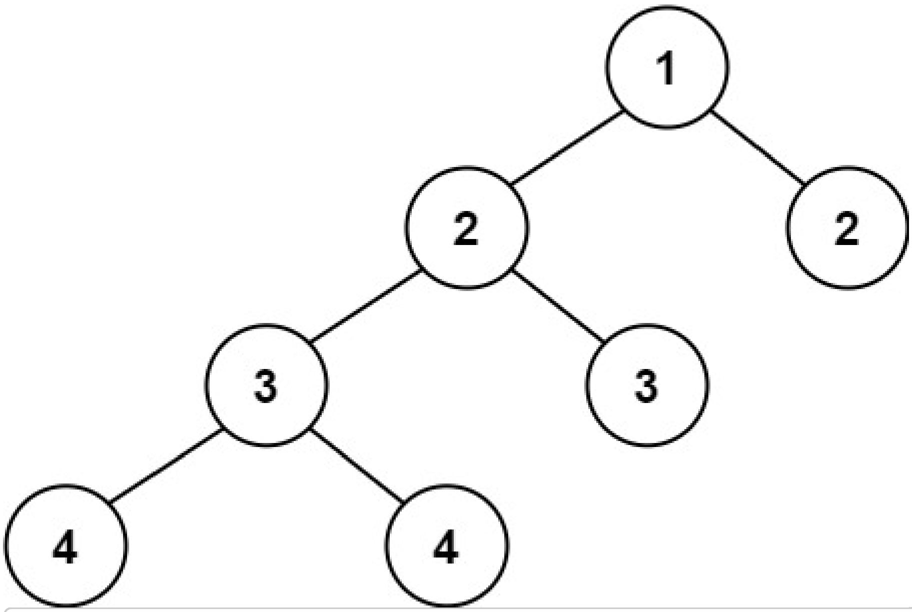
Given a binary tree, determine if it is **height-balanced**.

Example 1:




```
Input: root = [3,9,20,null,null,15,7]
Output: true
```

Example 2:




```
Input: root = [1,2,2,3,3,null,null,4,4]
Output: false
```

Example 3:

```
Input: root = []
Output: true
```

Constraints:

- The number of nodes in the tree is in the range `[0, 5000]`.
- -10^4 <= Node.val <= 10^4

Height-Balanced

A height-balanced binary tree is a binary tree in which the depth of the two subtrees of every node never differs by more than one.

```
public boolean isBalanced(TreeNode root) {
         if(root == null){
           return true;
       }
       return helper(root) != -1;
   }
   private int helper(TreeNode root){
       if(root == null){
           return 0;
       }
       int left = helper(root.left);
       int right = helper(root.right);
       if(left == -1 || right == -1 || Math.abs(left - right) > 1){
           return -1;
       }
       return Math.max(left, right) + 1;
   }
```

```
class Solution {
    boolean output=true;
    public boolean isBalanced(TreeNode root) {
        if(root==null)
        return true;
        lengthNode(root);
        return output;
    }
    public int lengthNode(TreeNode node)
    {
        if(node==null)
            return 0;
        System.out.println("Node="+node.val);
        int left=lengthNode(node.left);
        int right=lengthNode(node.right);

        if(Math.abs(left-right)>1)
        {
            output=false;
        }
        System.out.println("Node="+node.val+" left="+left+" right="+right+"
output="+output);

        return Math.max(left,right)+1;

    }
}
```

121. Best Time to Buy and Sell Stock

You are given an array `prices` where `prices[i]` is the price of a given stock on the i^{th} day.

You want to maximize your profit by choosing a **single day** to buy one stock and choosing a **different day in the future** to sell that stock.

Return *the maximum profit you can achieve from this transaction*. If you cannot achieve any profit, return `0`.

Example 1:

```
Input: prices = [7,1,5,3,6,4]
Output: 5
Explanation: Buy on day 2 (price = 1) and sell on day 5 (price = 6), profit =
Note that buying on day 2 and selling on day 1 is not allowed because you mus
```

Example 2:

```
Input: prices = [7,6,4,3,1]
Output: 0
Explanation: In this case, no transactions are done and the max profit = 0.
```

Constraints:

- `1 <= prices.length <= 10`^{5}
- `0 <= prices[i] <= 10`^{4}

Sliding window : https://www.youtube.com/watch?v=GcW4mgmgSbw (https://www.youtube.com/watch?v=GcW4mgmgSbw)

```
class Solution {
    public int maxProfit(int[] prices) {
        int lsf = Integer.MAX_VALUE;
        int op = 0;
        int pist = 0;

        for(int i = 0; i < prices.length; i++){
        lsf=(lsf<prices[i])?lsf:prices[i];
        op=(op>prices[i]-lsf)?op:prices[i]-lsf;
        }
        return op;
    }
}
```

Sliding window/ two pointer

```
class Solution {
    public int maxProfit(int[] prices) {
        int op = 0;
        int start = 0;
        int end = 1;
        while(end<prices.length)
        {
            if(prices[start]<prices[end])
            {
                op=Math.max(op,prices[end]-prices[start]);
            }
            else
            {
                start=end;
            }
            end++;
        }
        return op;
    }
}
```

---

125. Valid Palindrome

A phrase is a **palindrome** if, after converting all uppercase letters into lowercase letters and removing all non-alphanumeric characters, it reads the same forward and backward. Alphanumeric characters include letters and numbers.

Given a string `s`, return `true` *if it is a* ***palindrome****, or* `false` *otherwise*.

Example 1:

```
Input: s = "A man, a plan, a canal: Panama"
Output: true
Explanation: "amanaplanacanalpanama" is a palindrome.
```

Example 2:

```
Input: s = "race a car"
Output: false
Explanation: "raceacar" is not a palindrome.
```

Example 3:

```
Input: s = " "
Output: true
Explanation: s is an empty string "" after removing non-alphanumeric characte
Since an empty string reads the same forward and backward, it is a palindrome
```

Constraints:

- `1 <= s.length <= 2 * 10`^{5}
- `s` consists only of printable ASCII characters.

1.Array generic operation

```
class Solution {
    public boolean isPalindrome(String s) {
        s=s.toLowerCase().trim();
        s=s.replaceAll(" ","");
        char[] ch=s.toCharArray();
        ArrayList<Character>arrayList=new ArrayList<>();
        for(char i:ch)
        {
            if((i>='a'&& i<='z')||(i>='0'&&i<='9'))
                arrayList.add(i);
        }
         for(int i=0;i<(arrayList.size()-1);i++)
        {
            if(arrayList.get(i)!=arrayList.get(arrayList.size() - 1 - i))
                return false;
        }
        return true;
    }
}
```

2. 2 pointer Note: Character.isLetterOrDigit(cHead) -> allows alphanumeric

```
public class Solution {
 public boolean isPalindrome(String s) {
     if (s.isEmpty()) {
         return true;
     }
     int head = 0, tail = s.length() - 1;
     char cHead, cTail;
     while(head <= tail) {
         cHead = s.charAt(head);
         cTail = s.charAt(tail);
         if (!Character.isLetterOrDigit(cHead)) {
             head++;
         } else if(!Character.isLetterOrDigit(cTail)) {
             tail--;
         } else {
             if (Character.toLowerCase(cHead) != Character.toLowerCase
(cTail)) {
                 return false;
             }
             head++;
             tail--;
         }
     }

     return true;
 }
}
```

128. Longest Consecutive Sequence

Given an unsorted array of integers `nums`, return *the length of the longest consecutive elements sequence.*

You must write an algorithm that runs in `O(n)` time.

Example 1:

```
Input: nums = [100,4,200,1,3,2]
Output: 4
Explanation: The longest consecutive elements sequence is [1, 2, 3,
4]. Therefore its length is 4.
```

Example 2:

```
Input: nums = [0,3,7,2,5,8,4,6,0,1]
Output: 9
```

Constraints:

- `0 <= nums.length <= 10`^{5}
- `-10`^{9} `<= nums[i] <= 10`^{9}

```
class Solution {
    public int longestConsecutive(int[] nums) {
        // finding the number of digits that are continous
        Arrays.sort(nums);
        //get the result as maximum continous numbers
        int result=1;
        //continous number count for each count
        int conti=1;
        for(int i=0;i<nums.length-1;i++)
        {
            //continous number
            if(nums[i+1]==nums[i]+1)
            {
                conti++;
                result=conti>result?conti:result;
            }
            //same number
            else if(nums[i+1]==nums[i])
            {
                continue;
            }
            //reset for not continous
            else
            {
                conti=1;
            }
        }
        //if length if nums is zero then no continous number
        if(nums.length==0)
            return 0;
        else
        return result;

    }
}
```

---

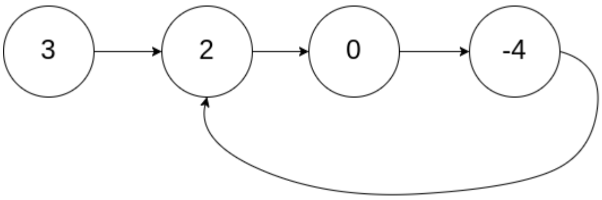
141. Linked List Cycle

Given `head` , the head of a linked list, determine if the linked list has a cycle in it.

