目录

201. Bitwise AND of Numbers Range

Medium

Given a range [m, n] where 0 <= m <= n <= 2147483647, return the bitwise AND of all numbers in this range, inclusive.

Example 1:

Input: [5,7]

Output: 4

Example 2:

Input: [0,1]

Output: 0

```
class Solution {
public:
    int rangeBitwiseAnd(int m, int n) {

    }
};
```

```
class Solution {
public:
    int rangeBitwiseAnd(int m, int n) {
        int x = 0x40000000, res = 0;
        while (x) {
            if ((m & x) == (n & x)) res += (m & x);
            else break;
            x >>= 1;
        }
        return res;
    }
};
```

202. Happy Number

Easy

Write an algorithm to determine if a number is "happy".

A happy number is a number defined by the following process: Starting with any positive integer, replace the number by the sum of the squares of its digits, and repeat the process until the number equals 1 (where it will stay), or it loops endlessly in a cycle which does not include 1. Those numbers for which this process ends in 1 are happy numbers.

Example:

Input: 19

Output: true

Explanation:

$1^2 + 9^2 = 82$

$8^2 + 2^2 = 68$

$6^2 + 8^2 = 100$

$1^2 + 0^2 + 0^2 = 1$

```
class Solution {
public:
    bool isHappy(int n) {

    }
};
```

```cpp
class Solution {
public:
    bool isHappy(int n) {
        unordered_set<int> My_set;
        while (1) {
            int t = 0;
            while (n) {
                t += (n%10)*(n%10);
                n /= 10;
            }
            if (t == 1) return true;
            else if (My_set.count(t)) return false;
            My_set.insert(n = t);
        }
        return true;
    }
};
```

203. Remove Linked List Elements

Easy

Remove all elements from a linked list of integers that have value ***val***.

Example:

Input: 1->2->6->3->4->5->6, ***val*** = 6

Output: 1->2->3->4->5

```
/**
 * Definition for singly-linked list.
 * struct ListNode {
 *     int val;
 *     ListNode *next;
 *     ListNode(int x) : val(x), next(NULL) {}
 * };
 */
class Solution {
public:
    ListNode* removeElements(ListNode* head, int val) {

    }
};
```

```
/**
 * Definition for singly-linked list.
 * struct ListNode {
 *     int val;
 *     ListNode *next;
 *     ListNode(int x) : val(x), next(NULL) {}
 * };
 */
class Solution {
public:
    ListNode* removeElements(ListNode* head, int val) {
        if (head == nullptr) return head;
        if (head->val == val) {
            return removeElements(head->next, val);
        else {
            head->next = removeElements(head->next, val);
            return head;
        }
    }
};
```

204. Count Primes(●ˇ∀ ˇ●)

Easy

Count the number of prime numbers less than a non-negative number, ***n***.

Example:

Input: 10

Output: 4

Explanation: There are 4 prime numbers less than 10, they are 2, 3, 5, 7.

```
class Solution {
public:
    int countPrimes(int n) {

    }
};
```

```cpp
class Solution {
public:
    int countPrimes(int n) {
        if (n <= 2) return 0;
        vector<bool> v(n, false);
        int Sqrt = sqrt(n)+0.5, cnt = n/2;
        for (int i = 3; i <= Sqrt; i += 2) {
            for (int j = i*i; j < n; j += 2*i) {
                if (!v[j]) {
                    v[j] = true;
                    --cnt;
                }
            }
        }
        return cnt;
    }
};
```

205. Isomorphic Strings

Easy

Given two strings ***s*** and ***t***, determine if they are isomorphic.

Two strings are isomorphic if the characters in ***s*** can be replaced to get ***t***.

All occurrences of a character must be replaced with another character while preserving the order of characters. No two characters may map to the same character but a character may map to itself.

Example 1:

Input: ***s*** = "egg", ***t*** = "add"

Output: true

Example 2:

Input: ***s*** = "foo", ***t*** = "bar"

Output: false

Example 3:

Input: ***s*** = "paper", ***t*** = "title"

Output: true

Note:
You may assume both ***s*** and ***t*** have the same length.

```
class Solution {
public:
    bool isIsomorphic(string s, string t) {

    }
};
```

```cpp
class Solution {
public:
    bool isIsomorphic(string s, string t) {
        if (s.length() != t.length()) return false;
        vector<int> a(256,-1), b(256,-1);
        int n = s.length();
        for (int i = 0; i < n; i++) {
            if (a[s[i]] != b[t[i]]) return false;
            else if (a[s[i]] == -1) a[s[i]] = b[t[i]] = i;
        }
        return true;
    }
};
```

206. Reverse Linked List

Easy

Reverse a singly linked list.

Example:

Input: 1->2->3->4->5->NULL

Output: 5->4->3->2->1->NULL

Follow up:

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

```
/**
 * Definition for singly-linked list.
 * struct ListNode {
 *     int val;
 *     ListNode *next;
 *     ListNode(int x) : val(x), next(NULL) {}
 * };
 */
class Solution {
public:
    ListNode* reverseList(ListNode* head) {

    }
};
```

```cpp
/**
 * Definition for singly-linked list.
 * struct ListNode {
 *     int val;
 *     ListNode *next;
 *     ListNode(int x) : val(x), next(NULL) {}
 * };
 */
class Solution {
public:
    ListNode* reverseList(ListNode* head) {
        ListNode *dummy = new ListNode(-1), *p, *t;
        p = head;
        while (p) {
            t = p->next;
            p->next = dummy->next;
            dummy->next = p;
            p = t;
        }
        return dummy->next;
    }
};
```

207. Course Schedule

Medium

There are a total of *n* courses you have to take, labeled from `0` to `n-1`.

Some courses may have prerequisites, for example to take course 0 you have to first take course 1, which is expressed as a pair: `[0,1]`

Given the total number of courses and a list of prerequisite **pairs**, is it possible for you to finish all courses?

Example 1:

Input: 2, [[1,0]]

Output: true

Explanation: There are a total of 2 courses to take.

To take course 1 you should have finished course 0. So it is possible.

Example 2:

Input: 2, [[1,0],[0,1]]

Output: false

Explanation: There are a total of 2 courses to take.

To take course 1 you should have finished course 0, and to take course 0 you should also have finished course 1. So it is impossible.

Note:

1. The input prerequisites is a graph represented by **a list of edges**, not adjacency matrices. Read more about how a graph is represented.
2. You may assume that there are no duplicate edges in the input prerequisites.

```
class Solution {
public:
    bool canFinish(int numCourses, vector<pair<int, int>>& prerequisites) {

    }
};
```

```cpp
class Solution {
public:
    bool canFinish(int numCourses, vector<pair<int, int>>& prerequisites) {
        vector<vector<int>> v(numCourses);
        vector<int> visited(numCourses, 0);
        for (auto &i : prerequisites) {
            v[i.first].push_back(i.second);
        }
        for (int i = 0; i < numCourses; i++) {
            if (visited[i] == 0) {
               if (!dfs(i, visited, v)) return false;
            }
        }
        return true;
    }

private:
    bool dfs(int cur, vector<int> &visited, vector<vector<int>> &v) {
        visited[cur] = -1;
        for (auto &j : v[cur]) {
            if (visited[j] == -1) return false;
            else if (visited[j] == 0 && !dfs(j, visited, v)) return false;
        }
        visited[cur] = 1;
        return true;
    }
};
```

208. Implement Trie (Prefix Tree)(●ˇ∀ˇ●)

Medium

Implement a trie with `insert`, `search`, and `startsWith` methods.

Example:

```
Trie trie = new Trie();

trie.insert("apple");
trie.search("apple");   // returns true
trie.search("app");     // returns false
trie.startsWith("app"); // returns true
trie.insert("app");
trie.search("app");     // returns true
```

Note:

- You may assume that all inputs are consist of lowercase letters `a-z`.
- All inputs are guaranteed to be non-empty strings.

```
class Trie {
public:
    Trie() {}

    void insert(string word) {
        Trie *node = this;
        for (char c : word) {
            if (!node->next.count(c)) {node->next[c] = new Trie();}
            node = node->next[c];
        }
        node->isword = true;
    }

    bool search(string word) {
        Trie *node = this;
        for (char c : word) {
            if (!node->next.count(c))  return false;
            node = node->next[c];
        }
        return node->isword;
    }

    bool startsWith(string prefix) {
        Trie *node = this;
        for (auto c : prefix) {
            if (!node->next.count(c))  return false;
            node = node->next[c];
        }
        return true;
    }

private:
    unordered_map<char, Trie*> next;
    bool isword = false;
};
```

209. Minimum Size Subarray Sum

Medium

Given an array of **n** positive integers and a positive integer **s**, find the minimal length of a **contiguous** subarray of which the sum ≥ **s**. If there isn't one, return 0 instead.

Example:

Input: s = 7, nums = [2,3,1,2,4,3]

Output: 2

Explanation: the subarray [4,3] has the minimal length under the problem constraint.

Follow up:
If you have figured out the *O*(*n*) solution, try coding another solution of which the time complexity is *O*(*n* log *n*).

```
class Solution {
public:
    int minSubArrayLen(int s, vector<int>& nums) {

    }
};
```

```cpp
class Solution {
public:
    int minSubArrayLen(int s, vector<int>& nums) {
        int n = nums.size(), ans = INT_MAX;
        int left = 0, sum = 0;
        for (int i = 0; i < n; i++) {
            sum += nums[i];
            while (sum >= s) {
                ans = min(ans, i + 1 - left);
                sum -= nums[left++];
            }
        }
        return (ans != INT_MAX) ? ans : 0;
    }
};
```

```
//////////////////////////////////nlogn////////////////////////////////
class Solution {
public:
    int minSubArrayLen(int s, vector<int>& nums) {
        vector<int> sums = accumulatedSums(nums);
        int n = sums.size(), len = INT_MAX;
        for (int i = n-1; i >= 0 && sums[i] >= s; i--) {
            int j = upper_bound(sums.begin(), sums.begin() + i, sums[i] - s)
                    - sums.begin();
            len = min(len, i-j+1);
        }
        return len == INT_MAX ? 0 : len;
    }

private:
    vector<int> accumulatedSums(vector<int>& nums) {
        int n = nums.size();
        vector<int> sums(n + 1, 0);
        for (int i = 1; i < n + 1; i++) {
            sums[i] = sums[i-1] + nums[i-1];
        }
        return sums;
    }
};
```

210. Course Schedule II

Medium

There are a total of *n* courses you have to take, labeled from `0` to `n-1`.

Some courses may have prerequisites, for example to take course 0 you have to first take course 1, which is expressed as a pair: `[0,1]`

Given the total number of courses and a list of prerequisite **pairs**, return the ordering of courses you should take to finish all courses.

There may be multiple correct orders, you just need to return one of them. If it is impossible to finish all courses, return an empty array.

Example 1:

Input: 2, [[1,0]]

Output: [0,1]

Explanation: There are a total of 2 courses to take. To take course 1 you should have finished course 0. So the correct course order is [0,1] .

Example 2:

Input: 4, [[1,0],[2,0],[3,1],[3,2]]

Output: [0,1,2,3] or [0,2,1,3]

Explanation: There are a total of 4 courses to take. To take course 3 you should have finished both courses 1 and 2. Both courses 1 and 2 should be taken after you finished course 0.

So one correct course order is [0,1,2,3]. Another correct ordering is [0,2,1,3] .

Note:

1. The input prerequisites is a graph represented by **a list of edges**, not adjacency matrices. Read more about how a graph is represented.
2. You may assume that there are no duplicate edges in the input prerequisites.

```cpp
class Solution {
public:
    vector<int> findOrder(int numCourses, vector<vector<int>> &pres) {
        visited.resize(numCourses, 0);
        v.resize(numCourses);
        for (auto &i : pres)   v[i[0]].push_back(i[1]);
        for (int i = 0; i < numCourses; i++) {
            if (!visited[i] && !dfs(i))
                return vector<int> ();
        }
        return path;
    }

private:
    vector<int> path, visited;
    vector<vector<int>> v;

    bool dfs(int i) {
        visited[i] = -1;
        for (auto &j : v[i]) {
            if (visited[j] == -1) return false;
            else if (!visited[j] && !dfs(j)) return false;
        }
        path.push_back(i);
        visited[i] = 1;
        return true;
    }
};
```

211. Add and Search WordData structure design(●ˇ∀ˇ●)

Medium

Design a data structure that supports the following two operations:

```
void addWord(word)

bool search(word)
```

search(word) can search a literal word or a regular expression string containing only letters `a-z` or `.`. A `.` means it can represent any one letter.

Example:

```
addWord("bad")

addWord("dad")

addWord("mad")

search("pad") -> false

search("bad") -> true

search(".ad") -> true

search("b..") -> true
```

Note:
You may assume that all words are consist of lowercase letters `a-z`.

```cpp
class WordDictionary {
public:

    WordDictionary() {}

    void addWord(string word) {
        WordDictionary *node = this;
        for (char c : word) {
            if (!node->next.count(c)) {
                node->next[c] = new WordDictionary();
            }
            node = node->next[c];
        }
        node->isword = true;
    }

    bool search(string word) {
        WordDictionary *node = this;
        for (int i = 0; i < word.length(); i++) {
            char c = word[i];
            if (c == '.') {
                for (auto p : node->next) {
                    if (p.second->search(word.substr(i+1))) return true;
                }
                return false;
            }
            else if (!node->next.count(c))  return false;
            node = node->next[c];
        }
        return node->isword;
    }

private:
    unordered_map<char, WordDictionary*> next;
    bool isword = false;
};
```

212. Word Search II(●ˇ∀ ˇ●)

Hard

Given a 2D board and a list of words from the dictionary, find all words in the board.

Each word must be constructed from letters of sequentially adjacent cell, where "adjacent" cells are those horizontally or vertically neighboring. The same letter cell may not be used more than once in a word.

Example:

Input:

words = ["oath","pea","eat","rain"] and **board** =

[

  ['o','a','a','n'],

  ['e','t','a','e'],

  ['i','h','k','r'],

  ['i','f','l','v']

]

Output: ["eat","oath"]

Note:

You may assume that all inputs are consist of lowercase letters `a-z`.

```
//////////////////////注意本题我用了两个 class//////////////////////
class Trie {
    friend class Solution;
public:
    Trie() {}
    void insert(string word) {
        Trie *node = this;
        for (char c : word) {
            if (!node->next.count(c)) {node->next[c] = new Trie();}
            node = node->next[c];
        }
        node->isword = true;
    }

    Trie* search(char c) {
        Trie *node = this;
        if (!node->next.count(c)) return nullptr;
        else return node->next[c];
    }


private:
    unordered_map<char, Trie*> next;
    bool isword = false;
};
```

```
class Solution {
public:
    vector<string> findWords(vector<vector<char>>& board,
                             vector<string>& words) {
      n = board.size(), m = board[0].size();
      visited.resize(n, vector<bool>(m, false));
      Trie *node = new Trie();
      for (auto i : words) node->insert(i);
      for (int i = 0; i < n; i++) {
         for (int j = 0; j < m; j++) {
            string s;
            dfs(i, j, s, node, board);
         }
      }
      vector<string> res;
      for (auto &i : My_set) res.push_back(i);
      return res;
    }

private:
    int n, m;
    unordered_set<string> My_set;
    vector<vector<bool>> visited;

    void dfs(int i,int j, string s, Trie *node, vector<vector<char>> &board){
       if (i < 0 || i >= n || j < 0 || j >= m) return;
       else if (visited[i][j]) return;
       visited[i][j] = true;
       char c = board[i][j];
       s += c;
       if (!(node = node->search(c))) {
          visited[i][j] = false;
          return;
       } else if (node->isword) {
          My_set.insert(s);
       }
       dfs(i+1, j, s, node, board);
       dfs(i-1, j, s, node, board);
       dfs(i, j+1, s, node, board);
       dfs(i, j-1, s, node, board);
       visited[i][j] = false;
    }
};
```

213. House Robber II(●ˇ∀ ˇ●)

Medium

You are a professional robber planning to rob houses along a street. Each house has a certain amount of money stashed. All houses at this place are **arranged in a circle.** That means the first house is the neighbor of the last one. Meanwhile, adjacent houses have security system connected and **it will automatically contact the police if two adjacent houses were broken into on the same night**.

Given a list of non-negative integers representing the amount of money of each house, determine the maximum amount of money you can rob tonight **without alerting the police**.

Example 1:

Input: [2,3,2]

Output: 3

Explanation: You cannot rob house 1 (money = 2) and then rob house 3 (money = 2),

because they are adjacent houses.

Example 2:

Input: [1,2,3,1]

Output: 4

Explanation: Rob house 1 (money = 1) and then rob house 3 (money = 3).

