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第 1 章

Array, List, Hashtable, Stack, Sort

1.1 Two Sum

Description

Given an array of integers, return indices of the two numbers such that they add up to a specific target.

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

Example:

Given nums = [2, 7, 11, 15], target = 9,

Because $\text{nums}[0] + \text{nums}[1] = 2 + 7 = 9$,

return [0, 1].

Solution

```
/**
 * 如果符合条件的不止一组呢? 则找到一组就从 map 删除一组
 * @return
 */
public int[] twoSum(int[] nums, int target) {
    HashMap<Integer, Integer> map = new HashMap<>();
    for (int i = 0; i < nums.length; i++) {
        map.put(nums[i], i);
    }
    for (int i = 0; i < nums.length; i++) {
        Integer index = map.get(target - nums[i]);
        if (index != null && index != i) {
            return new int[] {
                i, index
            };
        }
    }
    return null;
}
```

1.2 Two Sum II - Input array is sorted

Description

Given an array of integers that is already sorted in ascending order, find two numbers such that they add up to a specific target number.

The function twoSum should return indices of the two numbers such that they add up to the target, where index1 must be less than index2. Please note that your returned answers (both index1 and index2) are not zero-based.

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

Input: numbers=2, 7, 11, 15, target=9

Output: index1=1, index2=2

Solution

```
public int[] twoSum(int[] numbers, int target) {
    for (int i = 0, j = numbers.length - 1; i < j; ) {
        int sum = numbers[i] + numbers[j];
        if (sum > target) {
            j--;
        } else if (sum < target) {
            i++;
        } else {
            return new int[] {i + 1, j + 1};
        }
    }
    return null;
}
```

1.3 Two Sum III - Data structure design

Description

Design and implement a TwoSum class. It should support the following operations: add and find.

add - Add the number to an internal data structure.

find - Find if there exists any pair of numbers which sum is equal to the value.

For example,

```
add(1); add(3); add(5);
```

```
find(4) -> true
```

```
find(7) -> false
```

Solution

```
private HashMap<Integer, Integer> mMap;  
  
public TwoSumIII() {  
    mMap = new HashMap<>();  
}  
  
/** Add the number to an internal data structure.. */  
public void add(int number) {  
    mMap.put(number, mMap.getOrDefault(number, 0) + 1);  
}  
  
/** Find if there exists any pair of numbers which sum is equal to the value. */  
public boolean find(int value) {  
    for (Integer n : mMap.keySet()) {  
        int cnt = mMap.getOrDefault(value - n, 0);  
        if (value - n != n && cnt > 0) {  
            return true;  
        }  
        if (value - n == n && cnt > 1) {  
            return true;  
        }  
    }  
    return false;  
}
```

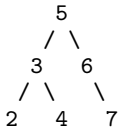
1.4 Two Sum IV - Input is a BST

Description

Given a Binary Search Tree and a target number, return true if there exist two elements in the BST such that their sum is equal to the given target.

Example 1:

Input:

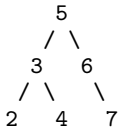


Target = 9

Output: True

Example 2:

Input:



Target = 28

Output: False

Solution

```

public boolean findTarget(TreeNode root, int k) {
    HashSet<Integer> set = new HashSet<>();
    return dfs(root, set, k);
}

private boolean dfs(TreeNode node, HashSet<Integer> set, int k) {
    if (node == null) {
        return false;
    }
    if (set.contains(k - node.val)) {
        return true;
    }
    set.add(node.val);
    return dfs(node.left, set, k) || dfs(node.right, set, k);
}
  
```

1.5 3Sum

Description

Given an array S of n integers, are there elements a, b, c in S such that $a + b + c = 0$? Find all unique triplets in the array which gives the sum of zero.

Note: The solution set must not contain duplicate triplets.

For example, given array $S = [-1, 0, 1, 2, -1, -4]$,

A solution set is:

```
[
  [-1, 0, 1],
  [-1, -1, 2]
]
```

Solution

```
// 耗时 30ms
public List<List<Integer>> threeSum(int[] nums) {
    Arrays.sort(nums);

    List<List<Integer>> result = new LinkedList<>();

    for (int i = 0; i < nums.length; i++) {
        if (i > 0 && nums[i] == nums[i - 1]) {
            continue;
        }
        for (int j = i + 1, k = nums.length - 1; j < k; ) {
            int sum = nums[i] + nums[j] + nums[k];

            if (sum > 0) {
                k--;
            } else if (sum < 0) {
                j++;
            } else {
                result.add(Arrays.asList(nums[i], nums[j], nums[k]));
                for (j++, k--; j < k && nums[j] == nums[j - 1]; j++);
            }
        }
    }

    return result;
}
```

1.6 3Sum Closest

Description

Given an array S of n integers, find three integers in S such that the sum is closest to a given number, target. Return the sum of the three integers. You may assume that each input would have exactly one solution.

For example, given array S = -1 2 1 -4, and target = 1.

The sum that is closest to the target is 2. (-1 + 2 + 1 = 2).

Solution

```
public int threeSumClosest(int[] nums, int target) {
    Arrays.sort(nums);

    long dis = Integer.MAX_VALUE, result = 0;

    for (int i = 0; i < nums.length - 2; i++) {
        int newTarget = target - nums[i];

        for (int j = i + 1, k = nums.length - 1; j < k; ) {
            int sum = nums[j] + nums[k];

            if (sum > newTarget) {
                k--;
            } else if (sum < newTarget) {
                j++;
            } else {
                return target;
            }

            long delta = Math.abs(newTarget - sum);
            if (delta < dis) {
                dis = delta;
                result = sum + nums[i];
            }
        }
    }

    return (int) result;
}
```


1.7 3Sum Smaller

Description

Given an array of n integers `nums` and a `target`, find the number of index triplets i, j, k with $0 \leq i < j < k < n$ that satisfy the condition `nums[i] + nums[j] + nums[k] < target`.

For example, given `nums = [-2, 0, 1, 3]`, and `target = 2`.