There is a cycle in a linked list if there is some node in the list that can be reached again by continuously following the `next` pointer. Internally, `pos` is used to denote the index of the node that tail's `next` pointer is connected to. **Note that `pos` is not passed as a parameter**.

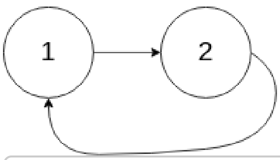
Return `true` *if there is a cycle in the linked list*. Otherwise, return `false`.

Example 1:




```
Input: head = [3,2,0,-4], pos = 1
Output: true
Explanation: There is a cycle in the linked list, where the tail connects to
```

Example 2:




```
Input: head = [1,2], pos = 0
Output: true
Explanation: There is a cycle in the linked list, where the tail connects to
```

Example 3:


```
Input: head = [1], pos = -1
Output: false
Explanation: There is no cycle in the linked list.
```

Constraints:

- The number of the nodes in the list is in the range $[0, 10^4]$.
- $-10^5 <= Node.val <= 10^5$
- `pos` is `-1` or a **valid index** in the linked-list.

Follow up: Can you solve it using `O(1)` (i.e. constant) memory?

```
/**
 * Definition for singly-linked list.
 * class ListNode {
 *     int val;
 *     ListNode next;
 *     ListNode(int x) {
 *         val = x;
 *         next = null;
 *     }
 * }
 */
public class Solution {
    public boolean hasCycle(ListNode head) {
        ListNode fast=head;
        ListNode slow=head;
        while(fast!=null && slow!=null && fast.next!=null)
        {
            slow=slow.next;
            if(fast.next!=null)
            fast=fast.next.next;

            if(fast==slow)
                return true;
        }
        return false;
    }
}
```

143. Reorder List

You are given the head of a singly linked-list. The list can be represented as:

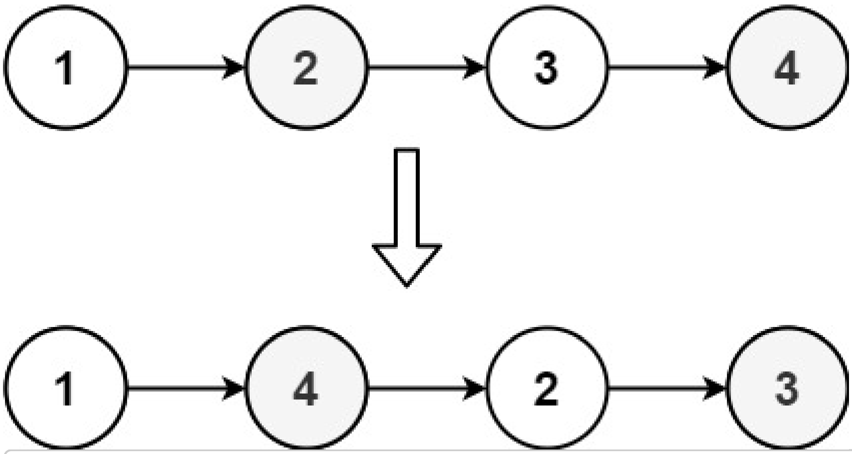
$L_0 \to L_1 \to \dots \to L_{n-1} \to L_n$

Reorder the list to be on the following form:

$L_0 \to L_n \to L_1 \to L_{n-1} \to L_2 \to L_{n-2} \to \dots$

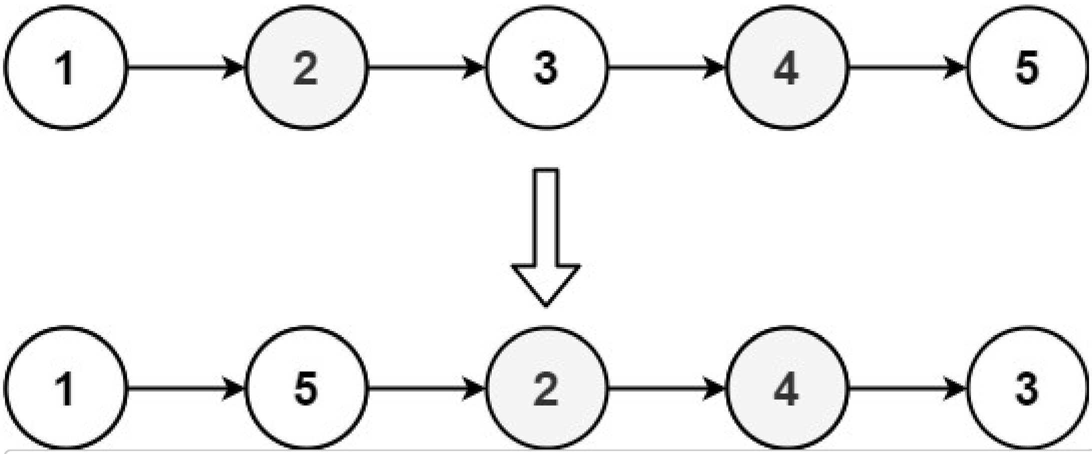
You may not modify the values in the list's nodes. Only nodes themselves may be changed.

Example 1:




```
Input: head = [1,2,3,4]
Output: [1,4,2,3]
```

Example 2:




```
Input: head = [1,2,3,4,5]
Output: [1,5,2,4,3]
```

Constraints:

- The number of nodes in the list is in the range `[1, 5 * 10`^{4}`]`.
- `1 <= Node.val <= 1000`

```java
public void reorderList(ListNode head) {

    Stack<ListNode> stack = new Stack<>();
    ListNode curr = head;
    while (curr != null) {
        stack.push(curr);
        curr = curr.next;
    }

    ListNode headCurr = head;

    int size = stack.size();
    while (stack.size() >  Math.ceil((double)size/2)) {
        ListNode next = stack.pop();
        ListNode nextNext = headCurr.next;
        next.next = null;
        headCurr.next = next;
        next.next = nextNext;
        headCurr = nextNext;
    }


    if (headCurr != null)
        headCurr.next = null;

}
```

```
    public void reorderList(ListNode head) {
        if (head == null) {
            return;
        }

        // Find the middle node
        ListNode slow = head, fast = head.next;
        while (fast != null && fast.next != null) {
            slow = slow.next;
            fast = fast.next.next;
        }

        // Reverse the second half
        ListNode head2 = reverse(slow.next);
        slow.next = null;

        // Link the two halves together
        while (head != null && head2 != null) {
            ListNode tmp1 = head.next;
            ListNode tmp2 = head2.next;
            head2.next = head.next;
            head.next = head2;
            head = tmp1;
            head2 = tmp2;
        }
    }

    private ListNode reverse(ListNode n) {
        ListNode prev = null;
        ListNode cur = n;
        while (cur != null) {
            ListNode tmp = cur.next;
            cur.next = prev;
            prev = cur;
            cur = tmp;
        }
        return prev;
    }
```

150. Evaluate Reverse Polish Notation

You are given an array of strings `tokens` that represents an arithmetic expression in a Reverse Polish Notation (http://en.wikipedia.org/wiki/Reverse_Polish_notation).

Evaluate the expression. Return *an integer that represents the value of the expression*.

Note that:

- The valid operators are `'+'`, `'-'`, `'*'`, and `'/'`.

- Each operand may be an integer or another expression.
- The division between two integers always **truncates toward zero**.
- There will not be any division by zero.
- The input represents a valid arithmetic expression in a reverse polish notation.
- The answer and all the intermediate calculations can be represented in a **32-bit** integer.

Example 1:

```
Input: tokens = ["2","1","+","3","*"]
Output: 9
Explanation: ((2 + 1) * 3) = 9
```

Example 2:

```
Input: tokens = ["4","13","5","/","+"]
Output: 6
Explanation: (4 + (13 / 5)) = 6
```

Example 3:

```
Input: tokens = ["10","6","9","3","+","-11","*","/","*","17","+","5","+"]
Output: 22
Explanation: ((10 * (6 / ((9 + 3) * -11))) + 17) + 5
= ((10 * (6 / (12 * -11))) + 17) + 5
= ((10 * (6 / -132)) + 17) + 5
= ((10 * 0) + 17) + 5
= (0 + 17) + 5
= 17 + 5
= 22
```

Constraints:

- `1 <= tokens.length <= ` 10^4
- `tokens[i]` is either an operator: `"+"`, `"-"`, `"*"`, or `"/"`, or an integer in the range `[-200, 200]`.

```
public class Solution {
    public int evalRPN(String[] tokens) {
        int a,b;
        Stack<Integer> S = new Stack<Integer>();
        for (String s : tokens) {
            if(s.equals("+")) {
                S.add(S.pop()+S.pop());
            }
            else if(s.equals("/")) {
                b = S.pop();
                a = S.pop();
                S.add(a / b);
            }
            else if(s.equals("*")) {
                S.add(S.pop() * S.pop());
            }
            else if(s.equals("-")) {
                b = S.pop();
                a = S.pop();
                S.add(a - b);
            }
            else {
                S.add(Integer.parseInt(s));
            }
        }
        return S.pop();
    }
}
```

Note:

to convert string to integer

```
    Integer.parseInt(s)
```

---

153. Find Minimum in Rotated Sorted Array

Suppose an array of length `n` sorted in ascending order is **rotated** between `1` and `n` times. For example, the array `nums = [0,1,2,4,5,6,7]` might become:

- `[4,5,6,7,0,1,2]` if it was rotated `4` times.
- `[0,1,2,4,5,6,7]` if it was rotated `7` times.