Total amount you can rob = 1 + 3 = 4.

```
class Solution {
public:
    int rob(vector<int>& nums) {

    }
};
```

```cpp
class Solution {
public:
    int rob(vector<int>& nums) {
        int n = nums.size();
        if (n < 2) return n ? nums[0] : 0;
        return max(rob(nums, 0, n - 1), rob(nums, 1, n));
    }

private:
    int rob(vector<int>& nums, int l, int r) {
        int pre = 0, cur = 0;
        for (int i = l; i < r; i++) {
            int temp = max(pre + nums[i], cur);
            pre = cur;
            cur = temp;
        }
        return cur;
    }
};
```

214. Shortest Palindrome(●ˇ∀ˇ●)

Hard

Given a string ***s***, you are allowed to convert it to a palindrome by adding characters in front of it. Find and return the shortest palindrome you can find by performing this transformation.

Example 1:

Input: "aacecaaa"

Output: "aaacecaaa"

Example 2:

Input: "abcd"

Output: "dcbabcd"

```
//////////////////////////////O(n^2)////////////////////////////////
class Solution {
public:
    string shortestPalindrome(string s) {
        int n = s.size(), i = 0;
        for (int j = n - 1; j >= 0; j--) {
            if (s[i] == s[j])
                i++;
        }
        if (i == n) return s;
        string remain_rev = s.substr(i);
        reverse(remain_rev.begin(), remain_rev.end());
        return remain_rev + shortestPalindrome(s.substr(0, i)) + s.substr(i);
    }
};
```

```
//////////////////////O(n^2)////////////////////////////
class Solution {
public:
   string shortestPalindrome(string s) {
       int n = s.size();
       string rev(s);
       reverse(rev.begin(), rev.end());
       for (int i = 0; i < n; i++) {
           if (s.substr(0, n - i) == rev.substr(i))
               return rev.substr(0, i) + s;
       }
       return "";
   }
};
```

```
//////////////////////////O(n)//////////////////////
class Solution {
public:
    string shortestPalindrome(string s) {
        string rev(s);
        reverse(rev.begin(), rev.end());
        string str = s + "#" + rev;
        int n = str.size();
        vector<int> f(n, 0);
        for (int i = 1, len = 0; i < n;) {
            if (str[i] == str[len])  f[i++] = ++len;
            else if (len) len = f[len - 1];
            else  f[i++] = 0;
        }
        return rev.substr(0, s.length()- f[n - 1]) + s;
    }
}
```

215. Kth Largest Element in an Array(●ˇ∀ ˇ●)

Medium

Find the **k**th largest element in an unsorted array. Note that it is the kth largest element in the sorted order, not the kth distinct element.

Example 1:

Input: [3,2,1,5,6,4] and k = 2

Output: 5

Example 2:

Input: [3,2,3,1,2,4,5,5,6] and k = 4

Output: 4

Note:
You may assume k is always valid, 1 ≤ k ≤ array's length.

```
class Solution {
public:
    int findKthLargest(vector<int>& nums, int k) {

    }
};
```

```cpp
class Solution {
public:
    int findKthLargest(vector<int>& nums, int k) {
        int left = 0, right = nums.size() - 1;
        while (1) {
            int idx = partition(nums, left, right);
            if (idx == k-1)  break;
            if (idx < k-1) left = idx + 1;
            else right = idx - 1;
        }
        return nums[k-1];
    }
private:
    int partition(vector<int>& nums, int left, int right) {
        int pivot = nums[left], l = left + 1, r = right;
        while (l <= r) {
            while (l <= r && nums[l] >= pivot)  l++;
            while (l <= r && nums[r] <= pivot)  r--;
            if (l <= r && nums[l] < pivot && nums[r] > pivot) {
                swap(nums[l++], nums[r--]);
            }
        }
        swap(nums[left], nums[r]);
        // swap(nums[left], nums[l];会在 nums = [1] 时出错
        return r;
    }
};
```

216. Combination Sum III

Medium

Find all possible combinations of ***k*** numbers that add up to a number ***n***, given that only numbers from 1 to 9 can be used and each combination should be a unique set of numbers.

Note:

- All numbers will be positive integers.
- The solution set must not contain duplicate combinations.

Example 1:

Input: ***k*** = 3, ***n*** = 7

Output: [[1,2,4]]

Example 2:

Input: ***k*** = 3, ***n*** = 9

Output: [[1,2,6], [1,3,5], [2,3,4]]

```
class Solution {
public:
    vector<vector<int>> combinationSum3(int k, int n) {

    }
};
```

```cpp
class Solution {
public:
    vector<vector<int>> combinationSum3(int k, int n) {
        vector<int> path;
        vector<vector<int>> res;
        dfs(1, 0, k, n, path, res);
        return res;
    }
private:
    void dfs(int i, int cur, int k, int n, vector<int> &path,
             vector<vector<int>> &res) {
        if (cur == k && n == 0) {
            res.push_back(path);
            return;
        }
        for (int j = i; j <= 9 && n-j >= 0; j++) {
            path.push_back(j);
            dfs(j+1, cur+1, k, n-j, path, res);
            path.pop_back();
        }
    }
};
```

217. Contains Duplicate

Easy

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.

Example 1:

Input: [1,2,3,1]

Output: true

Example 2:

Input: [1,2,3,4]

Output: false

Example 3:

Input: [1,1,1,3,3,4,3,2,4,2]

Output: true

```
class Solution {
public:
    bool containsDuplicate(vector<int>& nums) {

    }
};
```

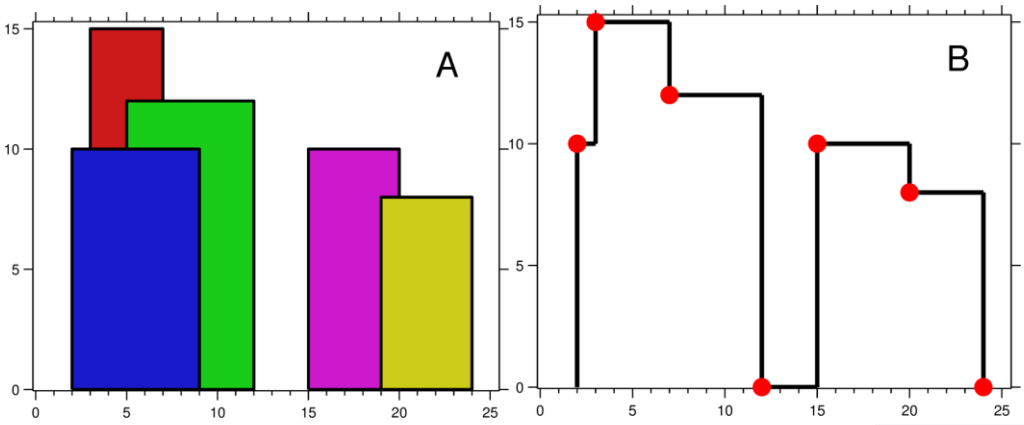
```cpp
class Solution {
public:
    bool containsDuplicate(vector<int>& nums) {
        sort(nums.begin(), nums.end());
        int n = nums.size();
        for (int i = 1; i < n; i++){
            if (nums[i-1] == nums[i])
                return true;
        }
        return false;
    }
};
```

```cpp
class Solution {
public:
    bool containsDuplicate(vector<int>& nums) {
        unordered_set<int> My_set;
        for (auto &i: nums) {
            if (My_set.count(i)) return true;
            else My_set.insert(i);
        }
        return false;
    }
};
```

218. The Skyline Problem(●ˇ∀ˇ●)

Hard

A city's skyline is the outer contour of the silhouette formed by all the buildings in that city when viewed from a distance. Now suppose you are **given the locations and height of all the buildings** as shown on a cityscape photo (Figure A), write a program to **output the skyline** formed by these buildings collectively (Figure B).



The geometric information of each building is represented by a triplet of integers `[Li, Ri, Hi]`, where `Li` and `Ri` are the x coordinates of the left and right edge of the ith building, respectively, and `Hi` is its height. It is guaranteed that `0 ≤ Li, Ri ≤ INT_MAX`, `0 < Hi ≤ INT_MAX`, and `Ri - Li > 0`. You may assume all buildings are perfect rectangles grounded on an absolutely flat surface at height 0.

For instance, the dimensions of all buildings in Figure A are recorded as: `[ [2 9 10], [3 7 15], [5 12 12], [15 20 10], [19 24 8] ]` .

The output is a list of "**key points**" (red dots in Figure B) in the format of `[ [x1,y1], [x2, y2], [x3, y3], ... ]` that uniquely defines a skyline. **A key point is the left endpoint of a horizontal line segment**. Note that the last key point, where the rightmost building ends, is merely used to mark the termination of the skyline, and always has zero height. Also, the ground in between any two adjacent buildings should be considered part of the skyline contour.

For instance, the skyline in Figure B should be represented as:`[ [2 10], [3 15], [7 12], [12 0], [15 10], [20 8], [24, 0] ]`.

Notes:

- The number of buildings in any input list is guaranteed to be in the range `[0, 10000]`.
- The input list is already sorted in ascending order by the left x position `Li`.
- The output list must be sorted by the x position.
- There must be no consecutive horizontal lines of equal height in the output skyline. For instance, `[...[2 3], [4 5], [7 5], [11 5], [12 7]...]` is not acceptable; the three lines of height 5 should be merged into one in the final output as such: `[...[2 3], [4 5], [12 7], ...]`

```cpp
class Solution {
public:
    vector<vector<int>> getSkyline(vector<vector<int>>& buildings) {
        vector<pair<int, int>> edges;
        for(const auto &v : buildings) {
            edges.push_back(make_pair(v[0], -v[2]));
            edges.push_back(make_pair(v[1], v[2]));
        }
        sort(edges.begin(), edges.end());
        vector<vector<int>> res;
        multiset<int> My_set{0};
        int pre_top = 0;
        for (const auto &e : edges){
            if (e.second < 0)  My_set.insert(-e.second);
            else My_set.erase(My_set.find(e.second));
            int cur_top = *(My_set.rbegin());
            if (cur_top != pre_top){
                res.push_back({e.first, pre_top = cur_top});
            }
        }
        return res;
    }
};
```

219. Contains Duplicate II

Easy

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 **nums[i] = nums[j]** and the **absolute** difference between *i* and *j* is at most *k*.

Example 1:

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

Output: true

Example 2:

Input: nums = [1,0,1,1], k = 1

Output: true

Example 3:

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

Output: false

```
class Solution {
public:
    bool containsNearbyDuplicate(vector<int>& nums, int k) {

    }
};
```

```cpp
class Solution {
public:
    bool containsNearbyDuplicate(vector<int>& nums, int k) {
        unordered_set<int> My_set;
        for (int i = 0; i < nums.size(); i++){
            if (My_set.count(nums[i])) return true;
            My_set.insert(nums[i]);
            if (i >= k) My_set.erase(nums[i-k]);
        }
        return false;
    }
};
```

220. Contains Duplicate III(●ˇ∀ ˇ●)

Medium

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 **nums[i]** and **nums[j]** is at most *t* and the **absolute** difference between *i* and *j* is at most *k*.

Example 1:

Input: nums = [1,2,3,1], k = 3, t = 0

Output: true

Example 2:

Input: nums = [1,0,1,1], k = 1, t = 2

Output: true

Example 3:

Input: nums = [1,5,9,1,5,9], k = 2, t = 3

Output: false

```
class Solution {
public:
    bool containsNearbyAlmostDuplicate(vector<int>& nums, int k, int t) {

    }
};
```

```cpp
class Solution {
public:
    bool containsNearbyAlmostDuplicate(vector<int>& nums, int k, int t) {
        multiset<long long> My_set;
        for (int i = 0; i < nums.size(); i++){
            auto pos = My_set.lower_bound((long long)(nums[i])-t);
            if (pos != My_set.end() && *pos - (long long)(nums[i]) <= t) {
                return true;
            }
            My_set.insert(nums[i]);
            if (i >= k) My_set.erase(nums[i-k]);
        }
        return false;
    }
};
```

221. Maximal Square(●ˇ∀ ˇ●)

Medium

Given a 2D binary matrix filled with 0's and 1's, find the largest square containing only 1's and return its area.

Example:

Input:

1 0 1 0 0

1 0 1 1 1

1 1 1 1 1

1 0 0 1 0

Output: 4

```
class Solution {
public:
    int maximalSquare(vector<vector<char>>& matrix) {

    }
};
```

```
class Solution {
public:
    int maximalSquare(vector<vector<char>>& matrix) {
        if (matrix.empty()) return 0;
        int n = matrix.size(), m = matrix[0].size(), res = 0;
        vector<vector<int>> dp(2, vector<int>(m, 0));
        int k = 0;
        for (int i = 0; i < n; ++i) {
            for (int j = 0; j < m; ++j) {
                if (i == 0 && matrix[i][j] == '1') dp[k][j] = 1;
                else if (matrix[i][j] == '0') dp[k][j] = 0;
                else if (j == 0) dp[k][j] = 1;
                else dp[k][j] = 1 + min(min(dp[k][j-1], dp[k^1][j]),
                                        dp[k^1][j-1]);
                res = max(res, dp[k][j]);
            }
            k ^= 1;
        }
        return res*res;
    }
};
```

222. Count Complete Tree Nodes(●ˇ∀ˇ●)

Medium

Given a **complete** binary tree, count the number of nodes.

Note:

Definition of a complete binary tree from Wikipedia:

In a complete binary tree every level, except possibly the last, is completely filled, and all nodes in the last level are as far left as possible. It can have between 1 and 2^h nodes inclusive at the last level h.

Example:

Input:

```
    1
   /\
  2   3
 /\   /
4  5 6
```

Output: 6

```
/**
 * Definition for a binary tree node.
 * struct TreeNode {
 *     int val;
 *     TreeNode *left;
 *     TreeNode *right;
 *     TreeNode(int x) : val(x), left(NULL), right(NULL) {}
 * };
 */
class Solution {
public:
    int countNodes(TreeNode* root) {

    }
};
```

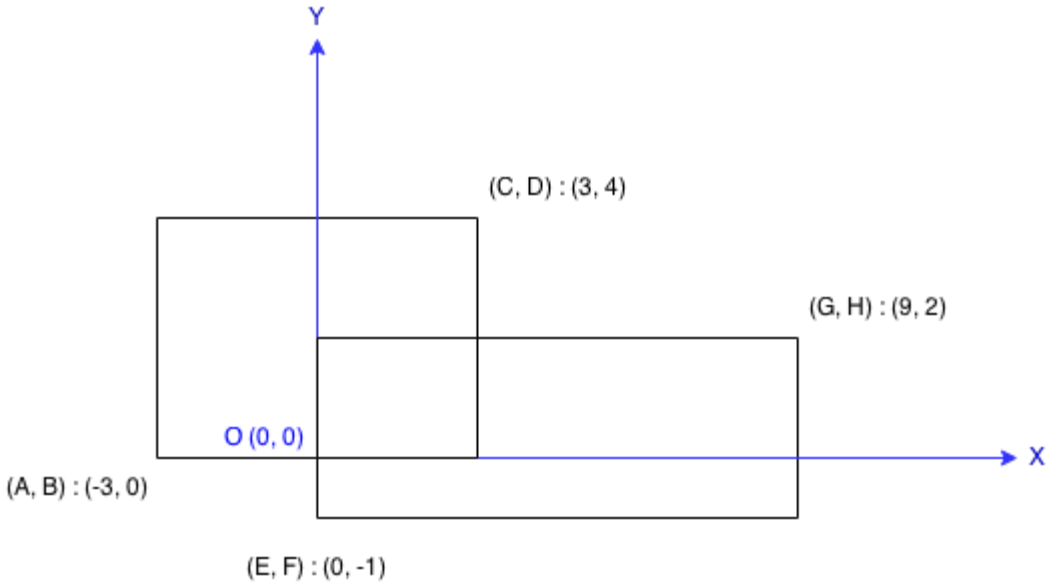
```cpp
/**
 * Definition for a binary tree node.
 * struct TreeNode {
 *     int val;
 *     TreeNode *left;
 *     TreeNode *right;
 *     TreeNode(int x) : val(x), left(NULL), right(NULL) {}
 * };
 */
class Solution {
public:
    int countNodes(TreeNode* root) {
        if (!root)  return 0;
        int hl = 0, hr = 0;
        TreeNode *l = root, *r = root;
        while(l) {hl++; l = l->left;}
        while(r) {hr++; r = r->right;}
        if (hl == hr) return (1 << hl) - 1;
        return 1 + countNodes(root->left) + countNodes(root->right);
    }
};
```

223. Rectangle Area

Medium

Find the total area covered by two **rectilinear** rectangles in a **2D** plane.

Each rectangle is defined by its bottom left corner and top right corner as shown in the figure.