Return 2. Because there are two triplets which sums are less than 2:

`[-2, 0, 1]`

`[-2, 0, 3]`

Follow up:

Could you solve it in $O(n^2)$ runtime?

Solution

```
/**
 * 注意这里别画蛇添足的加上
 * if (nums[i] > target) {
 *     break;
 * }
 * 虽然后面的数大于等于 nums[i], 但是有可能是负数, 三个数之和还是可能小于 target 的
 */
public int threeSumSmaller(int[] nums, int target) {
    Arrays.sort(nums);

    int count = 0;
    for (int i = 0; i < nums.length - 2; i++) {
        for (int j = i + 1, k = nums.length - 1; j < k; ) {
            if (nums[i] + nums[j] + nums[k] >= target) {
                k--;
            } else {
                count += k - j;
                j++;
            }
        }
    }
    return count;
}
```

1.8 Median of Two Sorted Arrays

Description

There are two sorted arrays `nums1` and `nums2` of size `m` and `n` respectively.

Find the median of the two sorted arrays. The overall run time complexity should be $O(\log(m+n))$.

Example 1:

`nums1 = [1, 3]`

`nums2 = [2]`

The median is 2.0

Example 2:

`nums1 = [1, 2]`

`nums2 = [3, 4]`

The median is $(2 + 3)/2 = 2.5$

Solution

```
public double findMedianSortedArrays(int[] nums1, int[] nums2) {
    int len1 = nums1.length;
    int len2 = nums2.length;
    int total = len1 + len2;
    if ((total & 1) != 0) {
        return findKth(nums1, 0, len1 - 1, nums2, 0, len2 - 1, total / 2 + 1);
    } else {
        return (findKth(nums1, 0, len1 - 1, nums2, 0, len2 - 1, total / 2) + findKth(nums1, 0, len1 - 1,
        nums2, 0, len2 - 1, total / 2 + 1)) / 2;
    }
}

private double findKth(int[] nums1, int start1, int end1, int[] nums2, int start2, int end2, int k) {
    int len1 = end1 - start1 + 1;
    int len2 = end2 - start2 + 1;
    if (len1 > len2) {
        return findKth(nums2, start2, end2, nums1, start1, end1, k);
    } else if (len1 == 0) {
        return nums2[k - 1];
    } else if (k == 1) {
        return Math.min(nums1[start1], nums2[start2]);
    }
    int ia = Math.min(k / 2, len1), ib = k - ia;
    if (nums1[start1 + ia - 1] > nums2[start2 + ib - 1]) {
        return findKth(nums1, start1, end1, nums2, start2 + ib, end2, k - ib);
    } else if (nums1[start1 + ia - 1] < nums2[start2 + ib - 1]) {
        return findKth(nums1, start1 + ia, end1, nums2, start2, end2, k - ia);
    } else {
        return nums1[start1 + ia - 1];
    }
}
```

1.9 Move Zeroes

Description

Given an array `nums`, write a function to move all 0's to the end of it while maintaining the relative order of the non-zero elements. For example, given `nums = [0, 1, 0, 3, 12]`, after calling your function, `nums` should be `[1, 3, 12, 0, 0]`.

Note:

You must do this in-place without making a copy of the array.

Minimize the total number of operations.

Solution

```
public void moveZeroes(int[] nums) {
    for (int i = 0, j = 0; j < nums.length; j++) {
        if (nums[j] != 0) {
            swap(nums, i++, j);
        }
    }
}

private void swap(int[] nums, int i, int j) {
    int t = nums[i];
    nums[i] = nums[j];
    nums[j] = t;
}

/**
 * 要求操作次数最少，如果不要求保持顺序，无需理会超出的部分，所以这里不用 swap，
 * 另外当 i==j 时就不要多余地操作一次了，最后返回有效部分的长度
 */
public int moveZeroes2(int[] nums) {
    int i = 0, j = nums.length - 1;
    while (i <= j) {
        if (nums[i] != 0) {
            i++;
        } else if (nums[j] == 0) {
            j--;
        } else {
            if (i != j) {
                nums[i] = nums[j];
            }
            i++;
            j--;
        }
    }
    return i;
}
```

1.10 Plus One

Description

Given a non-negative integer represented as a non-empty array of digits, plus one to the integer.

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

The digits are stored such that the most significant digit is at the head of the list.

Solution

```
public int[] plusOne(int[] digits) {
    for (int i = digits.length - 1; i >= 0; i--) {
        if (digits[i] < 9) {
            digits[i]++;
            return digits;
        }
        digits[i] = 0;
    }
    int[] res = new int[digits.length + 1];
    res[0] = 1;
    return res;
}
```

1.11 Plus One Linked List

Description

Given a non-negative integer represented as non-empty a singly linked list of digits, plus one to the integer.

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

The digits are stored such that the most significant digit is at the head of the list.

Example:

Input:

1->2->3

Output:

1->2->4

Solution

```
public ListNode plusOne(ListNode head) {
    if (head == null) {
        return head;
    }
    Stack<ListNode> stack = new Stack<ListNode>();
    for (ListNode node = head; node != null; node = node.next) {
        stack.push(node);
    }
    int k = 1;
    while (!stack.isEmpty()) {
        ListNode node = stack.pop();
        int val = node.val + k;
        node.val = val % 10;
        k = val / 10;
        if (k == 0) {
            return head;
        }
    }
    ListNode node = new ListNode(k);
    node.next = head;
    return node;
}
```

1.12 Container With Most Water

Description

Given n non-negative integers a_1, a_2, \dots, a_n , where each represents a point at coordinate (i, a_i) . n vertical lines are drawn such that the two endpoints of line i is at (i, a_i) and $(i, 0)$. Find two lines, which together with x-axis forms a container, such that the container contains the most water.

Note: You may not slant the container and n is at least 2.