Notice that **rotating** an array `[a[0], a[1], a[2], ..., a[n-1]]` 1 time results in the array `[a[n-1], a[0], a[1], a[2], ..., a[n-2]]`.

Given the sorted rotated array `nums` of **unique** elements, return *the minimum element of this array*.

You must write an algorithm that runs in `O(log n) time.`

Example 1:

```
Input: nums = [3,4,5,1,2]
Output: 1
Explanation: The original array was [1,2,3,4,5] rotated 3 times.
```

Example 2:

```
Input: nums = [4,5,6,7,0,1,2]
Output: 0
Explanation: The original array was [0,1,2,4,5,6,7] and it was rotated 4 time
```

Example 3:

```
Input: nums = [11,13,15,17]
Output: 11
Explanation: The original array was [11,13,15,17] and it was rotated 4 times.
```

Constraints:

- `n == nums.length`
- `1 <= n <= 5000`
- `-5000 <= nums[i] <= 5000`
- All the integers of `nums` are **unique**.
- `nums` is sorted and rotated between `1` and `n` times.

```
public class Solution {
    public int findMin(int[] num) {
        if (num == null || num.length == 0) {
            return 0;
        }
        if (num.length == 1) {
            return num[0];
        }
        int start = 0, end = num.length - 1;
        while (start < end) {
            int mid = (start + end) / 2;
            if (mid > 0 && num[mid] < num[mid - 1]) {
                return num[mid];
            }
            if (num[start] <= num[mid] && num[mid] > num[end]) {
                start = mid + 1;
            } else {
                end = mid - 1;
            }
        }
        return num[start];
    }
}
```

```
class Solution {
    public int findMin(int[] nums) {
        Arrays.sort(nums);
        return nums[0];
    }

}
```

155. Min Stack

Design a stack that supports push, pop, top, and retrieving the minimum element in constant time.

Implement the `MinStack` class:

- `MinStack()` initializes the stack object.
- `void push(int val)` pushes the element `val` onto the stack.
- `void pop()` removes the element on the top of the stack.
- `int top()` gets the top element of the stack.
- `int getMin()` retrieves the minimum element in the stack.

You must implement a solution with `O(1)` time complexity for each function.

Example 1:

```
Input
["MinStack","push","push","push","getMin","pop","top","getMin"]
[[],[-2],[0],[-3],[],[],[],[]]

Output
[null,null,null,null,-3,null,0,-2]

Explanation
MinStack minStack = new MinStack();
minStack.push(-2);
minStack.push(0);
minStack.push(-3);
minStack.getMin(); // return -3
minStack.pop();
minStack.top();    // return 0
minStack.getMin(); // return -2
```

Constraints:

- -2^{31} <= val <= 2^{31} - 1
- Methods `pop` , `top` and `getMin` operations will always be called on **non-empty** stacks.
- At most $3 * 10^4$ calls will be made to `push` , `pop` , `top` , and `getMin` .

```
class MinStack {
        Stack<Integer> st;
        PriorityQueue<Integer> pq;
    public MinStack() {
        st=new Stack<>();
        pq=new PriorityQueue<>();
    }

    public void push(int val) {
        st.push(val);
        pq.add(val);
    }

    public void pop() {
        pq.remove(st.pop());

    }

    public int top() {
        return st.peek();
    }

    public int getMin() {
        return pq.peek();
    }
}

/**
 * Your MinStack object will be instantiated and called as such:
 * MinStack obj = new MinStack();
 * obj.push(val);
 * obj.pop();
 * int param_3 = obj.top();
 * int param_4 = obj.getMin();
 */
```

167. Two Sum II - Input Array Is Sorted

Given a **1-indexed** array of integers `numbers` that is already ***sorted in non-decreasing order***, find two numbers such that they add up to a specific `target` number. Let these two numbers be `numbers[index`$_1$`]` and `numbers[index`$_2$`]` where `1 <= index`$_1$ `< index`$_2$ `<= numbers.length`.

Return *the indices of the two numbers,* `index`$_1$ *and* `index`$_2$, ***added by one*** *as an integer array* `[index`$_1$`, index`$_2$`]` *of length 2.*

The tests are generated such that there is **exactly one solution**. You **may not** use the same element twice.

Your solution must use only constant extra space.

Example 1:

Input: numbers = [2,7,11,15], target = 9
Output: [1,2]
Explanation: The sum of 2 and 7 is 9. Therefore, $index_1$ = 1, $index_2$ = 2. We re

Example 2:

Input: numbers = [2,3,4], target = 6
Output: [1,3]
Explanation: The sum of 2 and 4 is 6. Therefore $index_1$ = 1, $index_2$ = 3. We re

Example 3:

Input: numbers = [-1,0], target = -1
Output: [1,2]
Explanation: The sum of -1 and 0 is -1. Therefore $index_1$ = 1, $index_2$ = 2. We

Constraints:

- `2 <= numbers.length <= 3 * 10`^{4}
- `-1000 <= numbers[i] <= 1000`
- `numbers` is sorted in **non-decreasing order**.
- `-1000 <= target <= 1000`
- The tests are generated such that there is **exactly one solution**.

1.

```
class Solution {
   public int[] twoSum(int[] numbers, int target) {
    int l = 0, r = numbers.length - 1;
    while (numbers[l] + numbers[r] != target) {
        if (numbers[l] + numbers[r] > target) r--;
        else l++;
    }
    return new int[]{l + 1, r + 1};
}
}
```

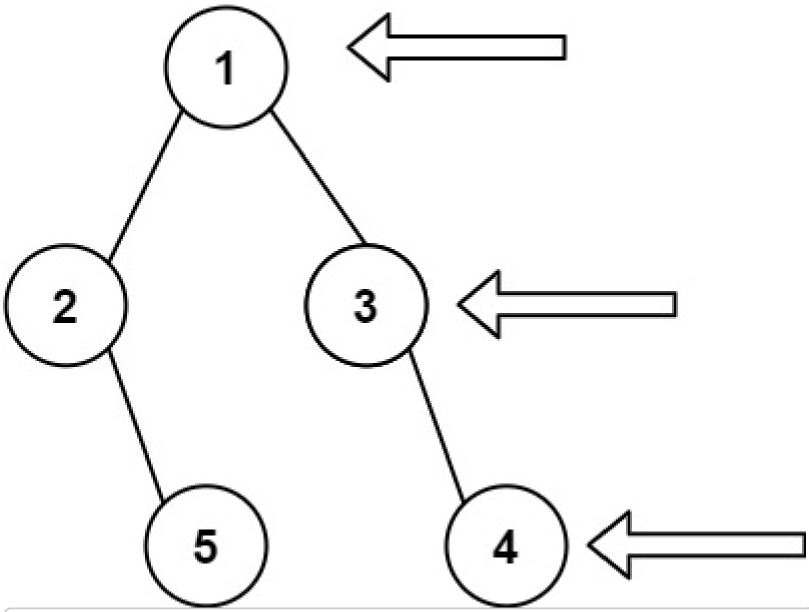
2.

```
class Solution {
    public int[] twoSum(int[] numbers, int target) {
        int [] result=new int[2];
        int j=numbers.length-1;
        int i=0;
        while(i<j)
        {
            if(numbers[i]+numbers[j]==target)
            {
                result[0]=i+1;
                result[1]=j+1;
               break;
            }
            else if(numbers[i]+numbers[j]>target)
            {
                j--;
            }
            else
            {
                i++;
            }
        }
        return result;
    }
}
```

199. Binary Tree Right Side View

Given the `root` of a binary tree, imagine yourself standing on the **right side** of it, return *the values of the nodes you can see ordered from top to bottom*.

Example 1:




```
Input: root = [1,2,3,null,5,null,4]
Output: [1,3,4]
```

Example 2:

```
Input: root = [1,null,3]
Output: [1,3]
```

Example 3:

```
Input: root = []
Output: []
```

Constraints:

- The number of nodes in the tree is in the range `[0, 100]`.
- `-100 <= Node.val <= 100`

```java
class Solution {

    public List<Integer> rightSideView(TreeNode root) {
        List<Integer> list = new ArrayList<Integer>();
        if (root == null) return list;
        bfs(list, root);
        return list;
    }

    public void bfs(List<Integer> list, TreeNode root) {
        Queue<TreeNode> q = new LinkedList<>();
        q.offer(root);
        while (!q.isEmpty()) {
            int levelSize = q.size();
            for (int i = 0; i < levelSize; i++) {
                TreeNode cur = q.poll();
                if (i == 0) list.add(cur.val);
                if (cur.right != null) q.offer(cur.right);
                if (cur.left != null) q.offer(cur.left);
            }
        }
    }
}
```

```
class Solution {
    public List<Integer> rightSideView(TreeNode root) {
        List<Integer> list=new ArrayList<Integer>();
        Queue<TreeNode> queue=new LinkedList<>();
        if(root==null)
        return list;
        queue.add(root);
        list.add(root.val);
        while(!queue.isEmpty())
        {
            int queueSize=queue.size();
            int value=-1;
            for(int i=0;i<queueSize;i++)
            {
                TreeNode t=queue.remove();
                if(t.right!=null)
                {
                    queue.add(t.right);
                    if(value==-1)
                    value=t.right.val;
                }
                if(t.left!=null)
                {
                    queue.add(t.left);
                    if(value==-1)
                    value=t.left.val;
                }


            }
            if(value!=-1)
            list.add(value);
        }
        return list;
    }
}
```

200. Number of Islands

Given an `m x n` 2D binary grid `grid` which represents a map of `'1'` s (land) and `'0'` s (water), return *the number of islands*.

