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## 1. Two Sum

Easy

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

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

**Example:**

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

Because nums[**0**] + nums[**1**] = 2 + 7 = 9,

return [**0**, **1**].

class Solution **{**

public**:**

vector**<**int**>** twoSum**(**vector**<**int**>&** nums**,** int target**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**int**>** twoSum**(**vector**<**int**>&** nums**,** int target**)** **{**

unordered\_map**<**int**,** int**>** my\_map**;**

**for (**int i **=** 0**;** i **<** nums**.**size**();** i**++){**

**if (**my\_map**.**count**(**target**-**nums**[**i**])** **&&** i **!=** my\_map**[**target**-**nums**[**i**]]) {**

**return** **{**i**,** my\_map**[**target**-**nums**[**i**]]};**

**}**

my\_map**[**nums**[**i**]]** **=** i**;**

**}**

**}**

**};**

## 2. Add Two Numbers

Medium

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

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

**Example:**

**Input:** (2 -> 4 -> 3) + (5 -> 6 -> 4)

**Output:** 7 -> 0 -> 8

**Explanation:** 342 + 465 = 807.

/\*\*

\* Definition for singly-linked list.

\* struct ListNode {

\* int val;

\* ListNode \*next;

\* ListNode(int x) : val(x), next(NULL) {}

\* };

\*/

class Solution **{**

public**:**

ListNode**\*** addTwoNumbers**(**ListNode**\*** l1**,** ListNode**\*** l2**)** **{**

**}**

**};**

class Solution **{**

public**:**

ListNode**\*** addTwoNumbers**(**ListNode **\***l1**,** ListNode **\***l2**)** **{**

ListNode **\***res **=** **new** ListNode**(-**1**),** **\***p **=** res**;**

int c **=** 0**;**

**while (**l1 **||** l2**){**

int a **=** l1 **?** l1**->**val **:** 0**;**

int b **=** l2 **?** l2**->**val **:** 0**;**

p**->**next **=** **new** ListNode**((**c **+** a **+** b**)** **%** 10**);**

c **=** **(**c **+** a **+** b**)** **/** 10**;**

p **=** p**->**next**;**

**if** **(**l1**)** l1 **=** l1**->**next**;**

**if** **(**l2**)** l2 **=** l2**->**next**;**

**}**

**if (**c **>** 0**)** p**->**next **=** **new** ListNode**(**c**);**

**return** res**->**next**;**

**}**

**};**

## 3. Longest Substring Without Repeating Characters★★

Medium

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

**Example 1:**

**Input:** "abcabcbb"

**Output:** 3

**Explanation:** The answer is "abc", with the length of 3.

**Example 2:**

**Input:** "bbbbb"

**Output:** 1

**Explanation:** The answer is "b", with the length of 1.

**Example 3:**

**Input:** "pwwkew"

**Output:** 3

**Explanation:** The answer is "wke", with the length of 3.

Note that the answer must be a **substring**, "pwke" is a *subsequence* and not a substring.

class Solution **{**

public**:**

int lengthOfLongestSubstring**(**string s**)** **{**

**}**

**};**

class Solution **{**

public**:**

int lengthOfLongestSubstring**(**string s**)** **{**

**if (**s**.**empty**())** **return** 0**;**

int n **=** s**.**length**(),** left **=** **-**1**,** res **=** 1**;**

vector**<**int**>** m**(**128**,-**1**);**

**for (**int i **=** 0**;** i **<** n**;** i**++) {**

left **=** max**(**left**,** m**[**s**[**i**]]);**

m**[**s**[**i**]]** **=** i**;**

res **=** max**(**res**,** i**-**left**);**

**}**

**return** res**;**

**}**

**};**

## 4. Median of Two Sorted Arrays★★

Hard

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

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

You may assume **nums1** and **nums2** cannot be both empty.

**Example 1:**

nums1 = [1, 3]

nums2 = [2]

The median is 2.0

**Example 2:**

nums1 = [1, 2]

nums2 = [3, 4]

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

class Solution **{**

public**:**

double findMedianSortedArrays**(**vector**<**int**>&** nums1**,** vector**<**int**>&** nums2**)** **{**

**}**

**};**

class Solution **{**

public**:**

double findMedianSortedArrays**(**vector**<**int**>&** nums1**,** vector**<**int**>&** nums2**)** **{**

int m **=** nums1**.**size**(),** n **=** nums2**.**size**();**

double res **=** findKth**(**nums1**,** 0**,** nums2**,** 0**,** **(**m**+**n**+**1**)/**2**);**

**if** **((**m**+**n**)** **%** 2 **!=** 0**)** **return** res**;**

res **+=** findKth**(**nums1**,** 0**,** nums2**,** 0**,** **(**m**+**n**+**2**)/**2**);**

**return** res **/** 2.0**;**

**}**

private**:**

int findKth**(**vector**<**int**>&** nums1**,** int i**,** vector**<**int**>&** nums2**,** int j**,** int k**)** **{**

**if** **(**i **>=** nums1**.**size**())** **return** nums2**[**j **+** k **-** 1**];**

**if** **(**j **>=** nums2**.**size**())** **return** nums1**[**i **+** k **-** 1**];**

**if** **(**k **==** 1**)** **return** min**(**nums1**[**i**],** nums2**[**j**]);**

int midVal1 **=** **(**i**+**k**/**2**-**1 **<** nums1**.**size**())** **?** nums1**[**i**+**k**/**2**-**1**]** **:** INT\_MAX**;**

int midVal2 **=** **(**j**+**k**/**2**-**1 **<** nums2**.**size**())** **?** nums2**[**j**+**k**/**2**-**1**]** **:** INT\_MAX**;**

**if** **(**midVal1 **<** midVal2**)** **return** findKth**(**nums1**,** i**+**k**/**2**,** nums2**,** j**,** k**-**k**/**2**);**

**else** **return** findKth**(**nums1**,** i**,** nums2**,** j**+**k**/**2**,** k**-**k**/**2**);**

**}**

**};**

## 5. Longest Palindromic Substring★★

Medium

Given a string **s**, find the longest palindromic substring in **s**. You may assume that the maximum length of **s** is 1000.

**Example 1:**

**Input:** "babad"

**Output:** "bab"

**Note:** "aba" is also a valid answer.

**Example 2:**

**Input:** "cbbd"

**Output:** "bb"

class Solution **{**

public**:**

string longestPalindrome**(**string s**)** **{**

**}**

**};**

class Solution **{**

public**:**

string longestPalindrome**(**string s**)** **{**

string T **=** preProcess**(**s**);**

const int n **=** T**.**length**();**

int P**[**n**];**

int C **=** 0**,** R **=** 0**;**

**for** **(**int i **=** 1**;** i **<** n **-** 1**;** i**++)** **{**

int i\_mirror **=** 2 **\*** C **-** i**;**

P**[**i**]** **=** **(**R **>** i**)** **?** min**(**R **-** i**,** P**[**i\_mirror**])** **:** 0**;**

**while** **(**T**[**i **+** 1 **+** P**[**i**]]** **==** T**[**i **-** 1 **-** P**[**i**]])** P**[**i**]++;**

**if** **(**i **+** P**[**i**]** **>** R**)** **{**

C **=** i**;**

R **=** i **+** P**[**i**];**

**}**

**}**

int max\_len **=** 0**,** center\_index **=** 0**;**

**for** **(**int i **=** 1**;** i **<** n **-** 1**;** i**++)** **{**

**if** **(**P**[**i**]** **>** max\_len**)** **{**

max\_len **=** P**[**i**];**

center\_index **=** i**;**

**}**

**}**

**return** s**.**substr**((**center\_index **-** 1 **-** max\_len**)** **/** 2**,** max\_len**);**

**}**

private**:**

string preProcess**(**string **&**s**)** **{**

int n **=** s**.**length**();**

**if** **(**n **==** 0**)** **return** "^$"**;**

string ret **=** "^"**;**

**for** **(**int i **=** 0**;** i **<** n**;** i**++)** ret **+=** "#" **+** s**.**substr**(**i**,** 1**);**

**return** ret **+** "#$"**;**

**}**

**};**

## 6. ZigZag Conversion

Medium

The string "PAYPALISHIRING" is written in a zigzag pattern on a given number of rows like this: (you may want to display this pattern in a fixed font for better legibility)

P A H N

A P L S I I G

Y I R

And then read line by line: "PAHNAPLSIIGYIR"

Write the code that will take a string and make this conversion given a number of rows:

string convert(string s, int numRows);

**Example 1:**

**Input:** s = "PAYPALISHIRING", numRows = 3

**Output:** "PAHNAPLSIIGYIR"

**Example 2:**

**Input:** s = "PAYPALISHIRING", numRows = 4

**Output:** "PINALSIGYAHRPI"

**Explanation:**

P I N

A L S I G

Y A H R

P I

class Solution **{**

public**:**

string convert**(**string s**,** int numRows**)** **{**

**}**

**};**

class Solution **{**

public**:**

string convert**(**string s**,** int numRows**)** **{**

**if (**numRows **==** 1**)** **return** s**;**

int n **=** s**.**length**();**

string res**;**

**for (**int i **=** 0**;** i **<** numRows**;** i**++) {**

**for (**int j **=** i**;** j **<** n**;** j **+=** 2**\***numRows**-**2**) {**

res **+=** s**[**j**];**

**if (**i **==** 0 **||** i **==** numRows**-**1**)** **continue;**

**if (**j**+**2**\*(**numRows**-**i**-**1**)** **<** n**)** res **+=** s**[**j**+**2**\*(**numRows**-**i**-**1**)];**

**}**

**}**

**return** res**;**

**}**

**};**

## 7. Reverse Integer

Easy

Given a 32-bit signed integer, reverse digits of an integer.

**Example 1:**

**Input:** 123

**Output:** 321

**Example 2:**

**Input:** -123

**Output:** -321

**Example 3:**

**Input:** 120

**Output:** 21

**Note:**  
Assume we are dealing with an environment which could only store integers within the 32-bit signed integer range: [−231,  231− 1]. For the purpose of this problem, assume that your function returns 0 when the reversed integer overflows.

class Solution **{**

public**:**

int reverse**(**int x**)** **{**

**}**

**};**

class Solution **{**

public**:**

int reverse**(**int x**)** **{**

int rev **=** 0**;**

**while** **(**x **!=** 0**)** **{**

int pop **=** x **%** 10**;**

x **/=** 10**;**

**if** **(**rev **>** INT\_MAX**/**10 **||** **(**rev **==** INT\_MAX**/**10 **&&** pop **>** 7**)) return** 0**;**

**if** **(**rev **<** INT\_MIN**/**10 **||** **(**rev **==** INT\_MIN**/**10 **&&** pop **<** **-**8**)) return** 0**;**

rev **=** rev **\*** 10 **+** pop**;**

**}**

**return** rev**;**

**}**

**};**

## 8. String to Integer (atoi)

Medium

Implement atoi which converts a string to an integer.

The function first discards as many whitespace characters as necessary until the first non-whitespace character is found. Then, starting from this character, takes an optional initial plus or minus sign followed by as many numerical digits as possible, and interprets them as a numerical value.

The string can contain additional characters after those that form the integral number, which are ignored and have no effect on the behavior of this function.

If the first sequence of non-whitespace characters in str is not a valid integral number, or if no such sequence exists because either str is empty or it contains only whitespace characters, no conversion is performed.

If no valid conversion could be performed, a zero value is returned.

**Note:**

* Only the space character ' ' is considered as whitespace character.
* Assume we are dealing with an environment which could only store integers within the 32-bit signed integer range: [−231,  231− 1]. If the numerical value is out of the range of representable values, INT\_MAX (231− 1) or INT\_MIN (−231) is returned.

**Example 1:**

**Input:** "42"

**Output:** 42

**Example 2:**

**Input:** " -42"

**Output:** -42

**Explanation:** The first non-whitespace character is '-', which is the minus sign.

  Then take as many numerical digits as possible, which gets 42.

**Example 3:**

**Input:** "4193 with words"

**Output:** 4193

**Explanation:** Conversion stops at digit '3' as the next character is not a numerical digit.

**Example 4:**

**Input:** "words and 987"

**Output:** 0

**Explanation:** The first non-whitespace character is 'w', which is not a numerical

  digit or a +/- sign. Therefore no valid conversion could be performed.

**Example 5:**

**Input:** "-91283472332"

**Output:** -2147483648

**Explanation:** The number "-91283472332" is out of the range of a 32-bit signed integer.

  Therefore INT\_MIN (−231) is returned.

class Solution **{**

public**:**

int myAtoi**(**string str**)** **{**

**}**

**};**

class Solution **{**

public**:**

int myAtoi**(**string str**)** **{**

long res **=** 0**;**

int sign **=** 1**,** n **=** str**.**length**(),** i **=** str**.**find\_first\_not\_of**(**' '**);**

**if** **(**str**[**i**]** **==** '+' **||** str**[**i**]** **==** '-'**)** sign **=** str**[**i**++]** **==** '+' **?** 1 **:** **-**1**;**

**while** **(**i **<** n **&&** isdigit**(**str**[**i**]))** **{**

res **=** res **\*** 10 **+** str**[**i**++]-**'0'**;**

**if** **(**res **\*** sign **>** INT\_MAX**)** **return** INT\_MAX**;**

**if** **(**res **\*** sign **<** INT\_MIN**)** **return** INT\_MIN**;**

**}**

**return** res **\*** sign**;**

**}**

**};**

## 9. Palindrome Number

Easy

Determine whether an integer is a palindrome. An integer is a palindrome when it reads the same backward as forward.

**Example 1:**

**Input:** 121

**Output:** true

**Example 2:**

**Input:** -121

**Output:** false

**Explanation:** From left to right, it reads -121. From right to left, it becomes 121-. Therefore it is not a palindrome.

**Example 3:**

**Input:** 10

**Output:** false

**Explanation:** Reads 01 from right to left. Therefore it is not a palindrome.

**Follow up:**

Could you solve it without converting the integer to a string?

class Solution **{**

public**:**

bool isPalindrome**(**int x**)** **{**

**}**

**}**

class Solution **{**

public**:**

bool isPalindrome**(**int x**)** **{**

**if** **(**x **<** 0 **||** **(**x **%** 10 **==** 0 **&&** x **!=** 0**))** **return** **false;**

int y **=** 0**,** n **=** x**;**

**while** **(**n**)** **{**

**if** **(**y **>=** INT\_MAX **/** 10**)** **return** **false;**

y **=** y **\*** 10 **+** n **%** 10**;**

n **/=** 10**;**

**}**

**return** x **==** y**;**

**}**

**};**

///////////////////////////////////////////////////////////////////

class Solution **{**

public**:**

bool isPalindrome**(**int x**)** **{**

// 特殊情况：

// 如上所述，当 x < 0 时，x 不是回文数。

// 同样地，如果数字的最后一位是 0，为了使该数字为回文，

// 则其第一位数字也应该是 0

// 只有 0 满足这一属性

**if (**x **<** 0 **||** **(**x **%** 10 **==** 0 **&&** x **!=** 0**))** **return** **false;**

int revertedNumber **=** 0**;**

**while (**x **>** revertedNumber**)** **{**

revertedNumber **=** revertedNumber **\*** 10 **+** x **%** 10**;**

x **/=** 10**;**

**}**

// 当数字长度为奇数时，我们可以通过 revertedNumber/10 去除处于中位的数字。

// 例如，当输入为 12321 时，在 while 循环的末尾我们可以得到 x = 12，revertedNumber = 123，

// 由于处于中位的数字不影响回文（它总是与自己相等），所以我们可以简单地将其去除。

**return** x **==** revertedNumber **||** x **==** revertedNumber**/**10**;**

**}**

**};**

## 10. Regular Expression Matching★★

Hard

Given an input string (s) and a pattern (p), implement regular expression matching with support for '.' and '\*'.

'.' Matches any single character.

'\*' Matches zero or more of the preceding element.

The matching should cover the **entire** input string (not partial).

**Note:**

* s could be empty and contains only lowercase letters a-z.
* p could be empty and contains only lowercase letters a-z, and characters like . or \*.

**Example 1:**

**Input:**

s = "aa"

p = "a"

**Output:** false

**Explanation:** "a" does not match the entire string "aa".

**Example 2:**

**Input:**

s = "aa"

p = "a\*"

**Output:** true

**Explanation:** '\*' means zero or more of the precedeng element, 'a'. Therefore, by repeating 'a' once, it becomes "aa".

**Example 3:**

**Input:**

s = "ab"

p = ".\*"

**Output:** true

**Explanation:** ".\*" means "zero or more (\*) of any character (.)".

**Example 4:**

**Input:**

s = "aab"

p = "c\*a\*b"

**Output:** true

**Explanation:** c can be repeated 0 times, a can be repeated 1 time. Therefore it matches "aab".

**Example 5:**

**Input:**

s = "mississippi"

p = "mis\*is\*p\*."

**Output:** false

class Solution **{**

public**:**

bool isMatch**(**string s**,** string p**)** **{**

**}**

**};**

class Solution **{**

public**:**

bool isMatch**(**string s**,** string p**)** **{**

**if** **(**p**.**empty**())** **return** s**.**empty**();**

**if** **(**p**.**length**()** **>** 1 **&&** p**[**1**]** **==** '\*'**)** **{**

**return** isMatch**(**s**,** p**.**substr**(**2**))**

**||** **(!**s**.**empty**()** **&&** **(**s**[**0**]** **==** p**[**0**]** **||** p**[**0**]** **==** '.'**)**

**&&** isMatch**(**s**.**substr**(**1**),** p**));**

**}**

**else** **return** **!**s**.**empty**()** **&&** **(**s**[**0**]** **==** p**[**0**]** **||** p**[**0**]** **==** '.'**)**

**&&** isMatch**(**s**.**substr**(**1**),** p**.**substr**(**1**));**

**}**

**};**

**///////////////////////////////////////////dp///////////////////////////////////////////**

class Solution **{**

public**:**

bool isMatch**(**string s**,** string p**)** **{**

**if** **(**p**.**empty**())** **return** s**.**empty**();**

int m **=** s**.**size**(),** n **=** p**.**size**(),** k **=** 0**;**

vector**<**vector**<**bool**>>** dp**(**2**,** vector**<**bool**>(**n **+** 1**,** **false));**

**for** **(**int i **=** 0**;** i **<=** m**;** i**++)** **{**

**for** **(**int j **=** 0**;** j **<=** n**;** j**++)** **{**

**if** **(**j **==** 0**)** dp**[**k**][**j**]** **=** i **==** 0**;**

**else** **if** **(**p**[**j**-**1**]** **==** '\*'**)** **{**

dp**[**k**][**j**]** **=** dp**[**k**][**j**-**2**]**

**||** **(**i **&&** dp**[**k**^**1**][**j**]**

**&&** **(**s**[**i**-**1**]** **==** p**[**j**-**2**]** **||** p**[**j**-**2**]** **==** '.'**));**

**}** **else** **{**

dp**[**k**][**j**]** **=** i **&&** dp**[**k**^**1**][**j**-**1**]**

**&&** **(**s**[**i**-**1**]** **==** p**[**j**-**1**]** **||** p**[**j**-**1**]** **==** '.'**);**

**}**

**}**

k **^=** 1**;**

**}**

**return** dp**[**k**^**1**][**n**];**

**}**

**};**

## 11. Container With Most Water

Medium

Given *n* non-negative integers *a1*, *a2*, ..., *an*, where each represents a point at coordinate (*i*, *ai*). *n* vertical lines are drawn such that the two endpoints of line *i* is at (*i*, *ai*) and (*i*, 0). Find two lines, which together with x-axis forms a container, such that the container contains the most water.