Analysis

本体可用暴力法，但显然会超时一种 $O(n)$ 的方法是对于区间 $[left, right]$ ，假如 $height[left] < height[right]$ ，则我们可以认定 $[left, right - 1]$ ， $[left, right - 2]$... 都不会比 $[left, right]$ 装的水更多。原因是假如 $height[right - 1]$ 比 $height[left]$ 高，则水平面高度不变，但宽度减小了。假如 $height[right - 1]$ 比 $height[left]$ 矮，则一样装的水会更少。所以对于一个区间，我们总是从矮的一方往前递进。

Solution

```
public int maxArea(int[] height) {
    int max = 0;

    for (int left = 0, right = height.length - 1; left < right; ) {
        max = Math.max(max, Math.min(height[left], height[right]) * (right - left));

        if (height[left] < height[right]) {
            left++;
        } else {
            right--;
        }
    }

    return max;
}
```

1.13 Contains Duplicate

Description

Given an array of integers, find if the array contains any duplicates. Your function should return true if any value appears at least twice in the array, and it should return false if every element is distinct.

Solution

```
public boolean containsDuplicate(int[] nums) {  
    Set<Integer> set = new HashSet<Integer>();  
    for (int n : nums) {  
        if (set.contains(n)) {  
            return true;  
        }  
        set.add(n);  
    }  
    return false;  
}
```

1.14 Contains Duplicate II

Description

Given an array of integers and an integer k , find out whether there are two distinct indices i and j in the array such that $\text{nums}[i] = \text{nums}[j]$ and the absolute difference between i and j is at most k .

Solution I

```
public boolean containsNearbyDuplicate(int[] nums, int k) {
    HashMap<Integer, Integer> map = new HashMap<Integer, Integer>();
    for (int i = 0; i < nums.length; i++) {
        if (map.containsKey(nums[i])) {
            if (i - map.get(nums[i]) <= k) {
                return true;
            }
        }
        map.put(nums[i], i);
    }
    return false;
}
```

Solution II

```
public boolean containsNearbyDuplicate2(int[] nums, int k) {
    Set<Integer> set = new HashSet<Integer>();
    for (int i = 0; i < nums.length; i++) {
        if (i >= k + 1) {
            set.remove(nums[i - k - 1]);
        }
        if (set.contains(nums[i])) {
            return true;
        }
        set.add(nums[i]);
    }
    return false;
}
```


1.15 Contains Duplicate III

Description

Given an array of integers, find out whether there are two distinct indices i and j in the array such that the absolute difference between $\text{nums}[i]$ and $\text{nums}[j]$ is at most t and the absolute difference between i and j is at most k .

Solution

```
/**
 * 这题关键要注意溢出的问题
 * TestCase
 * [-1, 2147483647], k = 1, t = 2147483647
 */
public boolean containsNearbyAlmostDuplicate(int[] nums, int k, int t) {
    if (k < 1 || t < 0) {
        return false;
    }

    Map<Long, Integer> map = new HashMap<Long, Integer>();

    for (int i = 0; i < nums.length; i++) {
        long index = ((long) nums[i] - Integer.MIN_VALUE) / ((long) t + 1);
        if (map.containsKey(index) ||
            (map.containsKey(index - 1) && (long) nums[i] - map.get(index - 1) <= t)
            || (map.containsKey(index + 1) && map.get(index + 1) - (long) nums[i] <= t)) {
            return true;
        }
        if (map.size() >= k) {
            long index1 = ((long) nums[i - k] - Integer.MIN_VALUE) / (t + 1);
            map.remove(index1);
        }
        map.put(index, nums[i]);
    }

    return false;
}
```

1.16 Trapping Rain Water

Description

Given n non-negative integers representing an elevation map where the width of each bar is 1, compute how much water it is able to trap after raining.

For example, Given $[0,1,0,2,1,0,1,3,2,1,2,1]$, return 6.



Analysis

核心思路就是对于每根柱子，找到其左边最高的柱子和右边最高的柱子，构成一个桶，形成一个水平面，然后对该柱子形成的高度差就是能装的水

Solution

```
// 耗时 24ms
public int trap(int[] height) {
    int len = height.length;

    if (len == 0) {
        return 0;
    }

    int[] left = new int[len];
    int[] right = new int[len];

    left[0] = 0;
    right[len - 1] = 0;

    for (int i = 1; i < len; i++) {
        left[i] = Math.max(left[i - 1], height[i - 1]);
    }
    for (int i = len - 2; i >= 0; i--) {
        right[i] = Math.max(right[i + 1], height[i + 1]);
    }
    int sum = 0;
    for (int i = 0; i < len; i++) {
        int high = Math.min(left[i], right[i]);
        if (high > height[i]) {
            sum += high - height[i];
        }
    }
    return sum;
}
```

1.17 Trapping Rain Water II

Description

Given an $m \times n$ matrix of positive integers representing the height of each unit cell in a 2D elevation map, compute the volume of water it is able to trap after raining.

Note:

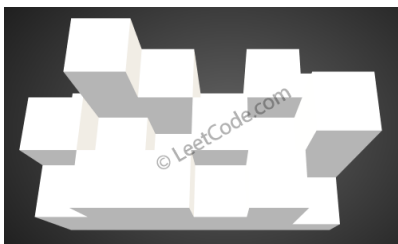
Both m and n are less than 110. The height of each unit cell is greater than 0 and is less than 20,000.

Example:

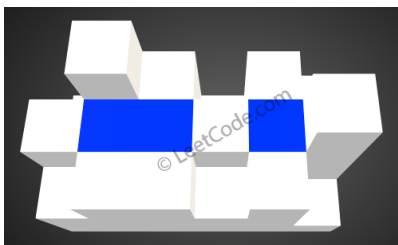
Given the following 3x6 height map:

```
[  
  [1,4,3,1,3,2],  
  [3,2,1,3,2,4],  
  [2,3,3,2,3,1]  
]
```

Return 4.



The above image represents the elevation map $[[1,4,3,1,3,2],[3,2,1,3,2,4],[2,3,3,2,3,1]]$ before the rain.