Example:

Input: A = -3, B = 0, C = 3, D = 4, E = 0, F = -1, G = 9, H = 2

Output: 45

Note:

Assume that the total area is never beyond the maximum possible value of **int**.

```
class Solution {
public:
    int computeArea(int A, int B, int C, int D, int E, int F, int G, int H) {

    }
};
```

```
class Solution {
public:
    int computeArea(int A, int B, int C, int D, int E, int F, int G, int H) {
        int sum = (C - A) * (D - B) + (H - F) * (G - E);
        if (E >= C || F >= D || B >= H || A >= G) return sum;
        return sum - ((min(G, C) - max(A, E)) * (min(D, H) - max(B, F)));
    }
};
```

224. Basic Calculator

Hard

Implement a basic calculator to evaluate a simple expression string.

The expression string may contain open `(` and closing parentheses `)`, the plus `+` or minus sign `-`, **non-negative** integers and empty spaces .

Example 1:

Input: "1 + 1"

Output: 2

Example 2:

Input: " 2-1 + 2 "

Output: 3

Example 3:

Input: "(1+(4+5+2)-3)+(6+8)"

Output: 23

Note:

- You may assume that the given expression is always valid.
- **Do not** use the `eval` built-in library function.

```
class Solution {
public:
    int calculate(string s) { //加强版考虑 + - * /
        s = '(' + s + ')';
        stack<long> digit;
        stack<char> punct;
        int i = 0, n = s.length();
        while (i < n) {
            if (isspace(s[i])) i++;
            else if (isdigit(s[i])) {
                long temp = 0;
                while (isdigit(s[i])) {
                   temp = temp*10 + s[i++]-'0';
                }
                digit.push(temp);
            }else if (s[i] == '(') {
                punct.push(s[i++]);
            }else if (s[i] == ')') {
                char c;
                while ((c = punct.top()) != '(') {
                    punct.pop();
                    digit.push(fun(digit, c));
                }
                punct.pop();
                i++;
            }else if (s[i] == '*' || s[i] == '/') {
                char c;
                while (!punct.empty() && (c = punct.top()) != '('
                        && c != '+' && c != '-') {
                    punct.pop();
                    digit.push(fun(digit, c));
                }
                punct.push(s[i++]);
            }else {
                char c;
                while (!punct.empty() && (c = punct.top()) != '(') {
                    punct.pop();
                    digit.push(fun(digit, c));
                }
                punct.push(s[i++]);
            }
        }
        return digit.top();
    }
```

```
private:
    long fun(stack<long> &digit, char c) {
        long b = digit.top(); digit.pop();
        long a = digit.top(); digit.pop();
        switch (c) {
            case '+' : return a+b;
            case '-' : return a-b;
            case '*' : return a*b;
            case '/' : return a/b;
        }
        return -1;
    }
};
```

225. Implement Stack using Queues

Easy

Implement the following operations of a stack using queues.

- push(x) -- Push element x onto stack.
- pop() -- Removes the element on top of the stack.
- top() -- Get the top element.
- empty() -- Return whether the stack is empty.

Example:

```
MyStack stack = new MyStack();



stack.push(1);

stack.push(2);

stack.top();      // returns 2

stack.pop();      // returns 2

stack.empty(); // returns false
```

Notes:

- You must use *only* standard operations of a queue -- which means only `push to back`, `peek/pop from front`, `size`, and `is empty` operations are valid.
- Depending on your language, queue may not be supported natively. You may simulate a queue by using a list or deque (double-ended queue), as long as you use only standard operations of a queue.
- You may assume that all operations are valid (for example, no pop or top operations will be called on an empty stack).

```
class MyStack {
public:
    queue<int> q;
    MyStack() {}

    void push(int x) {
        int sz = q.size();
        q.push(x);
        while (sz--) {
            q.push(q.front());
            q.pop();
        }
    }

    int pop() {
        int t = q.front();
        q.pop();
        return t;
    }


    int top() {
        return q.front();
    }


    bool empty() {
        return q.empty();
    }
};
```

226. Invert Binary Tree

Easy

Invert a binary tree.

Example:

Input:

```
     4
   /   \
  2     7
 /\     /\
1  3  6  9
```

Output:

```
     4
   /   \
  7     2
 /\     /\
9  6  3  1
```

Trivia:

This problem was inspired by this original tweet by Max Howell:

> Google: 90% of our engineers use the software you wrote (Homebrew), but you can't invert a binary tree on a whiteboard so f*** off.

```
class Solution {
public:
    TreeNode* invertTree(TreeNode* root) {

    }
};
```

```cpp
class Solution {
public:
    TreeNode* invertTree(TreeNode* root) {
        if (root == nullptr) return nullptr;
        swap(root->left, root->right);
        invertTree(root->left);
        invertTree(root->right);
        return root;
    }
};
```

227. Basic Calculator II(●ˇ∀ ˇ●)

Medium

Implement a basic calculator to evaluate a simple expression string.

The expression string contains only **non-negative** integers, `+`, `-`, `*`, `/` operators and empty spaces . The integer division should truncate toward zero.

Example 1:

Input: "3+2*2"

Output: 7

Example 2:

Input: " 3/2 "

Output: 1

Example 3:

Input: " 3+5 / 2 "

Output: 5

Note:

- You may assume that the given expression is always valid.
- **Do not** use the `eval` built-in library function.

```
class Solution {
public:
    int calculate(string s) {

    }
};
```

```cpp
class Solution {
public:
    int calculate(string s) {
        stringstream ss("+" + s);
        char op;
        int n, last, ans = 0;
        while (ss >> op >> n) {
            if (op == '+' || op == '-') {
                n = op == '+' ? n : -n;
                ans += n;
            } else {
                n = op == '*' ? last * n : last / n;
                ans = ans - last + n;
                // simulate a stack by recovering last values
            }
            last = n;
        }
        return ans;
    }
};
```

228. Summary Ranges

Medium

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"]

Explanation: 0,1,2 form a continuous range; 4,5 form a continuous range.

Example 2:

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

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

Explanation: 2,3,4 form a continuous range; 8,9 form a continuous range.

```
class Solution {
public:
    vector<string> summaryRanges(vector<int>& nums) {

    }
};
```

```cpp
class Solution {
public:
    vector<string> summaryRanges(vector<int>& nums) {
        vector<string> res;
        if (nums.empty()) return res;
        nums.push_back(nums.back());
        long low, st, i = 0;
        string s;
        while (i < nums.size()) {
            if (s.empty()) {
                s = to_string(st = low = nums[i++]);
            }
            else if (nums[i] != ++low) {
               if (low-1 != st) res.push_back(s + "->" + to_string(low-1));
               else res.push_back(s);
               s.clear();
            }
            else i++;
        }
        return res;
    }
};
```

229. Majority Element II

Medium

Given an integer array of size *n*, find all elements that appear more than `⌊ n/3 ⌋` times.

Note: The algorithm should run in linear time and in O(1) space.

Example 1:

Input: [3,2,3]

Output: [3]

Example 2:

Input: [1,1,1,3,3,2,2,2]

Output: [1,2]

```
class Solution {
public:
    vector<int> majorityElement(vector<int>& nums) {

    }
};
```

```cpp
class Solution {
public:
    vector<int> majorityElement(vector<int>& nums) {
        vector<int> res;
        int n = 0, m = 0, cnt_n = 0, cnt_m = 0;
        for (auto &i : nums) {
            if (i == n) cnt_n++;
            else if (i == m) cnt_m++;
            else if (!cnt_n) {n = i; cnt_n = 1;}
            else if (!cnt_m) {m = i; cnt_m = 1;}
            else {cnt_n--;  cnt_m--;}
        }
        cnt_n = cnt_m = 0;
        for (auto &i : nums){
            if (i == n) cnt_n++;
            else if (i == m) cnt_m++;
        }
        if (cnt_n > floor(nums.size()/3)) res.push_back(n);
        if (cnt_m > floor(nums.size()/3)) res.push_back(m);
        return res;
    }
};
```

230. Kth Smallest Element in a BST

Medium

Given a binary search tree, write a function `kthSmallest` to find the **k**th smallest element in it.

Note:
You may assume k is always valid, 1 ≤ k ≤ BST's total elements.

Example 1:

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

```
   3
  / \
 1   4
  \
   2
```

Output: 1

Example 2:

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

```
       5
      / \
     3   6
    / \
   2   4
  /
 1
```

Output: 3

Follow up:
What if the BST is modified (insert/delete operations) often and you need to find the kth smallest frequently? How would you optimize the kthSmallest routine?

```
class Solution {
public:
    int kthSmallest(TreeNode* root, int k) {
        stack<TreeNode*> stk;
        TreeNode *p = root;
        while (p || !stk.empty()) {
            while(p) {
                stk.push(p);
                p = p->left;
            }
            p = stk.top();
            stk.pop();
            if(--k == 0) return p->val;
            p = p->right;
        }
        return -1;
    }
};
```

231. Power of Two

Easy

Given an integer, write a function to determine if it is a power of two.

Example 1:

Input: 1

Output: true

Explanation: $2^0 = 1$

Example 2:

Input: 16

Output: true

Explanation: $2^4 = 16$

Example 3:

Input: 218

Output: false

```
class Solution {
public:
    bool isPowerOfTwo(int n) {

    }
};
```

```cpp
class Solution {
public:
    bool isPowerOfTwo(int n) {
        int cnt = 0;
        while (n) {
            if (n & 0x00000001) ++cnt;
            if (cnt >= 2) return false;
            n >>= 1;
        }
        return cnt == 1;
    }
};
```

```cpp
class Solution {
public:
    bool isPowerOfTwo(int n) {
        if (n <= 0) return false;
        else return (n & (n-1)) == 0;
    }
};
```

232. Implement Queue using Stacks

Easy

Implement the following operations of a queue using stacks.

- push(x) -- Push element x to the back of queue.
- pop() -- Removes the element from in front of queue.
- peek() -- Get the front element.
- empty() -- Return whether the queue is empty.

Example:

```
MyQueue queue = new MyQueue();

queue.push(1);

queue.push(2);

queue.peek();    // returns 1

queue.pop();     // returns 1

queue.empty(); // returns false
```

Notes:

- You must use *only* standard operations of a stack -- which means only `push to top`, `peek/pop from top`, `size`, and `is empty` operations are valid.
- Depending on your language, stack may not be supported natively. You may simulate a stack by using a list or deque (double-ended queue), as long as you use only standard operations of a stack.
- You may assume that all operations are valid (for example, no pop or peek operations will be called on an empty queue).

```
class MyQueue {
public:
    /** Initialize your data structure here. */
    stack<int> s1, s2;
    MyQueue() {}

    /** Push element x to the back of queue. */
    void push(int x) {
        s2.push(x);
    }

    /*Removes the element from in front of queue and returns that element. */
    int pop() {
        if(s1.empty()) {
            while(!s2.empty()){
                s1.push(s2.top());
                s2.pop();
            }
        }
        int t = s1.top();
        s1.pop();
        return t;
    }

    /** Get the front element. */
    int peek() {
        if(s1.empty()) {
            while(!s2.empty()){
                s1.push(s2.top());
                s2.pop();
            }
        }
        return s1.top();
    }

    /** Returns whether the queue is empty. */
    bool empty() {
       return s1.empty() && s2.empty();
    }
};
```

233. Number of Digit One

Hard

Given an integer n, count the total number of digit 1 appearing in all non-negative integers less than or equal to n.

Example:

Input: 13

Output: 6

Explanation: Digit 1 occurred in the following numbers: 1, 10, 11, 12, 13.

```
class Solution {
public:
    int countDigitOne(int n) {

    }
};
```

```
class Solution {
public:
    int countDigitOne(int n) {
        int res = 0;
        if (n <= 0) return res;
        long int high = n, low = 0, fact = 1, cur;
        while (high) {
            cur = high%10;
            high /= 10;
            res += (high+ (cur > 1 ? 1: 0))*fact+(cur == 1 ? low+1 : 0);
            low += fact*cur;
            fact *= 10;
        }
        return res;
    }
};
```

234. Palindrome Linked List

Easy

Given a singly linked list, determine if it is a palindrome.

Example 1:

Input: 1->2

Output: false

Example 2:

Input: 1->2->2->1

Output: true

Follow up:
Could you do it in O(n) time and O(1) space?

```
class Solution {
public:
    bool isPalindrome(ListNode* head) {

    }
};
```

```cpp
class Solution {
public:
    bool isPalindrome(ListNode* head) {
        if (head == nullptr || head->next == nullptr) return true;
        ListNode *fast = head, *slow = head;
        while (fast && fast->next && fast->next->next) {
            fast = fast->next->next;
            slow = slow->next;
        }
        ListNode *p = slow->next, *q;
        slow->next = nullptr;
        while (p) {
            q = p->next;
            p->next = slow->next;
            slow->next = p;
            p = q;
        }
        p = head; q = slow->next;
        while (p && q) {
            if (p->val != q->val) return false;
            p = p->next;
            q = q->next;
        }
        return true;
    }
};
```

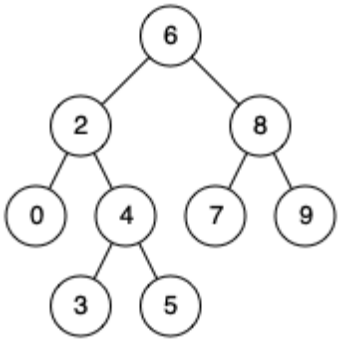
235. Lowest Common Ancestor of a Binary Search Tree

Easy

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

According to the definition of LCA on Wikipedia: “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**).”

Given binary search tree: root = [6,2,8,0,4,7,9,null,null,3,5]



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 of itself according to the LCA definition.

Note:

- All of the nodes' values will be unique.
- p and q are different and both values will exist in the BST.

```
class Solution {
public:
    TreeNode* lowestCommonAncestor(TreeNode* root, TreeNode* p, TreeNode* q){
        if (root->val > p->val && root->val > q->val)
            return lowestCommonAncestor(root->left, p, q);
        else if (root->val < p->val && root->val < q->val)
            return lowestCommonAncestor(root->right, p, q);
        else return root;
    }
};
```

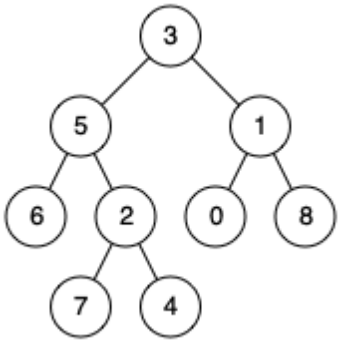
236. Lowest Common Ancestor of a Binary Tree(●ˇ∀ ˇ●)

Medium

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

According to the definition of LCA on Wikipedia: “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**).”

Given the following binary tree: root = [3,5,1,6,2,0,8,null,null,7,4]



Example 1:

Input: root = [3,5,1,6,2,0,8,null,null,7,4], p = 5, q = 1

Output: 3

Explanation: The LCA of nodes 5 and 1 is 3.

Example 2:

Input: root = [3,5,1,6,2,0,8,null,null,7,4], p = 5, q = 4

Output: 5

Explanation: The LCA of nodes 5 and 4 is 5, since a node can be a descendant of itself according to the LCA definition.

Note:

- All of the nodes' values will be unique.
- p and q are different and both values will exist in the binary tree.

```cpp
/**
 * Definition for a binary tree node.
 * struct TreeNode {
 *     int val;
 *     TreeNode *left;
 *     TreeNode *right;
 *     TreeNode(int x) : val(x), left(NULL), right(NULL) {}
 * };
 */
class Solution {
public:
    TreeNode* lowestCommonAncestor(TreeNode* root, TreeNode* p, TreeNode* q){
        TreeNode *cur = root, *last = nullptr;
        vector<TreeNode*> pathp, pathq, temp;
        while (pathp.empty() || pathq.empty()) {
            while (cur) {
                temp.push_back(cur);
                if (cur == p) pathp = temp; // check and set path for p
                if (cur == q) pathq = temp; // check and set path for q
                cur = cur->left;
            }
            if (temp.back()->right && temp.back()->right != last)
                cur = temp.back()->right;
            else {
                last = temp.back();
                temp.pop_back();
            }
        }
        // compare paths and get lowest common ancestor
        int n = min(pathp.size(), pathq.size());
        for (int i = 1; i < n; i++) {
            if (pathp[i] != pathq[i]) return pathp[i-1];
        }
        return pathp[n-1];
    }
};
```

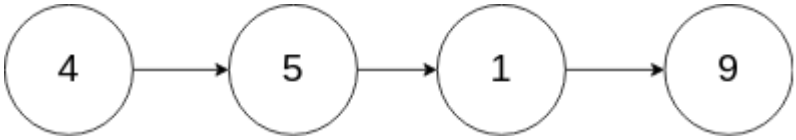
```
class Solution {
public:
    TreeNode* lowestCommonAncestor(TreeNode* root, TreeNode* p, TreeNode* q){
      if (!root || root == p || root == q) return root;
      TreeNode *left = lowestCommonAncestor(root->left, p, q);
      TreeNode *right = lowestCommonAncestor(root->right, p, q);
      return !left ? right : !right ? left : root;
    }
};
```

237. Delete Node in a Linked List

Easy

Write a function to delete a node (except the tail) in a singly linked list, given only access to that node.