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



The above vertical lines are represented by array [1,8,6,2,5,4,8,3,7]. In this case, the max area of water (blue section) the container can contain is 49.

**Example:**

**Input:** [1,8,6,2,5,4,8,3,7]

**Output:** 49

class Solution **{**

public**:**

int maxArea**(**vector**<**int**>&** height**)** **{**

**}**

**};**

class Solution **{**

public**:**

int maxArea**(**vector**<**int**>&** height**)** **{**

int MAX **=** **-**1**,** L **=** 0**,** R **=** height**.**size**()-**1**;**

**while (**L **<** R**){**

MAX **=** max**(**MAX**,** **(**R**-**L**) \*** min**(**height**[**L**],** height**[**R**]));**

height**[**L**]** **>** height**[**R**] ?** R**-- :** L**++;**

**}**

**return** MAX**;**

**}**

**};**

## 12. Integer to Roman

Medium

Roman numerals are represented by seven different symbols: I, V, X, L, C, D and M.

**Symbol** **Value**

I 1

V 5

X 10

L 50

C 100

D 500

M 1000

For example, two is written as II in Roman numeral, just two one's added together. Twelve is written as, XII, which is simply X + II. The number twenty seven is written as XXVII, which is XX + V + II.

Roman numerals are usually written largest to smallest from left to right. However, the numeral for four is not IIII. Instead, the number four is written as IV. Because the one is before the five we subtract it making four. The same principle applies to the number nine, which is written as IX. There are six instances where subtraction is used:

* I can be placed before V (5) and X (10) to make 4 and 9.
* X can be placed before L (50) and C (100) to make 40 and 90.
* C can be placed before D (500) and M (1000) to make 400 and 900.

Given an integer, convert it to a roman numeral. Input is guaranteed to be within the range from 1 to 3999.

**Example 1:**

**Input:** 3

**Output:** "III"

**Example 2:**

**Input:** 4

**Output:** "IV"

**Example 3:**

**Input:** 9

**Output:** "IX"

**Example 4:**

**Input:** 58

**Output:** "LVIII"

**Explanation:** L = 50, V = 5, III = 3.

**Example 5:**

**Input:** 1994

**Output:** "MCMXCIV"

**Explanation:** M = 1000, CM = 900, XC = 90 and IV = 4.

class Solution **{**

public**:**

string intToRoman**(**int num**)** **{**

**}**

**};**

class Solution **{**

public**:**

string intToRoman**(**int num**)** **{**

string res **=** ""**;**

vector**<**int**>** val**{**1000**,** 900**,** 500**,** 400**,** 100**,** 90**,** 50**,** 40**,** 10**,** 9**,** 5**,** 4**,** 1**};**

vector**<**string**>** str**{**"M"**,** "CM"**,** "D"**,** "CD"**,** "C"**,** "XC"**,** "L"**,** "XL"**,** "X"**,** "IX"**,** "V"**,** "IV"**,** "I"**};**

**for** **(**int i **=** 0**;** i **<** val**.**size**();** **++**i**)** **{**

**while** **(**num **>=** val**[**i**])** **{**

num **-=** val**[**i**];**

res **+=** str**[**i**];**

**}**

**}**

**return** res**;**

**}**

**};**

## 13. Roman to Integer

Easy

Roman numerals are represented by seven different symbols: I, V, X, L, C, D and M.

**Symbol** **Value**

I 1

V 5

X 10

L 50

C 100

D 500

M 1000

For example, two is written as II in Roman numeral, just two one's added together. Twelve is written as, XII, which is simply X + II. The number twenty seven is written as XXVII, which is XX + V + II.

Roman numerals are usually written largest to smallest from left to right. However, the numeral for four is not IIII. Instead, the number four is written as IV. Because the one is before the five we subtract it making four. The same principle applies to the number nine, which is written as IX. There are six instances where subtraction is used:

* I can be placed before V (5) and X (10) to make 4 and 9.
* X can be placed before L (50) and C (100) to make 40 and 90.
* C can be placed before D (500) and M (1000) to make 400 and 900.

Given a roman numeral, convert it to an integer. Input is guaranteed to be within the range from 1 to 3999.

**Example 1:**

**Input:** "III"

**Output:** 3

**Example 2:**

**Input:** "IV"

**Output:** 4

**Example 3:**

**Input:** "IX"

**Output:** 9

**Example 4:**

**Input:** "LVIII"

**Output:** 58

**Explanation:** L = 50, V= 5, III = 3.

**Example 5:**

**Input:** "MCMXCIV"

**Output:** 1994

**Explanation:** M = 1000, CM = 900, XC = 90 and IV = 4.

class Solution **{**

public**:**

int romanToInt**(**string s**)** **{**

**}**

**};**

class Solution **{**

public**:**

int romanToInt**(**string s**)** **{**

**if (**s**.**empty**())** **return** 0**;**

map**<**char**,** int**>** My\_map**{{**'I'**,**1**},{**'V'**,**5**},{**'X'**,** 10**},{**'L'**,**50**},**

**{**'C'**,**100**},{**'D'**,**500**},{**'M'**,** 1000**}};**

int len **=** s**.**length**(),** res **=** My\_map**[**s**[**len**-**1**]];**

**for(**int i **=** 0**;** i **<** len**-**1**;** i**++){**

**if (**My\_map**[**s**[**i**]]** **<** My\_map**[**s**[**i**+**1**]])** res **-=** My\_map**[**s**[**i**]];**

**else** res **+=** My\_map**[**s**[**i**]];**

**}**

**return** res**;**

**}**

**};**

## 14. Longest Common Prefix

Easy

Write a function to find the longest common prefix string amongst an array of strings.

If there is no common prefix, return an empty string "".

**Example 1:**

**Input:** ["flower","flow","flight"]

**Output:** "fl"

**Example 2:**

**Input:** ["dog","racecar","car"]

**Output:** ""

**Explanation:** There is no common prefix among the input strings.

**Note:**

All given inputs are in lowercase letters a-z.

class Solution **{**

public**:**

string longestCommonPrefix**(**vector**<**string**>&** strs**)** **{**

**}**

**};**

class Solution **{**

public**:**

string longestCommonPrefix**(**vector**<**string**>&** strs**)** **{**

string res **=** ""**;**

**if** **(**strs**.**empty**())** **return** res**;**

int len **=** strs**[**0**].**length**();**

**for (**int i **=** 0**;** i **<** len**;** i**++){**

char c **=** strs**[**0**][**i**];**

**for (**auto **&**str **:** strs**){**

**if (**str**.**length**()** **<** i **||** str**[**i**]** **!=** c**)** **return** res**;**

**}**

res **+=** c**;**

**}**

**return** res**;**

**}**

**};**

## 15. 3Sum

Medium

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

**Note:**

The solution set must not contain duplicate triplets.

**Example:**

Given array nums = [-1, 0, 1, 2, -1, -4],

A solution set is:

[

[-1, 0, 1],

[-1, -1, 2]

]

class Solution **{**

public**:**

vector**<**vector**<**int**>>** threeSum**(**vector**<**int**>&** nums**)** **{**

**}**

**};**

class Solution {

public:

    vector<vector<int>> threeSum(vector<int>& nums) {

        vector<vector<int>> ans;

        if (nums.size() < 3) return ans;

        sort(nums.begin(), nums.end());

        for (auto i = nums.begin(); i != nums.end()-2; i++){

            if (i > nums.begin() && \*i == \*(i-1)) continue;

            auto j = i + 1, k = nums.end() - 1;

            while (j < k){

                if (\*i + \*j + \*k < 0)   {

                    j++;

                    while (j < k && \*j == \*(j-1)) j++;

                }

                else if (\*i + \*j + \*k > 0)  {

                    k--;

                    while (j < k && \*k == \*(k+1)) k--;

                }

                else {

                    ans.push\_back({\*i,\*j,\*k});

                    j++; k--;

                    while (j < k && \*j == \*(j-1)) j++;

                    while (j < k && \*k == \*(k+1)) k--;

                }

            }

        }

        return ans;

    }

};

## 16. 3Sum Closest

Medium

Given an array nums of *n* integers and an integer target, find three integers in nums such that the sum is closest to target. Return the sum of the three integers. You may assume that each input would have exactly one solution.

**Example:**

Given array nums = [-1, 2, 1, -4], and target = 1.

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

class Solution **{**

public**:**

int threeSumClosest**(**vector**<**int**>&** nums**,** int target**)** **{**

**}**

**};**

class Solution **{**

public**:**

int threeSumClosest**(**vector**<**int**>&** nums**,** int target**)** **{**

sort**(**nums**.**begin**(),** nums**.**end**());**

int ans**,** minn **=** numeric\_limits**<**int**>::**max**();**

**for** **(**auto i **=** nums**.**begin**();** i **!=** nums**.**end**()** **-** 2**;** i**++){**

auto j **=** i **+** 1**,** k **=** nums**.**end**()** **-** 1**;**

**while** **(**j **<** k**) {**

int sum **=** **\***i **+** **\***j **+** **\***k**;**

**if** **(**minn **>** abs**(**sum **-** target**))** **{**

minn **=** abs**(**sum **-** target**);**

ans **=** sum**;**

**}**

**if** **(**sum **<** target**)** j**++;**

**else** **if** **(**sum **>** target**)** k**--;**

**else** **return** target**;**

**}**

**}**

**return** ans**;**

**}**

**};**

## 17. Letter Combinations of a Phone Number

Medium

Given a string containing digits from 2-9 inclusive, return all possible letter combinations that the number could represent.

A mapping of digit to letters (just like on the telephone buttons) is given below. Note that 1 does not map to any letters.



**Example:**

**Input:** "23"

**Output:** ["ad", "ae", "af", "bd", "be", "bf", "cd", "ce", "cf"].

**Note:**

Although the above answer is in lexicographical order, your answer could be in any order you want.

class Solution **{**

public**:**

vector**<**string**>** letterCombinations**(**string digits**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**string**>** letterCombinations**(**string digits**)** **{**

vector**<**string**>** res**;**

**if** **(**digits**.**empty**())** **return** res**;**

dfs**(””,** 0**,** digits**,** res**);**

**return** res**;**

**}**

private**:**

string a**[**8**]** **=** **{**"abc"**,** "def"**,** "ghi"**,** "jkl"**,**

"mno"**,** "pqrs"**,** "tuv"**,** "wxyz"**};**

void dfs**(**string s**,** int i**,** string **&**digits**,** vector**<**string**>** **&**res**){**

**if** **(**i **==** digits**.**length**())** res**.**push\_back**(**s**);**

**else** **for (**auto c **:** a**[**digits**[**i**]-**'2'**]) {**

dfs**(**s**+**c**,** i**+**1**,** digits**,** res**);**

**}**

**}**

**};**

## 18. 4Sum

Medium

Given an array nums of *n* integers and an integer target, are there elements *a*, *b*, *c*, and *d* in nums such that *a* + *b* + *c* + *d* = target? Find all unique quadruplets in the array which gives the sum of target.

**Note:**

The solution set must not contain duplicate quadruplets.

**Example:**

Given array nums = [1, 0, -1, 0, -2, 2], and target = 0.

A solution set is:

[

[-1, 0, 0, 1],

[-2, -1, 1, 2],

[-2, 0, 0, 2]

]

class Solution **{**

public**:**

vector**<** vector**<**int**>** **>** fourSum**(**vector**<**int**>** **&**nums**,** int target**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**vector**<**int**>>** fourSum**(**vector**<**int**>** **&**nums**,** int target**)** **{**

vector**<**vector**<**int**>>** res**;**

int n **=** nums**.**size**();**

sort**(**nums**.**begin**(),** nums**.**end**());**

**for** **(**int i **=** 0**;** i **<** n**-**3**;** **++**i**)** **{**

**if (**i **>** 0 **&&** nums**[**i**]** **==** nums**[**i**-**1**])** **continue;**

**for** **(**int j **=** i**+**1**;** j **<** n**-**2**;** **++**j**)** **{**

**if** **(**j **>** i**+**1 **&&** nums**[**j**]** **==** nums**[**j**-**1**])** **continue;**

int left **=** j**+**1**,** right **=** n**-**1**;**

**while** **(**left **<** right**)** **{**

int sum **=** nums**[**i**]** **+** nums**[**j**]** **+** nums**[**left**]** **+** nums**[**right**];**

**if** **(**sum **==** target**)** **{**

res**.**push\_back**(** **{**nums**[**i**],** nums**[**j**],**

nums**[**left**],** nums**[**right**]}** **);**

**while** **(**left **<** right **&&** nums**[**left**]** **==** nums**[**left**+**1**])**

**++**left**;**

**while** **(**left **<** right **&&** nums**[**right**]** **==** nums**[**right**-**1**])**

**--**right**;**

**++**left**;** **--**right**;**

**}**

**else** **if** **(**sum **<** target**)** **++**left**;**

**else** **--**right**;**

**}**

**}**

**}**

**return** res**;**

**}**

**};**

/////////////////////好O（n^2） 坏O（n^4）//////////////////////////////

class Solution {

public:

    vector<vector<int>> fourSum(vector<int>& nums, int target) {

        vector<vector<int>> res;

        unordered\_map<int, vector<pair<int,int>>> My\_map;

        int n = nums.size();

        if (n < 4) return res;

        sort(nums.begin(), nums.end());

        for (auto i = 0; i < n; i++){

            for (int j = i+1; j < n; j++)

                My\_map[nums[i]+nums[j]].emplace\_back(i, j);

        }

        for (auto &i : My\_map) if (My\_map.count(target-i.first)){

            auto j = My\_map.find(target-i.first);

            for(auto &[a, b] : i.second){

                for(auto &[c, d] : j->second) {

                    if (b >= c) continue;

                    res.push\_back({nums[a],nums[b],nums[c],nums[d]});

                }

            }

        }

        sort(res.begin(), res.end());

        res.erase(unique(res.begin(), res.end()), res.end());

        return  res;

    }

};

## 19. Remove Nth Node From End of List

Medium

Given a linked list, remove the *n*-th node from the end of list and return its head.

**Example:**

Given linked list: **1->2->3->4->5**, and ***n* = 2**.

After removing the second node from the end, the linked list becomes **1->2->3->5**.

**Note:**

Given *n* will always be valid.

**Follow up:**

Could you do this in one pass?

/\*\*

\* Definition for singly-linked list.

\* struct ListNode {

\* int val;

\* ListNode \*next;

\* ListNode(int x) : val(x), next(NULL) {}

\* };

\*/

class Solution **{**

public**:**

ListNode**\*** removeNthFromEnd**(**ListNode**\*** head**,** int n**)** **{**

**}**

**};**

class Solution **{**

public**:**

ListNode**\*** removeNthFromEnd**(**ListNode**\*** head**,** int n**)** **{**

ListNode \*dummy **= new ListNode(-1);**

dummy**->**next **=** head**;**

ListNode **\***pre **=** dummy**,** **\***p **=** pre**;**

**While (**n**--)** p **=** p**->**next**;**

**While (**p**->**next**) {**

p **=** p**->**next**;**

pre **=** pre**->**next**;**

**}**

pre**->**next **=** pre**->**next**->**next**;**

**return** dummy**->**next**;**

**}**

**};**

## 20. Valid Parentheses

Easy

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

An input string is valid if:

1. Open brackets must be closed by the same type of brackets.
2. Open brackets must be closed in the correct order.

Note that an empty string is also considered valid.

**Example 1:**

**Input:** "()"

**Output:** true

**Example 2:**

**Input:** "()[]{}"

**Output:** true

**Example 3:**

**Input:** "(]"

**Output:** false

**Example 4:**

**Input:** "([)]"

**Output:** false

**Example 5:**

**Input:** "{[]}"

**Output:** true

class Solution **{**

public**:**

bool isValid**(**string s**)** **{**

**}**

**};**

class Solution {

public:

    unordered\_map<char, char> mp{{'{', '}'}, {'(', ')'}, {'[', ']'}};

    bool isValid(string s) {

        stack<char> Stack;

        for (auto c : s){

           if (mp.count(c)) Stack.push(c);

           else if (!Stack.empty() && mp[Stack.top()] == c) {

               Stack.pop();

           }

           else return false;

        }

        return Stack.empty();

    }

};

## 21. Merge Two Sorted Lists

Easy

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

**Example:**

**Input:** 1->2->4, 1->3->4

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

/\*\*

\* Definition for singly-linked list.

\* struct ListNode {

\* int val;

\* ListNode \*next;

\* ListNode(int x) : val(x), next(NULL) {}

\* };

\*/

class Solution **{**

public**:**

ListNode**\*** mergeTwoLists**(**ListNode**\*** l1**,** ListNode**\*** l2**)** **{**

**}**

**};**

class Solution **{**

public**:**

ListNode**\*** mergeTwoLists**(**ListNode**\*** l1**,** ListNode**\*** l2**)** **{**

ListNode \*dummy = new ListNode**(-**1**),** **\***p **=** dummy**;**

**while (**l1 **&&** l2**){**

**if (**l1**->**val **<** l2**->**val**){**

p**->**next **=** l1**;**

l1 **=** l1**->**next**;**

**}**

**else** **{**

p**->**next **=** l2**;**

l2 **=** l2**->**next**;**

**}**

p **=** p**->**next**;**

**}**

**if (**l1**)** p**->**next **=** l1**;**

**if (**l2**)** p**->**next **=** l2**;**

**return** dummy**->**next**;**

**}**

**};**

## 22. Generate Parentheses

Medium

Given *n* pairs of parentheses, write a function to generate all combinations of well-formed parentheses.