An **island** is surrounded by water and is formed by connecting adjacent lands horizontally or vertically. You may assume all four edges of the grid are all surrounded by water.

Example 1:

```
Input: grid = [
  ["1","1","1","1","0"],
  ["1","1","0","1","0"],
  ["1","1","0","0","0"],
  ["0","0","0","0","0"]
]
Output: 1
```

Example 2:

```
Input: grid = [
  ["1","1","0","0","0"],
  ["1","1","0","0","0"],
  ["0","0","1","0","0"],
  ["0","0","0","1","1"]
]
Output: 3
```

Constraints:

- `m == grid.length`
- `n == grid[i].length`
- `1 <= m, n <= 300`
- `grid[i][j]` is `'0'` or `'1'`.

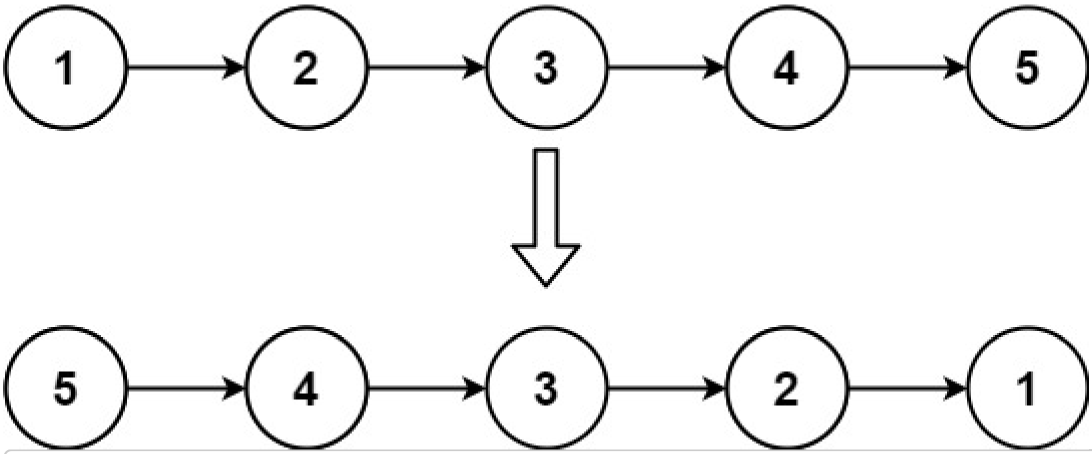
```
class Solution {
    char[][] g;
    int m;
    int n;
    public int numIslands(char[][] grid) {
        g=grid;
        if(g.length==0)
            return 0;
        m=g.length;
        n=g[0].length;
        int count=0;
        for(int i=0;i<m;i++)
        {
            for(int j=0;j<n;j++)
            {
                if(g[i][j]=='1')
                {
                    dfs(i,j);
                    count++;
                }
            }
        }
        return count;
    }
    public void dfs(int i,int j)
    {
        if(i<0 || i>=m || j<0 || j>=n || g[i][j]!='1')
        return;
        g[i][j]='0';
        dfs(i+1,j);
        dfs(i-1,j);
        dfs(i,j+1);
        dfs(i,j-1);
    }
}
```

---

206. Reverse Linked List

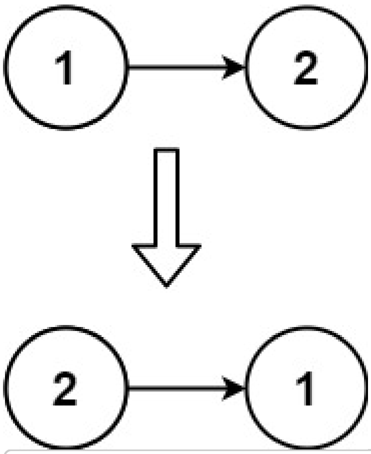
Given the `head` of a singly linked list, reverse the list, and return *the reversed list*.

Example 1:




```
Input: head = [1,2,3,4,5]
Output: [5,4,3,2,1]
```

Example 2:




```
Input: head = [1,2]
Output: [2,1]
```

Example 3:

```
Input: head = []
Output: []
```

Constraints:

- The number of nodes in the list is the range `[0, 5000]`.
- `-5000 <= Node.val <= 5000`

Follow up: A linked list can be reversed either iteratively or recursively. Could you implement both?

```
/**
 * Definition for singly-linked list.
 * public class ListNode {
 *     int val;
 *     ListNode next;
 *     ListNode() {}
 *     ListNode(int val) { this.val = val; }
 *     ListNode(int val, ListNode next) { this.val = val; this.next = next;
}
 * }
 */
class Solution {
    public ListNode reverseList(ListNode head) {
        if(head==null||head.next==null)
        return head;
        ListNode right=head.next;
        ListNode left=head;
        ListNode prev=null;
        while(right!=null)
        {
           left.next=prev;
           prev=left;
           left=right;
           right=right.next;
        }
        left.next=prev;
        head=left;
        return head;
    }
}
```

217. Contains Duplicate

Given an integer array `nums` , return `true` if any value appears **at least twice** in the array, and return `false` if every element is distinct.

Example 1:

```
Input: nums = [1,2,3,1]
Output: true
```

Example 2:

```
Input: nums = [1,2,3,4]
Output: false
```

Example 3:

```
Input: nums = [1,1,1,3,3,4,3,2,4,2]
Output: true
```

Constraints:

- `1 <= nums.length <= 10`^{5}
- `-10`^{9} `<= nums[i] <= 10`^{9}

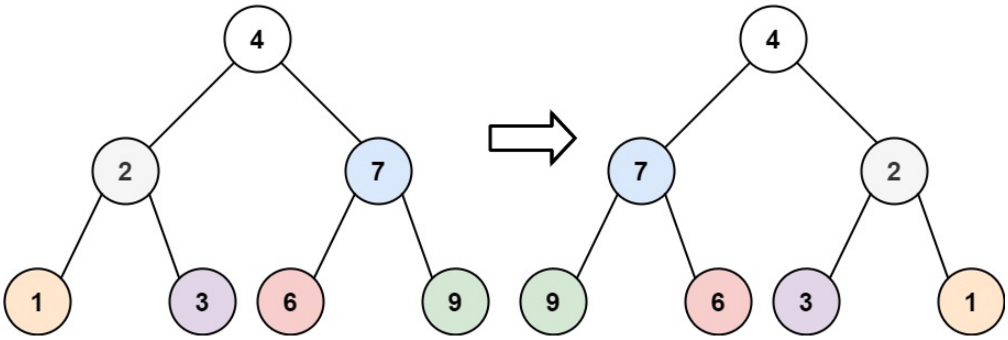
```
class Solution {
    public boolean containsDuplicate(int[] nums) {
    HashSet<Integer> flag = new HashSet<Integer>();

    for(int i : nums) {
        if(!flag.add(i)) {
            return true;
        }
    }
    return false;
    }
}
```

---

226. Invert Binary Tree

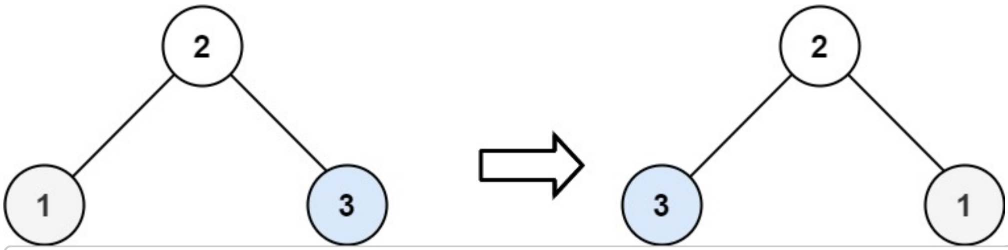
Given the `root` of a binary tree, invert the tree, and return *its root*.