After the rain, water are trapped between the blocks. The total volume of water trapped is 4.

Analysis

思路是从外围开始，选择最短的柱子，以该柱子为标准，计算其四周的柱子所能容纳的水，并且更新四周柱子的高度，并加到小堆中。为什么这样呢？一个柱子所能蓄的水和该柱子相邻的四根柱子有关，所以我们从边界开始，不断向中间靠拢，每次都取队列中最短的那根柱子计算

Solution

```

public int trapRainWater(int[] [] heightMap) {
    if (heightMap.length == 0) {
        return 0;
    }
    Queue<int[]> queue = new PriorityQueue<>(new Comparator<int[]>() {
        @Override
        public int compare(int[] o1, int[] o2) {
            return o1[2] - o2[2];
        }
    });
    int row = heightMap.length, col = heightMap[0].length;
    boolean[] [] visited = new boolean[row][col];
    for (int i = 0; i < col; i++) {
        queue.add(new int[] {0, i, heightMap[0][i]});
        queue.add(new int[] {row - 1, i, heightMap[row - 1][i]});
        visited[0][i] = true;
        visited[row - 1][i] = true;
    }
    for (int i = 0; i < row; i++) {
        queue.add(new int[] {i, 0, heightMap[i][0]});
        queue.add(new int[] {i, col - 1, heightMap[i][col - 1]});
        visited[i][0] = true;
        visited[i][col - 1] = true;
    }
    int res = 0;
    int[] [] delta = new int[] [] {
        {-1, 0}, {1, 0}, {0, -1}, {0, 1}
    };
    while (!queue.isEmpty()) {
        int[] node = queue.poll();
        int x = node[0], y = node[1], z = node[2];
        for (int i = 0; i < delta.length; i++) {
            int xx = x + delta[i][0], yy = y + delta[i][1];
            if (xx >= 0 && xx < row && yy >= 0 && yy < col && !visited[xx][yy]) {
                visited[xx][yy] = true;
                res += Math.max(0, z - heightMap[xx][yy]);
                /**
                 * 这里要更新柱子的高度, 因为水平面肯定是 Math.max(z, heightMap[xx][yy])
                 */
                queue.add(new int[] {xx, yy, Math.max(z, heightMap[xx][yy])});
            }
        }
    }
    return res;
}

```

1.18 Product of Array Except Self

Description

Given an array of n integers where $n > 1$, `nums`, return an array `output` such that `output[i]` is equal to the product of all the elements of `nums` except `nums[i]`.

Solve it without division and in $O(n)$.

For example, given `[1,2,3,4]`, return `[24,12,8,6]`.

Follow up:

Could you solve it with constant space complexity? (Note: The output array does not count as extra space for the purpose of space complexity analysis.)

Solution

```
public int[] productExceptSelf(int[] nums) {
    if (nums.length == 0) {
        return null;
    }
    int[] result = new int[nums.length];
    result[0] = 1;
    for (int i = 1; i < nums.length; i++) {
        result[i] = nums[i - 1] * result[i - 1];
    }
    int right = 1;
    for (int i = nums.length - 1; i >= 0; i--) {
        result[i] *= right;
        right *= nums[i];
    }
    return result;
}
```

1.19 Find Minimum in Rotated Sorted Array

Description

Suppose an array sorted in ascending order is rotated at some pivot unknown to you beforehand.

(i.e., 0 1 2 4 5 6 7 might become 4 5 6 7 0 1 2).

Find the minimum element.

You may assume no duplicate exists in the array.

Solution

```
public int findMin(int[] nums) {
    for (int left = 0, right = nums.length - 1; left >= 0 && left <= right; ) {
        if (nums[right] > nums[left]) {
            return nums[left];
        }
        int mid = left + ((right - left) >> 1);

        if (nums[mid] > nums[left]) {
            left = mid + 1;
        } else if (nums[mid] < nums[right]) {
            right = mid;
        } else {
            return Math.min(nums[left], nums[right]);
        }
    }
    return 0;
}
```

1.20 Find Minimum in Rotated Sorted Array II

Description

Follow up for "Find Minimum in Rotated Sorted Array":

What if duplicates are allowed?

Would this affect the run-time complexity? How and why? Suppose an array sorted in ascending order is rotated at some pivot unknown to you beforehand.

(i.e., 0 1 2 4 5 6 7 might become 4 5 6 7 0 1 2).

Find the minimum element.

The array may contain duplicates.

Solution

```
public int findMin(int[] nums) {
    int left = 0, right = nums.length - 1;

    for ( ; left < right; ) {
        int mid = left + ((right - left) >> 1);

        if (nums[right] > nums[left]) {
            return nums[left];
        }

        if (nums[mid] > nums[left]) {
            left = mid + 1;
        } else if (nums[mid] < nums[right]) {
            right = mid;
        } else {
            left++;
        }
    }

    return nums[left];
}
```

1.21 Search in Rotated Sorted Array

Description

Suppose an array sorted in ascending order is rotated at some pivot unknown to you beforehand.

(i.e., 0 1 2 4 5 6 7 might become 4 5 6 7 0 1 2).

You are given a target value to search. If found in the array return its index, otherwise return -1.

You may assume no duplicate exists in the array.

Solution

```
public int search(int[] nums, int target) {
    int left = 0, right = nums.length - 1;

    // 注意这里的等号
    while (left <= right) {
        int mid = left + ((right - left) >>> 1);

        if (target == nums[mid]) {
            return mid;
        }

        // 注意这里的等号
        // 先确定单调区间, 然后判断 target 是不是在单调区间内, 如果不在就在另一半区间
        if (nums[mid] >= nums[left]) {
            if (target >= nums[left] && target < nums[mid]) {
                right = mid - 1;
            } else {
                left = mid + 1;
            }
        } else if (nums[mid] < nums[right]) {
            if (target > nums[mid] && target <= nums[right]) {
                left = mid + 1;
            } else {
                right = mid - 1;
            }
        }
    }

    return -1;
}
```


1.22 Search in Rotated Sorted Array II

Description

Follow up for "Search in Rotated Sorted Array": What if duplicates are allowed?