For example, given *n* = 3, a solution set is:

[

"((()))",

"(()())",

"(())()",

"()(())",

"()()()"

]

class Solution **{**

public**:**

vector**<**string**>** generateParenthesis**(**int n**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**string**>** res**;**

vector**<**string**>** generateParenthesis**(**int n**)** **{**

dfs**(**n**,** n**,** ""**);**

**return** res**;**

**}**

void dfs**(**int n**,** int m**,** string s**){**

**if (**n **<** 0**||** m **<** 0 **||** n **>** m**)** **return;**

**if (!**n **&&** **!**m**){**

res**.**push\_back**(**s**);**

**return;**

**}**

dfs**(**n**-**1**,** m**,** s**+**'('**);**

dfs**(**n**,** m**-**1**,** s**+**')'**);**

**}**

**};**

## 23. Merge k Sorted Lists★★

Hard

Merge *k* sorted linked lists and return it as one sorted list. Analyze and describe its complexity.

**Example:**

**Input:**

[

  1->4->5,

  1->3->4,

  2->6

]

**Output:** 1->1->2->3->4->4->5->6

/\*\*

\* Definition for singly-linked list.

\* struct ListNode {

\* int val;

\* ListNode \*next;

\* ListNode(int x) : val(x), next(NULL) {}

\* };

\*/

class Solution **{**

public**:**

ListNode**\*** mergeKLists**(**vector**<**ListNode**\*>&** lists**)** **{**

**}**

**};**

class Solution **{**

public**:**

ListNode**\*** mergeKLists**(**vector**<**ListNode**\*>&** lists**)** **{**

ListNode**\*** dummy **=** **new** ListNode**(-**1**),** **\***p **=** dummy**;**

auto cmp **=** **[](**const ListNode **\***lhs**,** const ListNode **\***rhs**) {**

**return** lhs**->**val **>** rhs**->**val**;**

**};**

priority\_queue**<**ListNode**\*,** vector**<**ListNode**\*>,** decltype**(**cmp**)>** pq**(**cmp**);**

**for (**auto **&**i **:** lists**)** **if** **(**i**) {**

pq**.**push**(**i**);**

**}**

**while** **(!**pq**.**empty**()) {**

auto t **=** pq**.**top**();**

pq**.**pop**();**

p**->**next **=** t**;**

p **=** t**;**

t **=** t**->**next**;**

**if** **(**t**)** pq**.**push**(**t**);**

**}**

**return** dummy**->**next**;**

**}**

**};**

## 24. Swap Nodes in Pairs

Medium

Given a linked list, swap every two adjacent nodes and return its head.

**Example:**

Given 1->2->3->4, you should return the list as 2->1->4->3.

**Note:**

* Your algorithm should use only constant extra space.
* You may **not** modify the values in the list's nodes, only nodes itself may be changed.

/\*\*

\* Definition for singly-linked list.

\* struct ListNode {

\* int val;

\* ListNode \*next;

\* ListNode(int x) : val(x), next(NULL) {}

\* };

\*/

class Solution **{**

public**:**

ListNode**\*** swapPairs**(**ListNode**\*** head**)** **{**

**}**

**};**

class Solution **{**

public**:**

ListNode**\*** swapPairs**(**ListNode**\*** head**)** **{**

ListNode \*dummy = new ListNode**(-**1**);**

dummy**->**next **=** head**;**

ListNode **\***p **=** dummy**,** **\***q **=** p**->**next**;**

**while (**q **&&** q**->**next**) {**

p**->**next **=** q**->**next**;**

q**->**next **=** p**->**next**->**next**;**

p**->**next**->**next **=** q**;**

p **=** q**;**

q **=** q**->**next**;**

**}**

**return** dummy**->**next**;**

**}**

**};**

## 25. Reverse Nodes in k-Group

Hard

Given a linked list, reverse the nodes of a linked list *k* at a time and return its modified list.

*k* is a positive integer and is less than or equal to the length of the linked list. If the number of nodes is not a multiple of *k* then left-out nodes in the end should remain as it is.

**Example:**

Given this linked list: 1->2->3->4->5

For *k* = 2, you should return: 2->1->4->3->5

For *k* = 3, you should return: 3->2->1->4->5

**Note:**

* Only constant extra memory is allowed.
* You may not alter the values in the list's nodes, only nodes itself may be changed.

class Solution **{**

public**:**

ListNode**\*** reverseKGroup**(**ListNode**\*** head**,** int k**)** **{**

**}**

**};**

class Solution **{**

public**:**

ListNode**\*** reverseKGroup**(**ListNode**\*** head**,** int k**)** **{**

**if (**head **==** **nullptr** **||** k **<** 2**)** **return** head**;**

ListNode **\***head2 **=** head**,** **\***q**;**

**for** **(**int i **=** 1**;** i **<** k**;** i**++)** **{**

head2 **=** head2**->**next**;**

**if** **(**head2 **==** **nullptr)** **return** head**;**

**}**

head2**->**next **=** reverseKGroup**(**head2**->**next**,** k**);**

**while (--**k**)** **{**

q **=** head**->**next**;**

head**->**next **=** head2**->**next**;**

head2**->**next **=** head**;**

head **=** q**;**

**}**

**return** head2**;**

**}**

**};**

## 26. Remove Duplicates from Sorted Array

Easy

Given a sorted array nums, remove the duplicates [**in-place**](https://en.wikipedia.org/wiki/In-place_algorithm) such that each element appear only once and return the new length.

Do not allocate extra space for another array, you must do this by **modifying the input array** [**in-place**](https://en.wikipedia.org/wiki/In-place_algorithm) with O(1) extra memory.

**Example 1:**

Given nums = **[1,1,2]**,

Your function should return length = **2**, with the first two elements of *nums* being **1** and **2** respectively.

It doesn't matter what you leave beyond the returned length.

**Example 2:**

Given nums = **[0,0,1,1,1,2,2,3,3,4]**,

Your function should return length = **5**, with the first five elements of *nums* being modified to **0**, **1**, **2**, **3**, and **4** respectively.

It doesn't matter what values are set beyond the returned length.

**Clarification:**

Confused why the returned value is an integer but your answer is an array?

Note that the input array is passed in by **reference**, which means modification to the input array will be known to the caller as well.

Internally you can think of this:

// **nums** is passed in by reference. (i.e., without making a copy)

int len = removeDuplicates(nums);

// any modification to **nums** in your function would be known by the caller.

// using the length returned by your function, it prints the first **len** elements.

for (int i = 0; i < len; i++) {

    print(nums[i]);

}

class Solution **{**

public**:**

int removeDuplicates**(**vector**<**int**>&** nums**)** **{**

**if** **(**nums**.**empty**())** **return** 0**;**

int index **=** 1**;**

**for** **(**int i **=** 1**;** i **<** nums**.**size**();** i**++)** **{**

**if** **(**nums**[**i**]** **!=** nums**[**index**-**1**])**

nums**[**index**++]** **=** nums**[**i**];**

**}**

**return** index**;**

**}**

**};**

## 27. Remove Element

Easy

Given an array nums and a value val, remove all instances of that value [**in-place**](https://en.wikipedia.org/wiki/In-place_algorithm) and return the new length.

Do not allocate extra space for another array, you must do this by **modifying the input array** [**in-place**](https://en.wikipedia.org/wiki/In-place_algorithm) with O(1) extra memory.

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

**Example 1:**

Given nums = **[3,2,2,3]**, val = **3**,

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

It doesn't matter what you leave beyond the returned length.

**Example 2:**

Given nums = **[0,1,2,2,3,0,4,2]**, val = **2**,

Your function should return length = **5**, with the first five elements of *nums* containing **0**, **1**, **3**, **0**, and **4**.

Note that the order of those five elements can be arbitrary.

It doesn't matter what values are set beyond the returned length.

**Clarification:**

Confused why the returned value is an integer but your answer is an array?

Note that the input array is passed in by **reference**, which means modification to the input array will be known to the caller as well.

Internally you can think of this:

// **nums** is passed in by reference. (i.e., without making a copy)

int len = removeElement(nums, val);

// any modification to **nums** in your function would be known by the caller.

// using the length returned by your function, it prints the first **len** elements.

for (int i = 0; i < len; i++) {

    print(nums[i]);

}

class Solution **{**

public**:**

int removeElement**(**vector**<**int**>&** nums**,** int val**)** **{**

int index **=** 0**;**

**for** **(**int i **=** 0**;** i **<** nums**.**size**();** i**++){**

**if** **(**nums**[**i**]** **!=** val**)**

nums**[**index**++]** **=** nums**[**i**];**

**}**

**return** index**;**

**}**

**};**

## 28. Implement strStr()★★

Easy

Implement [strStr()](http://www.cplusplus.com/reference/cstring/strstr/).

Return the index of the first occurrence of needle in haystack, or **-1** if needle is not part of haystack.

**Example 1:**

**Input:** haystack = "hello", needle = "ll"

**Output:** 2

**Example 2:**

**Input:** haystack = "aaaaa", needle = "bba"

**Output:** -1

**Clarification:**

What should we return when needle is an empty string? This is a great question to ask during an interview.

For the purpose of this problem, we will return 0 when needle is an empty string. This is consistent to C's [strstr()](http://www.cplusplus.com/reference/cstring/strstr/) and Java's [indexOf()](https://docs.oracle.com/javase/7/docs/api/java/lang/String.html#indexOf(java.lang.String)).

class Solution **{**

public**:**

int removeElement**(**vector**<**int**>&** nums**,** int val**)** **{**

**}**

**};**

class Solution **{**

public**:**

int strStr**(**string haystack**,** string needle**)** **{**

int m **=** haystack**.**size**(),** n **=** needle**.**size**();**

**if** **(!**n**)** **return** 0**;**

vector**<**int**>** f **=** get\_fail**(**needle**);**

**for** **(**int i **=** 0**,** j **=** 0**;** i **<** m**;)** **{**

**if** **(**haystack**[**i**]** **==** needle**[**j**])** **{**

i**++,** j**++;**

**}**

**if** **(**j **==** n**)** **return** i**-**j**;**

**else** **if** **(**i **<** m **&&** haystack**[**i**]** **!=** needle**[**j**])** **{**

j **?** j **=** f**[**j **-** 1**]** **:** i**++;**

**}**

**}**

**return** **-**1**;**

**}**

private**:**

vector**<**int**>** get\_fail**(**string str**)** **{**

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** f**;**

**}**

**};**

## 29. Divide Two Integers★★

Medium

Given two integers dividend and divisor, divide two integers without using multiplication, division and mod operator.

Return the quotient after dividing dividend by divisor.

The integer division should truncate toward zero.

**Example 1:**

**Input:** dividend = 10, divisor = 3

**Output:** 3

**Example 2:**

**Input:** dividend = 7, divisor = -3

**Output:** -2

**Note:**

* Both dividend and divisor will be 32-bit signed integers.
* The divisor will never be 0.
* Assume we are dealing with an environment which could only store integers within the 32-bit signed integer range: [−231,  231 − 1]. For the purpose of this problem, assume that your function returns 231 − 1 when the division result overflows.

class Solution **{**

public**:**

int divide**(**int dividend**,** int divisor**)** **{**

**}**

**};**

class Solution **{**

public**:**

int divide**(**int dividend**,** int divisor**)** **{**

**if (**divisor **==** 0 **||** **(**dividend **==** INT\_MIN **&&** divisor **==** **-**1**))**

**return** INT\_MAX**;**

int sign **=** **(**dividend **>** 0**)** **^** **(**divisor **>** 0**)** **?** **-**1 **:** 1**;**

long long Dividend **=** labs**(**dividend**);**

long long Divisor **=** labs**(**divisor**);**

int res **=** 0**;**

**while** **(**Dividend **>=** Divisor**)** **{**

long long mul **=** 1**,** temp **=** Divisor**;**

**while (**Dividend **>** **(**temp **<<** 1**))** **{**

mul **<<=** 1**;**

temp **<<=** 1**;**

**}**

res **+=** mul**;**

Dividend **-=** temp**;**

**}**

**return** sign**\***res**;**

**}**

**};**

## 30. Substring with Concatenation of All Words★★

Hard

You are given a string, **s**, and a list of words, **words**, that are all of the same length. Find all starting indices of substring(s) in **s** that is a concatenation of each word in **words** exactly once and without any intervening characters.

**Example 1:**

**Input:**

**s =** "barfoothefoobarman",

**words =** ["foo","bar"]

**Output:** [0,9]

**Explanation:** Substrings starting at index 0 and 9 are "barfoor" and "foobar" respectively.

The output order does not matter, returning [9,0] is fine too.

**Example 2:**

**Input:**

**s =** "wordgoodgoodgoodbestword",

**words =** ["word","good","best","word"]

**Output:** []

class Solution **{**

public**:**

vector**<**int**>** findSubstring**(**string s**,** vector**<**string**>&** words**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**int**>** findSubstring**(**string s**,** vector**<**string**>&** words**)** **{**

vector**<**int**>** res**;**

**if (**words**.**empty**()** **||** s**.**empty**())** **return** res**;**

unordered\_map**<**string**,** int**>** M0**,** M1**;**

const int N **=** words**[**0**].**length**(),** M **=** s**.**length**(),** K **=** words**.**size**();**

**for (**auto **&**i **:** words**)** M0**[**i**]++;**

**for** **(**int i **=** 0**;** i **<** N**;** i**++)** **{**

int cnt **=** 0**,** left **=** i**;**

M1**.**clear**();**

**for** **(**int j **=** i**;** j**+**N **<=** M**;** j **+=** N**){**

string a **=** s**.**substr**(**j**,** N**);**

**if** **(**M0**.**count**(**a**))** **{**

**if** **(++**M1**[**a**]** **<=** M0**[**a**]){**

**if** **(++**cnt **==** K**){**

res**.**push\_back**(**left**);**

cnt**--;** M1**[**s**.**substr**(**left**,** N**)]--;** left **+=** N**;**

**}**

**} else{**

**While (**s**.**substr**(**left**,** N**)** **!=** a**) {**

cnt**--;** M1**[**s**.**substr**(**left**,** N**)]--;** left **+=** N**;**

**}**

left **+=** N**;** M1**[**a**]--;**

**}**

**} else{**

M1**.**clear**();**

left **=** j**+**N**;**

cnt **=** 0**;**

**}**

**}**

**}**

**return** res**;**

**}**

**};**

## 31. Next Permutation

Medium

Implement **next permutation**, which rearranges numbers into the lexicographically next greater permutation of numbers.

If such arrangement is not possible, it must rearrange it as the lowest possible order (ie, sorted in ascending order).

The replacement must be [**in-place**](http://en.wikipedia.org/wiki/In-place_algorithm) and use only constant extra memory.

Here are some examples. Inputs are in the left-hand column and its corresponding outputs are in the right-hand column.

1,2,3 → 1,3,2  
3,2,1 → 1,2,3  
1,1,5 → 1,5,1

class Solution **{**

public**:**

void nextPermutation**(**vector**<**int**>&** nums**)** **{**

**}**

**};**

class Solution **{**

public**:**

void nextPermutation**(**vector**<**int**>&** nums**)** **{**

permutation**(**nums**,** 0**,** nums**.**size**());**

**}**

private**:**

bool permutation**(**vector**<**int**> &**nums**,** int begin**,** int end**) {**

int p **=** end **-** 2**;**

**while (**p **>** **-**1 **&&** nums**[**p**]** **>=** nums**[**p**+**1**])** p**--;**

**if (**p **==** **-**1**)** **{**

reverse**(**nums**.**begin**(),**nums**.**end**());**

**return** **false;**

**}**

int c **=** end**-**1**;**

**while (**nums**[**p**]** **>=** nums**[**c**])** c**--;**

swap**(**nums**[**p**],**nums**[**c**]);**

reverse**(**nums**.**begin**()+**p**+**1**,** nums**.**end**());**

**return** **true;**

**}**

**};**

## 32. Longest Valid Parentheses★★

Hard

Given a string containing just the characters '(' and ')', find the length of the longest valid (well-formed) parentheses substring.

**Example 1:**

**Input:** "(()"

**Output:** 2

**Explanation:** The longest valid parentheses substring is "()"

**Example 2:**

**Input:** ")()())"

**Output:** 4

**Explanation:** The longest valid parentheses substring is "()()"

class Solution **{**

public**:**

int longestValidParentheses**(**string s**)** **{**

**}**

**};**

//////////////////////stack/////////////////////////////////////

class Solution **{**

public**:**

int longestValidParentheses**(**string s**)** **{**

int res **=** 0**,** left **=** **-**1**,** n **=** s**.**length**();**

stack**<**int**>** S**;**

**for** **(**int i **=** 0**;** i **<** n**;** i**++){**

**if** **(**s**[**i**]** **==** '('**)** S**.**push**(**i**);**

**else** **if** **(**S**.**empty**())** left **=** i**;**

**else** **{**

S**.**pop**();**

**if** **(**S**.**empty**())** res **=** max**(**res**,** i**-**left**);**

**else** res **=** max**(**res**,** i**-**S**.**top**());**

**}**

**}**

**return** res**;**

**}**

**};**

//////////////////////dp/////////////////////////////////////

class Solution **{**

public**:**

int longestValidParentheses**(**string s**)** **{**

**if** **(**s**.**length**()** **<=** 1**)** **return** 0**;**

int res **=** 0**;**

vector**<**int**>** dp**(**s**.**size**(),** 0**);**

//dp[i] 表示以s[i]结尾最长匹配括号的长度

**for (**int i **=** 1**;** i **<** s**.**length**();** i**++){**

**if** **(**s**[**i**]** **==** '('**)** **continue;**

**if** **(**s**[**i**-**1**]** **==** '('**)** **{**

dp**[**i**]** **=** **(**i**-**2**)** **>=** 0 **?** dp**[**i**-**2**]+**2 **:** 2**;**

res **=** max**(**dp**[**i**],** res**);**

**} else** **if (**i**-**dp**[**i**-**1**]-**1 **>=** 0 **&&** s**[**i**-**dp**[**i**-**1**]-**1**]** **==** '('**)** **{**

dp**[**i**]** **=** dp**[**i**-**1**] +** 2**+ ((**i**-**dp**[**i**-**1**]-**2**>=**0**)** **?** dp**[**i**-**dp**[**i**-**1**]-**2**]** **:** 0**);**

res **=** max**(**dp**[**i**],** res**);**

**}**

**}**

**return** res**;**

**}**

**};**

## 33. Search in Rotated Sorted Array

Medium

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

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

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

You may assume no duplicate exists in the array.