Given linked list -- head = [4,5,1,9], which looks like following:



Example 1:

Input: head = [4,5,1,9], node = 5

Output: [4,1,9]

Explanation: You are given the second node with value 5, the linked list should become 4 -> 1 -> 9 after calling your function.

Example 2:

Input: head = [4,5,1,9], node = 1

Output: [4,5,9]

Explanation: You are given the third node with value 1, the linked list should become 4 -> 5 -> 9 after calling your function.

Note:

- The linked list will have at least two elements.
- All of the nodes' values will be unique.
- The given node will not be the tail and it will always be a valid node of the linked list.
- Do not return anything from your function.

```
/**
 * Definition for singly-linked list.
 * struct ListNode {
 *     int val;
 *     ListNode *next;
 *     ListNode(int x) : val(x), next(NULL) {}
 * };
 */
class Solution {
public:
    void deleteNode(ListNode* node) {
        *node = *(node->next);
    }
};
```

238. Product of Array Except Self

Medium

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

Example:

Input: [1,2,3,4]

Output: [24,12,8,6]

Note: Please solve it **without division** and in O(*n*).

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

```
class Solution {
public:
    vector<int> productExceptSelf(vector<int>& nums) {

    }
};
```

```cpp
class Solution {
public:
    vector<int> productExceptSelf(vector<int>& nums) {
        int n = nums.size();
        vector<int> res(n);
        res[0] = 1;
        for (int i = 1; i < n; i++)  res[i] = nums[i-1]*res[i-1];
        int a = nums[n-1];
        for (int i = n-2; i >= 0; i--) {
            res[i] *= a;
            a *= nums[i];
        }
        return res;
    }
};
```

239. Sliding Window Maximum(●ˇ∀ ˇ●)

Hard

Given an array *nums*, there is a sliding window of size *k* which is moving from the very left of the array to the very right. You can only see the *k* numbers in the window. Each time the sliding window moves right by one position. Return the max sliding window.

Example:

Input: *nums* = [1,3,-1,-3,5,3,6,7], and *k* = 3

Output: [3,3,5,5,6,7]

Explanation:

```
Window position                Max
---------------               -----
[1  3  -1] -3  5  3  6  7       3
 1 [3  -1  -3] 5  3  6  7       3
 1  3 [-1  -3  5] 3  6  7       5
 1  3  -1 [-3  5  3] 6  7       5
 1  3  -1  -3 [5  3  6] 7       6
 1  3  -1  -3  5 [3  6  7]      7
```

Note:

You may assume *k* is always valid, 1 ≤ k ≤ input array's size for non-empty array.

Follow up:

Could you solve it in linear time?

```
class Solution {
public:
    vector<int> maxSlidingWindow(vector<int>& nums, int k) {

    }
};
```

```cpp
class Solution {
public:
    vector<int> maxSlidingWindow(vector<int>& nums, int k) {
        int n = nums.size(), cnt = 0;
        vector<int> res;
        deque<int> deq;
        for (int i = 0; i < n; i++) {
            while (!deq.empty() && nums[deq.back()] <= nums[i]) {
                deq.pop_back();
            }
            deq.push_back(i);
            if (i-deq.front() >= k) deq.pop_front();
            if (i >= k-1) res.push_back(nums[deq.front()]);
        }
        return res;
    }
};
```

240. Search a 2D Matrix II(●ˇ∀ˇ●)

Medium

Write an efficient algorithm that searches for a value in an *m* x *n* matrix. This matrix has the following properties:

- Integers in each row are sorted in ascending from left to right.
- Integers in each column are sorted in ascending from top to bottom.

Example:

Consider the following matrix:

```
[
  [1,   4,   7,   11,  15],
  [2,   5,   8,   12,  19],
  [3,   6,   9,   16,  22],
  [10,  13,  14,  17,  24],
  [18,  21,  23,  26,  30]
]
```

Given target = `5`, return `true`.

Given target = `20`, return `false`.

```
class Solution {
public:
    bool searchMatrix(vector<vector<int>>& matrix, int target) {

    }
};
```

```cpp
class Solution {
public:
    bool searchMatrix(vector<vector<int>>& matrix, int target) {
        if (matrix.empty()) return false;
        int n = matrix.size(), m  = matrix[0].size();
        int i = 0, j = m-1;
        while (i < n && j >= 0) {
            if (matrix[i][j] == target) return true;
            else if (matrix[i][j] < target) i++;
            else  j--;
        }
        return false;
    }
};
```

241. Different Ways to Add Parentheses(●ˇ∀ ˇ●)

Medium

Given a string of numbers and operators, return all possible results from computing all the different possible ways to group numbers and operators. The valid operators are `+`, `-` and `*`.

Example 1:

Input: "2-1-1"

Output: [0, 2]

Explanation:

((2-1)-1) = 0

(2-(1-1)) = 2

Example 2:

Input: "2*3-4*5"

Output: [-34, -14, -10, -10, 10]

Explanation:

(2*(3-(4*5))) = -34

((2*3)-(4*5)) = -14

((2*(3-4))*5) = -10

(2*((3-4)*5)) = -10

(((2*3)-4)*5) = 10

```
class Solution {
public:
    vector<int> diffWaysToCompute(string input) {
        vector<int> output;
        for (int i = 0; i < input.size(); i++) {
            char c = input[i];
            if (ispunct(c)) {
                for (int a : diffWaysToCompute(input.substr(0, i))) {
                    for (int b : diffWaysToCompute(input.substr(i+1))) {
                        output.push_back(c == '+' ? a+b
                                                  : c == '-' ? a-b : a*b);
                    }
                }
            }
        }
        return output.size() ? output : vector<int> {stoi(input)};
    }
};
```

```cpp
//////////////////DP//////////////////////////////////
class Solution {
public:
    vector<int> diffWaysToCompute(string input) {
        return computeWithDP(input);
    }

private:
    unordered_map<string, vector<int>> dp;

    vector<int> computeWithDP(string input) {
        vector<int> result;
        int sz = input.size();
        for (int i = 0; i < sz; i++) {
            char c = input[i];
            if (ispunct(c)) {
                string substr = input.substr(0, i);
                auto res1 = dp.find(substr) != dp.end()
                                ? dp[substr]: computeWithDP(substr);
                substr = input.substr(i+1);
                auto res2 = dp.find(substr) != dp.end()
                                ? dp[substr]: computeWithDP(substr);
                for (auto n1 : res1) {
                    for (auto n2 : res2) {
                        result.push_back(c == '+' ? n1+n2
                                                  : c == '-' ? n1-n2 : n1*n2);
                    }
                }
            }
        }
        if (result.empty()) result.push_back(atoi(input.c_str()));
        return dp[input] = result;
    }
};
```

242. Valid Anagram

Easy

Given two strings *s* and *t* , write a function to determine if *t* is an anagram of *s*.

Example 1:

Input: *s* = "anagram", *t* = "nagaram"

Output: true

Example 2:

Input: *s* = "rat", *t* = "car"

Output: false

Note:
You may assume the string contains only lowercase alphabets.

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

```
class Solution {
public:
    bool isAnagram(string s, string t) {

    }
};
```

```cpp
class Solution {
public:
    bool isAnagram(string s, string t) {
        if (s.length() != t.length()) return false;
        int a[26] = {0};
        for (auto &i : s)  a[i-'a']++;
        for (auto &i : t){
            if(--a[i-'a'] < 0)
                return false;
        }
        return true;
    }
};
```

243.Shortest Word Distance

Given a list of words and two words *word1* and *word2*, return the shortest distance between these two words in the list.

Example:
Assume that words = `["practice", "makes", "perfect", "coding", "makes"]`.

```
Input: word1 = “coding”, word2 = “practice”

Output: 3

Input: word1 = "makes", word2 = "coding"

Output: 1
```

Note:
You may assume that *word1* **does not equal to** *word2*, and *word1* and *word2* are both in the list.

```
class Solution {
public:
    int shortestDistance(vector<string>& words, string word1, string word2) {
        int p1 = -1, p2 = -1;
        int n = words.size(), res = INT_MAX;
        for (int i = 0; i < n; i++) {
            if (words[i] == word1) p1 = i;
            else if (words[i] == word2) p2 = i;
            if (p1 != -1 && p2 != -1) res = min(res, abs(p1 - p2));
        }
        return res;
    }
};
```

244.Shortest Word Distance II

Design a class which receives a list of words in the constructor, and implements a method that takes two words *word1* and *word2* and return the shortest distance between these two words in the list. Your method will be called *repeatedly* many times with different parameters.

Example:
Assume that words = `["practice", "makes", "perfect", "coding", "makes"]`.

```
Input: word1 = “coding”, word2 = “practice”

Output: 3

Input: word1 = "makes", word2 = "coding"

Output: 1
```

Note:
You may assume that *word1* **does not equal to** *word2*, and *word1* and *word2* are both in the list.

```
class WordDistance {
public:
    WordDistance(vector<string>& words) {
    }

    int shortest(string word1, string word2) {

    }
};
```

```cpp
class WordDistance {
public:
    WordDistance(vector<string>& words) {
        for (int i = 0; i < words.size(); i++) {
            m[words[i]].push_back(i);
        }
    }

    int shortest(string word1, string word2) {
        vector<int> &u = m[word1];
        vector<int> &v = m[word2];
        int n = u.size(), m = v.size();
        int i = 0, j = 0, dist = INT_MAX;
        while (i < n && j < m) {
            if (u[i] < v[j])  dist = min(dist, v[j]-u[i++]);
            else  dist = min(dist, u[i]-v[j++]);
        }
        return dist;
    }

private:
    unordered_map<string, vector<int>> m;
};
```

245.Shortest Word Distance III

Given a list of words and two words *word1* and *word2*, return the shortest distance between these two words in the list.

word1 and *word2* may be the same and they represent two individual words in the list.

Example:
Assume that words = `["practice", "makes", "perfect", "coding", "makes"]`.

```
Input: word1 = “makes”, word2 = “coding”

Output: 1

Input: word1 = "makes", word2 = "makes"

Output: 3
```

Note:
You may assume *word1* and *word2* are both in the list.

```
class Solution {
public:
    int shortestWordDistance(vector<string>& words, string word1, string
word2) {

    }
};
```

```
class Solution {
public:
    int shortestWordDistance(vector<string>& words, string word1, string
word2) {
        int res = INT_MAX;
        vector<int> v[2];
        for (int i = 0; i < words.size(); i++) {
            if (words[i] == word1) v[0].push_back(i);
            if (words[i] == word2) v[1].push_back(i);
        }
        int n = v[0].size(), m = v[1].size();
        int i = 0, j = 0;
        while (i < n && j < m) {
            if (v[0][i] == v[1][j]) i++;
            else if (v[0][i] < v[1][j])  res = min(res, v[1][j]-v[0][i++]);
            else  res = min(res, v[0][i]-v[1][j++]);

        }
        return res;
    }
};
```

246.Strobogrammatic Number

A strobogrammatic number is a number that looks the same when rotated 180 degrees (looked at upside down).

Write a function to determine if a number is strobogrammatic. The number is represented as a string.

Example 1:

```
Input:  "69"

Output: true
```

Example 2:

```
Input:  "88"

Output: true
```

Example 3:

```
Input:  "962"

Output: false
```

```
class Solution {
public:
    bool isStrobogrammatic(string s) {

    }
};
```

```cpp
class Solution {
public:
    bool isStrobogrammatic(string s) {
        unordered_map<char, char> m{{'6','9'}, {'9','6'}, {'8','8'},
                                    {'1','1'}, {'0','0'}};
        int n = s.size();
        for (int i = 0; i <= n/2; i++) {
            if (m[s[i]] != s[n-1-i]) {
                return false;
            }
        }
        return true;
    }
};
```

247.Strobogrammatic Number II

A strobogrammatic number is a number that looks the same when rotated 180 degrees (looked at upside down).

Find all strobogrammatic numbers that are of length = n.

Example:

```
Input:  n = 2

Output: ["11","69","88","96"]
```

```
class Solution {
public:
    vector<string> findStrobogrammatic(int n) {

    }
};
```

```cpp
class Solution {
public:
    vector<string> findStrobogrammatic(int n) {
        return f(n, n);
    }
    vector<string> f(int m, int n) {
        if (m == 0) return {""};
        if (m == 1) return {"0", "1", "8"};
        vector<string> v(f(m-2, n)), res;
        for (auto &a : v) {
            if (m != n) res.push_back("0" + a + "0");
            res.push_back("1" + a + "1");
            res.push_back("6" + a + "9");
            res.push_back("8" + a + "8");
            res.push_back("9" + a + "6");
        }
        return res;
    }
};
```

248.Strobogrammatic Number III

A strobogrammatic number is a number that looks the same when rotated 180 degrees (looked at upside down).

Write a function to count the total strobogrammatic numbers that exist in the range of low <= num <= high.

Example:

```
Input: low = "50", high = "100"

Output: 3

Explanation: 69, 88, and 96 are three strobogrammatic numbers.
```

Note:
Because the range might be a large number, the *low* and *high* numbers are represented as string.

```
class Solution {
public:
    int strobogrammaticInRange(string low, string high) {

    }
};
```

```cpp
class Solution {
public:
    int strobogrammaticInRange(string low, string high) {
        int len0 = low.length(), len1 = high.length();
        int res = 0;
        for (int n = len0; n <= len1; n++) {
            vector<string> v = f(n, n);
            if (n != len0 && n != len1) res += v.size();
            else for (auto &num : v) {
                if (len0 == len1) {
                    if (num >= low && num <= high) res++;
                }
                else if (n == len0 && num >= low) res++;
                else if (n == len1 && num <= high) res++;
            }
        }
        return res;
    }

private:
    vector<string> f(int m, int n) {
        if (m == 0) return {""};
        if (m == 1) return {"0", "1", "8"};
        vector<string> v(f(m-2, n)), res;
        for (auto &a : v) {
            if (m != n) res.push_back("0" + a + "0");
            res.push_back("1" + a + "1");
            res.push_back("6" + a + "9");
            res.push_back("8" + a + "8");
            res.push_back("9" + a + "6");
        }
        return res;
    }
};
```

249.Group Shifted Strings

Given a string, we can "shift" each of its letter to its successive letter, for example: `"abc" -> "bcd"`. We can keep "shifting" which forms the sequence:

```
"abc" -> "bcd" -> ... -> "xyz"
```

Given a list of strings which contains only lowercase alphabets, group all strings that belong to the same shifting sequence.

Example:

```
Input: ["abc", "bcd", "acef", "xyz", "az", "ba", "a", "z"],

Output:

[

  ["abc","bcd","xyz"],

  ["az","ba"],

  ["acef"],

  ["a","z"]

]
```

```
class Solution {
public:
    vector<vector<string>> groupStrings(vector<string>& strings) {

    }
};
```

```cpp
class Solution {
public:
    vector<vector<string>> groupStrings(vector<string>& strings) {
        unordered_map<string, vector<string>> m;
        for (auto &s : strings) {
            string t;
            for (auto &c : s) {
                t += char((c-s[0]+26) % 26);
            }
            m[t].push_back(s);
        }
        vector<vector<string>> res;
        for (auto &i : m) res.push_back(i.second);
        return res;
    }
};
```

250.Count Univalue Subtrees

Given a binary tree, count the number of uni-value subtrees.

A Uni-value subtree means all nodes of the subtree have the same value.

Example :

```
Input:  root = [5,1,5,5,5,null,5]


              5
             / \
            1   5
           / \   \
          5   5   5


Output: 4
```

```
class Solution {
public:
    int countUnivalSubtrees(TreeNode* root) {

    }
};
```

```cpp
class Solution {
public:
    int countUnivalSubtrees(TreeNode* root) {
        if (!root) return 0;
        return f(root, root->val).second;
    }
private:
    pair<bool, int> f(TreeNode *root, int val) {
        if (!root)  return {true, 0};
        auto l = f(root->left, root->val);
        auto r = f(root->right, root->val);
        int res = l.second + r.second;
        if (l.first && r.first) return {root->val == val, res+1};
        else return {false, res};
    }
};
```

251. Flatten 2D Vector

Design and implement an iterator to flatten a 2d vector. It should support the following operations: `next` and `hasNext`.