Example 1:



```
Input: root = [4,2,7,1,3,6,9]
Output: [4,7,2,9,6,3,1]
```

Example 2:




```
Input: root = [2,1,3]
Output: [2,3,1]
```

Example 3:

```
Input: root = []
Output: []
```

Constraints:

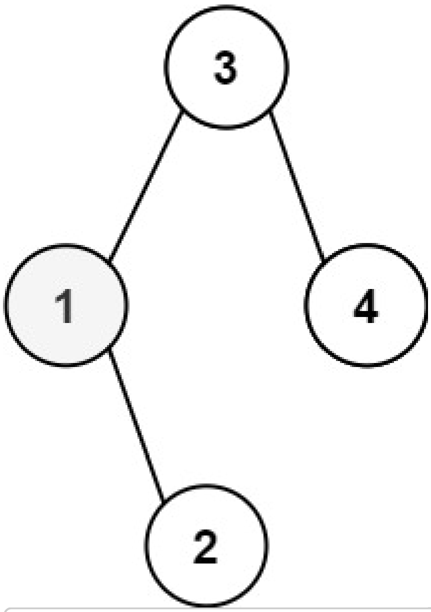
- The number of nodes in the tree is in the range `[0, 100]`.
- `-100 <= Node.val <= 100`

```
/**
 * Definition for a binary tree node.
 * public class TreeNode {
 *     int val;
 *     TreeNode left;
 *     TreeNode right;
 *     TreeNode() {}
 *     TreeNode(int val) { this.val = val; }
 *     TreeNode(int val, TreeNode left, TreeNode right) {
 *         this.val = val;
 *         this.left = left;
 *         this.right = right;
 *     }
 * }
 */
class Solution {
    public TreeNode invertTree(TreeNode root) {
        if(root==null)
        return null;
        TreeNode temp= root.left;
        root.left=invertTree( root.right);
        root.right=invertTree(temp);
        return root;
    }
}
```

230. Kth Smallest Element in a BST

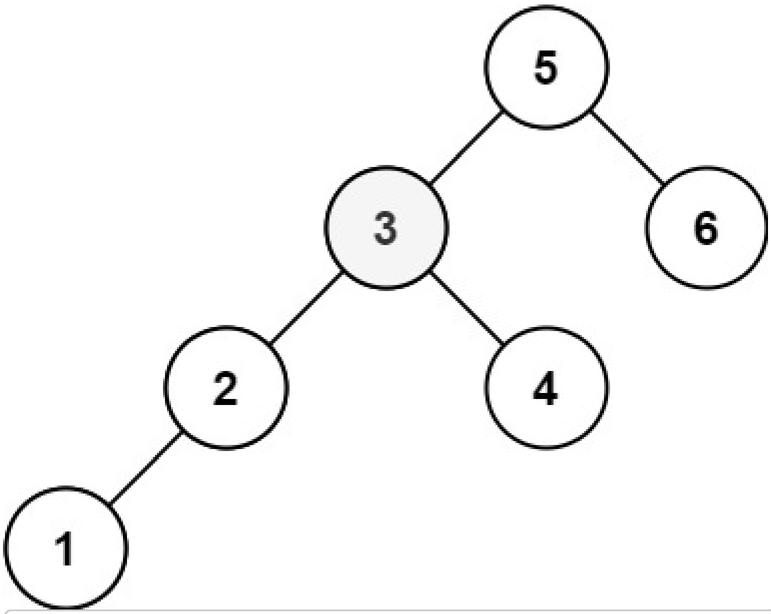
Given the `root` of a binary search tree, and an integer `k`, return *the* k^{th} *smallest value (**1-indexed**) of all the values of the nodes in the tree*.

Example 1:



```
Input: root = [3,1,4,null,2], k = 1
Output: 1
```

Example 2:



```
Input: root = [5,3,6,2,4,null,null,1], k = 3
Output: 3
```

Constraints:

- The number of nodes in the tree is `n`.
- `1 <= k <= n <=` 10^4
- `0 <= Node.val <=` 10^4

Follow up: If the BST is modified often (i.e., we can do insert and delete operations) and you need to find the kth smallest frequently, how would you optimize?

```
class Solution {
   public int kthSmallest(TreeNode root, int k) {
        List<Integer> list = new ArrayList<>();
        inorder(root, list);
        return list.get(k - 1);
    }

    private void inorder(TreeNode root, List<Integer> list) {
        if (root == null) return;

        inorder(root.left, list);
        list.add(root.val);
        inorder(root.right, list);
    }

}
```

```
class Solution {
    PriorityQueue<Integer> queue=new PriorityQueue<>();

    public int kthSmallest(TreeNode root, int k) {
        dfs(root);
       // Creating an iterator
       int val=-1;
        for(int i=0;i<k;i++)
            val=queue.remove();
        return val;
    }

    public void dfs(TreeNode root)
    {
        if(root==null)
        return;
        queue.add(root.val);
        dfs(root.left);
        dfs(root.right);
    }

}
```

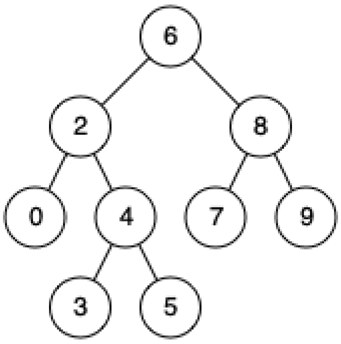
---

235. Lowest Common Ancestor of a Binary Search Tree

Given a binary search tree (BST), find the lowest common ancestor (LCA) node of two given nodes in the BST.

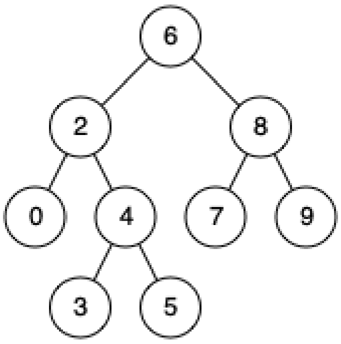
According to the definition of LCA on Wikipedia (https://en.wikipedia.org/wiki/Lowest_common_ancestor): “The lowest common ancestor is defined between two nodes `p` and `q` as the lowest node in `T` that has both `p` and `q` as descendants (where we allow **a node to be a descendant of itself**).”

Example 1:




```
Input: root = [6,2,8,0,4,7,9,null,null,3,5], p = 2, q = 8
Output: 6
Explanation: The LCA of nodes 2 and 8 is 6.
```

Example 2:




```
Input: root = [6,2,8,0,4,7,9,null,null,3,5], p = 2, q = 4
Output: 2
Explanation: The LCA of nodes 2 and 4 is 2, since a node can be a descendant
```

Example 3:

```
Input: root = [2,1], p = 2, q = 1
Output: 2
```

Constraints:

- The number of nodes in the tree is in the range $[2, 10^5]$.
- -10^9 <= Node.val <= 10^9
- All `Node.val` are **unique**.
- `p != q`

- p and q will exist in the BST.

```
class Solution {
    public TreeNode lowestCommonAncestor(TreeNode root, TreeNode p, TreeNod
e q) {
        if (p.val > root.val && q.val > root.val)
        return lowestCommonAncestor(root.right,p,q);
        if (p.val < root.val && q.val < root.val)
        return lowestCommonAncestor(root.left,p,q);
        return root;
    }
}
```

238. Product of Array Except Self

Given an integer array `nums`, return *an array* `answer` *such that* `answer[i]` *is equal to the product of all the elements of* `nums` *except* `nums[i]`.

The product of any prefix or suffix of `nums` is **guaranteed** to fit in a **32-bit** integer.

You must write an algorithm that runs in `O(n)` time and without using the division operation.

Example 1:

```
Input: nums = [1,2,3,4]
Output: [24,12,8,6]
```

Example 2:

```
Input: nums = [-1,1,0,-3,3]
Output: [0,0,9,0,0]
```

Constraints:

- $2 <= nums.length <= 10^5$
- `-30 <= nums[i] <= 30`
- The product of any prefix or suffix of `nums` is **guaranteed** to fit in a **32-bit** integer.

Follow up: Can you solve the problem in `O(1)` extra space complexity? (The output array **does not** count as extra space for space complexity analysis.)

```
class Solution {
    public int[] productExceptSelf(int[] nums) {
         int n = nums.length;
        int[] res = new int[n];
        // Calculate lefts and store in res.
        int left = 1;
        for (int i = 0; i < n; i++) {
            if (i > 0)
                left = left * nums[i - 1];
            res[i] = left;
        }
        // Calculate rights and the product from the end of the array.
        int right = 1;
        for (int i = n - 1; i >= 0; i--) {
            if (i < n - 1)
                right = right * nums[i + 1];
            res[i] *= right;
        }
        return res;

    }
}
```

---

242. Valid Anagram

Given two strings `s` and `t`, return `true` *if* `t` *is an anagram of* `s`*, and* `false` *otherwise*.

An **Anagram** is a word or phrase formed by rearranging the letters of a different word or phrase, typically using all the original letters exactly once.

Example 1:

```
Input: s = "anagram", t = "nagaram"
Output: true
```

Example 2:

```
Input: s = "rat", t = "car"
Output: false
```

Constraints:

- `1 <= s.length, t.length <= 5 * 10`^{4}
- `s` and `t` consist of lowercase English letters.

Follow up: What if the inputs contain Unicode characters? How would you adapt your solution to such a case?

```
class Solution {
    public boolean isAnagram(String s, String t) {
        int arr[]=new int[30];
        for(int i=0;i<s.length();i++)
        {
            int ch=(int)(s.charAt(i)-'a');
            arr[ch]++;
        }
        for(int i=0;i<t.length();i++)
        {
            int ch=(int)(t.charAt(i)-'a');
            arr[ch]--;
        }
        // int t=0;
        for(int i=0;i<30;i++)
        {
            if(arr[i]!=0)
            return false;
        }
        return true;

    }
}
```

---

287. Find the Duplicate Number

Given an array of integers `nums` containing `n + 1` integers where each integer is in the range `[1, n]` inclusive.