Your algorithm's runtime complexity must be in the order of *O*(log *n*).

**Example 1:**

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

**Output:** 4

**Example 2:**

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

**Output:** -1

class Solution **{**

public**:**

int search**(**vector**<**int**>&** nums**,** int target**)** **{**

**}**

**};**

class Solution **{**

public**:**

int search**(**vector**<**int**>&** nums**,** int target**)** **{**

int left **=** 0**,** right **=** nums**.**size**()** **-** 1**;**

**while** **(**left **<=** right**)** **{**

int mid **=** left **+** **(**right **-** left**)** **/** 2**;**

**if** **(**nums**[**mid**]** **==** target**)** **return** mid**;**

**else** **if** **(**nums**[**mid**]** **<** nums**[**right**])** **{**

**if(**nums**[**mid**]** **<** target **&&** nums**[**right**]** **>=** target**)** left **=** mid **+** 1**;**

**else** right **=** mid **-** 1**;**

**}** **else** **{**

**if(**nums**[**left**]** **<=** target **&&** nums**[**mid**]** **>** target**)** right **=** mid **-** 1**;**

**else** left **=** mid **+** 1**;**

**}**

**}**

**return** **-**1**;**

**}**

**};**

## 34. Find First and Last Position of Element in Sorted Array★★

Medium

Given an array of integers nums sorted in ascending order, find the starting and ending position of a given target value.

Your algorithm's runtime complexity must be in the order of *O*(log *n*).

If the target is not found in the array, return [-1, -1].

**Example 1:**

**Input:** nums = [5,7,7,8,8,10], target = 8

**Output:** [3,4]

**Example 2:**

**Input:** nums = [5,7,7,8,8,10], target = 6

**Output:** [-1,-1]

class Solution **{**

public**:**

vector**<**int**>** searchRange**(**vector**<**int**>&** nums**,** int target**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**int**>** searchRange**(**vector**<**int**>&** nums**,** int target**)** **{**

/\*

if (nums.empty()) return {-1, -1};

auto p = equal\_range(nums.begin(), nums.end(), target);

if (p.first == nums.end() || \*(p.first) != target) return {-1, -1};

else return {p.first-nums.begin(), p.second-nums.begin()-1};

\*/

vector**<**int**>** res**{-**1**,** **-**1**};**

**if** **(**nums**.**empty**())** **return** res**;**

int left **=** 0**,** right **=** nums**.**size**();**

**while** **(**left **<** right**)** **{**

int mid **=** left **+** **(**right **-** left**)** **/** 2**;**

**if** **(**nums**[**mid**]** **<** target**)** left **=** mid **+** 1**;**

**else** right **=** mid**;**

**}**

**if** **(**left **==** nums**.**size**()** **||** nums**[**left**]** **!=** target**)** **return** res**;**

res**[**0**]** **=** left**;**

right **=** nums**.**size**();**

**while** **(**left **<** right**)** **{**

int mid **=** left **+** **(**right**-**left**)** **/** 2**;**

**if** **(**nums**[**mid**]** **<=** target**)** left **=** mid**+**1**;**

**else** right **=** mid**;**

**}**

res**[**1**]** **=** left**-**1**;** //or right-1;

**return** res**;**

**}**

**};**

## 35. Search Insert Position

Easy

Given a sorted array and a target value, return the index if the target is found. If not, return the index where it would be if it were inserted in order.

You may assume no duplicates in the array.

**Example 1:**

**Input:** [1,3,5,6], 5

**Output:** 2

**Example 2:**

**Input:** [1,3,5,6], 2

**Output:** 1

**Example 3:**

**Input:** [1,3,5,6], 7

**Output:** 4

**Example 4:**

**Input:** [1,3,5,6], 0

**Output:** 0

class Solution **{**

public**:**

int searchInsert**(**vector**<**int**>&** nums**,** int target**)** **{**

**}**

**};**

class Solution **{**

public**:**

int searchInsert**(**vector**<**int**>&** nums**,** int target**)** **{**

**if** **(**nums**.**back**()** **<** target**)** **return** nums**.**size**();**

int left **=** 0**,** right **=** nums**.**size**();**

**while** **(**left **<** right**)** **{**

int mid **=** left **+** **(**right **-** left**)** **/** 2**;**

**if** **(**nums**[**mid**]** **<** target**)** left **=** mid **+** 1**;**

**else** right **=** mid**;**

**}**

**return** left**;**

**}**

**};**

## 36. Valid Sudoku

Medium

Determine if a 9x9 Sudoku board is valid. Only the filled cells need to be validated **according to the following rules**:

1. Each row must contain the digits 1-9 without repetition.
2. Each column must contain the digits 1-9 without repetition.
3. Each of the 9 3x3 sub-boxes of the grid must contain the digits 1-9 without repetition.

  
A partially filled sudoku which is valid.

The Sudoku board could be partially filled, where empty cells are filled with the character '.'.

**Example 1:**

**Input:**

[

["5","3",".",".","7",".",".",".","."],

["6",".",".","1","9","5",".",".","."],

[".","9","8",".",".",".",".","6","."],

["8",".",".",".","6",".",".",".","3"],

["4",".",".","8",".","3",".",".","1"],

["7",".",".",".","2",".",".",".","6"],

[".","6",".",".",".",".","2","8","."],

[".",".",".","4","1","9",".",".","5"],

[".",".",".",".","8",".",".","7","9"]

]

**Output:** true

**Example 2:**

**Input:**

[

  ["8","3",".",".","7",".",".",".","."],

  ["6",".",".","1","9","5",".",".","."],

  [".","9","8",".",".",".",".","6","."],

  ["8",".",".",".","6",".",".",".","3"],

  ["4",".",".","8",".","3",".",".","1"],

  ["7",".",".",".","2",".",".",".","6"],

  [".","6",".",".",".",".","2","8","."],

  [".",".",".","4","1","9",".",".","5"],

  [".",".",".",".","8",".",".","7","9"]

]

**Output:** false

**Explanation:** Same as Example 1, except with the **5** in the top left corner being

modified to **8**. Since there are two 8's in the top left 3x3 sub-box, it is invalid.

**Note:**

* A Sudoku board (partially filled) could be valid but is not necessarily solvable.
* Only the filled cells need to be validated according to the mentioned rules.
* The given board contain only digits 1-9 and the character '.'.
* The given board size is always 9x9.

class Solution **{**

public**:**

bool isValidSudoku**(**vector**<**vector**<**char**>>&** board**)** **{**

**}**

**};**

class Solution **{**

public**:**

bool isValidSudoku**(**vector**<**vector**<**char**>>&** board**)** **{**

bool used**[**9**];**

**for (**int i **=** 0**;** i **<** 9**;** i**++){**

fill**(**used**,** used**+**9**,** **false);**

**for (**int j **=** 0**;** j **<** 9**;** j**++) {**

**if (!**check**(**board**[**i**][**j**],** used**))**

**return** **false;**

**}**

fill **(**used**,** used**+**9**,** **false);**

**for (**int j **=** 0**;** j **<** 9**;** j**++) {**

**if (!**check**(**board**[**j**][**i**],** used**))**

**return** **false;**

**}**

**}**

**for (**int i **=** 0**;** i **<** 3**;** i**++){**

**for (**int j **=** 0**;** j **<** 3**;** j**++) {**

fill**(**used**,** used**+**9**,** **false);**

**for (**int a **=** 3**\***i**;** a **<** 3**\***i**+**3**;** a**++) {**

**for (**int b **=** 3**\***j**;** b **<** 3**\***j**+**3**;** b**++)**

**if (!**check**(**board**[**a**][**b**],**used**))**

**return** **false;**

**}**

**}**

**}**

**return** **true;**

**}**

private**:**

bool check**(**char a**,** bool used**[]){**

**if (**a **==** '.'**)** **return** **true;**

**if (**used**[**a**-**'1'**])** **return** **false;**

used**[**a**-**'1'**]** **=** **true;**

**return** **true;**

**}**

**};**

## 37. Sudoku Solver

Hard

Write a program to solve a Sudoku puzzle by filling the empty cells.

A sudoku solution must satisfy **all of the following rules**:

1. Each of the digits 1-9 must occur exactly once in each row.
2. Each of the digits 1-9 must occur exactly once in each column.
3. Each of the the digits 1-9 must occur exactly once in each of the 9 3x3 sub-boxes of the grid.

Empty cells are indicated by the character '.'.

  
A sudoku puzzle...

  
...and its solution numbers marked in red.

**Note:**

* The given board contain only digits 1-9 and the character '.'.
* You may assume that the given Sudoku puzzle will have a single unique solution.
* The given board size is always 9x9.

class Solution **{**

public**:**

void solveSudoku**(**vector**<**vector**<**char**>>** **&**board**)** **{**

solveSudoku**(**board**,** 0**,** 0**);**

**}**

private**:**

bool check**(**vector**<**vector**<**char**>>** **&**board**,** int i**,** int j**,** char val**)** **{**

int row **=** i**-**i**%**3**,** column **=** j**-**j**%**3**;**

**for** **(**int x **=** 0**;** x **<** 9**;** x**++)** **{**

**if** **(**board**[**x**][**j**]** **==** val **||** board**[**i**][**x**]** **==** val**)**

**return** **false;**

**}**

**for** **(**int x **=** 0**;** x **<** 3**;** x**++)** **{**

**for** **(**int y **=** 0**;** y **<** 3**;** y**++)** **{**

**if** **(**board**[**row**+**x**][**column**+**y**]** **==** val**)**

**return** **false;**

**}**

**}**

**return** **true;**

**}**

bool solveSudoku**(**vector**<**vector**<**char**>>** **&**board**,** int i**,** int j**){**

**if** **(**i **==** 9**)** **return** **true;**

**else** **if** **(**j **==** 9**)** **return** solveSudoku**(**board**,** i**+**1**,** 0**);**

**if** **(**board**[**i**][**j**]** **!=** '.'**)** **return** solveSudoku**(**board**,** i**,** j**+**1**);**

**else** **for** **(**char c **=** '1'**;** c **<=** '9'**;** c**++){**

**if** **(**check**(**board**,** i**,** j**,** c**))** **{**

board**[**i**][**j**]** **=** c**;**

**if** **(**solveSudoku**(**board**,** i**,** j**+**1**))** **return** **true;**

board**[**i**][**j**]** **=** '.'**;**

**}**

**}**

**return** **false;**

**}**

**};**

## 38. Count and Say

Easy

The count-and-say sequence is the sequence of integers with the first five terms as following:

1. 1

2. 11

3. 21

4. 1211

5. 111221

1 is read off as "one 1" or 11.  
11 is read off as "two 1s" or 21.  
21 is read off as "one 2, then one 1" or 1211.

Given an integer *n* where 1 ≤ *n* ≤ 30, generate the *n*th term of the count-and-say sequence.

Note: Each term of the sequence of integers will be represented as a string.

**Example 1:**

**Input:** 1

**Output:** "1"

**Example 2:**

**Input:** 4

**Output:** "1211"

class Solution **{**

public**:**

string countAndSay**(**int n**)** **{**

**}**

**};**

class Solution **{**

public**:**

string countAndSay**(**int n**)** **{**

string s **=** "1"**;**

**while** **(--**n**)** **{**

string t**;**

char c **=** s**[**0**];**

int cnt **=** 1**;**

**for (**int i **=** 1**;** i **<** s**.**length**();** i**++){**

**if** **(**s**[**i**]** **==** c**)** cnt**++;**

**else** **{**

t **+=** to\_string**(**cnt**)+**c**;**

cnt **=** 1**;**

c **=** s**[**i**];**

**}**

**}**

s **=** t **+** to\_string**(**cnt**)+**c**;**

**}**

**return** s**;**

**}**

**};**

## 39. Combination Sum

Medium

Given a **set** of candidate numbers (candidates) **(without duplicates)** and a target number (target), find all unique combinations in candidates where the candidate numbers sums to target.

The **same** repeated number may be chosen from candidates unlimited number of times.

**Note:**

* All numbers (including target) will be positive integers.
* The solution set must not contain duplicate combinations.

**Example 1:**

**Input:** candidates = [2,3,6,7], target = 7,

**A solution set is:**

[

[7],

[2,2,3]

]

**Example 2:**

**Input:** candidates = [2,3,5], target = 8,

**A solution set is:**

[

  [2,2,2,2],

  [2,3,3],

  [3,5]

]

class Solution **{**

public**:**

vector**<**vector**<**int**>>** combinationSum**(**vector**<**int**>&** candidates**,** int target**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**vector**<**int**>>** res**;**

vector**<**vector**<**int**>>** combinationSum**(**vector**<**int**>** **&**candidates**,** int target**)** **{**

vector**<**int**>** t**;**

sort**(**candidates**.**begin**(),** candidates**.**end**());**

dfs**(**candidates**,** 0**,** target**,** t**);**

**return** res**;**

**}**

private**:**

void dfs**(**vector**<**int**>** **&**v**,** int cur**,** int target**,** vector**<**int**>** **&**t**)** **{**

**if** **(**target **==** 0**)** res**.**push\_back**(**t**);**

**else** **for(**auto i **=** cur**;** i **<** v**.**size**()** **&&** target**-**v**[**i**]** **>=** 0**;** i**++)** **{**

t**.**push\_back**(**v**[**i**]);**

dfs**(**v**,** i**,** target**-**v**[**i**],** t**);**

t**.**pop\_back**();**

**}**

**}**

**};**

## 40. Combination Sum II★★

Medium

Given a collection of candidate numbers (candidates) and a target number (target), find all unique combinations in candidates where the candidate numbers sums to target.

Each number in candidates may only be used **once** in the combination.

**Note:**

* All numbers (including target) will be positive integers.
* The solution set must not contain duplicate combinations.

**Example 1:**

**Input:** candidates = [10,1,2,7,6,1,5], target = 8,

**A solution set is:**

[

[1, 7],

[1, 2, 5],

[2, 6],

[1, 1, 6]

]

**Example 2:**

**Input:** candidates = [2,5,2,1,2], target = 5,

**A solution set is:**

[

  [1,2,2],

  [5]

]

class Solution **{**

public**:**

vector**<**vector**<**int**>>** combinationSum2**(**vector**<**int**>&** candidates**,** int target**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**vector**<**int**>>** res**;**

vector**<**vector**<**int**>>**combinationSum2**(**vector**<**int**>** **&**candidates**,** int target**)** **{**

vector**<**int**>** t**;**

sort**(**candidates**.**begin**(),** candidates**.**end**());**

dfs**(**candidates**,** 0**,** target**,** t**);**

**return** res**;**

**}**

private**:**

void dfs**(**vector**<**int**>** **&**v**,** int cur**,** int target**,** vector**<**int**>** **&**t**)** **{**

**if** **(**target **==** 0**)** res**.**push\_back**(**t**);**

**else** **for(**auto i **=** cur**;** i **<** v**.**size**()** **&&** target**-**v**[**i**]** **>=** 0**;** i**++)** **{**

**if** **(**i **!=** cur **&&** v**[**i**]** **==** v**[**i**-**1**])** **continue; //不同之处1**

t**.**push\_back**(**v**[**i**]);**

dfs**(**v**,** i**+**1**,** target**-**v**[**i**],** t**); //不同之处2**

t**.**pop\_back**();**

**}**

**}**

**};**

## 41. First Missing Positive★★

Hard

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

**Example 1:**

Input: [1,2,0]

Output: 3

**Example 2:**

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

Output: 2

**Example 3:**

Input: [7,8,9,11,12]

Output: 1

**Note:**

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

class Solution **{**

public**:**

int firstMissingPositive**(**vector**<**int**>&** nums**)** **{**

**}**

**};**

class Solution **{**

public**:**

int firstMissingPositive**(**vector**<**int**>&** nums**)** **{**

int n **=** nums**.**size**();**

**for** **(**int i **=** 0**;** i **<** n**;** i**++)** **{**

**while** **(**nums**[**i**]** **>** 0 **&&** nums**[**i**]** **<=** n

**&&** nums**[**nums**[**i**]** **-** 1**]** **!=** nums**[**i**])** **{**

swap**(**nums**[**i**],** nums**[**nums**[**i**]** **-** 1**]);**

**}**

**}**

**for** **(**int i **=** 0**;** i **<** n**;** i**++)** **{**

**if** **(**nums**[**i**]** **!=** i **+** 1**)**

**return** i **+** 1**;**

**}**

**return** n **+** 1**;**

**}**

**};**

## 42. Trapping Rain Water★★

Hard

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

  
The above elevation map is represented by array [0,1,0,2,1,0,1,3,2,1,2,1]. In this case, 6 units of rain water (blue section) are being trapped. **Thanks Marcos** for contributing this image!

**Example:**

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

**Output:** 6

class Solution **{**

public**:**

int trap**(**vector**<**int**>&** height**)** **{**

**}**

**};**

class Solution **{**

public**:**

int trap**(**vector**<**int**>&** height**)** **{**

int res **=** 0**,** l **=** 0**,** r **=** height**.**size**()-**1**;**

**while** **(**l **<** r**)** **{**

int MIN **=** min**(**height**[**l**],** height**[**r**]);**

**if** **(**MIN **==** height**[**l**])** **{**

**++**l**;**

**while** **(**l **<** r **&&** height**[**l**]** **<** MIN**)** res **+=** MIN**-**height**[**l**++];**

**}** **else** **{**

**--**r**;**

**while** **(**l **<** r **&&** height**[**r**]** **<** MIN**)** res **+=** MIN**-**height**[**r**--];**

**}**

**}**

**return** res**;**

**}**

**};**

## 43. Multiply Strings

Medium

Given two non-negative integers num1 and num2 represented as strings, return the product of num1 and num2, also represented as a string.