Example:

```
Vector2D iterator = new Vector2D([[1,2],[3],[4]]);


iterator.next(); // return 1

iterator.next(); // return 2

iterator.next(); // return 3

iterator.hasNext(); // return true

iterator.hasNext(); // return true

iterator.next(); // return 4

iterator.hasNext(); // return false
```

Notes:

1. Please remember to **RESET** your class variables declared in Vector2D, as static/class variables are **persisted across multiple test cases**. Please see here for more details.
2. You may assume that `next()` call will always be valid, that is, there will be at least a next element in the 2d vector when `next()` is called.

Follow up:

As an added challenge, try to code it using only iterators in C++ or iterators in Java.

```cpp
class Vector2D {
public:
    Vector2D(vector<vector<int>> &v): x(v.begin()), end(v.end()) {}

    int next() {
        hasNext();
        return (*x)[y++];
    }

    bool hasNext() {
        while (x != end && y == (*x).size()) {
            ++x;
            y = 0;
        }
        return x != end;
    }
private:
    int y = 0;
    vector<vector<int>>::iterator x, end;
};
```

```cpp
class Vector2D {
public:
    Vector2D(vector<vector<int>>& v) {
        this->v = v;
    }

    int next() {
        hasNext();
        return v[i][j++];
    }

    bool hasNext() {
        if (i >= v.size()) return false;
        else if (j == v[i].size()) {
            i++;
            j = 0;
            return hasNext();
        }
        return true;
    }

private:
    int i = 0, j = 0;
    vector<vector<int>> v;
};
```

252. Meeting Rooms

Given an array of meeting time intervals consisting of start and end times `[[s1,e1],[s2,e2],...]` ($s_i < e_i$), determine if a person could attend all meetings.

Example 1:

```
Input: [[0,30],[5,10],[15,20]]

Output: false
```

Example 2:

```
Input: [[7,10],[2,4]]

Output: true
```

NOTE: input types have been changed on April 15, 2019. Please reset to default code definition to get new method signature.

```
class Solution {
public:
    bool canAttendMeetings(vector<vector<int>>& intervals) {
        auto cmp = [](const vector<int> &lhs, const vector<int> &rhs) {
            return lhs[0] < rhs[0];
        };
        sort(intervals.begin(), intervals.end(), cmp);
        for (int i = 1; i < intervals.size(); i++) {
            if (intervals[i][0] < intervals[i-1][1]) {
                return false;
            }
        }
        return true;
    }
};
```

253. Meeting Rooms II

Given an array of meeting time intervals consisting of start and end times `[[s1,e1],[s2,e2],...]` ($s_i < e_i$), find the minimum number of conference rooms required.

Example 1:

```
Input: [[0, 30],[5, 10],[15, 20]]

Output: 2
```

Example 2:

```
Input: [[7,10],[2,4]]

Output: 1
```

NOTE: input types have been changed on April 15, 2019. Please reset to default code definition to get new method signature.

```
class Solution {
public:
    int minMeetingRooms(vector<vector<int>>& intervals) {


    }
};
```

```cpp
class Solution {
public:
    int minMeetingRooms(vector<vector<int>>& intervals) {
        map<int, int> m;
        for (auto &v : intervals) {
            ++m[v[0]];
            --m[v[1]];
        }
        int rooms = 0, res = 0;
        for (auto &it : m) {
            res = max(res, rooms += it.second);
        }
        return res;
    }
};
```

```cpp
class Solution {
public:
    int minMeetingRooms(vector<vector<int>>& intervals) {
        if (intervals.empty()) return 0;
        auto cmp = [](const vector<int> &lhs, const vector<int> &rhs) {
            return lhs[0] < rhs[0];
        };
        sort(intervals.begin(), intervals.end(), cmp);
        priority_queue<int, vector<int>, greater<int>> q;
        for (auto &v : intervals) {
            if (!q.empty() && q.top() <= v[0]) q.pop();
            q.push(v[1]);
        }
        return q.size();
    }
};
```

254. Factor Combinations

Numbers can be regarded as product of its factors. For example,

```
8 = 2 x 2 x 2;
  = 2 x 4.
```

Write a function that takes an integer *n* and return all possible combinations of its factors.

Note:

1. You may assume that *n* is always positive.
2. Factors should be greater than 1 and less than *n*.

Example 1:

```
Input: 1
Output: []
```

Example 2:

```
Input: 37
Output:[]
```

Example 3:

```
Input: 12
Output:
[
  [2, 6],
  [2, 2, 3],
  [3, 4]
]
```

Example 4:

```
Input: 32
Output:
[
  [2, 16],
```

```
  [2, 2, 8],
  [2, 2, 2, 4],
  [2, 2, 2, 2, 2],
  [2, 4, 4],
  [4, 8]
]
```

```cpp
class Solution {
public:
    vector<vector<int>> getFactors(int n) {
        vector<int> path;
        dfs(2, n, path);
        return res;
    }
private:
    vector<vector<int>> res;
    void dfs(int cur, int n, vector<int> &path) {
        int Sqrt = sqrt(n)+0.5;
        for (int i = cur; i <= Sqrt; i++) {
           if (n % i == 0) {
               vector<int> temp = path;
               temp.push_back(i);
               dfs(i, n/i, temp);
               temp.push_back(n / i);
               res.push_back(temp);
           }
        }
    }
};
```

255. Verify Preorder Sequence in Binary Search Tree

Given an array of numbers, verify whether it is the correct preorder traversal sequence of a binary search tree.

You may assume each number in the sequence is unique.

Consider the following binary search tree:

```
    5
   / \
  2   6
 / \
1   3
```

Example 1:

```
Input: [5,2,6,1,3]
Output: false
```

Example 2:

```
Input: [5,2,1,3,6]
Output: true
```

Follow up:
Could you do it using only constant space complexity?

```
class Solution {
public:
    bool verifyPreorder(vector<int>& preorder) {
        stack<int> s;
        int min = INT_MIN;
        for(int i = 0; i < preorder.size(); i++){
            if (preorder[i] < min) return false;
            while (!s.empty() && s.top() < preorder[i]) {
                min = s.top();
                s.pop();
            }
            s.push(preorder[i]);
        }
        return true;
    }
};
```

```cpp
class Solution {
public:
    bool verifyPreorder(vector<int>& preorder) {
        int min = INT_MIN;
        int i = -1;
        for (auto p : preorder) {
            if (p < min) return false;
            while (i >= 0 && p > preorder[i]) {
                min = preorder[i--];
            }
            preorder[++i] = p;
        }
        return true;
    }
};
```

256. Paint House

There are a row of *n* houses, each house can be painted with one of the three colors: red, blue or green. The cost of painting each house with a certain color is different. You have to paint all the houses such that no two adjacent houses have the same color.

The cost of painting each house with a certain color is represented by a `n x 3` cost matrix. For example, `costs[0][0]` is the cost of painting house 0 with color red; `costs[1][2]` is the cost of painting house 1 with color green, and so on... Find the minimum cost to paint all houses.

Note:
All costs are positive integers.

Example:

```
Input: [[17,2,17],[16,16,5],[14,3,19]]

Output: 10

Explanation: Paint house 0 into blue, paint house 1 into green, paint house
2 into blue.

             Minimum cost: 2 + 5 + 3 = 10.
```

```
class Solution {
public:
    int minCost(vector<vector<int>>& costs) {

    }
};
```

```cpp
class Solution {
public:
    int minCost(vector<vector<int>>& costs) {
        if (costs.empty()) return 0;
        int min1 = 0, min2 = 0, idx = -1;
        for (auto &cost : costs) {
            int m1 = INT_MAX, m2 = m1, id = -1;
            for (int j = 0; j < cost.size(); j++) {
                int temp = cost[j] + (j == idx ? min2 : min1);
                if (temp < m1) {
                    m2 = m1; m1 = temp; id = j;
                } else if (temp < m2) {
                    m2 = temp;
                }
            }
            min1 = m1; min2 = m2; idx = id;
        }
        return min1;
    }
};
```

257. Binary Tree Paths

Given a binary tree, return all root-to-leaf paths.

Note: A leaf is a node with no children.

Example:

```
Input:


   1
 /   \
2     3
 \
  5


Output: ["1->2->5", "1->3"]


Explanation: All root-to-leaf paths are: 1->2->5, 1->3
```

```
/**
 * Definition for a binary tree node.
 * struct TreeNode {
 *     int val;
 *     TreeNode *left;
 *     TreeNode *right;
 *     TreeNode(int x) : val(x), left(NULL), right(NULL) {}
 * };
 */
class Solution {
public:
    vector<string> binaryTreePaths(TreeNode* root) {

    }
};
```

```cpp
/**
 * Definition for a binary tree node.
 * struct TreeNode {
 *     int val;
 *     TreeNode *left;
 *     TreeNode *right;
 *     TreeNode(int x) : val(x), left(NULL), right(NULL) {}
 * };
 */
class Solution {
public:
    vector<string> binaryTreePaths(TreeNode* root) {
        vector<string> res;
        if (root == nullptr) return res;
        dfs(root, "", res);
        return res;
    }

private:
    void dfs(TreeNode* root, string path, vector<string> &res) {
        path +=  to_string(root->val);
        if (root->left == nullptr && root->right == nullptr) {
            res.push_back(path);
            return;
        }
        path += "->";
        if (root->left) dfs(root->left, path, res);
        if (root->right) dfs(root->right, path, res);
    }
};
```

258. Add Digits

Given a non-negative integer `num`, repeatedly add all its digits until the result has only one digit.

Example:

```
Input: 38

Output: 2

Explanation: The process is like: 3 + 8 = 11, 1 + 1 = 2.

             Since 2 has only one digit, return it.
```

Follow up:
Could you do it without any loop/recursion in O(1) runtime?

```
class Solution {
public:
    int addDigits(int num) {

    }
};
```

```
class Solution {
public:
    int addDigits(int num) {
        while (num > 9) {
            int t = 0;
            while (num > 0) {
                t += num%10;
                num /= 10;
            }
            num = t;
        }
        return num;
    }
};
```

```
//////////? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ////////
class Solution {
public:
    int addDigits(int num) {
        return 1 + (num - 1) % 9;
    }
};
```

259. Sum Smaller

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

Example:

```
Input: nums = [-2,0,1,3], and target = 2

Output: 2

Explanation: 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?

```
class Solution {
public:
    int threeSumSmaller(vector<int>& nums, int target) {


    }
};
```

```cpp
class Solution {
public:
    int threeSumSmaller(vector<int>& nums, int target) {
        int res = 0, n = nums.size();
        sort(nums.begin(), nums.end());
        for (int i = 0; i < n; i++) {
            int j = i+1, k = n-1;
            while (j < k) {
                int sum = nums[i] + nums[j] + nums[k];
                if (sum < target) res += k-(j++);
                else  k--;
            }
        }
        return res;
    }
};
```

260. Single Number III

Given an array of numbers `nums`, in which exactly two elements appear only once and all the other elements appear exactly twice. Find the two elements that appear only once.

Example:

```
Input:  [1,2,1,3,2,5]

Output: [3,5]
```

Note:

1. The order of the result is not important. So in the above example, `[5, 3]` is also correct.
2. Your algorithm should run in linear runtime complexity. Could you implement it using only constant space complexity?

```
class Solution {
public:
    vector<int> singleNumber(vector<int>& nums) {

    }
};
```

```cpp
class Solution {
public:
    vector<int> singleNumber(vector<int>& nums) {
        int x = 0, y = 0, z = 0, bit = 1;
        for (auto &i : nums) x ^= i;
        while ((bit & x) == 0) bit <<= 1;
        for (auto &i : nums) {
            if (bit & i) y ^= i;
            else z ^= i;
        }
        return {y, z};
    }
};
```

261. Graph Valid Tree

Given `n` nodes labeled from `0` to `n-1` and a list of undirected edges (each edge is a pair of nodes), write a function to check whether these edges make up a valid tree.

Example 1:

```
Input: n = 5, and edges = [[0,1], [0,2], [0,3], [1,4]]

Output: true
```

Example 2:

```
Input: n = 5, and edges = [[0,1], [1,2], [2,3], [1,3], [1,4]]

Output: false
```

Note: you can assume that no duplicate edges will appear in `edges`. Since all edges are undirected, `[0,1]` is the same as `[1,0]` and thus will not appear together in `edges`.

```
class Solution {
public:
    bool validTree(int n, vector<vector<int>>& edges) {

    }
};
```

```cpp
class Solution {
public:
    bool validTree(int n, vector<vector<int>>& edges) {
        if (edges.size() != n-1) return false;
        fa.resize(n, -1);
        for (auto a : edges) {
            int x = find(a[0]), y = find(a[1]);
            if (x == y) return false;
            else fa[x] = y;
        }
        return true;
    }
private:
    vector<int> fa;
    int find(int i) {
        return (fa[i] == -1) ? i : (fa[i] = find(fa[i]));
    }
};
```

```cpp
class Solution {
public:
        bool validTree(int n, vector<vector<int>>& edges) {
        vector<bool> v(n, false);
        vector<vector<int>> g(n);
        for (auto &edge : edges) {
            g[edge[0]].push_back(edge[1]);
            g[edge[1]].push_back(edge[0]);
        }
        if (!dfs(g, v, 0, -1)) return false;
        for (auto a : v) {
            if (!a) return false;
        }
        return true;
    }
    bool dfs(vector<vector<int>> &g, vector<bool> &v, int cur, int pre) {
        if (v[cur]) return false;
        v[cur] = true;
        for (auto a : g[cur]) {
            if (a != pre) {
                if (!dfs(g, v, a, cur)) return false;
            }
        }
        return true;
    }
};
```

262. Trips and Users（SQL）

The `Trips` table holds all taxi trips. Each trip has a unique Id, while Client_Id and Driver_Id are both foreign keys to the Users_Id at the `Users` table. Status is an ENUM type of (‘completed’, ‘cancelled_by_driver’, ‘cancelled_by_client’).

```
+----+-----------+-----------+---------+--------------------+----------+
| Id | Client_Id | Driver_Id | City_Id |       Status       |Request_at|
+----+-----------+-----------+---------+--------------------+----------+
| 1  |     1     |    10     |    1    |     completed      |2013-10-01|
| 2  |     2     |    11     |    1    | cancelled_by_driver|2013-10-01|
| 3  |     3     |    12     |    6    |     completed      |2013-10-01|
| 4  |     4     |    13     |    6    | cancelled_by_client|2013-10-01|
| 5  |     1     |    10     |    1    |     completed      |2013-10-02|
| 6  |     2     |    11     |    6    |     completed      |2013-10-02|
| 7  |     3     |    12     |    6    |     completed      |2013-10-02|
| 8  |     2     |    12     |    12   |     completed      |2013-10-03|
| 9  |     3     |    10     |    12   |     completed      |2013-10-03|
| 10 |     4     |    13     |    12   | cancelled_by_driver|2013-10-03|
+----+-----------+-----------+---------+--------------------+----------+
```

The `Users` table holds all users. Each user has an unique Users_Id, and Role is an ENUM type of (‘client’, ‘driver’, ‘partner’).

```
+----------+--------+--------+
| Users_Id | Banned |  Role  |
+----------+--------+--------+
|    1     |   No   | client |
|    2     |   Yes  | client |
|    3     |   No   | client |
|    4     |   No   | client |
|    10    |   No   | driver |
```

```
|    11    |   No   | driver |

|    12    |   No   | driver |

|    13    |   No   | driver |

+----------+--------+--------+
```

Write a SQL query to find the cancellation rate of requests made by unbanned users between **Oct 1, 2013** and **Oct 3, 2013**. For the above tables, your SQL query should return the following rows with the cancellation rate being rounded to *two* decimal places.

```
+------------+-------------------+

|     Day    | Cancellation Rate |

+------------+-------------------+

| 2013-10-01 |      0.33         |

| 2013-10-02 |      0.00         |

| 2013-10-03 |      0.50         |

+------------+-------------------+
```

Credits:
Special thanks to @cak1erlizhou for contributing this question, writing the problem description and adding part of the test cases.

263. Ugly Number

Easy

Write a program to check whether a given number is an ugly number.

Ugly numbers are **positive numbers** whose prime factors only include `2, 3, 5`.

Example 1:

Input: 6

Output: true

Explanation: 6 = 2 × 3

Example 2:

Input: 8

Output: true

Explanation: 8 = 2 × 2 × 2

Example 3:

Input: 14

Output: false

Explanation: 14 is not ugly since it includes another prime factor 7.

Note:

1. `1` is typically treated as an ugly number.
2. Input is within the 32-bit signed integer range: $[-2^{31}, 2^{31}-1]$.

```
class Solution {
public:
    bool isUgly(int num) {

    }
};
```

```cpp
class Solution {
public:
    bool isUgly(int num) {
        if (num < 1) return false;
        int a[3] = {2, 3, 5};
        for (auto &i : a) {
            while (num % i == 0) num /= i;
        }
        return num == 1;
    }
};
```

264. Ugly Number II

Medium

Write a program to find the `n`-th ugly number.

Ugly numbers are **positive numbers** whose prime factors only include `2, 3, 5`.

Example:

Input: n = 10

Output: 12

Explanation: 1, 2, 3, 4, 5, 6, 8, 9, 10, 12 is the sequence of the first 10 ugly numbers.

Note:

1. `1` is typically treated as an ugly number.
2. `n` **does not exceed 1690**.