There is only **one repeated number** in `nums` , return *this repeated number*.

You must solve the problem **without** modifying the array `nums` and uses only constant extra space.

Example 1:

```
Input: nums = [1,3,4,2,2]
Output: 2
```

Example 2:

```
Input: nums = [3,1,3,4,2]
Output: 3
```

Constraints:

- `1 <= n <= 10^5`
- `nums.length == n + 1`
- `1 <= nums[i] <= n`
- All the integers in `nums` appear only **once** except for **precisely one integer** which appears **two or more** times.

Follow up:

- How can we prove that at least one duplicate number must exist in `nums`?
- Can you solve the problem in linear runtime complexity?

```
class Solution {
    public int findDuplicate(int[] nums) {
        int arr[]=new int[nums.length];
        for(int i=0;i<nums.length;i++)
        {
            arr[nums[i]-1]++;
        }
        for(int i=0;i<arr.length;i++)
        {
            if(arr[i]>1)
            return i+1;
        }
        return -1;
    }
}
```

```
//Fast and slow pointer approach
// Time Complexity: O(n)
// Space Complexity: O(1)

class Solution {

    public int findDuplicate(int[] nums) {
        int fast = nums[0];
        int slow = nums[0];
        boolean first = true;
        while (first || fast != slow) {
            if (first) first = false;
            slow = nums[slow];
            fast = nums[nums[fast]];
            if (fast == slow) break;
        }
        int slow2 = nums[0];
        while (slow2 != slow) {
            if (first) first = false;
            slow2 = nums[slow2];
            slow = nums[slow];
            if (slow2 == slow) return slow;
        }
        return slow;
    }
}
```

347. Top K Frequent Elements

Given an integer array `nums` and an integer `k`, return *the* `k` *most frequent elements*. You may return the answer in **any order**.

Example 1:

```
Input: nums = [1,1,1,2,2,3], k = 2
Output: [1,2]
```

Example 2:

```
Input: nums = [1], k = 1
Output: [1]
```

Constraints:

- `1 <= nums.length <= 10`^{5}
- `-10`^{4} `<= nums[i] <= 10`^{4}
- `k` is in the range `[1, the number of unique elements in the array]`.
- It is **guaranteed** that the answer is **unique**.

Follow up: Your algorithm's time complexity must be better than `O(n log n)`, where n is the array's size.

```
class Solution {
    public int[] topKFrequent(int[] nums, int k) {
        HashMap<Integer, Integer> map = new HashMap<>();
        for (int n : nums) {
            map.put(n, map.getOrDefault(n,0) + 1);
        }

        PriorityQueue<int[]> pq = new PriorityQueue<>((a,b) -> Integer.comp
are(a[1], b[1]));
        for (Map.Entry<Integer, Integer> e : map.entrySet()) {
            pq.add(new int[]{e.getKey(), e.getValue()});
            while (pq.size() > k) {
                pq.poll();
            }
        }

        int[] result = new int[k];
        for (int i = 0; i < k; i++) {
            result[i] = pq.poll()[0];
        }

        return result;
    }
}
```

---

424. Longest Repeating Character Replacement

You are given a string `s` and an integer `k`. You can choose any character of the string and change it to any other uppercase English character. You can perform this operation at most `k` times.

Return *the length of the longest substring containing the same letter you can get after performing the above operations*.

Example 1:

```
Input: s = "ABAB", k = 2
Output: 4
Explanation: Replace the two 'A's with two 'B's or vice versa.
```

Example 2:

```
Input: s = "AABABBA", k = 1
Output: 4
Explanation: Replace the one 'A' in the middle with 'B' and form "AABBBBA".
The substring "BBBB" has the longest repeating letters, which is 4.
```

Constraints:

- `1 <= s.length <= 10^5`
- `s` consists of only uppercase English letters.
- `0 <= k <= s.length`

---

need to check for the less frequent characters to be < k. lessFreq= lengthOfTheWindow - mostFrequentCharacterFromMap

```
class Solution {

    public int characterReplacement(String s, int k) {
        int[] arr = new int[26];
        int ans = 0;
        int max = 0;
        int i = 0;
        for (int j = 0; j < s.length(); j++) {
            arr[s.charAt(j) - 'A']++;
            max = Math.max(max, arr[s.charAt(j) - 'A']);
            if (j - i + 1 - max > k) {
                arr[s.charAt(i) - 'A']--;
                i++;
            }
            ans = Math.max(ans, j - i + 1);
        }
        return ans;
    }
}
```

---

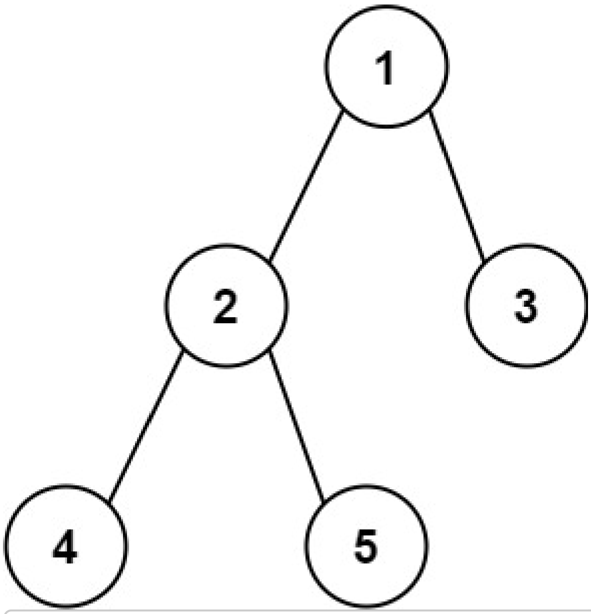
543. Diameter of Binary Tree

Given the `root` of a binary tree, return *the length of the **diameter** of the tree*.

The **diameter** of a binary tree is the **length** of the longest path between any two nodes in a tree. This path may or may not pass through the `root` .

The **length** of a path between two nodes is represented by the number of edges between them.

Example 1:



```
Input: root = [1,2,3,4,5]
Output: 3
Explanation: 3 is the length of the path [4,2,1,3] or [5,2,1,3].
```

Example 2:

```
Input: root = [1,2]
Output: 1
```

Constraints:

- The number of nodes in the tree is in the range `[1, 10^4]` .
- `-100 <= Node.val <= 100`

```
class Solution {

    int result = -1;

    public int diameterOfBinaryTree(TreeNode root) {
        dfs(root);
        return result;
    }

    private int dfs(TreeNode current) {
        if (current == null) {
            return -1;
        }
        int left = 1 + dfs(current.left);
        int right = 1 + dfs(current.right);
        result = Math.max(result, (left + right));
        return Math.max(left, right);
    }
}
```

---

567. Permutation in String

Given two strings `s1` and `s2`, return `true` *if* `s2` *contains a permutation of* `s1`, *or* `false` *otherwise*.

In other words, return `true` if one of `s1`'s permutations is the substring of `s2`.

Example 1:

```
Input: s1 = "ab", s2 = "eidbaooo"
Output: true
Explanation: s2 contains one permutation of s1 ("ba").
```

Example 2:

```
Input: s1 = "ab", s2 = "eidboaoo"
Output: false
```

Constraints:

- `1 <= s1.length, s2.length <=` 10^4
- `s1` and `s2` consist of lowercase English letters.

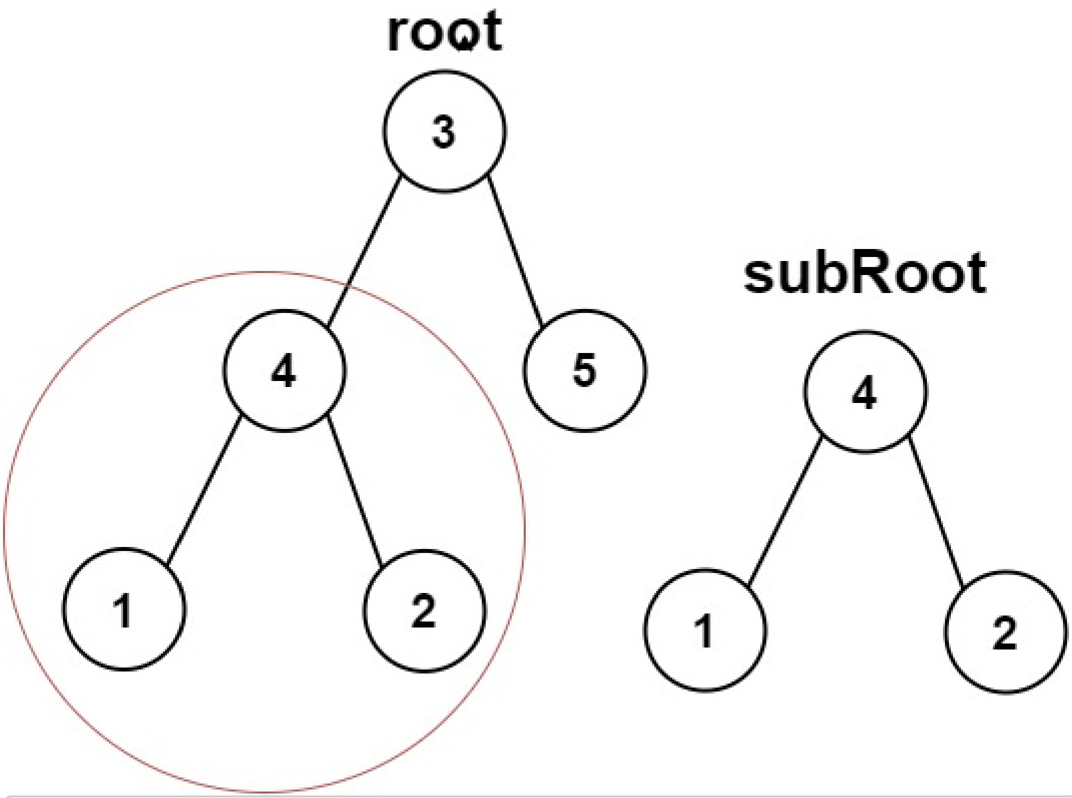
```java
class Solution {

    public boolean checkInclusion(String s1, String s2) {
        if (s2.length() < s1.length()) return false;
        int[] arr = new int[26];
        //add the values to the hash array
        for (int i = 0; i < s1.length(); i++) {
            arr[s1.charAt(i) - 'a']++;
        }
        int i = 0;
        int j = 0;
        //point j to it's position
        for (; j < s1.length(); j++) {
            arr[s2.charAt(j) - 'a']--;
        }
        j--;
        if (isEmpty(arr)) return true;
        while (j < s2.length()) {
            arr[s2.charAt(i) - 'a']++;
            i++;
            j++;
            if (j < s2.length()) arr[s2.charAt(j) - 'a']--;
            if (isEmpty(arr)) return true;
        }
        return isEmpty(arr);
    }

    public boolean isEmpty(int[] arr) {
        for (int i = 0; i < arr.length; i++) {
            if (arr[i] != 0) return false;
        }
        return true;
    }
}
```