**Example 1:**

**Input:** num1 = "2", num2 = "3"

**Output:** "6"

**Example 2:**

**Input:** num1 = "123", num2 = "456"

**Output:** "56088"

**Note:**

1. The length of both num1 and num2 is < 110.
2. Both num1 and num2 contain only digits 0-9.
3. Both num1 and num2 do not contain any leading zero, except the number 0 itself.
4. You **must not use any built-in BigInteger library** or **convert the inputs to integer** directly.

class Solution **{**

public**:**

string multiply**(**string num1**,** string num2**)** **{**

**}**

**};**

class Solution **{**

public**:**

string multiply**(**string num1**,** string num2**)** **{**

**if** **(**num1 **==** "0" **||** num2 **==** "0"**)** **return** "0"**;**

int n **=** num1**.**size**(),** m **=** num2**.**size**();**

vector**<**int**>** sum**(**n**+**m**);**

**for (**int i **=** 0**;** i **<** n**;** i**++)** **{**

**for (**int j **=** 0**;** j **<** m**;** j**++)** **{**

sum**[**n**+**m**-**i**-**j**-**2**]** **+=** **(**num1**[**i**]-**'0'**)\*(**num2**[**j**]-**'0'**);**

**}**

**}**

int carry **=** 0**;**

string res**;**

**for (**int i **=** 0**;** i **<** n**+**m**-**1**;** i**++)** **{**

carry **+=** sum**[**i**];**

res **+=** carry**%**10**+**'0'**;**

carry **/=** 10**;**

**}**

**if (**carry**)** res **+=** carry**+**'0'**;**

reverse**(**res**.**begin**(),** res**.**end**());**

**return** res**;**

**}**

**};**

## 44. Wildcard Matching★★

Hard

Given an input string (s) and a pattern (p), implement wildcard pattern matching with support for '?' and '\*'.

'?' Matches any single character.

'\*' Matches any sequence of characters (including the empty sequence).

The matching should cover the **entire** input string (not partial).

**Note:**

* s could be empty and contains only lowercase letters a-z.
* p could be empty and contains only lowercase letters a-z, and characters like ? or \*.

**Example 1:**

**Input:**

s = "aa"

p = "a"

**Output:** false

**Explanation:** "a" does not match the entire string "aa".

**Example 2:**

**Input:**

s = "aa"

p = "\*"

**Output:** true

**Explanation:** '\*' matches any sequence.

**Example 3:**

**Input:**

s = "cb"

p = "?a"

**Output:** false

**Explanation:** '?' matches 'c', but the second letter is 'a', which does not match 'b'.

**Example 4:**

**Input:**

s = "adceb"

p = "\*a\*b"

**Output:** true

**Explanation:** The first '\*' matches the empty sequence, while the second '\*' matches the substring "dce".

**Example 5:**

**Input:**

s = "acdcb"

p = "a\*c?b"

**Output:** false

class Solution **{**

public**:**

bool isMatch**(**string s**,** string p**)** **{**

**}**

**}**

class Solution **{**

public**:**

bool isMatch**(**string s**,** string p**)** **{**

int slen **=** s**.**size**(),** plen **=** p**.**size**(),** i**,** j**,** iStar **=** **-**1**,** jStar **=** **-**1**;**

**for(**i **=** 0**,** j **=** 0 **;** i **<** slen**;** **++**i**,** **++**j**)** **{**

**if** **(**p**[**j**]** **==** '\*'**)** **{**

//meet a new '\*', update traceback i/j info

iStar **=** i**;**

jStar **=** j**;**

**--**i**;**

**}**

**else** **if** **(**p**[**j**]** **!=** s**[**i**]** **&&** p**[**j**]** **!=** '?'**)** **{**

// mismatch happens

**if** **(**iStar **<** 0**)** **return** **false;**

// met a '\*' before, then do traceback

i **=** iStar**++;**

j **=** jStar**;**

**}**

**}**

**while** **(**p**[**j**]** **==** '\*'**)** **++**j**;**

**return** j **==** plen**;**

**}**

**}**

## 45. Jump Game II

Hard

Given an array of non-negative integers, you are initially positioned at the first index of the array.

Each element in the array represents your maximum jump length at that position.

Your goal is to reach the last index in the minimum number of jumps.

**Example:**

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

**Output:** 2

**Explanation:** The minimum number of jumps to reach the last index is 2.

Jump 1 step from index 0 to 1, then 3 steps to the last index.

**Note:**

You can assume that you can always reach the last index.

class Solution **{**

public**:**

int jump**(**vector**<**int**>&** nums**)** **{**

**}**

**};**

class Solution **{**

public**:**

int jump**(**vector**<**int**>&** nums**)** **{**

**if** **(**nums**.**size**()** **<=** 1**)** **return** 0**;**

int res **=** 1**,** n **=** nums**.**size**(),** i **=** 0**;**

**while** **(**i **<** n**)** **{**

int farest **=** i**+**nums**[**i**],** temp **=** farest**;**

**if** **(**farest **>=** n**-**1**)** **return** res**;**

**else** **for** **(**int k **=** i**+**1**;** k **<=** farest**;** k**++)** **{**

**if** **(**k**+**nums**[**k**]** **>** temp**)** temp **=** k **+** nums**[**i **=** k**];**

**}**

res**++;**

**}**

**return** res**;**

**}**

**};**

## 46. Permutations

Medium

Given a collection of **distinct** integers, return all possible permutations.

**Example:**

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

**Output:**

[

[1,2,3],

[1,3,2],

[2,1,3],

[2,3,1],

[3,1,2],

[3,2,1]

]

class Solution **{**

public**:**

vector**<**vector**<**int**>>** permute**(**vector**<**int**>&** nums**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**vector**<**int**>>** permute**(**vector**<**int**>&** nums**)** **{**

sort**(**nums**.**begin**(),** nums**.**end**());**

vector**<**vector**<**int**>** **>**res**;**

**do{**

res**.**push\_back**(**nums**);**

**}** **while(**Next\_Permutation**(**nums**));**

**return** res**;**

**}**

bool Next\_Permutation**(**vector**<**int**>** **&**nums**)** **{**

int n **=** nums**.**size**(),** i**,** j**;**

**for** **(**i **=** n**-**2**,** j **=** n**-**1**;** i **>=** 0**;** i**--)** **{**

**if** **(**nums**[**i**]** **<** nums**[**i**+**1**])** **{**

**while** **(**nums**[**j**]** **<** nums**[**i**])** j**--;**

swap**(**nums**[**i**],** nums**[**j**]);**

int l **=** i**+**1**,** r **=** n**-**1**;**

**while(**l **<** r**)** swap**(**nums**[**l**++],** nums**[**r**--]);**

**return** **true;**

**}**

**}**

**return** **false;**

**}**

**};**

////////////////////////////////////DFS////////////////////////////

class Solution **{**

public**:**

vector**<**vector**<**int**>** **>** permute**(**vector**<**int**>** **&**num**)** **{**

vector**<**vector**<**int**>>** res**;**

dfs**(**num**,** 0**,** res**);**

**return** res**;**

**}**

private**:**

void dfs**(**vector**<**int**>** **&**num**,** int cur**,** vector**<**vector**<**int**>>** **&**res**)** **{**

**if** **(**cur **>=** num**.**size**())** **{**

res**.**push\_back**(**num**);**

**return;**

**}**

**for** **(**int i **=** cur**;** i **<** num**.**size**();** i**++)** **{**

swap**(**num**[**cur**],** num**[**i**]);**

dfs**(**num**,** cur **+** 1**,** res**);**

swap**(**num**[**cur**],** num**[**i**]);**

**}**

**}**

**};**

## 47. Permutations II★★

Medium

Given a collection of numbers that might contain duplicates, return all possible unique permutations.

**Example:**

**Input:** [1,1,2]

**Output:**

[

[1,1,2],

[1,2,1],

[2,1,1]

class Solution **{**

public**:**

vector**<**vector**<**int**>>** permuteUnique**(**vector**<**int**>&** nums**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**vector**<**int**>>** permuteUnique**(**vector**<**int**>&** nums**)** **{**

sort**(**nums**.**begin**(),** nums**.**end**());**

vector**<**vector**<**int**>** **>**res**;**

**do{**

res**.**push\_back**(**nums**);**

**}** **while(**Next\_Permutation**(**nums**));**

**return** res**;**

**}**

bool Next\_Permutation**(**vector**<**int**>** **&**nums**)** **{**

int n **=** nums**.**size**(),** i**,** j**;**

**for** **(**i **=** n**-**2**,** j **=** n**-**1**;** i **>=** 0**;** i**--)** **{**

**if** **(**nums**[**i**]** **<** nums**[**i**+**1**])** **{**

**while** **(**nums**[**j**]** **<=** nums**[**i**])** j**--;**

swap**(**nums**[**i**],** nums**[**j**]);**

int l **=** i**+**1**,** r **=** n**-**1**;**

**while(**l **<** r**)** swap**(**nums**[**l**++],** nums**[**r**--]);**

**return** **true;**

**}**

**}**

**return** **false;**

**}**

**};**

/////////////////////DFS/////////////////////////////////

class Solution **{**

public**:**

vector**<**vector**<**int**>>** permuteUnique**(**vector**<**int**>&** num**)** **{**

vector**<**vector**<**int**>>** res**;**

dfs**(**num**,** 0**,** res**);**

**return** res**;**

**}**

private**:**

void dfs**(**vector**<**int**>** **&**num**,** int cur**,** vector**<**vector**<**int**>>** **&**res**)** **{**

**if** **(**cur **>=** num**.**size**())** **{**

res**.**push\_back**(**num**);**

**return;**

**}**

unordered\_set**<**int**>** st**;**

**for** **(**int i **=** cur**;** i **<** num**.**size**();** i**++)** **{**

**if** **(**st**.**count**(**num**[**i**]))** **continue;**

st**.**insert**(**num**[**i**]);**

swap**(**num**[**cur**],** num**[**i**]);**

dfs**(**num**,** cur **+** 1**,** res**);**

swap**(**num**[**cur**],** num**[**i**]);**

**}**

**}**

**};**

/////////////////////注意nums为值传递////////////////////////

class Solution **{**

public**:**

vector**<**vector**<**int**>>** permuteUnique**(**vector**<**int**>** **&**nums**)** **{**

sort**(**nums**.**begin**(),** nums**.**end**());**

vector**<**vector**<**int**>>** res**;**

permute**(**nums**,** 0**,** res**);**

**return** res**;**

**}**

void permute**(**vector**<**int**>** nums**,** int i**,** vector**<**vector**<**int**>>** **&**res**)** **{**

**if** **(**i **==** nums**.**size**())** res**.**push\_back**(**nums**);**

**else** **for** **(**int k **=** i**;** k **<** nums**.**size**();** k**++)** **{**

**if** **(**i **!=** k **&&** nums**[**i**]** **==** nums**[**k**])** **continue;**

swap**(**nums**[**i**],** nums**[**k**]);**

permute**(**nums**,** i**+**1**,** res**);**

**}**

**}**

**};**

## 48. Rotate Image

Medium

You are given an *n* x *n* 2D matrix representing an image.

Rotate the image by 90 degrees (clockwise).

**Note:**

You have to rotate the image [**in-place**](https://en.wikipedia.org/wiki/In-place_algorithm), which means you have to modify the input 2D matrix directly. **DO NOT** allocate another 2D matrix and do the rotation.

**Example 1:**

Given **input matrix** =

[

[1,2,3],

[4,5,6],

[7,8,9]

],

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

[

[7,4,1],

[8,5,2],

[9,6,3]

]

**Example 2:**

Given **input matrix** =

[

[ 5, 1, 9,11],

[ 2, 4, 8,10],

[13, 3, 6, 7],

[15,14,12,16]

],

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

[

[15,13, 2, 5],

[14, 3, 4, 1],

[12, 6, 8, 9],

[16, 7,10,11]

]

class Solution **{**

public**:**

void rotate**(**vector**<**vector**<**int**>>&** matrix**)** **{**

**}**

**};**

class Solution **{**

public**:**

void rotate**(**vector**<**vector**<**int**>>&** matrix**)** **{**

int n **=** matrix**.**size**();**

int i **=** 0**,** j **=** n**-**1**;**

**while (**i **<** j**){**

**for (**int k **=** 0**;** k **<** n**;** k**++)** swap**(**matrix**[**k**][**i**],** matrix**[**k**][**j**]);**

i**++;** j**--;**

**}**

**for (**int i **=** 0**;** i **<** n**;** i**++) {**

**for (**int j **=** 0**;** j **+** i **<** n**-**1**;** j**++)**

swap**(**matrix**[**i**][**j**],**matrix**[**n**-**1**-**j**][**n**-**1**-**i**]);**

**}**

**}**

**};**

## 49. Group Anagrams

Medium

Given an array of strings, group anagrams together.

**Example:**

**Input:** ["eat", "tea", "tan", "ate", "nat", "bat"],

**Output:**

[

["ate","eat","tea"],

["nat","tan"],

["bat"]

]

**Note:**

* All inputs will be in lowercase.
* The order of your output does not matter.

class Solution **{**

public**:**

vector**<**vector**<**string**>>** groupAnagrams**(**vector**<**string**>&** strs**)** **{**

**};**

class Solution **{**

public**:**

vector**<**vector**<**string**>>** groupAnagrams**(**vector**<**string**>&** strs**)** **{**

unordered\_map**<**string**,** vector**<**string**>>** m**;**

**for** **(**string s **:** strs**)** **{**

string t **=** s**;**

sort**(**t**.**begin**(),** t**.**end**());**

m**[**t**].**push\_back**(**s**);**

**}**

vector**<**vector**<**string**>>** res**;**

**for** **(**auto &p **:** m**)** **{**

res**.**push\_back**(**p**.**second**);**

**}**

**return** res**;**

**}**

**};**

## 50. Pow(x, n) ★★

Medium

Implement [pow(x, n)](http://www.cplusplus.com/reference/valarray/pow/), which calculates x raised to the power n (xn).

**Example 1:**

**Input:** 2.00000, 10

**Output:** 1024.00000

**Example 2:**

**Input:** 2.10000, 3

**Output:** 9.26100

**Example 3:**

**Input:** 2.00000, -2

**Output:** 0.25000

**Explanation:** 2-2 = 1/22 = 1/4 = 0.25

**Note:**

* -100.0 < x < 100.0
* n is a 32-bit signed integer, within the range [−231, 231− 1]

class Solution **{**

public**:**

double myPow**(**double x**,** int n**)** **{**

**}**

**};**

class Solution **{**

public**:**

double myPow**(**double x**,** int n**)** **{**

**if (**x **==** 1 **||** n **==** 0**)** **return** 1**;**

**if** **(**n **<** 0**)** x **=** 1**/**x**;**

double res **=** 1**;**

unsigned long long m **=** abs**(**n**);**

**while** **(**m**)** **{**

**if** **(**m**&**1**)** res **\*=** x**;**

x **\*=** x**;**

m **>>=** 1**;**

**}**

**return** res**;**

**}**

**};**

## 51. N-Queens

Hard

The *n*-queens puzzle is the problem of placing *n* queens on an *n*×*n* chessboard such that no two queens attack each other.



Given an integer *n*, return all distinct solutions to the *n*-queens puzzle.

Each solution contains a distinct board configuration of the *n*-queens' placement, where 'Q' and '.' both indicate a queen and an empty space respectively.

**Example:**

**Input:** 4

**Output:** [

[".Q..", // Solution 1

"...Q",

"Q...",

"..Q."],

["..Q.", // Solution 2

"Q...",

"...Q",

".Q.."]

]

**Explanation:** There exist two distinct solutions to the 4-queens puzzle as shown above.

class Solution **{**

public**:**

vector**<**vector**<**string**>>** solveNQueens**(**int n**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**vector**<**string**>>** res**;**

vector**<**vector**<**string**>>** solveNQueens**(**int n**)** **{**

col**.**resize**(**n**,** **false);**

main\_diag**.**resize**(**2**\***n**-**1**,** **false);**

anti\_diag**.**resize**(**2**\***n**-**1**,** **false);**

vector**<**string**>** v**;**

dfs**(**0**,** n**,** v**);**

**return** res**;**

**}**

private**:**

vector**<**bool**>** col**;**

vector**<**bool**>** main\_diag**;**

vector**<**bool**>** anti\_diag**;**

void dfs**(**int x**,** int n**,** vector**<**string**>** **&**v**)** **{**

**if** **(**x **==** n**)** res**.**push\_back**(**v**);**

**else** **for** **(**int y **=** 0**;** y **<** n**;** y**++)** **{**

**if** **(!**col**[**y**]** **&&** **!**main\_diag**[**x**+**y**]** **&&** **!**anti\_diag**[**x**-**y**+**n**-**1**]){**

col**[**y**]** **=** main\_diag**[**x**+**y**]** **=** anti\_diag**[**x**-**y**+**n**-**1**]** **=** **true;**

v**.**push\_back**(** string**(**y**,**'.'**)** **+** 'Q' **+** string**(**n**-**y**-**1**,**'.'**)** **);**

dfs**(**x**+**1**,** n**,** v**);**

v**.**pop\_back**();**

col**[**y**]** **=** main\_diag**[**x**+**y**]** **=** anti\_diag**[**x**-**y**+**n**-**1**]** **=** **false;**

**}**

**}**

**}**

**};**

## 52. N-Queens II

Hard

The *n*-queens puzzle is the problem of placing *n* queens on an *n*×*n* chessboard such that no two queens attack each other.



Given an integer *n*, return the number of distinct solutions to the *n*-queens puzzle.

**Example:**

**Input:** 4

**Output:** 2

**Explanation:** There are two distinct solutions to the 4-queens puzzle as shown below.

[

 [".Q..",  // Solution 1

  "...Q",

  "Q...",

  "..Q."],

 ["..Q.",  // Solution 2

  "Q...",

  "...Q",

  ".Q.."]

]

class Solution **{**

public**:**

int totalNQueens**(**int n**)** **{**

**}**

**};**

class Solution **{**

public**:**

int totalNQueens**(**int n**)** **{**

col**.**resize**(**n**,** **false);**

main\_diag**.**resize**(**2**\***n**-**1**,** **false);**

anti\_diag**.**resize**(**2**\***n**-**1**,** **false);**

**return** dfs**(**0**,** n**);**

**}**

private**:**

vector**<**bool**>** col**;**

vector**<**bool**>** main\_diag**;**

vector**<**bool**>** anti\_diag**;**

int dfs**(**int x**,** int n**)** **{**

**if** **(**x **==** n**)** **return** 1**;**

int res **=** 0**;**

**for** **(**int y **=** 0**;** y **<** n**;** y**++)** **{**

**if** **(!**col**[**y**]** **&&** **!**main\_diag**[**x**+**y**]** **&&** **!**anti\_diag**[**x**-**y**+**n**-**1**]){**

col**[**y**]** **=** main\_diag**[**x**+**y**]** **=** anti\_diag**[**x**-**y**+**n**-**1**]** **=** **true;**

res **+=** dfs**(**x**+**1**,** n**);**

col**[**y**]** **=** main\_diag**[**x**+**y**]** **=** anti\_diag**[**x**-**y**+**n**-**1**]** **=** **false;**

**}**

**}**

**return** res**;**

**}**

**};**

## 53. Maximum Subarray

Easy

Given an integer array nums, find the contiguous subarray (containing at least one number) which has the largest sum and return its sum.