```
class Solution {
public:
    int nthUglyNumber(int n) {

    }
};
```

```cpp
class Solution {
public:
    int nthUglyNumber(int n) {
        vector <int> res {1};
        int i = 0, j = 0, k = 0;
        while (--n) {
            res.push_back(min(res[i]*2, min(res[j]*3, res[k]*5)));
            if (res.back() == res[i] * 2) ++i;
            if (res.back() == res[j] * 3) ++j;
            if (res.back() == res[k] * 5) ++k;
        }
        return res.back();
    }
};
```

```cpp
class Solution {
public:
    struct cmp{
      bool operator () (int &lhs, int &rhs) const {
         return lhs > rhs;
      }
    };

    int nthUglyNumber(int n) {
        int a[3] = {2, 3, 5};
        priority_queue<int, vector<int>, greater<int>> pq;
    //  priority_queue<int, vector<int>, cmp> pq;
        unordered_set<int> My_set;
        pq.push(1);
        while (--n) {
            int t = pq.top();
            pq.pop();
            for (int i : a) {
                if (INT_MAX / i < t) continue;
                i *= t;
                if (My_set.count(i)) continue;
                My_set.insert(i);
                pq.push(i);
            }
        }
        return pq.top();
    }
};
```

265. Paint House II

There are a row of *n* houses, each house can be painted with one of the *k* colors. The cost of painting each house with a certain color is different. You have to paint all the houses such that no two adjacent houses have the same color.

The cost of painting each house with a certain color is represented by a `n x k` cost matrix. For example, `costs[0][0]` is the cost of painting house 0 with color 0; `costs[1][2]` is the cost of painting house 1 with color 2, and so on... Find the minimum cost to paint all houses.

Note:
All costs are positive integers.

Example:

```
Input: [[1,5,3],[2,9,4]]

Output: 5

Explanation: Paint house 0 into color 0, paint house 1 into color 2.
Minimum cost: 1 + 4 = 5;

             Or paint house 0 into color 2, paint house 1 into color 0.
Minimum cost: 3 + 2 = 5.
```

Follow up:
Could you solve it in *O*(*nk*) runtime?

```
class Solution {
public:
    int minCostII(vector<vector<int>>& costs) {

    }
};
```

```cpp
class Solution {
public:
    int minCostII(vector<vector<int>>& costs) {
        if (costs.empty()) return 0;
        int min1 = 0, min2 = 0, idx = -1;
        for (auto &cost : costs) {
            int m1 = INT_MAX, m2 = m1, id = -1;
            for (int j = 0; j < cost.size(); j++) {
                int temp = cost[j] + (j == idx ? min2 : min1);
                if (temp < m1) {
                    m2 = m1; m1 = temp; id = j;
                } else if (temp < m2) {
                    m2 = temp;
                }
            }
            min1 = m1; min2 = m2; idx = id;
        }
        return min1;
    }
};
```

266. Palindrome Permutation

Given a string, determine if a permutation of the string could form a palindrome.

Example 1:

```
Input: "code"

Output: false
```

Example 2:

```
Input: "aab"

Output: true
```

Example 3:

```
Input: "carerac"

Output: true
```

```
class Solution {
public:
    bool canPermutePalindrome(string s) {

    }
};
```

```cpp
class Solution {
public:
    bool canPermutePalindrome(string s) {
        bitset<256> b;
        for (auto &c : s) {
            b.flip(c);
        }
        return b.count() < 2;
    }
};
```

```cpp
class Solution {
public:
    bool canPermutePalindrome(string s) {
        int n = s.length();
        vector<bool> v(256, false);
        for (auto &c : s) {
           if (v[c]) n -= 2;
           v[c] = !v[c];
        }
        return n <= 1;
    }
};
```

267. Palindrome Permutation II

Given a string `s`, return all the palindromic permutations (without duplicates) of it. Return an empty list if no palindromic permutation could be form.

Example 1:

```
Input: "aabb"

Output: ["abba", "baab"]
```

Example 2:

```
Input: "abc"

Output: []
```

```
class Solution {
public:
    vector<string> generatePalindromes(string s) {

    }
};
```

```cpp
class Solution {
public:
    vector<string> generatePalindromes(string s) {
        for (auto &c : s)  m[c]++;
        int cnt = 0, n = s.length();
        char mid;
        for (auto &i : m) if (i.second % 2) {
            if (++cnt > 1) return res;
            else mid = i.first;
        }
        if (cnt == 1) m[s[n/2] = mid]--;
        dfs(0, n, s);
        return res;
    }
private:
    unordered_map<char, int> m;
    vector<string> res;

    void dfs(int i, int n, string &s) {
        if (i == n/2)  res.push_back(s);
        else for (auto &it : m) if (it.second >= 2) {
            s[i] = s[n-1-i] = it.first;
            it.second -= 2;
            dfs(i+1, n, s);
            it.second += 2;
        }
    }
};
```

268. Missing Number

Easy

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

Example 1:

Input: [3,0,1]

Output: 2

Example 2:

Input: [9,6,4,2,3,5,7,0,1]

Output: 8

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

```
class Solution {
public:
    int missingNumber(vector<int>& nums) {

    }
};
```

```cpp
class Solution {
public:
    int missingNumber(vector<int>& nums) {
        int n = nums.size(), res = n;
        for (int i = 0; i < n; i++) res ^= i ^ nums[i];
        return res;
    }
};
```

```cpp
class Solution {
public:
    int missingNumber(vector<int>& nums) {
        sort (nums.begin(), nums.end());
        int left = 0, right = nums.size()-1;
        while (left < right) {
            int mid = left + (right-left)/2;
            if (nums[mid] == mid) left = mid+1;
            else right = mid;
        }
        if (nums[left] == left) return nums.size();
        else return nums[left]-1;
    }
};
```

269. Alien Dictionary

There is a new alien language which uses the latin alphabet. However, the order among letters are unknown to you. You receive a list of **non-empty** words from the dictionary, where **words are sorted lexicographically by the rules of this new language**. Derive the order of letters in this language.

Example 1:

```
Input:
[
  "wrt",
  "wrf",
  "er",
  "ett",
  "rftt"
]

Output: "wertf"
```

Example 2:

```
Input:
[
  "z",
  "x"
]

Output: "zx"
```

Example 3:

```
Input:
[
  "z",
```

```
  "x",
  "z"
]


Output: ""


Explanation: The order is invalid, so return "".
```

Note:

1. You may assume all letters are in lowercase.
2. You may assume that if a is a prefix of b, then a must appear before b in the given dictionary.
3. If the order is invalid, return an empty string.
4. There may be multiple valid order of letters, return any one of them is fine.

```cpp
class Solution {
public:
    string alienOrder(vector<string>& words) {
        g.resize(256);
        v.resize(256, 1);
        f(0, 0, words.size()-1, words);
        for (auto &s : words) for (auto &c : s)  v[c] = 0;
        string res;
        for (int i = 0; i < 256; i++) if (!v[i]) {
          if (!topo(i, res)) return "";
        }
        return res;
    }

private:
    vector<vector<int>> g;
    vector<int> v;

    void f(int pos, int st, int ed, vector<string> &words) {
        if (st >= ed || words[st].length() < pos) return;
        char pre = words[st][pos];
        int new_st = st;
        for (int i = st; i <= ed; i++) {
            string &s = words[i];
            if (s[pos] != pre) {
                g[s[pos]].push_back(pre);
                pre = s[pos];
                f(pos+1, new_st, i-1, words);
                new_st = i;
            }
        }
        f(pos+1, new_st, ed, words);
    }

    bool topo(int i, string &res) {
        v[i] = -1;
        for (auto &j : g[i]) if (v[j] != 1) {
            if (v[j] == -1 || !topo(j, res)) return false;
        }
        v[i] = 1;
        res += char(i);
        return true;
    }
};
```

270. Closest Binary Search Tree Value

Given a non-empty binary search tree and a target value, find the value in the BST that is closest to the target.

Note:

- Given target value is a floating point.
- You are guaranteed to have only one unique value in the BST that is closest to the target.

Example:

```
Input: root = [4,2,5,1,3], target = 3.714286



    4

   / \

  2   5

 / \

1   3



Output: 4
```

```
/**
 * Definition for a binary tree node.
 * struct TreeNode {
 *     int val;
 *     TreeNode *left;
 *     TreeNode *right;
 *     TreeNode(int x) : val(x), left(NULL), right(NULL) {}
 * };
 */
class Solution {
public:
    int closestValue(TreeNode* root, double target) {

    }
};
```

```cpp
/**
 * Definition for a binary tree node.
 * struct TreeNode {
 *     int val;
 *     TreeNode *left;
 *     TreeNode *right;
 *     TreeNode(int x) : val(x), left(NULL), right(NULL) {}
 * };
 */
class Solution {
public:
    int closestValue(TreeNode* root, double target) {
        dfs(root, target);
        return res;
    }

private:
    int res;
    double sub = numeric_limits<double>::max();

    void dfs(TreeNode* root, double target) {
        if (!root) return;
        if (sub > fabs(target-root->val)) {
            sub = fabs(target-root->val);
            res = root->val;
        }
        if (target > root->val) dfs(root->right, target);
        else if (target < root->val) dfs(root->left, target);
    }
};
```

271. Encode and Decode Strings

Design an algorithm to encode **a list of strings** to **a string**. The encoded string is then sent over the network and is decoded back to the original list of strings.

Machine 1 (sender) has the function:

```
string encode(vector<string> strs) {

  // ... your code

  return encoded_string;

}
```

Machine 2 (receiver) has the function:

```
vector<string> decode(string s) {

  //... your code

  return strs;

}
```

So Machine 1 does:

```
string encoded_string = encode(strs);
```

and Machine 2 does:

```
vector<string> strs2 = decode(encoded_string);
```

`strs2` in Machine 2 should be the same as `strs` in Machine 1.

Implement the `encode` and `decode` methods.

Note:

- The string may contain any possible characters out of 256 valid ascii characters. Your algorithm should be generalized enough to work on any possible characters.
- Do not use class member/global/static variables to store states. Your encode and decode algorithms should be stateless.
- Do not rely on any library method such as `eval` or serialize methods. You should implement your own encode/decode algorithm.

```cpp
class Codec {
public:
    // Encodes a list of strings to a single string.
    string encode(vector<string>& strs) {
        string res;
        for (auto s : strs) {
          string t(to_string(s.length()));
          res += string(3 - t.length(), '0') + t + s;
        }
        return res;
    }

    // Decodes a single string to a list of strings.
    vector<string> decode(string s) {
        vector<string> res;
        int i = 0, n = s.length();
        while (i < n) {
            int k = stoi(s.substr(i, 3));
            res.push_back(s.substr(i+3, k));
            i += 3 + k;
        }
        return res;
    }
};
```

272. Closest Binary Search Tree Value II

Given a non-empty binary search tree and a target value, find *k* values in the BST that are closest to the target.

Note:

- Given target value is a floating point.
- You may assume *k* is always valid, that is: $k \leq$ total nodes.
- You are guaranteed to have only one unique set of *k* values in the BST that are closest to the target.

Example:

```
Input: root = [4,2,5,1,3], target = 3.714286, and k = 2



    4

   / \

  2   5

 / \

1   3



Output: [4,3]
```

Follow up:
Assume that the BST is balanced, could you solve it in less than $O(n)$ runtime (where n = total nodes)?

```cpp
class Solution {
public:
    vector<int> closestKValues(TreeNode* root, double target, int k) {
        vector<int> res;
        stack<TreeNode*> s;
        TreeNode *p = root;
        while (p || !s.empty()) {
            while (p) {
                s.push(p);
                p = p->left;
            }
            p = s.top(); s.pop();
            if (res.size() < k) res.push_back(p->val);
            else if (abs(p->val - target) < abs(res[0] - target)) {
                res.erase(res.begin());
                res.push_back(p->val);
            } else break;
            p = p->right;
        }
        return res;
    }
};
```

```
class Solution {
public:
    struct node {
        double sub;
        int value;
        node(double s, int v):sub(s), value(v){}
        bool operator < (const node &rhs) const {
            return sub < rhs.sub;
        };
    };

    vector<int> closestKValues(TreeNode* root, double target, int k) {
        dfs(root, target, k);
        vector<int> res;
        while (!q.empty()) {
            res.push_back(q.top().value);
            q.pop();
        }
        return res;
    }

private:
    priority_queue<node> q;


    void dfs(TreeNode* root, double target, int k) {
        if (!root) return;
        double sub = q.size() < k ? numeric_limits<double>::max()
                                  : q.top().sub;
        double a = fabs(target-root->val);
        if (sub > a) {
            q.push({a, root->val});
            if (q.size() > k) q.pop();
        }
        if (q.size() < k || a != q.top().sub || target < root->val)
            dfs(root->left, target, k);
        if (q.size() < k || a != q.top().sub || target > root->val)
            dfs(root->right, target, k);
    }
};
```

273. Integer to English Words

Hard

Convert a non-negative integer to its english words representation. Given input is guaranteed to be less than $2^{31} - 1$.

Example 1:

Input: 123

Output: "One Hundred Twenty Three"

Example 2:

Input: 12345

Output: "Twelve Thousand Three Hundred Forty Five"

Example 3:

Input: 1234567

Output: "One Million Two Hundred Thirty Four Thousand Five Hundred Sixty Seven"

Example 4:

Input: 1234567891

Output: "One Billion Two Hundred Thirty Four Million Five Hundred Sixty Seven Thousand Eight Hundred Ninety One"

```cpp
class Solution {
public:
    string numberToWords(int num) {
        if (num == 0) return "Zero";
        string s[3] = {"Billion", "Million", "Thousand"}, res;
        for (int i = 0; i <= 3; i++) {
           int k = pow(10,9-3*i), t = num / k;
           if (t > 0) {
               read(t, res);
               if (i != 3) res += s[i] + ' ';
           }
           num %= k;
        }
        res.erase(prev(res.end()));
        return res;
    }

private:
    void read(int n, string &res) {
        string a[10] = {"", "", "Twenty", "Thirty", "Forty", "Fifty",
                        "Sixty", "Seventy", "Eighty", "Ninety"};
        string b[10] = {"", "One", "Two", "Three", "Four", "Five",
                        "Six", "Seven", "Eight", "Nine"};
        string c[10] = {"Ten", "Eleven", "Twelve", "Thirteen", "Fourteen",
                        "Fifteen", "Sixteen", "Seventeen", "Eighteen",
                        "Nineteen"};
        if (n/100 > 0)  res += b[n/100] + ' ' +  "Hundred ";
        n %= 100;
        if (n/10 == 1)  res += c[n-10] + ' ';
        else {
           if (n/10) res += a[n/10] + ' ';
           if (n%10) res += b[n%10] + ' ';
        }
    }
};
```

274. H-Index(●ˇ∀ˇ●)

Medium

Given an array of citations (each citation is a non-negative integer) of a researcher, write a function to compute the researcher's h-index.

According to the definition of h-index on Wikipedia: "A scientist has index *h* if *h* of his/her *N* papers have **at least** *h* citations each, and the other *N* − *h* papers have **no more than** *h* citations each."

Example:

Input: citations = [3,0,6,1,5]

Output: 3

Explanation: [3,0,6,1,5] means the researcher has 5 papers in total and each of them had received 3, 0, 6, 1, 5 citations respectively.
Since the researcher has 3 papers with **at least** 3 citations each and the remaining two with **no more than** 3 citations each, her h-index is 3.

Note: If there are several possible values for *h*, the maximum one is taken as the h-index.

```
class Solution {
public:
    int hIndex(vector<int>& citations) {

    }
};
```

```cpp
class Solution {
public:
    int hIndex(vector<int> &citations) {
        const int n = citations.size();
        vector<int> buckets(n+1, 0);
        for (int c : citations) {
            if (c >= n) buckets[n]++;
            else buckets[c]++;
        }
        int cnt = 0;
        for (int i = n; i >= 0; i--) {
            cnt += buckets[i];
            if (cnt >= i) return i;
        }
        return 0;
    }
};
```

275. H-Index II

Medium

Given an array of citations **sorted in ascending order** (each citation is a non-negative integer) of a researcher, write a function to compute the researcher's h-index.

According to the definition of h-index on Wikipedia: "A scientist has index *h* if *h* of his/her *N* papers have **at least** *h* citations each, and the other *N* − *h* papers have **no more than** *h* citations each."

Example:

Input: citations = [0,1,3,5,6]

Output: 3

Explanation: [0,1,3,5,6] means the researcher has 5 papers in total and each of them had received 0, 1, 3, 5, 6 citations respectively.
Since the researcher has 3 papers with **at least** 3 citations each and the remaining two with **no more than** 3 citations each, her h-index is 3.

Note:

If there are several possible values for *h*, the maximum one is taken as the h-index.

Follow up:

- This is a follow up problem to H-Index, where `citations` is now guaranteed to be sorted in ascending order.
- Could you solve it in logarithmic time complexity?