Would this affect the run-time complexity? How and why? Suppose an array sorted in ascending order is rotated at some pivot unknown to you beforehand.

(i.e., 0 1 2 4 5 6 7 might become 4 5 6 7 0 1 2).

Write a function to determine if a given target is in the array.

The array may contain duplicates.

Solution

```
public int search(int[] nums, int target) {
    int left = 0, right = nums.length - 1;

    // 注意这里的等号
    while (left <= right) {
        int mid = left + ((right - left) >>> 1);

        if (target == nums[mid]) {
            return mid;
        }

        // 注意这里的等号
        // 先确定单调区间, 然后判断 target 是不是在单调区间内, 如果不在就在另一半区间
        if (nums[mid] > nums[left]) {
            if (target >= nums[left] && target < nums[mid]) {
                right = mid - 1;
            } else {
                left = mid + 1;
            }
        } else if (nums[mid] == nums[left]) {
            // nums[mid]==nums[left] 有两种情况, 在不好确定哪种情况时, left++ 可以进一步缩小范围
            left++;
        } else {
            // 这里可以肯定 nums[mid]<nums[left], 所以 mid 肯定在拐点右边, 换言之之右边是单调的
            if (target > nums[mid] && target <= nums[right]) {
                left = mid + 1;
            } else {
                right = mid - 1;
            }
        }
    }

    return -1;
}
```

1.23 Pascal's Triangle

Description

Given numRows, generate the first numRows of Pascal's triangle.

For example, given numRows = 5,

Return

```
[
  [1],
  [1,1],
  [1,2,1],
  [1,3,3,1],
  [1,4,6,4,1]
]
```

Solution

```
public List<List<Integer>> generate(int numRows) {
    List<List<Integer>> allrows = new ArrayList<>();
    ArrayList<Integer> row = new ArrayList<>();
    for (int i = 0; i < numRows; i++) {
        row.add(0, 1);
        for (int j = 1; j < row.size() - 1; j++)
            row.set(j, row.get(j) + row.get(j + 1));
        allrows.add(new ArrayList<>(row));
    }
    return allrows;
}
```

1.24 Pascal's Triangle II

Description

Given an index k , return the k th row of the Pascal's triangle.

For example, given $k = 3$,

Return $[1, 3, 3, 1]$.

Note:

Could you optimize your algorithm to use only $O(k)$ extra space?

Solution

```
public List<Integer> getRow(int rowIndex) {
    List<Integer> list = new ArrayList<>();

    for (int i = 0; i <= rowIndex; i++) {
        int prev = 1;
        for (int j = 1; j < list.size(); j++) {
            int n = list.get(j) + prev;
            prev = list.get(j);
            list.set(j, n);
        }
        list.add(1);
    }

    return list;
}
```

1.25 Remove Element

Description

Given an array and a value, remove all instances of that value in place and return the new length.

Do not allocate extra space for another array, you must do this in place with constant memory.

The order of elements can be changed. It doesn't matter what you leave beyond the new length.

Example:

Given input array nums = [3,2,2,3], val = 3

Your function should return length = 2, with the first two elements of nums being 2.

Solution

```
public int removeElement(int[] nums, int val) {
    int index = 0;

    for (int i = 0; i < nums.length; i++) {
        if (nums[i] != val) {
            nums[index++] = nums[i];
        }
    }

    return index;
}
```

1.26 Summary Ranges

Description

Given a sorted integer array without duplicates, return the summary of its ranges.

Example 1:

Input: [0,1,2,4,5,7]

Output: ["0->2", "4->5", "7"]

Example 2:

Input: [0,2,3,4,6,8,9]

Output: ["0", "2->4", "6", "8->9"]

Solution

```
public List<String> summaryRanges(int[] nums) {
    List<String> list = new ArrayList();
    if (nums.length == 1) {
        list.add(nums[0] + "");
        return list;
    }
    for (int i = 0; i < nums.length; i++) {
        int a = nums[i];
        while (i + 1 < nums.length && (nums[i + 1] - nums[i]) == 1) {
            i++;
        }
        if (a != nums[i]) {
            list.add(a + "->" + nums[i]);
        } else {
            list.add(a + "");
        }
    }
    return list;
}
```

1.27 Merge Sorted Array

Description

Given two sorted integer arrays `nums1` and `nums2`, merge `nums2` into `nums1` as one sorted array.

Note:

You may assume that `nums1` has enough space (size that is greater or equal to $m + n$) to hold additional elements from `nums2`. The number of elements initialized in `nums1` and `nums2` are `m` and `n` respectively.

Solution

```
public void merge(int[] nums1, int m, int[] nums2, int n) {
    int j = m - 1, k = n - 1;
    for (int i = m + n - 1; i >= 0; i--) {
        if (j < 0) {
            nums1[i] = nums2[k--];
        } else if (k < 0) {
            nums1[i] = nums1[j--];
        } else {
            if (nums1[j] >= nums2[k]) {
                nums1[i] = nums1[j--];
            } else {
                nums1[i] = nums2[k--];
            }
        }
    }
}
```

1.28 Merge Two Sorted Lists

Description

Merge two sorted linked lists and return it as a new list. The new list should be made by splicing together the nodes of the first two lists.

Solution

```
// 耗时 15ms
public ListNode mergeTwoLists(ListNode l1, ListNode l2) {
    ListNode dummy = new ListNode(0);
    ListNode p = l1, q = l2, cur = dummy;
    for ( ; p != null && q != null; ) {
        if (p.val < q.val) {
            cur.next = p;
            p = p.next;
        } else {
            cur.next = q;
            q = q.next;
        }
        cur = cur.next;
    }
    cur.next = p != null ? p : q;
    return dummy.next;
}
```

1.29 Rotate Image

Description

You are given an $n \times n$ 2D matrix representing an image.

Rotate the image by 90 degrees (clockwise).