**Example:**

**Input:** [-2,1,-3,4,-1,2,1,-5,4],

**Output:** 6

**Explanation:** [4,-1,2,1] has the largest sum = 6.

**Follow up:**

If you have figured out the O(*n*) solution, try coding another solution using the divide and conquer approach, which is more subtle.

class Solution **{**

public**:**

int maxSubArray**(**vector**<**int**>&** nums**)** **{**

int sum **=** nums**[**0**],** cur **=** 0**;**

**for** **(**auto **&**i **:** nums**)** **{**

cur **+=** i**;**

sum **=** max**(**sum**,** cur**);**

**if** **(**cur **<=** 0**)** cur **=** 0**;**

**}**

**return** sum**;**

**}**

**};**

//////////////////divide and conquer approach///////////////////////////

class Solution **{**

public**:**

int maxSubArray**(**vector**<**int**>&** nums**)** **{**

**return** maxSubArray**(**nums**,** 0**,** nums**.**size**()-**1**);**

**}**

private**:**

int maxSubArray**(**vector**<**int**>&** nums**,** int left**,** int right**)** **{**

**if** **(**right **<** left**)** **return** INT\_MIN**;**

**else** **if** **(**right **==** left**)** **return** nums**[**left**];**

int mid **=** left**+(**right**-**left**)/**2**;**

int ret **=** max**(**maxSubArray**(**nums**,** left**,** mid**),**

maxSubArray**(**nums**,** mid**+**1**,** right**));**

int sum **=** nums**[**mid**],** temp **=** 0**;**

**for** **(**int i **=** mid**+**1**,** t **=** 0**;** i **<=** right**;** i**++)** **{**

temp **=** max**(**t **+=** nums**[**i**],** temp**);**

**}**

sum **+=** temp**;**

temp **=** 0**;**

**for** **(**int i **=** mid**-**1**,** t **=** 0**;** i **>=** left**;** i**--)** **{**

temp **=** max**(**t **+=** nums**[**i**],** temp**);**

**}**

**return** max**(**ret**,** sum **+=** temp**);**

**}**

**};**

## 54. Spiral Matrix

Medium

Given a matrix of *m* x *n* elements (*m* rows, *n* columns), return all elements of the matrix in spiral order.

**Example 1:**

**Input:**

[

[ 1, 2, 3 ],

[ 4, 5, 6 ],

[ 7, 8, 9 ]

]

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

**Example 2:**

**Input:**

[

[1, 2, 3, 4],

[5, 6, 7, 8],

[9,10,11,12]

]

**Output:** [1,2,3,4,8,12,11,10,9,5,6,7]

class Solution **{**

public**:**

vector**<**int**>** spiralOrder**(**vector**<**vector**<**int**>>&** matrix**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**int**>** spiralOrder**(**vector**<**vector**<**int**>>&** matrix**)** **{**

vector **<**int**>** res**;**

**if** **(**matrix**.**empty**())** **return** res**;**

int rowSize **=** matrix**.**size**(),** colSize **=** matrix**[**0**].**size**();**

int lb **=** 0**,** rb **=** colSize**-**1**,** ub **=** 0**,** db **=** rowSize**-**1**;**

// left bound, right bound, up bound, down bound;

int direction **=** 0**,** col **=** 0**,** row **=** 0**;**

**while** **(**lb **<=** rb **&&** ub **<=** db**)** **{**

res**.**push\_back**(**matrix**[**row**][**col**]);**

**switch** **(**direction**){**

**case** 0**:** // right

**if** **(**col **>=** rb**)** **{**direction **=** 1**;** row**++;** ub**++;}**

**else** col**++;**

**break;**

**case** 1**:** // down

**if** **(**row **>=** db**)** **{**direction **=** 2**;** col**--;** rb**--;}**

**else** row**++;**

**break;**

**case** 2**:** // left

**if** **(**col **<=** lb**)** **{**direction **=** 3**;** row**--;** db**--;}**

**else** col**--;**

**break;**

**case** 3**:** // up

**if** **(**row **<=** ub**)** **{**direction **=** 0**;** col**++;** lb**++;}**

**else** row**--;**

**}**

**}**

**return** res**;**

**}**

**};**

## 55. Jump Game

Medium

Given an array of non-negative integers, you are initially positioned at the first index of the array.

Each element in the array represents your maximum jump length at that position.

Determine if you are able to reach the last index.

**Example 1:**

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

**Output:** true

**Explanation:** Jump 1 step from index 0 to 1, then 3 steps to the last index.

**Example 2:**

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

**Output:** false

**Explanation:** You will always arrive at index 3 no matter what. Its maximum

  jump length is 0, which makes it impossible to reach the last index.

class Solution **{**

public**:**

bool canJump**(**vector**<**int**>&** nums**)** **{**

**}**

**};**

class Solution **{**

public**:**

bool canJump**(**vector**<**int**>&** nums**)** **{**

**if** **(**nums**.**size**()** **<=** 1**)** **return** **true;**

int n **=** nums**.**size**(),** temp **=** n**-**1**;**

**for** **(**int i **=** n**-**1**;** i **>=** 0**;** **--**i**)** **{**

int j **=** i **+** nums**[**i**];**

**if** **(**j **>=** temp**)** temp **=** i**;**

**}**

**return** temp **==** 0**;**

**}**

**};**

## 56. Merge Intervals★★

Medium

Given a collection of intervals, merge all overlapping intervals.

**Example 1:**

**Input:** [[1,3],[2,6],[8,10],[15,18]]

**Output:** [[1,6],[8,10],[15,18]]

**Explanation:** Since intervals [1,3] and [2,6] overlaps, merge them into [1,6].

**Example 2:**

**Input:** [[1,4],[4,5]]

**Output:** [[1,5]]

**Explanation:** Intervals [1,4] and [4,5] are considered overlapping.

class Solution **{**

public**:**

vector**<**vector**<**int**>>** merge**(**vector**<**vector**<**int**>>&** intervals**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**vector**<**int**>>** merge**(**vector**<**vector**<**int**>>&** intervals**)** **{**

vector**<**vector**<**int**>>** res**;**

**if** **(**intervals**.**empty**())** **return** res**;**

auto cmp **=** **[](**const vector**<**int**>** **&**a**,** const vector**<**int**>** **&**b**){**

**return** a**[**0**]** **<** b**[**0**];**

**};**

sort**(**intervals**.**begin**(),** intervals**.**end**(),** cmp**);**

res**.**push\_back**(**intervals**[**0**]);**

**for** **(**auto **&**v **:** intervals**)** **{**

**if** **(**res**.**back**()[**1**]** **<** v**[**0**])** res**.**push\_back**(**v**);**

**else** res**.**back**()[**1**]** **=** max**(**res**.**back**()[**1**],** v**[**1**]);**

**}**

**return** res**;**

**}**

**};**

## 57. Insert Interval★★

Hard

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

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

**Example 1:**

**Input:** intervals = [[1,3],[6,9]], newInterval = [2,5]

**Output:** [[1,5],[6,9]]

**Example 2:**

**Input:** intervals = [[1,2],[3,5],[6,7],[8,10],[12,16]], newInterval = [4,8]

**Output:** [[1,2],[3,10],[12,16]]

**Explanation:** Because the new interval [4,8] overlaps with [3,5],[6,7],[8,10].

class Solution **{**

public**:**

vector**<**vector**<**int**>>** insert**(**vector**<**vector**<**int**>>&** ins**,** vector**<**int**>&** newIn**){**

auto it **=** ins**.**begin**();**

**while** **(**it **!=** ins**.**end**())** **{**

**if** **((\***it**)[**1**]** **<** newIn**[**0**])** it**++;**

**else** **if** **((\***it**)[**0**]** **>** newIn**[**1**])** **{**

ins**.**insert**(**it**,** newIn**);**

**return** ins**;**

**}** **else** **{**

newIn**[**0**]** **=** min**(**newIn**[**0**],** **(\***it**)[**0**]);**

newIn**[**1**]** **=** max**(**newIn**[**1**],** **(\***it**)[**1**]);**

it **=** ins**.**erase**(**it**);**

**}**

**}**

ins**.**insert**(**ins**.**end**(),** newIn**);**

**return** ins**;**

**}**

**};**

class Solution **{**

public**:**

vector**<**vector**<**int**>>** insert**(**vector**<**vector**<**int**>>&** ins**,** vector**<**int**>&** newIn**){**

auto cmp **=** **[]** **(**const vector**<**int**>** **&**lhs**,** const vector**<**int**>** **&**rhs**)** **{**

**return** lhs**[**1**]** **<** rhs**[**0**];**

**};**

auto range **=** equal\_range**(**ins**.**begin**(),** ins**.**end**(),** newIn**,** cmp**);**

auto p **=** range**.**first**,** q **=** range**.**second**;**

**if** **(**p **==** q**)** ins**.**insert**(**p**,** newIn**);**

**else** **{**

q**--;**

**(\***q**)[**0**]** **=** min**(**newIn**[**0**],** **(\***p**)[**0**]);**

**(\***q**)[**1**]** **=** max**(**newIn**[**1**],** **(\***q**)[**1**]);**

ins**.**erase**(**p**,** q**);**

**}**

**return** ins**;**

**}**

**};**

## 58. Length of Last Word

Easy

Given a string *s* consists of upper/lower-case alphabets and empty space characters ' ', return the length of last word in the string.

If the last word does not exist, return 0.

**Note:** A word is defined as a character sequence consists of non-space characters only.

**Example:**

**Input:** "Hello World"

**Output:** 5

class Solution **{**

public**:**

int lengthOfLastWord**(**string s**)** **{**

**}**

**};**

class Solution **{**

public**:**

int lengthOfLastWord**(**string s**)** **{**

stringstream ss**(**s**);**

string res**;**

**while** **(**ss **>>** res**);**

**return** res**.**length**();**

**}**

**};**

class Solution **{**

public**:**

int lengthOfLastWord**(**string s**)** **{**

int i **=** s**.**find\_last\_not\_of**(**' '**);**

int res **=** 0**;**

**while** **(**i **>=** 0 **&&** s**[**i**--]** **!=** ' '**)** res**++;**

**return** res**;**

**}**

**};**

## 59. Spiral Matrix II

Medium

Given a positive integer *n*, generate a square matrix filled with elements from 1 to *n*2 in spiral order.

**Example:**

**Input:** 3

**Output:**

[

[ 1, 2, 3 ],

[ 8, 9, 4 ],

[ 7, 6, 5 ]

]

class Solution **{**

public**:**

vector**<**vector**<**int**>>** generateMatrix**(**int n**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**vector**<**int**>>** generateMatrix**(**int n**)** **{**

vector**<**vector**<**int**>>** res**(**n**,** vector**<**int**>(**n**,** 0**));**

int x **=** 0**,** y **=** 0**,** cnt **=** 0**;**

res**[**x**][**y**]** **=** **++**cnt**;**

**while** **(**cnt **<** n**\***n**)** **{**

**while** **(**y**+**1 **<** n **&&** **!**res**[**x**][**y**+**1**])** res**[**x**][++**y**]** **=** **++**cnt**;**

**while** **(**x**+**1 **<** n **&&** **!**res**[**x**+**1**][**y**])** res**[++**x**][**y**]** **=** **++**cnt**;**

**while** **(**y**-**1 **>=** 0 **&&** **!**res**[**x**][**y**-**1**])** res**[**x**][--**y**]** **=** **++**cnt**;**

**while** **(**x**-**1 **>=** 0 **&&** **!**res**[**x**-**1**][**y**])** res**[--**x**][**y**]** **=** **++**cnt**;**

**}**

**return** res**;**

**}**

**};**

## 60. Permutation Sequence★★

Medium

The set [1,2,3,...,*n*] contains a total of *n*! unique permutations.

By listing and labeling all of the permutations in order, we get the following sequence for *n* = 3:

1. "123"
2. "132"
3. "213"
4. "231"
5. "312"
6. "321"

Given *n* and *k*, return the *k*th permutation sequence.

**Note:**

* Given *n* will be between 1 and 9 inclusive.
* Given *k* will be between 1 and *n*! inclusive.

**Example 1:**

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

**Output:** "213"

**Example 2:**

**Input:** n = 4, k = 9

**Output:** "2314"

class Solution **{**

public**:**

string getPermutation**(**int n**,** int k**)** **{**

}

**};**

class Solution **{**

public**:**

string getPermutation**(**int n**,** int k**)** **{**

string s**(**n**,** '0'**);**

**for** **(**int i **=** 0**;** i **<** n**;** **++**i**)** s**[**i**]** **+=** i **+** 1**;**

**return** kth\_permutation**(**s**,** k**);**

**}**

private**:**

int factorial**(**int n**)** **{**

int result **=** 1**;**

**for** **(**int i **=** 1**;** i **<** n**+**1**;** **++**i**)** result **\*=** i**;**

**return** result**;**

**}**

string kth\_permutation**(**string **&**s**,** int k**)** **{**

int n **=** s**.**size**();**

string res**;**

int base **=** factorial**(**n **-** 1**);**

**--**k**;** // 康托编码从0开始

**for** **(**int i **=** n **-** 1**;;** i**--)** **{**

auto a **=** next**(**s**.**begin**(),** k **/** base**);**

res**.**push\_back**(\***a**);**

s**.**erase**(**a**);**

**if(!**i**)** **break;**

k **%=** base**;**

base **/=** i**;**

**}**

**return** res**;**

**}**

**};**

## 61. Rotate List

Medium

Given a linked list, rotate the list to the right by *k* places, where *k* is non-negative.

**Example 1:**

**Input:** 1->2->3->4->5->NULL, k = 2

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

**Explanation:**

rotate 1 steps to the right: 5->1->2->3->4->NULL

rotate 2 steps to the right: 4->5->1->2->3->NULL

**Example 2:**

**Input:** 0->1->2->NULL, k = 4

**Output:** 2->0->1->NULL

**Explanation:**

rotate 1 steps to the right: 2->0->1->NULL

rotate 2 steps to the right: 1->2->0->NULL

rotate 3 steps to the right: 0->1->2->NULL

rotate 4 steps to the right: 2->0->1->NULL

class Solution **{**

public**:**

ListNode**\*** rotateRight**(**ListNode**\*** head**,** int k**)** **{**

**}**

**};**

class Solution **{**

public**:**

ListNode**\*** rotateRight**(**ListNode**\*** head**,** int k**)** **{**

**if (**head **==** **nullptr)** **return** head**;**

int len **=** 1**;**

ListNode **\***last **=** head**,** **\***p **=** head**;**

**while (**last**->**next**)** **{**

last **=** last**->**next**;**

len**++;**

**}**

k **=** len**-**k**%**len**;**

**while (--**k**)** p **=** p**->**next**;**

last**->**next **=** head**;**

head **=** p**->**next**;**

p**->**next **=** **nullptr;**

**return** head**;**

**}**

**};**

## 62. Unique Paths

Medium

A robot is located at the top-left corner of a *m* x *n* grid (marked 'Start' in the diagram below).

The robot can only move either down or right at any point in time. The robot is trying to reach the bottom-right corner of the grid (marked 'Finish' in the diagram below).

How many possible unique paths are there?

  
Above is a 7 x 3 grid. How many possible unique paths are there?

**Note:** *m* and *n* will be at most 100.

**Example 1:**

**Input:** m = 3, n = 2

**Output:** 3

**Explanation:**

From the top-left corner, there are a total of 3 ways to reach the bottom-right corner:

1. Right -> Right -> Down

2. Right -> Down -> Right

3. Down -> Right -> Right

**Example 2:**

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

**Output:** 28

class Solution **{**

public**:**

int uniquePaths**(**int m**,** int n**)** **{**

**if** **(**n **>** m**)** swap**(**m**,** n**);**

long long res **=** 1**;**

int i **=** 1**;**

**while(**i **<** n**)** res **=** res**\*(**m**++)/**i**++;**

**return** res**;**

**}**

**};**

class Solution **{**

public**:**

int uniquePaths**(**int m**,** int n**)** **{**

vector**<**int**>** f**(**n**,** 1**);**

**while** **(--**m**)** **{**

**for** **(**int j **=** n**-**1**;** j **>=** 0**;** j**--)** **{**

**if** **(**j **!=** n**-**1**)** f**[**j**]** **+=** f**[**j**+**1**];**

**}**

**}**

**return** f**[**0**];**

**}**

**};**

## 63. Unique Paths II

Medium

A robot is located at the top-left corner of a *m* x *n* grid (marked 'Start' in the diagram below).

The robot can only move either down or right at any point in time. The robot is trying to reach the bottom-right corner of the grid (marked 'Finish' in the diagram below).

Now consider if some obstacles are added to the grids. How many unique paths would there be?



An obstacle and empty space is marked as 1 and 0 respectively in the grid.

**Note:** *m* and *n* will be at most 100.

**Example 1:**

**Input:**

[

  [0,0,0],

  [0,1,0],

  [0,0,0]

]

**Output:** 2

**Explanation:**

There is one obstacle in the middle of the 3x3 grid above.

There are two ways to reach the bottom-right corner:

1. Right -> Right -> Down -> Down

2. Down -> Down -> Right -> Right

class Solution **{**

public**:**

int uniquePathsWithObstacles**(**vector**<**vector**<**int**>>&** obstacleGrid**)** **{**

int m **=** obstacleGrid**.**size**(),** n **=** obstacleGrid**[**0**].**size**();**

**if** **(**obstacleGrid**[**0**][**0**]** **||** obstacleGrid**[**m**-**1**][**n**-**1**])** **return** 0**;**

vector**<**long long**>** f**(**n**,** 0**);**

f**[**n**-**1**]** **=** 1**;**

**for** **(**int i **=** m**-**1**;** i **>=** 0**;** i**--){**

**for** **(**int j **=** n**-**1**;** j **>=** 0**;** j**--)** **{**

**if** **(**i **==** m**-**1 **&&** j **==** n**-**1**)** **continue;**

**else if** **(**obstacleGrid**[**i**][**j**])** f**[**j**]** **=** 0**;**

**else** **if** **(**j **!=** n**-**1**)** f**[**j**]** **+=** f**[**j**+**1**];**

**}**

**}**

**return** f**[**0**];**

**}**

**};**

## 64. Minimum Path Sum

Medium

Given a *m* x *n* grid filled with non-negative numbers, find a path from top left to bottom right which *minimizes* the sum of all numbers along its path.