```
class Solution {
public:
    int hIndex(vector<int>& citations) {

    }
};
```

```cpp
class Solution {
public:
    int hIndex(vector<int>& citations) {
        int n = citations.size();
        if (!n /*|| citations.back() < 1*/) return 0;
        int l = 0, r = n;
        while (l < r) {
            int mid = l + (r-l)/2;
            if (citations[mid] < n-mid) l = mid+1;
            else r = mid;
        }
        return n-l;
    }
};
```

276. Paint Fence

There is a fence with n posts, each post can be painted with one of the k colors.

You have to paint all the posts such that no more than two adjacent fence posts have the same color.

Return the total number of ways you can paint the fence.

Note:
n and k are non-negative integers.

Example:

```
Input: n = 3, k = 2

Output: 6

Explanation: Take c1 as color 1, c2 as color 2. All possible ways are:


           post1  post2  post3

 -----      -----  -----  -----

   1         c1     c1     c2

   2         c1     c2     c1

   3         c1     c2     c2

   4         c2     c1     c1

   5         c2     c1     c2

   6         c2     c2     c1
```

```
class Solution {
public:
    int numWays(int n, int k) {

    }
};
```

```cpp
class Solution {
public:
    int numWays(int n, int k) {
        if (n == 0) return 0;
        int f_0 = 0, f_1 = k;
       // f_0 = 前两次相同颜色*(k-1) + 一次颜色相同*(k-1);
       // f_1 = 一次颜色相同
        for (int i = 1; i < n; i++) {
            int temp = (f_0 + f_1) * (k-1);
            f_0 = f_1;
            f_1 = temp;
        }
        return f_0 + f_1;
    }
};
```

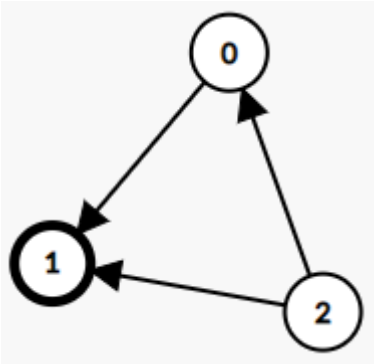
277. Find the Celebrity

Suppose you are at a party with `n` people (labeled from `0` to `n - 1`) and among them, there may exist one celebrity. The definition of a celebrity is that all the other `n - 1` people know him/her but he/she does not know any of them.

Now you want to find out who the celebrity is or verify that there is not one. The only thing you are allowed to do is to ask questions like: "Hi, A. Do you know B?" to get information of whether A knows B. You need to find out the celebrity (or verify there is not one) by asking as few questions as possible (in the asymptotic sense).

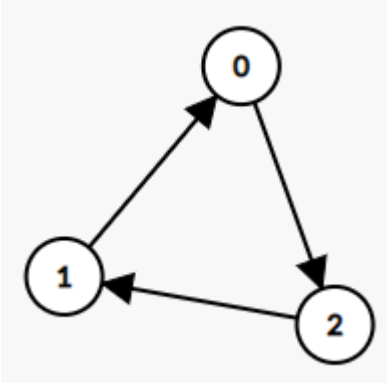
You are given a helper function `bool knows(a, b)` which tells you whether A knows B. Implement a function `int findCelebrity(n)`. There will be exactly one celebrity if he/she is in the party. Return the celebrity's label if there is a celebrity in the party. If there is no celebrity, return `-1`.

Example 1:




```
Input: graph = [
  [1,1,0],
  [0,1,0],
  [1,1,1]
]
Output: 1
Explanation: There are three persons labeled with 0, 1 and 2. graph[i][j] = 1 means person i knows person j, otherwise graph[i][j] = 0 means person i does not know person j. The celebrity is the person labeled as 1 because both 0 and 2 know him but 1 does not know anybody.
```

Example 2:




```
Input: graph = [
  [1,0,1],
  [1,1,0],
  [0,1,1]
]
Output: -1
Explanation: There is no celebrity.
```

Note:

1. The directed graph is represented as an adjacency matrix, which is an `n x n` matrix where `a[i][j] = 1` means person `i` knows person `j` while `a[i][j] = 0` means the contrary.
2. Remember that you won't have direct access to the adjacency matrix.

```cpp
// Forward declaration of the knows API.
bool knows(int a, int b);

class Solution {
private:
public:
    int findCelebrity(int n) {
        int left = 0, right = n - 1;
        while (left < right) {
            if (knows(left, right)) ++left;
            else --right;
        }
        for (int i = 0; i < n; i ++) {
            if (i != left && (!knows(i, left) || knows(left, i)))
                return -1;
        }
        return left;
    }
};
```

278. First Bad Version

Easy

You are a product manager and currently leading a team to develop a new product. Unfortunately, the latest version of your product fails the quality check. Since each version is developed based on the previous version, all the versions after a bad version are also bad.

Suppose you have `n` versions `[1, 2, ..., n]` and you want to find out the first bad one, which causes all the following ones to be bad.

You are given an API `bool isBadVersion(version)` which will return whether `version` is bad. Implement a function to find the first bad version. You should minimize the number of calls to the API.

Example:

```
Given n = 5, and version = 4 is the first bad version.



call isBadVersion(3) -> false

call isBadVersion(5) -> true

call isBadVersion(4) -> true



Then 4 is the first bad version.
```

```
// Forward declaration of isBadVersion API.
bool isBadVersion(int version);

class Solution {
public:
    int firstBadVersion(int n) {

    }
};
```

```cpp
bool isBadVersion(int version);

class Solution {
public:
    int firstBadVersion(int n) {
        int l = 1, r = n;
        while (l < r) {
            int mid = l+(r-l)/2;
            if (isBadVersion(mid)) r = mid;
            else l = mid+1;
        }
        return l;
    }
};
```

279. Perfect Squares(●ˇ∀ ˇ●)

Medium

Given a positive integer *n*, find the least number of perfect square numbers (for example, `1, 4, 9, 16, ...`) which sum to *n*.

Example 1:

Input: *n* = 12

Output: 3

Explanation: 12 = 4 + 4 + 4.

Example 2:

Input: *n* = 13

Output: 2

Explanation: 13 = 4 + 9.

```
class Solution {
public:
    int numSquares(int n) {
        vector<int> dp(n+1);
        for (int i = 1; i <= n; i++) {
            dp[i] = i;
            for (int j = 1; j*j <= i; j++) {
                dp[i] = min(dp[i], dp[i-j*j]+1);
            }
        }
        return dp[n];
    }
};
```

280. Wiggle Sort

Given an unsorted array `nums`, reorder it **in-place** such that `nums[0] <= nums[1] >= nums[2] <= nums[3]...`.

Example:

```
Input: nums = [3,5,2,1,6,4]

Output: One possible answer is [3,5,1,6,2,4]
```

```
class Solution {
public:
    void wiggleSort(vector<int> &nums) {
        int n = nums.size();
        if (n <= 1) return;
        for (int i = 1; i < n; ++i) {
            if (i%2 && nums[i] < nums[i-1] || !(i%2) && nums[i] > nums[i-1]) {
                swap(nums[i], nums[i-1]);
            }
        }
    }
};
```

281. Zigzag Iterator

Given two 1d vectors, implement an iterator to return their elements alternately.

Example:

```
Input:

v1 = [1,2]

v2 = [3,4,5,6]


Output: [1,3,2,4,5,6]


Explanation: By calling next repeatedly until hasNext returns false,

            the order of elements returned by next should be:
[1,3,2,4,5,6].
```

Follow up: What if you are given `k` 1d vectors? How well can your code be extended to such cases?

Clarification for the follow up question:
The "Zigzag" order is not clearly defined and is ambiguous for `k > 2` cases. If "Zigzag" does not look right to you, replace "Zigzag" with "Cyclic". For example:

```
Input:

[1,2,3]

[4,5,6,7]

[8,9]


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

```
class ZigzagIterator {
public:
    ZigzagIterator(vector<int>& v1, vector<int>& v2) {
        if (!v1.empty()) q.push(make_pair(v1.begin(), v1.end()));
        if (!v2.empty()) q.push(make_pair(v2.begin(), v2.end()));
    }
    int next() {
        auto it = q.front().first, end = q.front().second;
        q.pop();
        if (it + 1 != end) q.push(make_pair(it + 1, end));
        return *it;
    }
    bool hasNext() {
        return !q.empty();
    }
private:
    queue<pair<vector<int>::iterator, vector<int>::iterator>> q;
};
```

282. Expression Add Operators

Hard

Given a string that contains only digits `0-9` and a target value, return all possibilities to add **binary** operators (not unary) `+`, `-`, or `*` between the digits so they evaluate to the target value.

Example 1:

Input: *num* = "123", *target* = 6

Output: ["1+2+3", "1*2*3"]

Example 2:

Input: *num* = "232", *target* = 8

Output: ["2*3+2", "2+3*2"]

Example 3:

Input: *num* = "105", *target* = 5

Output: ["1*0+5","10-5"]

Example 4:

Input: *num* = "00", *target* = 0

Output: ["0+0", "0-0", "0*0"]

Example 5:

Input: *num* = "3456237490", *target* = 9191

Output: []

```
class Solution {
public:
    vector<string> addOperators(string num, int target) {

    }
};
```

```cpp
class Solution {
public:
    vector<string> addOperators(string num, int target) {
        if (num.empty()) return {};
        string expr(num.size()*2, '\0');
        this->num = num;
        this->target = target;
        dfs(0, expr, 0, 0, 0);
        return res;
    }

private:
    string num;
    int target;
    vector<string> res;

    void dfs(int pos, string &expr, int len, long prev, long cur) {
        if (pos == num.size()) {
            if (cur == target) res.push_back(expr.substr(0, len));
            return;
        }

        long n = 0;
        int start = pos;
        int l = len;
        if (start != 0) ++len; // leave the place for operator
        while (pos < num.size()) {
            n = 10*n + num[pos]-'0';
            if (num[start] == '0' && pos > start) break;
            expr[len++] = num[pos++];
            if (start == 0) dfs(pos, expr, len, n, n);
            else {
                expr[l] = '+';;
                dfs(pos, expr, len, n, cur+n);
                expr[l] = '-';
                dfs(pos, expr, len, -n, cur-n);
                expr[l] = '*';
                dfs(pos, expr, len, prev*n, cur-prev+prev*n);
            }
        }
    }
};
```

283. Move Zeroes

Easy

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.

Example:

Input: [0,1,0,3,12]

Output: [1,3,12,0,0]

Note:

1. You must do this **in-place** without making a copy of the array.
2. Minimize the total number of operations.

```
class Solution {
public:
    void moveZeroes(vector<int>& nums) {
        int cnt = 0, n = nums.size();
        for (int i = 0; i < n; i++) {
            if (nums[i] != 0) {
                nums[cnt++] = nums[i];
            }
        }
        while (cnt < n) nums[cnt++] = 0;
    }
};
```

284. Peeking Iterator

Medium

Given an Iterator class interface with methods: `next()` and `hasNext()`, design and implement a PeekingIterator that support the `peek()` operation -- it essentially peek() at the element that will be returned by the next call to next().

Example:

Assume that the iterator is initialized to the beginning of the list: **[1,2,3]**.

Call **next()** gets you **1**, the first element in the list.

Now you call **peek()** and it returns **2**, the next element. Calling **next()** after that ***still*** return **2**.

You call **next()** the final time and it returns **3**, the last element.

Calling **hasNext()** after that should return **false**.

Follow up: How would you extend your design to be generic and work with all types, not just integer?

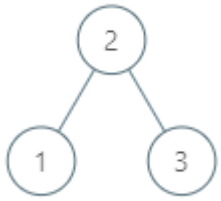
```
class Iterator {
    struct Data;
    Data* data;
public:
    Iterator(const vector<int>& nums);
    Iterator(const Iterator& iter);
    virtual ~Iterator();
    int next();
    bool hasNext() const;
};



class PeekingIterator : public Iterator {
public:
    PeekingIterator(const vector<int>& nums):Iterator(nums), isPeek(false) {}

    int peek() {
        //return Iterator(*this).next();
        if (isPeek) return next_element;
        isPeek = true;
        return next_element = Iterator::next();
    }


    int next() {
        if (isPeek) {
            isPeek = false;
            return next_element;
        }
        else return Iterator::next();
    }

    bool hasNext() const {
        if (isPeek) return true;
        else return Iterator::hasNext();
    }

private:
    bool isPeek;
    int next_element;
};
```

285. Inorder Successor in BST

Given a binary search tree and a node in it, find the in-order successor of that node in the BST.

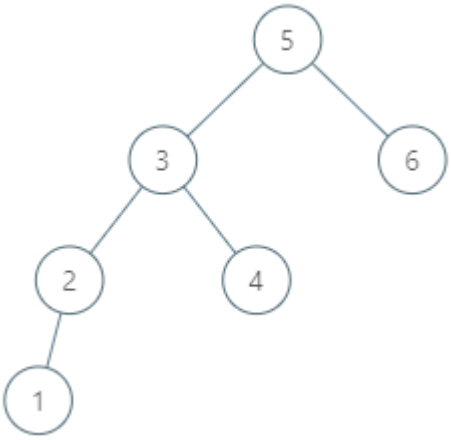
The successor of a node `p` is the node with the smallest key greater than `p.val`.

Example 1:




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

Output: 2

Explanation: 1's in-order successor node is 2. Note that both p and the return value is of TreeNode type.
```

Example 2:




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

Output: null

Explanation: There is no in-order successor of the current node, so the answer is null.
```

Note:

1. If the given node has no in-order successor in the tree, return `null`.
2. It's guaranteed that the values of the tree are unique.

```
/**
 * Definition for a binary tree node.
 * struct TreeNode {
 *     int val;
 *     TreeNode *left;
 *     TreeNode *right;
 *     TreeNode(int x) : val(x), left(NULL), right(NULL) {}
 * };
 */
class Solution {
public:
    TreeNode* inorderSuccessor(TreeNode* root, TreeNode* p) {
        if (!root) return nullptr;
        if (root->val > p->val) {
            auto q = inorderSuccessor(root->left, p);
            return q ? q : root;
        }
        else {
            return inorderSuccessor(root->right, p);
        }
    }
};
```

286. Walls and Gates

You are given a *m x n* 2D grid initialized with these three possible values.

1. `-1` - A wall or an obstacle.
2. `0` - A gate.
3. `INF` - Infinity means an empty room. We use the value $2^{31} - 1 = 2147483647$ to represent `INF` as you may assume that the distance to a gate is less than `2147483647`.

Fill each empty room with the distance to its *nearest* gate. If it is impossible to reach a gate, it should be filled with `INF`.

Example:

Given the 2D grid:

```
INF  -1  0  INF

INF INF INF  -1

INF  -1 INF  -1

  0  -1 INF INF
```

After running your function, the 2D grid should be:

```
  3  -1   0   1

  2   2   1  -1

  1  -1   2  -1

  0  -1   3   4
```

```cpp
class Solution {
public:
    void wallsAndGates(vector<vector<int>>& rooms) {
        if (rooms.empty()) return;
        n = rooms.size(), m = rooms[0].size();
        for (int i = 0; i < n; i++) {
            for (int j = 0; j < m; j++) {
                if (rooms[i][j] == 0) dfs(i, j, 0, rooms);
            }
        }
    }

private:
    int n, m;
    vector<int> dx{0,0,-1,1};
    vector<int> dy{-1,1,0,0};

    void dfs(int x, int y, int cnt, vector<vector<int>> &rooms) {
        for (int k = 0; k < 4; k++) {
            int xx = x + dx[k], yy = y + dy[k];
            if (xx >= 0 && yy >= 0 && xx < n && yy < m && rooms[xx][yy] > 0) {
                if (rooms[xx][yy] > cnt+1) {
                    dfs(xx, yy, rooms[xx][yy] = cnt+1, rooms);
                }
            }
        }
    }
};
```

287. Find the Duplicate Number(●ˇ∀ ˇ●)

Medium

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.