Note:

You have to rotate the image in-place, which means you have to modify the input 2D matrix directly. DO NOT allocate another 2D matrix and do the rotation.

Example 1:

Given input matrix =

```
[
  [1,2,3],
  [4,5,6],
  [7,8,9]
],
```

rotate the input matrix in-place such that it becomes:

```
[
  [7,4,1],
  [8,5,2],
  [9,6,3]
]
```

Solution

```
// 耗时 2ms
public void rotate(int[][] matrix) {
    int n = matrix.length;

    for (int i = 0; i < n / 2; i++) {
        for (int j = 0; j < n; j++) {
            int t = matrix[i][j];
            matrix[i][j] = matrix[n - 1 - i][j];
            matrix[n - 1 - i][j] = t;
        }
    }

    for (int i = 0; i < n; i++) {
        for (int j = 0; j < i; j++) {
            int t = matrix[i][j];
            matrix[i][j] = matrix[j][i];
            matrix[j][i] = t;
        }
    }
}
```


1.30 Remove Duplicates from Sorted Array

Description

Given a sorted array, remove the duplicates in place such that each element appear only once and return the new length.

Do not allocate extra space for another array, you must do this in place with constant memory.

For example,

Given input array `nums = [1,1,2]`,

Your function should return `length = 2`, with the first two elements of `nums` being 1 and 2 respectively. It doesn't matter what you leave beyond the new length.

Solution

```
public int removeDuplicates(int[] nums) {
    int j = -1;
    for (int i = 0; i < nums.length; i++) {
        if (j == -1 || nums[i] != nums[j]) {
            nums[++j] = nums[i];
        }
    }
    return j + 1;
}
```

1.31 Remove Duplicates from Sorted Array II

Description

Follow up for "Remove Duplicates": What if duplicates are allowed at most twice?

For example, Given sorted array nums = [1,1,1,2,2,3],

Your function should return length = 5, with the first five elements of nums being 1, 1, 2, 2 and 3. It doesn't matter what you leave beyond the new length.

Solution

```
public int removeDuplicates(int[] nums) {  
    int j = -1;  
    for (int i = 0; i < nums.length; i++) {  
        if (j < 1 || nums[i] != nums[j - 1]) {  
            nums[++j] = nums[i];  
        }  
    }  
    return j + 1;  
}
```

1.32 Rotate Array

Description

Rotate an array of n elements to the right by k steps.

For example, with $n = 7$ and $k = 3$, the array $[1,2,3,4,5,6,7]$ is rotated to $[5,6,7,1,2,3,4]$.

Note:

Try to come up as many solutions as you can, there are at least 3 different ways to solve this problem.

Hint:

Could you do it in-place with $O(1)$ extra space?

Solution

```
public void rotate(int[] nums, int k) {
    k %= nums.length;
    reverse(nums, 0, nums.length - 1);
    reverse(nums, 0, k - 1);
    reverse(nums, k, nums.length - 1);
}

public void reverse(int[] nums, int start, int end) {
    while (start < end) {
        int temp = nums[start];
        nums[start] = nums[end];
        nums[end] = temp;
        start++;
        end--;
    }
}
```

1.33 Spiral Matrix

Description

Given a matrix of $m \times n$ elements (m rows, n columns), return all elements of the matrix in spiral order.

For example,

Given the following matrix:

```
[
  [ 1, 2, 3 ],
  [ 4, 5, 6 ],
  [ 7, 8, 9 ]
]
```

You should return `[1,2,3,6,9,8,7,4,5]`.

Solution

```
public List<Integer> spiralOrder(int[] [] matrix) {
    List<Integer> res = new ArrayList<Integer>();

    if (matrix.length == 0) {
        return res;
    }

    int rowBegin = 0;
    int rowEnd = matrix.length - 1;
    int colBegin = 0;
    int colEnd = matrix[0].length - 1;

    while (rowBegin <= rowEnd && colBegin <= colEnd) {
        // Traverse Right
        for (int j = colBegin; j <= colEnd; j++) {
            res.add(matrix[rowBegin][j]);
        }
        rowBegin++;

        // Traverse Down
        for (int j = rowBegin; j <= rowEnd; j++) {
            res.add(matrix[j][colEnd]);
        }
        colEnd--;

        if (rowBegin <= rowEnd) {
            // Traverse Left
            for (int j = colEnd; j >= colBegin; j--) {
                res.add(matrix[rowEnd][j]);
            }
        }
        rowEnd--;

        if (colBegin <= colEnd) {
            // Traver Up
            for (int j = rowEnd; j >= rowBegin; j--) {
                res.add(matrix[j][colBegin]);
            }
        }
    }
}
```

```
        colBegin++;  
    }  
  
    return res;  
}
```

1.34 Merge Intervals

Description

Given a collection of intervals, merge all overlapping intervals.

For example,

Given [1,3],[2,6],[8,10],[15,18],

return [1,6],[8,10],[15,18].

Solution

```
// 耗时 26ms, 时间复杂度 O(nlgn)
public List<Interval> merge(List<Interval> intervals) {
    List<Interval> result = new LinkedList<Interval>();
    if (intervals.size() == 0) {
        return result;
    }
    Collections.sort(intervals, new Comparator<Interval>() {
        @Override
        public int compare(Interval o1, Interval o2) {
            return o1.start - o2.start;
        }
    });
    Interval prev = null;
    for (Interval interval : intervals) {
        if (prev == null) {
            prev = interval;
        } else {
            if (interval.start > prev.end) {
                result.add(prev);
                prev = interval;
            } else {
                prev.end = Math.max(prev.end, interval.end);
            }
        }
    }
    result.add(prev);
    return result;
}
```

1.35 Insert Interval

Description

Given a set of non-overlapping intervals, insert a new interval into the intervals (merge if necessary).

You may assume that the intervals were initially sorted according to their start times.

Example 1:

Given intervals [1,3],[6,9], insert and merge [2,5] in as [1,5],[6,9].