**Note:** You can only move either down or right at any point in time.

**Example:**

**Input:**

[

  [1,3,1],

[1,5,1],

[4,2,1]

]

**Output:** 7

**Explanation:** Because the path 1→3→1→1→1 minimizes the sum.

class Solution **{**

public**:**

int minPathSum**(**vector**<**vector**<**int**>>&** grid**)** **{**

**}**

**};**

class Solution **{**

public**:**

int minPathSum**(**vector**<**vector**<**int**>>&** grid**)** **{**

int res **=** 0**;**

**if** **(**grid**.**empty**())** **return** res**;**

int n **=** grid**.**size**(),** m **=** grid**[**0**].**size**();**

vector**<**int**>** f **=** grid**[**0**];**

**for** **(**int i **=** 0**;** i **<** n**;** **++**i**)** **{**

**for** **(**int j **=** 0**;** j **<** m**;** **++**j**)** **{**

**if** **(**i **==** 0**)** f**[**j**]** **+=** **(**j **==** 0 **?** 0**:** f**[**j**-**1**]);**

**else** **if** **(**j **==** 0**)** f**[**j**]** **+=** grid**[**i**][**j**];**

**else** f**[**j**]** **=** min**(**f**[**j**],** f**[**j**-**1**])** **+** grid**[**i**][**j**];**

**}**

**}**

**return** f**[**m**-**1**];**

**}**

**};**

## 65. Valid Number★★

Hard

Validate if a given string can be interpreted as a decimal number.

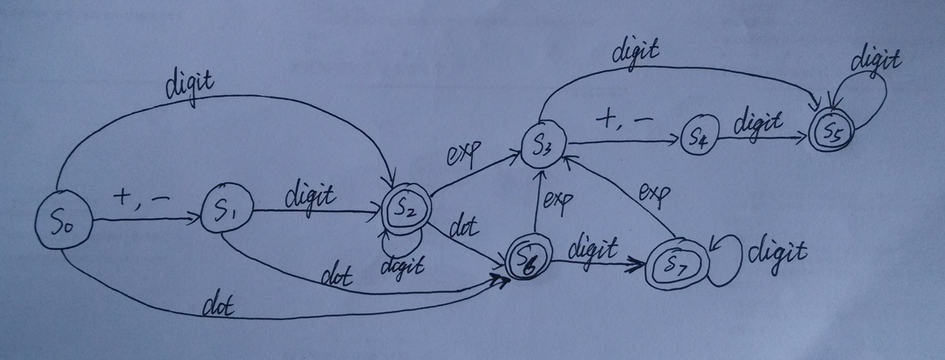
Some examples:  
"0" => true  
" 0.1 " => true  
"abc" => false  
"1 a" => false  
"2e10" => true  
" -90e3   " => true  
" 1e" => false  
"e3" => false  
" 6e-1" => true  
" 99e2.5 " => false  
"53.5e93" => true  
" --6 " => false  
"-+3" => false  
"95a54e53" => false

**Note:** It is intended for the problem statement to be ambiguous. You should gather all requirements up front before implementing one. However, here is a list of characters that can be in a valid decimal number:

* Numbers 0-9
* Exponent - "e"
* Positive/negative sign - "+"/"-"
* Decimal point - "."

Of course, the context of these characters also matters in the input.

**Update (2015-02-10):**  
The signature of the C++ function had been updated. If you still see your function signature accepts a const char \* argument, please click the reload button to reset your code definition.



class Solution **{**

public**:**

bool isNumber**(**string str**)** **{**

int state **=** 0**,** flag **=** 0**;**

**while** **(**str**[**0**]==**' '**)** str**.**erase**(**0**,**1**);**

**while** **(**str**.**back**()** **==** ' '**)** str**.**erase**(**str**.**length**()-**1**);**

**for** **(**auto **&**c **:** str**){**

**if** **(**isdigit**(**c**))** **{**

flag **=** 1**;**

**if** **(**state **<=** 2**)** state **=** 2**;**

**else** state **=** **(**state **<=** 5**)** **?** 5 **:** 7**;**

**}**

**else** **if(**'+' **==** c **||** '-' **==** c**){**

**if** **(**state **==** 0 **||** state **==** 3**)** state**++;**

**else** **return** **false;**

**}**

**else** **if(**'.' **==** c**){**

**if** **(**state **<=** 2**)** state **=** 6**;**

**else** **return** **false;**

**}**

**else** **if(**'e' **==** c**){**

**if(**flag **&&** **(**state **==** 2 **||** state **==** 6 **||** state **==** 7**))** state **=** 3**;**

**else** **return** **false;**

**}**

**else** **return** **false;**

**}**

**return** state **==** 2 **||** state **==** 5 **||** **(**flag **&&** state **==** 6**)** **||** state **==** 7**;**

**}**

**};**

## 66. Plus One

Easy

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

The digits are stored such that the most significant digit is at the head of the list, and each element in the array contain a single digit.

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

**Example 1:**

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

**Output:** [1,2,4]

**Explanation:** The array represents the integer 123.

**Example 2:**

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

**Output:** [4,3,2,2]

**Explanation:** The array represents the integer 4321.

class Solution **{**

public**:**

vector**<**int**>** plusOne**(**vector**<**int**>&** digits**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**int**>** plusOne**(**vector**<**int**>&** digits**)** **{**

int c **=** 1**;**

**for(**auto i **=** digits**.**rbegin**();** i **!=** digits**.**rend**();** i**++){**

c **+=** **\***i**;**

**\***i **=** c **%** 10**;**

c **/=** 10**;**

**}**

**if (**c**)** digits**.**insert**(**digits**.**begin**(),** c**);**

**return** digits**;**

**}**

**};**

## 67. Add Binary

Easy

Given two binary strings, return their sum (also a binary string).

The input strings are both **non-empty** and contains only characters 1 or 0.

**Example 1:**

**Input:** a = "11", b = "1"

**Output:** "100"

**Example 2:**

**Input:** a = "1010", b = "1011"

**Output:** "10101"

class Solution **{**

public**:**

string addBinary**(**string a**,** string b**)** **{**

**}**

**};**

class Solution **{**

public**:**

string addBinary**(**string a**,** string b**)** **{**

int c **=** 0**;**

string res**;**

reverse**(**a**.**begin**(),** a**.**end**());**

reverse**(**b**.**begin**(),** b**.**end**());**

auto p **=** a**.**begin**(),** q **=** b**.**begin**();**

**while** **(**p **!=** a**.**end**()** **||** q **!=** b**.**end**())** **{**

**if** **(**p **!=** a**.**end**())** **{**

c **+=** **\***p**-**'0'**;**

p**++;**

**}**

**if** **(**q **!=** b**.**end**())** **{**

c **+=** **\***q**-**'0'**;**

q**++;**

**}**

res **+=** c**%**2**+**'0'**;**

c **/=** 2**;**

**}**

**if (**c**)** res **+=** '1'**;**

reverse**(**res**.**begin**(),** res**.**end**());**

**return** res**;**

**}**

**};**

## 68. Text Justification

Hard

Given an array of words and a width *maxWidth*, format the text such that each line has exactly *maxWidth* characters and is fully (left and right) justified.

You should pack your words in a greedy approach; that is, pack as many words as you can in each line. Pad extra spaces ' ' when necessary so that each line has exactly *maxWidth* characters.

Extra spaces between words should be distributed as evenly as possible. If the number of spaces on a line do not divide evenly between words, the empty slots on the left will be assigned more spaces than the slots on the right.

For the last line of text, it should be left justified and no **extra** space is inserted between words.

**Note:**

* A word is defined as a character sequence consisting of non-space characters only.
* Each word's length is guaranteed to be greater than 0 and not exceed *maxWidth*.
* The input array words contains at least one word.

**Example 1:**

**Input:**

words = ["This", "is", "an", "example", "of", "text", "justification."]

maxWidth = 16

**Output:**

[

   "This    is    an",

   "example  of text",

   "justification.  "

]

**Example 2:**

**Input:**

words = ["What","must","be","acknowledgment","shall","be"]

maxWidth = 16

**Output:**

[

  "What   must   be",

  "acknowledgment  ",

  "shall be        "

]

**Explanation:** Note that the last line is "shall be " instead of "shall be",

  because the last line must be left-justified instead of fully-justified.

Note that the second line is also left-justified becase it contains only one word.

**Example 3:**

**Input:**

words = ["Science","is","what","we","understand","well","enough","to","explain",

  "to","a","computer.","Art","is","everything","else","we","do"]

maxWidth = 20

**Output:**

[

  "Science  is  what we",

"understand      well",

  "enough to explain to",

  "a  computer.  Art is",

  "everything  else  we",

  "do                  "

]

class Solution **{**

public**:**

vector**<**string**>** fullJustify**(**vector**<**string**>&** words**,** int maxWidth**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**string**>** fullJustify**(**vector**<**string**>&** words**,** int maxWidth**)** **{**

vector**<**string**>** res**;**

int n **=** words**.**size**(),** i **=** 0**;**

**while** **(**i **<** n**)** **{**

int width **=** 0**;**

vector**<**string**>** t**;**

**while** **(**i **<** n **&&** width **+** words**[**i**].**length**()**

**<=** maxWidth**-**t**.**size**())** **{**

width **+=** words**[**i**].**length**();**

t**.**push\_back**(**words**[**i**++]);**

**}**

string s **=** t**[**0**];**

int space\_num **=** maxWidth**-**width**;**

**if** **(**t**.**size**()** **==** 1**)** s **+=** string**(**space\_num**,** ' '**);**

**else** **if** **(**i **==** n**)** **{**

**for** **(**int j **=** 1**;** j **<** t**.**size**();** **++**j**)** **{**

s **+=** " " **+** t**[**j**];**

**}**

s **+=** string**(**maxWidth **-** s**.**length**(),** ' '**);**

**}**

**else** **{**

int aver **=** space\_num **/** **(**t**.**size**()-**1**);**

int k **=** space\_num **-** **(**t**.**size**()-**1**)\***aver**;**

**for** **(**int j **=** 1**;** j **<** t**.**size**();** **++**j**)** **{**

s **+=** string**((**j **<=** k **?** aver**+**1**:** aver**),** ' '**)** **+** t**[**j**];**

**}**

**}**

res**.**push\_back**(**s**);**

**}**

**return** res**;**

**}**

**};**

## 69. Sqrt(x) ★★

Easy

Implement int sqrt(int x).

Compute and return the square root of *x*, where *x* is guaranteed to be a non-negative integer.

Since the return type is an integer, the decimal digits are truncated and only the integer part of the result is returned.

**Example 1:**

**Input:** 4

**Output:** 2

**Example 2:**

**Input:** 8

**Output:** 2

**Explanation:** The square root of 8 is 2.82842..., and since

  the decimal part is truncated, 2 is returned.

class Solution **{**

public**:**

int mySqrt**(**int x**)** **{**

int low **=** 0**,** high **=** x**;**

**if** **(**x **<** 2**)** **return** x**;**

**while** **(**low **<** high**)** **{**

int mid **=** low **+** **(**high**-**low**)/**2**;**

**if (**x**/**mid **>=** mid**)** low **=** mid**+**1**;**

**else** high **=** mid**;**

**}**

**return** low**-**1**;**

**}**

**};**

## 70. Climbing Stairs

Easy

You are climbing a stair case. It takes *n* steps to reach to the top.

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

**Note:** Given *n* will be a positive integer.

**Example 1:**

**Input:** 2

**Output:** 2

**Explanation:** There are two ways to climb to the top.

1. 1 step + 1 step

2. 2 steps

**Example 2:**

**Input:** 3

**Output:** 3

**Explanation:** There are three ways to climb to the top.

1. 1 step + 1 step + 1 step

2. 1 step + 2 steps

3. 2 steps + 1 step

class Solution **{**

public**:**

int climbStairs**(**int n**)** **{**

**}**

**};**

class Solution **{**

public**:**

struct Matrix**{**

int a**[**2**][**2**]** **=** **{**0**};**

void init**() {**

**for** **(**int i **=** 0**;** i **<** 2**;** i**++)**

a**[**i**][**i**]** **=** 1**;**

**}**

**};**

Matrix MUL**(**Matrix A**,** Matrix B**){**

Matrix C**;**

**for** **(**int i **=** 0**;** i **<** 2**;** i**++)** **{**

**for** **(**int j **=** 0**;** j **<** 2**;** j**++)** **{**

**for** **(**int k **=** 0**;** k **<** 2**;** k**++) {**

C**.**a**[**i**][**j**]** **+=** A**.**a**[**i**][**k**]\***B**.**a**[**k**][**j**];**

**}**

**}**

**}**

**return** C**;**

**}**

int climbStairs**(**int n**)** **{**

**if** **(**n **==** 1**)** **return** 1**;**

**if** **(**n **==** 2**)** **return** 2**;**

Matrix res**,** x**;**

x**.**a**[**0**][**0**]** **=** x**.**a**[**0**][**1**]** **=** x**.**a**[**1**][**0**]** **=** 1**;**

x**.**a**[**1**][**1**]** **=** 0**;**

res**.**init**();**

**while** **(**n**)** **{**

**if** **(**n**&**1**)** res **=** MUL**(**res**,** x**);**

x **=** MUL**(**x**,** x**);**

n **>>=** 1**;**

**}**

**return** res**.**a**[**0**][**1**]+**res**.**a**[**1**][**1**];**

**}**

**};**

## 71. Simplify Path

Medium

Given an **absolute path** for a file (Unix-style), simplify it. Or in other words, convert it to the **canonical path**.

In a UNIX-style file system, a period . refers to the current directory. Furthermore, a double period .. moves the directory up a level. For more information, see: [Absolute path vs relative path in Linux/Unix](https://www.linuxnix.com/abslute-path-vs-relative-path-in-linuxunix/)

Note that the returned canonical path must always begin with a slash /, and there must be only a single slash / between two directory names. The last directory name (if it exists) **must not** end with a trailing /. Also, the canonical path must be the **shortest** string representing the absolute path.

**Example 1:**

**Input: "**/home/"

**Output: "**/home"

**Explanation:** Note that there is no trailing slash after the last directory name.

**Example 2:**

**Input: "**/../"

**Output: "**/"

**Explanation:** Going one level up from the root directory is a no-op, as the root level is the highest level you can go.

**Example 3:**

**Input: "**/home//foo/"

**Output: "**/home/foo"

**Explanation:** In the canonical path, multiple consecutive slashes are replaced by a single one.

**Example 4:**

**Input: "**/a/./b/../../c/"

**Output: "**/c"

**Example 5:**

**Input: "**/a/../../b/../c//.//"

**Output: "**/c"

**Example 6:**

**Input: "**/a//b////c/d//././/.."

**Output: "**/a/b/c"

class Solution **{**

public**:**

string simplifyPath**(**string path**)** **{**

**}**

**};**

class Solution **{**

public**:**

string simplifyPath**(**string path**)** **{**

string res**,** tmp**;**

vector**<**string**>** stk**;**

stringstream ss**(**path**);**

**while** **(**getline**(**ss**,** tmp**,**'/'**))** **{**

//getline(istream &is, string &str, char delim); delim终止符

**if** **(**tmp **==** "" **||** tmp **==** "."**)** **continue;**

**else** **if** **(**tmp **==** ".." **&&** **!**stk**.**empty**())** stk**.**pop\_back**();**

**else** **if** **(**tmp **!=** ".."**)** stk**.**push\_back**(**tmp**);**

**}**

**for** **(**auto **&**str **:** stk**)** res **+=** '/' **+** str**;**

**return** res**.**empty**()** **?** "/" **:** res**;**

**}**

**};**

## 72. Edit Distance★★

Hard

Given two words *word1* and *word2*, find the minimum number of operations required to convert *word1* to *word2*.

You have the following 3 operations permitted on a word:

1. Insert a character
2. Delete a character
3. Replace a character

**Example 1:**

**Input:** word1 = "horse", word2 = "ros"

**Output:** 3

**Explanation:**

horse -> rorse (replace 'h' with 'r')

rorse -> rose (remove 'r')

rose -> ros (remove 'e')

**Example 2:**

**Input:** word1 = "intention", word2 = "execution"

**Output:** 5

**Explanation:**

intention -> inention (remove 't')

inention -> enention (replace 'i' with 'e')

enention -> exention (replace 'n' with 'x')

exention -> exection (replace 'n' with 'c')

exection -> execution (insert 'u')

class Solution **{**

public**:**

int minDistance**(**string word1**,** string word2**)** **{**

int m **=** word1**.**size**(),** n **=** word2**.**size**();**

vector**<**vector**<**int**>>** dp**(**2**,** vector**<**int**>(**n**+**1**));**

int k **=** 0**;**

**for** **(**int i **=** 0**;** i **<=** m**;** i**++)** **{**

**for** **(**int j **=** 0**;** j **<=** n**;** j**++)** **{**

**if** **(**i **==** 0**)** dp**[**k**][**j**]** **=** j**;**

**else** **if** **(**j **==** 0**)** dp**[**k**][**j**]** **=** i**;**

**else** **if** **(**word1**[**i**-**1**]** **==** word2**[**j**-**1**])** dp**[**k**][**j**]** **=** dp**[**k**^**1**][**j**-**1**];**

**else** dp**[**k**][**j**]** **=** 1 **+** min**(**dp**[**k**^**1**][**j**-**1**],**

min**(**dp**[**k**][**j**-**1**],** dp**[**k**^**1**][**j**]));**

**}**

k **^=** 1**;**

**}**

**return** dp**[**k**^**1**][**n**];**

**}**

**};**

## 73. Set Matrix Zeroes★★

Medium

Given a *m* x *n* matrix, if an element is 0, set its entire row and column to 0. Do it [**in-place**](https://en.wikipedia.org/wiki/In-place_algorithm).