Example 1:

Input: [1,3,4,2,2]

Output: 2

Example 2:

Input: [3,1,3,4,2]

Output: 3

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.

```
class Solution {
public:
    int findDuplicate(vector<int>& nums) {

    }
};
```

```cpp
class Solution {
public:
    int findDuplicate(vector<int>& nums) {
        int slow = 0, fast = 0;
        while (1) {
            slow = nums[slow];
            fast = nums[nums[fast]];
            if (slow == fast) break;
        }
        fast = 0;
        while (1) {
            slow = nums[slow];
            fast = nums[fast];
            if (slow == fast)  return slow;
        }
    }
};
```

288. Unique Word Abbreviation

An abbreviation of a word follows the form <first letter><number><last letter>. Below are some examples of word abbreviations:

```
a) it                      --> it    (no abbreviation)



    1

    ↓

b) d|o|g                   --> d1g



              1    1  1

    1---5----0----5--8

    ↓   ↓    ↓    ↓  ↓

c) i|nternationalizatio|n  --> i18n

              1

    1---5----0

    ↓   ↓    ↓

d) l|ocalizatio|n          --> l10n
```

Assume you have a dictionary and given a word, find whether its abbreviation is unique in the dictionary. A word's abbreviation is unique if no *other* word from the dictionary has the same abbreviation.

Example:

```
Given dictionary = [ "deer", "door", "cake", "card" ]

isUnique("dear") -> false

isUnique("cart") -> true

isUnique("cane") -> false

isUnique("make") -> true
```

```
class ValidWordAbbr {
public:
    ValidWordAbbr(vector<string>& dictionary) {
        for(auto &s : dictionary) {
            string a = s[0] + to_string(s.length()-2) + s.back();
            if (m.count(a) && m[a] != s) m[a] = "";
            else m[a] = s;
        }
    }

    bool isUnique(string word) {
        string s = word[0] + to_string(word.length()-2) + word.back();
        return !m.count(s) || m[s] == word;
    }
private:
    unordered_map<string, string> m;
};
```

289. Game of Life

Medium

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. The next state is created by applying the above rules simultaneously to every cell in the current state, where births and deaths occur simultaneously.

Example:

Input:

[[0,1,0],

[0,0,1],

[1,1,1],

[0,0,0]]

Output:

[[0,0,0],

[1,0,1],

[0,1,1],

[0,1,0]]

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?

```cpp
// 2 live -> dead
// -1 dead-> live
// 1 live -> live
// 0 dead -> dead

class Solution {
public:
    int n, m;
    const int dx[8] = {1,1,1,0,0,-1,-1,-1};
    const int dy[8] = {1,0,-1,1,-1,1,0,-1};
    bool inside(int x, int y){
        return (x >= 0 && x < n && y >= 0 && y < m);
    }

    void gameOfLife(vector<vector<int>>& board) {
        n = board.size(), m = board[0].size();
        for (int i = 0; i < n; i++) {
           for (int j = 0; j < m; j++) {
              int cnt = 0;
              for (int k = 0; k < 8; k++){
                  int x = i+dx[k], y = j+dy[k];
                  if (inside(x, y) && board[x][y] > 0) cnt++;
              }
               if (board[i][j] > 0)  board[i][j] = (cnt < 2 || cnt > 3) ? 2 :1;
               else  board[i][j] = (cnt == 3) ? -1 : 0;
           }
        }
       for (int i = 0; i < n; i++) {
          for (int j = 0; j < m; j++){
             board[i][j] = (board[i][j] == 2 || board[i][j] == 0) ? 0 : 1;
          }
       }
    }
};
```

290. Word Pattern

Easy

Given a `pattern` and a string `str`, find if `str` follows the same pattern.

Here **follow** means a full match, such that there is a bijection between a letter in `pattern` and a **non-empty** word in `str`.

Example 1:

Input: pattern = "abba", str = "dog cat cat dog"

Output: true

Example 2:

Input:pattern = "abba", str = "dog cat cat fish"

Output: false

Example 3:

Input: pattern = "aaaa", str = "dog cat cat dog"

Output: false

Example 4:

Input: pattern = "abba", str = "dog dog dog dog"

Output: false

Notes:

You may assume `pattern` contains only lowercase letters, and `str` contains lowercase letters separated by a single space.

```
class Solution {
public:
    bool wordPattern(string pattern, string str) {

    }
};
```

```cpp
class Solution {
public:
    bool wordPattern(string pattern, string str) {
        stringstream ss(str), sss(pattern);
        int cnt = 0;
        char c;
        unordered_map<char, int> m1;
        unordered_map<string, int> m2;
        while (ss >> str) {
            if (!(sss >> c)) return false;
            if (m2[str] != m1[c]) return false;
            m1[c] = m2[str] = ++cnt;
        }
        return !(sss >> c);
    }
};
```

291. Word Pattern II

Given a `pattern` and a string `str`, find if `str` follows the same pattern.

Here **follow** means a full match, such that there is a bijection between a letter in `pattern` and a **non-empty** substring in `str`.

Example 1:

```
Input: pattern = "abab", str = "redblueredblue"

Output: true
```

Example 2:

```
Input: pattern = pattern = "aaaa", str = "asdasdasdasd"

Output: true
```

Example 3:

```
Input: pattern = "aabb", str = "xyzabcxzyabc"

Output: false
```

Notes:
You may assume both `pattern` and `str` contains only lowercase letters.

```cpp
class Solution {
public:
    bool wordPatternMatch(string pattern, string str) {
        v.resize(26, "");
        return dfs(0, pattern.size(), 0, str.size(), pattern, str);
    }
private:
    vector<string> v;
    unordered_set<string> myset;

    bool dfs(int i, int n, int j, int m, string &pattern, string &str) {
      if (i == n || j == m) {
          return i == n && j == m;
      }
      int c = pattern[i] - 'a';
      if (v[c] != "") {
          int len = v[c].size();
          if (m-j < len || str.substr(j, len) != v[c]) return false;
          return dfs(i+1, n, j+len, m, pattern, str);
      }
      for (int k = j+1; k <= m; ++k) {
          v[c] = str.substr(j, k-j);
          if (myset.count(v[c])) continue;
          myset.insert(v[c]);
          if (dfs(i+1, n, k, m, pattern, str)) return true;
          myset.erase(v[c]);
      }
      v[c] = "";
      return false;
    }
};
```

292. Nim Game

Easy

You are playing the following Nim Game with your friend: There is a heap of stones on the table, each time one of you take turns to remove 1 to 3 stones. The one who removes the last stone will be the winner. You will take the first turn to remove the stones.

Both of you are very clever and have optimal strategies for the game. Write a function to determine whether you can win the game given the number of stones in the heap.

Example:

Input: 4

Output: false

Explanation: If there are 4 stones in the heap, then you will never win the game;

No matter 1, 2, or 3 stones you remove, the last stone will always be

removed by your friend.

```
class Solution {
public:
    bool canWinNim(int n) {
        return n%4 != 0;
    }
};
```

293. Flip Game

You are playing the following Flip Game with your friend: Given a string that contains only these two characters: `+` and `-`, you and your friend take turns to flip two **consecutive** `"++"` into `"--"`. The game ends when a person can no longer make a move and therefore the other person will be the winner.

Write a function to compute all possible states of the string after one valid move.

Example:

```
Input: s = "++++"

Output:

[

  "--++",

  "+--+",

  "++--"

]
```

Note: If there is no valid move, return an empty list `[]`.

```
class Solution {
public:
    vector<string> generatePossibleNextMoves(string s) {

    }
};
```

```cpp
class Solution {
public:
    vector<string> generatePossibleNextMoves(string s) {
        vector<string> res;
        for (int i = s.length()-1; i > 0; i--) {
            if (s[i] == '+' && s[i-1] == '+') {
                string t = s;
                t[i] = t[i-1] = '-';
                res.push_back(t);
            }
        }
        return res;
    }
};
```

294. Flip Game II

You are playing the following Flip Game with your friend: Given a string that contains only these two characters: `+` and `-`, you and your friend take turns to flip two **consecutive** `"++"` into `"--"`. The game ends when a person can no longer make a move and therefore the other person will be the winner.

Write a function to determine if the starting player can guarantee a win.

Example:

```
Input: s = "++++"

Output: true

Explanation: The starting player can guarantee a win by flipping the middle
"++" to become "+--+".
```

Follow up:
Derive your algorithm's runtime complexity.

```
class Solution {
public:
    bool canWin(string s) {
        for (int i = s.length()-1; i > 0; i--) {
            if (s[i] == '+' && s[i-1] == '+') {
                string t = s.substr(0, i-1) + "--" + s.substr(i+1);
                if (!canWin(t)) return true;
            }
        }
        return false;
    }
};
```

295. Find Median from Data Stream

Hard

Median is the middle value in an ordered integer list. If the size of the list is even, there is no middle value. So the median is the mean of the two middle value.

For example,
`[2,3,4]`, the median is `3`

`[2,3]`, the median is `(2 + 3) / 2 = 2.5`

Design a data structure that supports the following two operations:

- void addNum(int num) - Add a integer number from the data stream to the data structure.
- double findMedian() - Return the median of all elements so far.

Example:

```
addNum(1)

addNum(2)

findMedian() -> 1.5

addNum(3)

findMedian() -> 2
```

Follow up:

1. If all integer numbers from the stream are between 0 and 100, how would you optimize it?
2. If 99% of all integer numbers from the stream are between 0 and 100, how would you optimize it?

```
class MedianFinder {
    priority_queue<long> small, large;
public:
    void addNum(int num) {
        small.push(num);
        large.push(-small.top());
        small.pop();
        if (small.size() < large.size()) {
            small.push(-large.top());
            large.pop();
        }
    }

    double findMedian() {
        if (small.size() > large.size()) return small.top();
        else return (small.top() - large.top()) / 2.0;
    }
};
```

296. Best Meeting Point

A group of two or more people wants to meet and minimize the total travel distance. You are given a 2D grid of values 0 or 1, where each 1 marks the home of someone in the group. The distance is calculated using Manhattan Distance, where distance(p1, p2) = `|p2.x - p1.x| + |p2.y - p1.y|`.

Example:

```
Input:


1 - 0 - 0 - 0 - 1

|   |   |   |   |

0 - 0 - 0 - 0 - 0

|   |   |   |   |

0 - 0 - 1 - 0 - 0


Output: 6


Explanation: Given three people living at (0,0), (0,4), and (2,2):

            The point (0,2) is an ideal meeting point, as the total travel
distance

            of 2+2+2=6 is minimal. So return 6.
```

```cpp
class Solution {
public:
    int minTotalDistance(vector<vector<int>>& grid) {
        vector<int> rows, cols;
        int n = grid.size(), m = grid[0].size();
        for (int i = 0; i < n; ++i) {
            for (int j = 0; j < m; ++j) {
                if (grid[i][j] == 1) {
                    rows.push_back(i);
                    cols.push_back(j);
                }
            }
        }
        sort(cols.begin(), cols.end());
        //row 已经排序好了
        int res = 0, i = 0, j = rows.size() - 1;
        while (i < j) res += rows[j] - rows[i] + cols[j--] - cols[i++];
        return res;
    }
};
```

297. Serialize and Deserialize Binary Tree(●ˇ∀ˇ●)

Hard

Serialization is the process of converting a data structure or object into a sequence of bits so that it can be stored in a file or memory buffer, or transmitted across a network connection link to be reconstructed later in the same or another computer environment.

Design an algorithm to serialize and deserialize a binary tree. There is no restriction on how your serialization/deserialization algorithm should work. You just need to ensure that a binary tree can be serialized to a string and this string can be deserialized to the original tree structure.

Example:

You may serialize the following tree:

```
    1
   / \
  2   3
     / \
    4   5
```

as "[1,2,3,null,null,4,5]"

Clarification: The above format is the same as how LeetCode serializes a binary tree. You do not necessarily need to follow this format, so please be creative and come up with different approaches yourself.

Note: Do not use class member/global/static variables to store states. Your serialize and deserialize algorithms should be stateless.

```
/**
 * Definition for a binary tree node.
 * struct TreeNode {
 *     int val;
 *     TreeNode *left;
 *     TreeNode *right;
 *     TreeNode(int x) : val(x), left(NULL), right(NULL) {}
 * };
 */
class Codec {
public:
    string serialize(TreeNode *root) {
        ostringstream out;
        serialize(root, out);
        return out.str();
    }

    TreeNode *deserialize(string data) {
        istringstream in(data);
        return deserialize(in);
    }

private:
    void serialize(TreeNode *root, ostringstream &out) {
        if (!root) {
            out << "# ";
            return;
        }
        out << root->val << ' ';
        serialize(root->left, out);
        serialize(root->right, out);
    }

    TreeNode* deserialize(istringstream &in) {
        string val;
        in >> val;
        if (val == "#") return nullptr;
        TreeNode* root = new TreeNode(stoi(val));
        root->left = deserialize(in);
        root->right = deserialize(in);
        return root;
    }
};
```

298. Binary Tree Longest Consecutive Sequence

Given a binary tree, find the length of the longest consecutive sequence path.

The path refers to any sequence of nodes from some starting node to any node in the tree along the parent-child connections. The longest consecutive path need to be from parent to child (cannot be the reverse).

Example 1:

```
Input:

   1
    \
     3
    / \
   2   4
        \
         5

Output: 3

Explanation: Longest consecutive sequence path is 3-4-5, so return 3.
```

Example 2:

```
Input:

   2
    \
     3
    /
   2
```

```
  /
 1
```

Output: 2

Explanation: Longest consecutive sequence path is 2-3, not 3-2-1, so return 2.

```
class Solution {
public:
    int longestConsecutive(TreeNode* root) {

    }
};
```

```
class Solution {
public:
    int longestConsecutive(TreeNode* root) {
        if (!root) return 0;
        dfs(root, root->val, 0);
        return res;
    }

private:
    int res = 0;
    void dfs(TreeNode *root, int pre, int len) {
        if (!root) return;
        res = max(res, len = (root->val == pre + 1) ? len+1 : 1);
        dfs(root->left, root->val, len);
        dfs(root->right, root->val, len);
    }
};
```

299. Bulls and Cows

Medium

You are playing the following Bulls and Cows game with your friend: You write down a number and ask your friend to guess what the number is. Each time your friend makes a guess, you provide a hint that indicates how many digits in said guess match your secret number exactly in both digit and position (called "bulls") and how many digits match the secret number but locate in the wrong position (called "cows"). Your friend will use successive guesses and hints to eventually derive the secret number.

Write a function to return a hint according to the secret number and friend's guess, use `A` to indicate the bulls and `B` to indicate the cows.

Please note that both secret number and friend's guess may contain duplicate digits.

Example 1:

Input: secret = "1807", guess = "7810"

Output: "1A3B"

Explanation: 1 bull and 3 cows. The bull is 8, the cows are 0, 1 and 7.

Example 2:

Input: secret = "1123", guess = "0111"

Output: "1A1B"

Explanation: The 1st 1 in friend's guess is a bull, the 2nd or 3rd 1 is a cow.

Note: You may assume that the secret number and your friend's guess only contain digits, and their lengths are always equal.

```
class Solution {
public:
    string getHint(string secret, string guess) {

    }
};
```

```cpp
class Solution {
public:
    string getHint(string secret, string guess) {
        int m[256] = {0};
        int bulls = 0, sum = 0, sz = guess.size();
        for (auto &c : secret) m[c]++;
        for (int i = 0; i < sz; ++i) {
            if (secret[i] == guess[i])   bulls++;
            if (m[guess[i]]) {
                sum++;
                m[guess[i]]--;
            }
        }
        return  to_string(bulls) + "A" + to_string(sum-bulls) + "B";
    }
};
```

300. Longest Increasing Subsequence(●ˇ∀ ˇ●)

Medium

Given an unsorted array of integers, find the length of longest increasing subsequence.

Example:

Input: [10,9,2,5,3,7,101,18]

Output: 4

Explanation: The longest increasing subsequence is [2,3,7,101], therefore the length is 4.

Note:

- There may be more than one LIS combination, it is only necessary for you to return the length.
- Your algorithm should run in O(n^2) complexity.

Follow up: Could you improve it to O(n log n) time complexity?

```
class Solution {
public:
    int lengthOfLIS(vector<int>& nums) {

    }
};
```

```
//////////////////////////////////////////////// O(n^2)//////////////////////////////////////////////////
class Solution {
public:
    int lengthOfLIS(vector<int>& nums) {
        if (nums.empty()) return 0;
        int n = nums.size(), res = 1;
        vector<int> f(n, 1);
        for (int i = 1; i < n; i++) {
            for (int j = 0; j < i; j++) {
                if (nums[i] > nums[j]) {
                    f[i] = max(f[j]+1, f[i]);
                    res = max(res, f[i]);
                }
            }
        }
        return res;
    }
};
```

//O($n \log n$)//

```
class Solution {
public:
    int lengthOfLIS(vector<int>& nums) {
        vector<int> res;
        for (auto &i : nums) {
            auto it = lower_bound(res.begin(), res.end(), i);
            if (it == res.end()) res.push_back(i);
            else *it = i;
        }
        return res.size();
    }
};
```