Example 2:

Given [1,2],[3,5],[6,7],[8,10],[12,16], insert and merge [4,9] in as [1,2],[3,10],[12,16].

This is because the new interval [4,9] overlaps with [3,5],[6,7],[8,10].

Solution

```
public List<Interval> insert(List<Interval> intervals, Interval newInterval) {
    List<Interval> result = new LinkedList<Interval>();
    for (Interval interval : intervals) {
        if (newInterval.start > interval.end) {
            result.add(interval);
        } else if (newInterval.end < interval.start) {
            result.add(newInterval);
            newInterval = interval;
        } else {
            newInterval.start = Math.min(interval.start, newInterval.start);
            newInterval.end = Math.max(interval.end, newInterval.end);
        }
    }
    result.add(newInterval);
    return result;
}
```

1.36 Meeting Rooms

Description

Given an array of meeting time intervals consisting of start and end times $[[s_1, e_1], [s_2, e_2], \dots]$ ($s_i < e_i$), determine if a person could attend all meetings.

For example,

Given $[[0, 30], [5, 10], [15, 20]]$,

return false.

Solution

```
// 时间复杂度  $O(n \lg n)$ 
public boolean canAttendMeetings(Interval[] intervals) {
    Arrays.sort(intervals, new Comparator<Interval>() {
        @Override
        public int compare(Interval o1, Interval o2) {
            return o1.start > o2.start ? 1 : -1;
        }
    });

    for (int i = 1; i < intervals.length; i++) {
        if (intervals[i].start < intervals[i - 1].end) {
            return false;
        }
    }

    return true;
}
```


1.37 Meeting Rooms II

Description

Given an array of meeting time intervals consisting of start and end times $[[s_1, e_1], [s_2, e_2], \dots]$ ($s_i < e_i$), find the minimum number of conference rooms required.

For example,

Given $[[0, 30], [5, 10], [15, 20]]$,

return 2.

Solution

```
// 耗时 17ms, 时间复杂度  $O(n \lg n)$ 
public int minMeetingRooms(Interval[] intervals) {
    Arrays.sort(intervals, new Comparator<Interval>() {
        @Override
        public int compare(Interval o1, Interval o2) {
            return o1.start - o2.start;
        }
    });
    Queue<Interval> queue = new PriorityQueue<Interval>(new Comparator<Interval>() {
        @Override
        public int compare(Interval o1, Interval o2) {
            return o1.end - o2.end;
        }
    });
    for (Interval interval : intervals) {
        if (!queue.isEmpty() && interval.start >= queue.peek().end) {
            queue.poll();
        }
        queue.add(interval);
    }
    return queue.size();
}
```

1.38 Find the Duplicate Number

Description

Given an array `nums` containing $n + 1$ integers where each integer is between 1 and n (inclusive), prove that at least one duplicate number must exist. Assume that there is only one duplicate number, find the duplicate one.

Note:

1. You must not modify the array (assume the array is read only).
2. You must use only constant, $O(1)$ extra space.
3. Your runtime complexity should be less than $O(n^2)$.
4. There is only one duplicate number in the array, but it could be repeated more than once.

Solution

```
public int findDuplicate(int[] nums) {
    int min = 1, max = nums.length - 1;

    while (min < max) {
        int mid = (min + max) / 2;

        int count = 0;

        for (int i = 0; i < nums.length; i++) {
            if (nums[i] <= mid) {
                count++;
            }
        }

        if (count > mid) {
            max = mid;
        } else {
            min = mid + 1;
        }
    }

    return min;
}
```

1.39 Missing Number

Description

Given an array containing n distinct numbers taken from $0, 1, 2, \dots, n$, find the one that is missing from the array.

For example,

Given `nums = [0, 1, 3]` return `2`.

Note:

Your algorithm should run in linear runtime complexity. Could you implement it using only constant extra space complexity?

Solution

```
public int missingNumber(int[] nums) {
    int xor = 0, i = 0;
    for (i = 0; i < nums.length; i++) {
        xor = xor ^ i ^ nums[i];
    }

    return xor ^ i;
}
```

1.40 Find Peak Element

Description

A peak element is an element that is greater than its neighbors.

Given an input array where $\text{num}[i] \neq \text{num}[i+1]$, find a peak element and return its index.

The array may contain multiple peaks, in that case return the index to any one of the peaks is fine.

You may imagine that $\text{num}[-1] = \text{num}[n] = -\infty$.

For example, in array $[1, 2, 3, 1]$, 3 is a peak element and your function should return the index number 2.

Note:

Your solution should be in logarithmic complexity.

Solution

```
public int findPeakElement(int[] nums) {
    return Helper(nums, 0, nums.length - 1);
}

private int Helper(int[] nums, int low, int high) {
    if (low == high) {
        return low;
    } else {
        int mid1 = (low + high) / 2;
        int mid2 = mid1 + 1;
        if (nums[mid1] > nums[mid2]) {
            return Helper(nums, low, mid1);
        } else {
            return Helper(nums, mid2, high);
        }
    }
}
```

1.41 Majority Element

Description

Given an array of size n , find the majority element. The majority element is the element that appears more than $\lfloor n/2 \rfloor$ times.

You may assume that the array is non-empty and the majority element always exist in the array.

Solution

```
public int majorityElement(int[] nums) {
    int major = nums[0], count = 1;
    for (int i = 1; i < nums.length; i++) {
        if (count == 0) {
            count++;
            major = nums[i];
        } else if (major == nums[i]) {
            count++;
        } else {
            count--;
        }
    }
    return major;
}
```

1.42 Majority Element II

Description

Given an integer array of size n , find all elements that appear more than $\lfloor n/3 \rfloor$ times. The algorithm should run in linear time and in $O(1)$ space.