572. Subtree of Another Tree

Given the roots of two binary trees `root` and `subRoot`, return `true` if there is a subtree of `root` with the same structure and node values of `subRoot` and `false` otherwise.

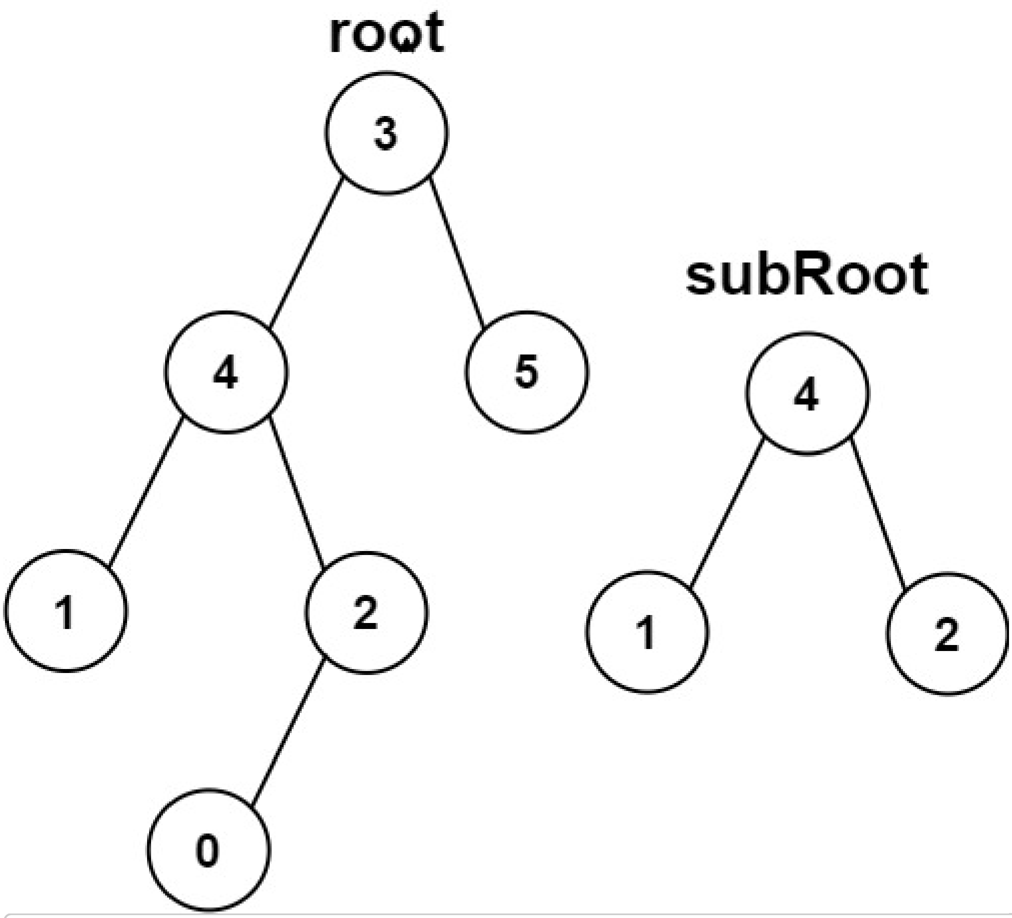
A subtree of a binary tree `tree` is a tree that consists of a node in `tree` and all of this node's descendants. The tree `tree` could also be considered as a subtree of itself.

Example 1:




```
Input: root = [3,4,5,1,2], subRoot = [4,1,2]
Output: true
```

Example 2:




```
Input: root = [3,4,5,1,2,null,null,null,null,0], subRoot = [4,1,2]
Output: false
```

Constraints:

- The number of nodes in the `root` tree is in the range `[1, 2000]`.
- The number of nodes in the `subRoot` tree is in the range `[1, 1000]`.
- $-10^4 <= root.val <= 10^4$
- $-10^4 <= subRoot.val <= 10^4$

```
// Time Complexity: O(n)
// Extra Space Complexity: O(n)
class Solution {

    public boolean isSubtree(TreeNode root, TreeNode subRoot) {
        if (root == null && subRoot == null) {
            return true;
        }
        if (root == null || subRoot == null) {
            return false;
        }
        if (isSameTree(root, subRoot)) {
            return true;
        }

        return (
            isSubtree(root.left, subRoot) || isSubtree(root.right, subRoot)
        );
    }

    private boolean isSameTree(TreeNode root, TreeNode subRoot) {
        if (root == null && subRoot == null) {
            return true;
        }
        if (root == null || subRoot == null) {
            return false;
        }
        if (root.val == subRoot.val) {
            return (
                isSameTree(root.left, subRoot.left) &&
                isSameTree(root.right, subRoot.right)
            );
        }

        return false;
    }
}
```

---

739. Daily Temperatures

Given an array of integers `temperatures` represents the daily temperatures, return *an array* `answer` *such that* `answer[i]` *is the number of days you have to wait after the* i^{th} *day to get a warmer temperature*. If there is no future day for which this is possible, keep `answer[i] == 0` instead.

Example 1:

```
Input: temperatures = [73,74,75,71,69,72,76,73]
Output: [1,1,4,2,1,1,0,0]
```

Example 2:

```
Input: temperatures = [30,40,50,60]
Output: [1,1,1,0]
```

Example 3:

```
Input: temperatures = [30,60,90]
Output: [1,1,0]
```

Constraints:

- `1 <= temperatures.length <=` 10^5
- `30 <= temperatures[i] <= 100`

---

1. Stacks

```
public int[] dailyTemperatures(int[] temperatures) {
 Stack<Integer> stack = new Stack<>();
 int[] ret = new int[temperatures.length];
 for(int i = 0; i < temperatures.length; i++) {
     while(!stack.isEmpty() && temperatures[i] > temperatures[stack.pe
ek()]) {
         int idx = stack.pop();
         ret[idx] = i - idx;
     }
     stack.push(i);
 }
 return ret;
}
```

2. Array

```
public int[] dailyTemperatures(int[] temperatures) {
 int[] stack = new int[temperatures.length];
 int top = -1;
 int[] ret = new int[temperatures.length];
 for(int i = 0; i < temperatures.length; i++) {
     while(top > -1 && temperatures[i] > temperatures[stack[top]]) {
         int idx = stack[top--];
         ret[idx] = i - idx;
     }
     stack[++top] = i;
 }
 return ret;
}
```

746. Min Cost Climbing Stairs

You are given an integer array `cost` where `cost[i]` is the cost of `i`th step on a staircase. Once you pay the cost, you can either climb one or two steps.

You can either start from the step with index `0`, or the step with index `1`.

Return *the minimum cost to reach the top of the floor*.

Example 1:

```
Input: cost = [10,15,20]
Output: 15
Explanation: You will start at index 1.
- Pay 15 and climb two steps to reach the top.
The total cost is 15.
```

Example 2:

```
Input: cost = [1,100,1,1,1,100,1,1,100,1]
Output: 6
Explanation: You will start at index 0.
- Pay 1 and climb two steps to reach index 2.
- Pay 1 and climb two steps to reach index 4.
- Pay 1 and climb two steps to reach index 6.
- Pay 1 and climb one step to reach index 7.
- Pay 1 and climb two steps to reach index 9.
- Pay 1 and climb one step to reach the top.
The total cost is 6.
```

Constraints:

- 2 <= cost.length <= 1000
- 0 <= cost[i] <= 999

Recursion

```
class Solution {
    public int minCostClimbingStairs(int[] cost) {
        return funCost(cost.length,cost);
    }
    int funCost(int n,int[] cost)
    {
        if(n==0)
        return cost[0];
        if(n==1)
        return cost[1];
        int costOneStep,costTwoStep;
        if(n==cost.length)
        {
        costOneStep=funCost(n-1,cost);
        costTwoStep=funCost(n-2,cost);
        }
        else
        {
        costOneStep=funCost(n-1,cost)+cost[n];
        costTwoStep=funCost(n-2,cost)+cost[n];
        }
        return Math.min(costOneStep,costTwoStep);
    }
}
```

---

704. Binary Search

Given an array of integers `nums` which is sorted in ascending order, and an integer `target`, write a function to search `target` in `nums`. If `target` exists, then return its index. Otherwise, return `-1`.

You must write an algorithm with `O(log n)` runtime complexity.

Example 1:

```
Input: nums = [-1,0,3,5,9,12], target = 9
Output: 4
Explanation: 9 exists in nums and its index is 4
```

Example 2:

```
Input: nums = [-1,0,3,5,9,12], target = 2
Output: -1
Explanation: 2 does not exist in nums so return -1
```

Constraints:

- `1 <= nums.length <= 10^4`
- `-10^4 < nums[i], target < 10^4`
- All the integers in `nums` are **unique**.
- `nums` is sorted in ascending order.

```
public int search(int[] nums, int target) {
        if(Arrays.binarySearch(nums,target)>=0)
            return Arrays.binarySearch(nums,target);
        else
            return -1;
    }
```

```
class Solution {
    public int search(int[] nums, int target) {

     int low = 0;
        int high = nums.length - 1;
        while(low <= high){
            int mid = low + (high - low) / 2;
            if(nums[mid] == target){
                return mid;
            }
            else if(nums[mid] < target){
                low = mid + 1;
            }
            else{
                high = mid - 1;
            }
        }
        return -1;
    }
}
```

---

853. Car Fleet

There are `n` cars going to the same destination along a one-lane road. The destination is `target` miles away.

You are given two integer array `position` and `speed`, both of length `n`, where `position[i]` is the position of the i^{th} car and `speed[i]` is the speed of the i^{th} car (in miles per hour).

A car can never pass another car ahead of it, but it can catch up to it and drive bumper to bumper **at the same speed**. The faster car will **slow down** to match the slower car's speed. The distance between these two cars is ignored (i.e., they are assumed to have the same position).

A **car fleet** is some non-empty set of cars driving at the same position and same speed. Note that a single car is also a car fleet.

If a car catches up to a car fleet right at the destination point, it will still be considered as one car fleet.

Return *the **number of car fleets** that will arrive at the destination*.

Example 1:

```
Input: target = 12, position = [10,8,0,5,3], speed = [2,4,1,1,3]
Output: 3
Explanation:
The cars starting at 10 (speed 2) and 8 (speed 4) become a fleet, meeting eac
The car starting at 0 does not catch up to any other car, so it is a fleet by
The cars starting at 5 (speed 1) and 3 (speed 3) become a fleet, meeting each
Note that no other cars meet these fleets before the destination, so the answ
```

Example 2:

```
Input: target = 10, position = [3], speed = [3]
Output: 1
Explanation: There is only one car, hence there is only one fleet.
```

Example 3:

```
Input: target = 100, position = [0,2,4], speed = [4,2,1]
Output: 1
Explanation:
The cars starting at 0 (speed 4) and 2 (speed 2) become a fleet, meeting each
Then, the fleet (speed 2) and the car starting at 4 (speed 1) become one flee
```

Constraints:

- `n == position.length == speed.length`
- $1 <= n <= 10^5$
- $0 < target <= 10^6$
- `0 <= position[i] < target`
- All the values of `position` are **unique**.
- $0 < speed[i] <= 10^6$

1. TreeMap: Note: Sorting in stored values

```
public int carFleet(int target, int[] pos, int[] speed) {
    Map<Integer, Double> m = new TreeMap<>(Collections.reverseOrder
());
    for (int i = 0; i < pos.length; ++i)
        m.put(pos[i], (double)(target - pos[i]) / speed[i]);
    int res = 0; double cur = 0;
    for (double time : m.values()) {
        if (time > cur) {
            cur = time;
            res++;
        }
    }
    return res;
}
```

2. Note: 2D array sorting

```
public int carFleet(int target, int[] pos, int[] speed) {
    int N = pos.length, res = 0;
    double[][] cars = new double[N][2];
    for (int i = 0; i < N; ++i)
        cars[i] = new double[] {pos[i], (double)(target - pos[i]) / s
peed[i]};
    Arrays.sort(cars, (a, b) -> Double.compare(a[0], b[0]));
    double cur = 0;
    for (int i = N - 1; i >= 0 ; --i) {
        if (cars[i][1] > cur) {
            cur = cars[i][1];
            res++;
        }
    }
    return res;
}
```

875. Koko Eating Bananas

Koko loves to eat bananas. There are `n` piles of bananas, the i^{th} pile has `piles[i]` bananas. The guards have gone and will come back in `h` hours.

Koko can decide her bananas-per-hour eating speed of `k` . Each hour, she chooses some pile of bananas and eats `k` bananas from that pile. If the pile has less than `k` bananas, she eats all of them instead and will not eat any more bananas during this hour.

Koko likes to eat slowly but still wants to finish eating all the bananas before the guards return.

Return *the minimum integer* `k` *such that she can eat all the bananas within* `h` *hours*.

Example 1:

```
Input: piles = [3,6,7,11], h = 8
Output: 4
```

Example 2:

```
Input: piles = [30,11,23,4,20], h = 5
Output: 30
```

Example 3:

```
Input: piles = [30,11,23,4,20], h = 6
Output: 23
```

Constraints:

- `1 <= piles.length <=` 10^4
- `piles.length <= h <=` 10^9
- `1 <= piles[i] <=` 10^9

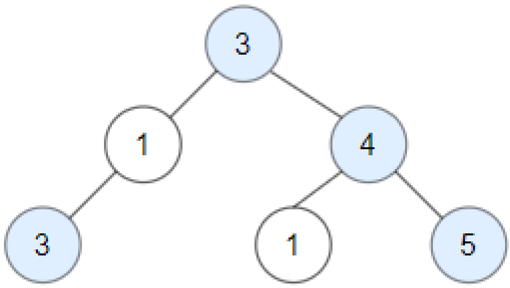
```
class Solution {
    public int minEatingSpeed(int[] piles, int H) {
        int low = 1, high = 1000000000, k = 0;
        while (low <= high) {
            //mid
            k = (low + high) / 2;
            //required result
            int h = 0;
            //Adding time to eat all piles with current rate of k
            for (int i = 0; i < piles.length; i ++)
                h += Math.ceil(1.0 * piles[i] / k);
            //if h>H (time consumed more than available)
            if (h > H)
                low = k + 1;
            else
                high = k - 1;
        }
        return low;
    }
}
```

1448. Count Good Nodes in Binary Tree

Given a binary tree `root`, a node *X* in the tree is named **good** if in the path from root to *X* there are no nodes with a value *greater than* X.

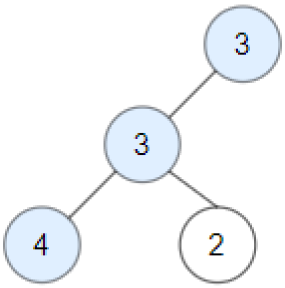
Return the number of **good** nodes in the binary tree.

Example 1:




```
Input: root = [3,1,4,3,null,1,5]
Output: 4
Explanation: Nodes in blue are good.
Root Node (3) is always a good node.
Node 4 -> (3,4) is the maximum value in the path starting from the root.
Node 5 -> (3,4,5) is the maximum value in the path
Node 3 -> (3,1,3) is the maximum value in the path.
```

Example 2:




```
Input: root = [3,3,null,4,2]
Output: 3
Explanation: Node 2 -> (3, 3, 2) is not good, because "3" is higher than it.
```

Example 3:

```
Input: root = [1]
Output: 1
Explanation: Root is considered as good.
```

Constraints:

- The number of nodes in the binary tree is in the range `[1, 10^5]` .
- Each node's value is between `[-10^4, 10^4]` .

```
class Solution {

    public int goodNodes(TreeNode root) {
        return helper(root, -99999);
    }

    public int helper(TreeNode root, int max) {
        if (root == null) return 0;

        int res = root.val >= max ? 1 : 0;

        res += helper(root.left, Math.max(root.val, max));
        res += helper(root.right, Math.max(root.val, max));

        return res;
    }
}
```

```
class Solution {
    int maxVal=0;
    public int goodNodes(TreeNode root) {
        if(root==null)
        return 0;
        dfs(root,Integer.MIN_VALUE);
        return maxVal;
    }
    public void dfs(TreeNode node,int max)
    {
        if(node==null)
        return;

        if(node.val>=max)
        {
        maxVal++;
        System.out.println("Node="+node.val+" max="+max+" maxVal="+maxVal);
        }

        max=Math.max(node.val,max);
        dfs(node.left,max);
        dfs(node.right,max);
    }
}
```