Solution

```
public List<Integer> majorityElement(int[] nums) {
    if (nums == null || nums.length == 0)
        return new ArrayList<Integer>();
    List<Integer> result = new ArrayList<Integer>();
    int number1 = nums[0], number2 = nums[0], count1 = 0, count2 = 0, len = nums.length;
    for (int i = 0; i < len; i++) {
        if (nums[i] == number1)
            count1++;
        else if (nums[i] == number2)
            count2++;
        else if (count1 == 0) {
            number1 = nums[i];
            count1 = 1;
        } else if (count2 == 0) {
            number2 = nums[i];
            count2 = 1;
        } else {
            count1--;
            count2--;
        }
    }
    count1 = 0;
    count2 = 0;
    for (int i = 0; i < len; i++) {
        if (nums[i] == number1)
            count1++;
        else if (nums[i] == number2)
            count2++;
    }
    if (count1 > len / 3)
        result.add(number1);
    if (count2 > len / 3)
        result.add(number2);
    return result;
}
```

1.43 First Missing Positive

Description

Given an unsorted integer array, find the first missing positive integer.

For example,

Given [1,2,0] return 3,

and [3,4,-1,1] return 2.

Your algorithm should run in $O(n)$ time and uses constant space.

Analysis

这里要注意的是 `nums[nums[i] - 1] != nums[i]` 这个条件，意思是目标坑和当前坑的值不等，此时才能 swap 倘若换成 `nums[i] - 1 != i` 是不行的，这表示目标坑和当前坑不是一个坑就 swap，会死循环

Solution

```
public int firstMissingPositive(int[] nums) {
    for (int i = 0; i < nums.length; i++) {
        while (nums[i] >= 1 && nums[i] <= nums.length && nums[nums[i] - 1] != nums[i]) {
            swap(nums, i, nums[i] - 1);
        }
    }
    for (int i = 0; i < nums.length; i++) {
        if (i != nums[i] - 1) {
            return i + 1;
        }
    }
    return nums.length + 1;
}

private void swap(int[] nums, int i, int j) {
    if (i != j) {
        int t = nums[i];
        nums[i] = nums[j];
        nums[j] = t;
    }
}
```

1.44 Game of Life

Description

According to the Wikipedia's article: "The Game of Life, also known simply as Life, is a cellular automaton devised by the British mathematician John Horton Conway in 1970."

Given a board with m by n cells, each cell has an initial state live (1) or dead (0). Each cell interacts with its eight neighbors (horizontal, vertical, diagonal) using the following four rules (taken from the above Wikipedia article):

1. Any live cell with fewer than two live neighbors dies, as if caused by under-population.
2. Any live cell with two or three live neighbors lives on to the next generation.
3. Any live cell with more than three live neighbors dies, as if by over-population..
4. Any dead cell with exactly three live neighbors becomes a live cell, as if by reproduction.

Write a function to compute the next state (after one update) of the board given its current state.

Follow up:

1. Could you solve it in-place? Remember that the board needs to be updated at the same time: You cannot update some cells first and then use their updated values to update other cells.
2. In this question, we represent the board using a 2D array. In principle, the board is infinite, which would cause problems when the active area encroaches the border of the array. How would you address these problems?

Solution

```
public void gameOfLife(int[][] board) {
    if (board == null || board.length == 0) return;
    int m = board.length, n = board[0].length;

    for (int i = 0; i < m; i++) {
        for (int j = 0; j < n; j++) {
            int lives = liveNeighbors(board, m, n, i, j);

            // In the beginning, every 2nd bit is 0;
            // So we only need to care about when will the 2nd bit become 1.
            if (board[i][j] == 1 && lives >= 2 && lives <= 3) {
                board[i][j] = 3; // Make the 2nd bit 1: 01 ---> 11
            }
            if (board[i][j] == 0 && lives == 3) {
                board[i][j] = 2; // Make the 2nd bit 1: 00 ---> 10
            }
        }
    }

    for (int i = 0; i < m; i++) {
        for (int j = 0; j < n; j++) {
            board[i][j] >>= 1; // Get the 2nd state.
        }
    }
}

public int liveNeighbors(int[][] board, int m, int n, int i, int j) {
    int lives = 0;
    for (int x = Math.max(i - 1, 0); x <= Math.min(i + 1, m - 1); x++) {
        for (int y = Math.max(j - 1, 0); y <= Math.min(j + 1, n - 1); y++) {
```



```
        lives += board[x][y] & 1;
    }
}
lives -= board[i][j] & 1;
return lives;
}
```

1.45 Set Matrix Zeroes

Description

Given a $m \times n$ matrix, if an element is 0, set its entire row and column to 0. Do it in place.

Follow up:

Did you use extra space?

A straight forward solution using $O(mn)$ space is probably a bad idea.

A simple improvement uses $O(m + n)$ space, but still not the best solution.

Could you devise a constant space solution?

Solution

```
public void setZeroes(int[] [] matrix) {
    if (matrix.length == 0) {
        return;
    }
    int row = matrix.length, col = matrix[0].length;
    boolean clearRow = false, clearCol = false;

    for (int i = 0; i < col; i++) {
        if (matrix[0][i] == 0) {
            clearRow = true;
            break;
        }
    }
    for (int i = 0; i < row; i++) {
        if (matrix[i][0] == 0) {
            clearCol = true;
            break;
        }
    }
    for (int i = 1; i < row; i++) {
        for (int j = 1; j < col; j++) {
            if (matrix[i][j] == 0) {
                matrix[0][j] = 0;
                matrix[i][0] = 0;
            }
        }
    }

    for (int i = 1; i < col; i++) {
        if (matrix[0][i] == 0) {
            for (int j = 0; j < row; j++) {
                matrix[j][i] = 0;
            }
        }
    }

    for (int i = 1; i < row; i++) {
        if (matrix[i][0] == 0) {
            for (int j = 0; j < col; j++) {
                matrix[i][j] = 0;
            }
        }
    }

    if (clearRow) {
        for (int i = 0; i < col; i++) {
            matrix[0][i] = 0;
        }
    }

    if (clearCol) {
        for (int i = 0; i < row; i++) {
            matrix[i][0] = 0;
        }
    }
}
```

1.46 Title

Description

Solution