**Example 1:**

**Input:**

[

  [1,1,1],

  [1,0,1],

  [1,1,1]

]

**Output:**

[

  [1,0,1],

  [0,0,0],

  [1,0,1]

]

**Example 2:**

**Input:**

[

  [0,1,2,0],

  [3,4,5,2],

  [1,3,1,5]

]

**Output:**

[

  [0,0,0,0],

  [0,4,5,0],

  [0,3,1,0]

]

**Follow up:**

* A straight forward solution using O(*mn*) space is probably a bad idea.
* A simple improvement uses O(*m* + *n*) space, but still not the best solution.
* Could you devise a constant space solution?

class Solution **{**

public**:**

void setZeroes**(**vector**<**vector**<**int**>>&** matrix**)** **{**

**}**

**};**

class Solution **{**

public**:**

void setZeroes**(**vector**<**vector**<**int**>>&** matrix**)** **{**

**if** **(**matrix**.**empty**())** **return;**

bool Row\_Zero **=** **false,** Col\_Zero **=** **false;**

int N **=** matrix**.**size**(),** M **=** matrix**[**0**].**size**();**

**for** **(**int i **=** 0**;** i **<** N**;** i**++)** **{**

**for** **(**int j **=** 0**;** j **<** M**;** j**++)** **{**

**if** **(!**i **&&** **!**matrix**[**i**][**j**])** Row\_Zero **=** **true;**

**if** **(!**j **&&** **!**matrix**[**i**][**j**])** Col\_Zero **=** **true;**

**if** **(!**matrix**[**i**][**j**])** matrix**[**i**][**0**]** **=** matrix**[**0**][**j**]** **=** 0**;**

**}**

**}**

**for** **(**int i **=** 1**;** i **<** N**;** i**++)** **{**

**for** **(**int j **=** 1**;** j **<** M**;** j**++)** **{**

**if** **(!**matrix**[**i**][**0**]** **||** **!**matrix**[**0**][**j**])**

matrix**[**i**][**j**]** **=** 0**;**

**}**

**}**

**if** **(**Row\_Zero**){**

**for** **(**int j **=** 0**;** j **<** M**;** j**++)** matrix**[**0**][**j**]** **=** 0**;**

**}**

**if** **(**Col\_Zero**){**

**for** **(**int i **=** 0**;** i **<** N**;** i**++)** matrix**[**i**][**0**]** **=** 0**;**

**}**

**}**

**};**

## 74. Search a 2D Matrix

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 from left to right.
* The first integer of each row is greater than the last integer of the previous row.

**Example 1:**

**Input:**

matrix = [

[1, 3, 5, 7],

[10, 11, 16, 20],

[23, 30, 34, 50]

]

target = 3

**Output:** true

**Example 2:**

**Input:**

matrix = [

[1, 3, 5, 7],

[10, 11, 16, 20],

[23, 30, 34, 50]

]

target = 13

**Output:** false

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 l **=** 0**,** r **=** m**\***n**;**

**while** **(**l **<** r**)** **{**

int mid **=** l **+** **(**r**-**l**)/**2**;**

int v **=** matrix**[**mid**/**m**][**mid**%**m**];**

**if** **(**v **==** target**)** **return** **true;**

**else** **if** **(**v **<** target**)** l **=** mid**+**1**;**

**else** r **=** mid**;**

**}**

**return** **false;**

**}**

**};**

## 75. Sort Colors★★

Medium

Given an array with *n* objects colored red, white or blue, sort them [**in-place**](https://en.wikipedia.org/wiki/In-place_algorithm)so that objects of the same color are adjacent, with the colors in the order red, white and blue.

Here, we will use the integers 0, 1, and 2 to represent the color red, white, and blue respectively.

**Note:** You are not suppose to use the library's sort function for this problem.

**Example:**

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

**Output:** [0,0,1,1,2,2]

**Follow up:**

* A rather straight forward solution is a two-pass algorithm using counting sort.  
  First, iterate the array counting number of 0's, 1's, and 2's, then overwrite array with total number of 0's, then 1's and followed by 2's.
* Could you come up with a one-pass algorithm using only constant space?

class Solution **{**

public**:**

void sortColors**(**vector**<**int**>&** nums**)** **{**

**}**

**};**

class Solution **{**

public**:**

void sortColors**(**vector**<**int**>&** nums**)** **{**

int red **=** 0**,** blue **=** nums**.**size**()-**1**,** i **=** 0**;**

**while** **(**i **<=** blue**)** **{**

**if** **(**nums**[**i**]** **==** 0**)** swap**(**nums**[**i**++],** nums**[**red**++]);**

**else** **if** **(**nums**[**i**]** **==** 2**)** swap**(**nums**[**i**],** nums**[**blue**--]);**

**else** i**++;**

**}**

**}**

**};**

## 76. Minimum Window Substring★★

Hard

Given a string S and a string T, find the minimum window in S which will contain all the characters in T in complexity O(n).

**Example:**

**Input: S** = "ADOBECODEBANC", **T** = "ABC"

**Output:** "BANC"

**Note:**

* If there is no such window in S that covers all characters in T, return the empty string "".
* If there is such window, you are guaranteed that there will always be only one unique minimum window in S.

class Solution **{**

public**:**

string minWindow**(**string s**,** string t**)** **{**

**}**

**};**

class Solution **{**

public**:**

string minWindow**(**string s**,** string t**)** **{**

string res**;**

vector**<**int**>** tab**(**256**,** 0**),** window**(**256**,**0**);**

**for(**char **&**c**:** t**)** **++**tab**[**c**];**

int st **=** 0**,** cur **=** 0**;**

int minlen **=** INT\_MAX**,** nums **=** 0**;**

**while** **(**1**)** **{**

**while** **(**cur **<** s**.**length**()** **&&** nums **<** t**.**length**()){**

int idx **=** s**[**cur**++];**

**if** **(**tab**[**idx**]** **>** 0 **&&** window**[**idx**]++** **<** tab**[**idx**])** **++**nums**;**

**}**

**if** **(**nums **<** t**.**length**())** **break;**

**if** **(**minlen **>** cur **-** st**)** **{**

res **=** s**.**substr**(**st**,** cur**-**st**);**

minlen **=** res**.**length**();**

**}**

int idx **=** s**[**st**++];**

**if** **(**tab**[**idx**]** **>** 0 **&&** **--**window**[**idx**]** **<** tab**[**idx**])** **--**nums**;**

**}**

**return** res**;**

**}**

**};**

## 77. Combinations

Medium

Given two integers *n* and *k*, return all possible combinations of *k* numbers out of 1 ... *n*.

**Example:**

**Input:** n = 4, k = 2

**Output:**

[

[2,4],

[3,4],

[2,3],

[1,2],

[1,3],

[1,4],

]

class Solution **{**

public**:**

vector**<**vector**<**int**>>** res**;**

**}**

**};**

class Solution **{**

public**:**

vector**<**vector**<**int**>>** res**;**

vector**<**vector**<**int**>>** combine**(**int n**,** int k**)** **{**

vector**<**int**>** v**;**

dfs**(**0**,** k**,** 1**,** n**,** v**);**

**return** res**;**

**}**

private**:**

void dfs**(**int cur**,** int k**,** int start**,** int n**,** vector**<**int**>** **&**v**)** **{**

**if** **(**cur **==** k**)** **{**

res**.**push\_back**(**v**);**

**return;**

**}**

**for** **(**int i **=** start**;** i **<=** n**;** i**++)** **{**

v**.**push\_back**(**i**);**

dfs**(**cur**+**1**,** k**,** i**+**1**,** n**,** v**);**

v**.**pop\_back**();**

**}**

**}**

**};**

## 78. Subsets

Medium

Given a set of **distinct** integers, *nums*, return all possible subsets (the power set).

**Note:** The solution set must not contain duplicate subsets.

**Example:**

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

**Output:**

[

[3],

  [1],

  [2],

  [1,2,3],

  [1,3],

  [2,3],

  [1,2],

  []

]

class Solution **{**

public**:**

vector**<**vector**<**int**>>** subsets**(**vector**<**int**>&** nums**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**vector**<**int**>>** res**;**

vector**<**vector**<**int**>>** subsets**(**vector**<**int**>&** nums**)** **{**

vector**<**int**>** v**;**

dfs**(**0**,** nums**,** v**);**

**return** res**;**

**}**

private**:**

void dfs**(**int cur**,** vector**<**int**>** **&**nums**,** vector**<**int**>** **&**v**)** **{**

**if** **(**cur **==** nums**.**size**())** **{**

res**.**push\_back**(**v**);**

**return;**

**}**

v**.**push\_back**(**nums**[**cur**]);**

dfs**(**cur**+**1**,** nums**,** v**);**

v**.**pop\_back**();**

dfs**(**cur**+**1**,** nums**,** v**);**

**}**

**};**

class Solution **{**

public**:**

vector**<**vector**<**int**>>** res**;**

vector**<**vector**<**int**>>** subsets**(**vector**<**int**>&** nums**)** **{**

vector**<**int**>** v**;**

dfs**(**0**,** nums**,** v**);**

**return** res**;**

**}**

private**:**

void dfs**(**int start**,** vector**<**int**>** **&**nums**,** vector**<**int**>** **&**v**)** **{**

res**.**push\_back**(**v**);**

**for** **(**int i **=** start**;** i **<** nums**.**size**();** i**++)** **{**

v**.**push\_back**(**nums**[**i**]);**

dfs**(**i**+**1**,** nums**,** v**);**

v**.**pop\_back**();**

**}**

**}**

**};**

class Solution **{**

public**:**

vector**<**vector**<**int**>>** subsets**(**vector**<**int**>&** nums**)** **{**

int n **=** nums**.**size**();**

vector**<**vector**<**int**>>** res**;**

**for** **(**int i **=** 0**;** i **<** **(**1**<<**n**)** **;** i**++)** **{**

vector**<**int**>** v**;**

**for** **(**int j **=** 0**;** j **<** n**;** j**++)** **{**

**if** **(**i **&** **(**1**<<**j**))** v**.**push\_back**(**nums**[**j**]);**

**}**

res**.**push\_back**(**v**);**

**}**

**return** res**;**

**}**

**};**

class Solution **{**

public**:**

vector**<**vector**<**int**>>** subsets**(**vector**<**int**>&** nums**)** **{**

int n **=** nums**.**size**();**

vector**<**vector**<**int**>>** res**{{}};**

**for(**auto **&**x **:** nums**){**

res**.**reserve**(**res**.**size**()\***2**);**

auto half **=** res**.**begin**()+**res**.**size**();** // auto half = res.end();

copy**(**res**.**begin**(),** res**.**end**(),** back\_inserter**(**res**));**

for\_each**(**res**.**begin**(),** half**,** **[&**x**](**decltype**(**res**[**0**])** **&**v**){**

v**.**push\_back**(**x**);**

**});**

/\*int sz = res.size();

for(int i = 0; i < sz; i++) {

res.push\_back(res[i]);

res.back().push\_back(x);

}\*/

**}**

**return** res**;**

**}**

**};**

## 79. Word Search

Medium

Given a 2D board and a word, find if the word exists in the grid.

The word can 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.

**Example:**

board =

[

['A','B','C','E'],

['S','F','C','S'],

['A','D','E','E']

]

Given word = "**ABCCED**", return **true**.

Given word = "**SEE**", return **true**.

Given word = "**ABCB**", return **false**.

class Solution **{**

public**:**

bool exist**(**vector**<**vector**<**char**>>&** board**,** string word**)** **{**

**}**

**};**

class Solution **{**

public**:**

bool exist**(**vector**<**vector**<**char**>>&** board**,** string word**)** **{**

n **=** board**.**size**();**

m **=** board**[**0**].**size**();**

visited**.**resize**(**n**,** vector**<**bool**>(**m**,** **false));**

**for** **(**int i **=** 0**;** i **<** n**;** i**++)** **{**

**for** **(**int j **=** 0**;** j **<** m**;** j**++)** **{**

**if** **(**dfs**(**i**,** j**,** 0**,** word**,** board**))**

**return** **true;**

**}**

**}**

**return** **false;**

**}**

private**:**

int n**,** m**;**

vector**<**vector**<**bool**>>** visited**;**

bool dfs**(**int i**,** int j**,** int cnt**,** string **&**s**,** vector**<**vector**<**char**>>&** board**)** **{**

**if(**cnt **==** s**.**length**())** **return** **true;**

**if** **(**i **<** 0 **||** j **<** 0 **||** i **>=** n **||** j **>=** m**)** **return** **false;**

**else** **if** **(**visited**[**i**][**j**]** **||** board**[**i**][**j**]** **!=** s**[**cnt**++])** **return** **false;**

visited**[**i**][**j**]** **=** **true;**

bool ret **=** dfs**(**i**-**1**,** j**,** cnt**,** s**,** board**)**

**||** dfs**(**i**+**1**,** j**,** cnt**,** s**,** board**)**

**||** dfs**(**i**,** j**-**1**,** cnt**,** s**,** board**)**

**||** dfs**(**i**,** j**+**1**,** cnt**,** s**,** board**);**

visited**[**i**][**j**]** **=** **false;**

**return** ret**;**

**}**

**};**

## 80. Remove Duplicates from Sorted Array II

Medium

Given a sorted array *nums*, remove the duplicates [**in-place**](https://en.wikipedia.org/wiki/In-place_algorithm) such that duplicates appeared at most *twice* and return the new length.

Do not allocate extra space for another array, you must do this by **modifying the input array** [**in-place**](https://en.wikipedia.org/wiki/In-place_algorithm) with O(1) extra memory.

**Example 1:**

Given *nums* = **[1,1,1,2,2,3]**,

Your function should return length = **5**, with the first five elements of *nums* being **1, 1, 2, 2** and **3** respectively.

It doesn't matter what you leave beyond the returned length.

**Example 2:**

Given *nums* = **[0,0,1,1,1,1,2,3,3]**,

Your function should return length = **7**, with the first seven elements of *nums* being modified to **0**, **0**, **1**, **1**, **2**, **3** and **3** respectively.

It doesn't matter what values are set beyond the returned length.

**Clarification:**

Confused why the returned value is an integer but your answer is an array?

Note that the input array is passed in by **reference**, which means modification to the input array will be known to the caller as well.

Internally you can think of this:

class Solution **{**

public**:**

int removeDuplicates**(**vector**<**int**>&** nums**)** **{**

**}**

**};**

class Solution **{**

public**:**

int removeDuplicates**(**vector**<**int**>&** nums**)** **{**

**if (**nums**.**size**()** **<=** 2**)** **return** nums**.**size**();**

int index **=** 2**,** n **=** nums**.**size**();**

**for** **(**int i **=** 2**;** i **<** n**;** i**++){**

**if (**nums**[**index**-**2**]** **!=** nums**[**i**]) {**

nums**[**index**++]** **=** nums**[**i**];**

**}**

**}**

**return** index**;**

**}**

**};**

## 81. Search in Rotated Sorted Array II★★

Medium

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

(i.e., [0,0,1,2,2,5,6] might become [2,5,6,0,0,1,2]).

You are given a target value to search. If found in the array return true, otherwise return false.

**Example 1:**

**Input:** nums = [2,5,6,0,0,1,2], target = 0

**Output:** true

**Example 2:**

**Input:** nums = [2,5,6,0,0,1,2], target = 3

**Output:** false

**Follow up:**

* This is a follow up problem to [Search in Rotated Sorted Array](https://leetcode.com/problems/search-in-rotated-sorted-array/description/), where nums may contain duplicates.
* Would this affect the run-time complexity? How and why?

class Solution **{**

public**:**

bool search**(**vector**<**int**>&** nums**,** int target**)** **{**

**}**

**};**

class Solution **{**

public**:**

bool search**(**vector**<**int**>&** nums**,** int target**)** **{**

int l **=** 0**,** r **=** nums**.**size**()-**1**;**

**while** **(**l **<=** r**)** **{**

int mid **=** l **+** **(**r**-**l**)/**2**;**

**if** **(**nums**[**mid**]** **==** target**)** **return** **true;**

**if** **(**nums**[**mid**]** **<** nums**[**r**])** **{**

**if** **(**nums**[**mid**]** **<** target **&&** target **<=** nums**[**r**])** l **=** mid **+** 1**;**

**else** r **=** mid **-** 1**;**

**}** **else** **if** **(**nums**[**mid**]** **>** nums**[**r**])** **{**

**if** **(**nums**[**l**]** **<=** target **&&** target **<** nums**[**mid**])** r **=** mid **-** 1**;**

**else** l **=** mid**+**1**;**

**}** **else** r**--;**

**}**

**return** **false;**

**}**

**};**

## 82. Remove Duplicates from Sorted List II

Medium

Given a sorted linked list, delete all nodes that have duplicate numbers, leaving only *distinct* numbers from the original list.

**Example 1:**

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

**Output:** 1->2->5

**Example 2:**

**Input:** 1->1->1->2->3

**Output:** 2->3

class Solution **{**

public**:**

ListNode**\*** deleteDuplicates**(**ListNode**\*** head**)** **{**

**}**

**};**

class Solution **{**

public**:**

ListNode**\*** deleteDuplicates**(**ListNode**\*** head**)** **{**

ListNode **\***dummy **=** **new** ListNode**(-**1**);**

dummy**->**next **=** head**;**

head **=** dummy**;**

ListNode **\***p **=** dummy**,** **\***q **=** dummy**->**next**;**

**while** **(**q**)** **{**

bool duplicated **=** **false;**

**while (**q**->**next **&&** p**->**next**->**val **==** q**->**next**->**val**)** **{**

duplicated **=** **true;**

q **=** q**->**next**;**

**}**

**if** **(!**duplicated**)** **{**head**->**next **=** q**;** head **=** q**;}**

p **=** q**;**

q **=** q**->**next**;**

**}**

head**->**next **=** **nullptr;**

**return** dummy**->**next**;**

**}**

**};**

/////////////////////递归///////////////////////////////////////////

class Solution **{**

public**:**

ListNode**\*** deleteDuplicates**(**ListNode**\*** head**)** **{**

**if** **(**head **==** **nullptr** **||** head**->**next **==** **nullptr)** **return** head**;**

ListNode **\***p **=** head**->**next**;**

**if** **(**head**->**val **==** p**->**val**)** **{**

**while** **(**p **&&** head**->**val **==** p**->**val**)** **{**

ListNode **\***t **=** p**;**

p **=** p**->**next**;**

**delete(**t**);**

**}**

**delete(**head**);**

**return** deleteDuplicates**(**p**);**

**}** **else** **{**

head**->**next **=** deleteDuplicates**(**p**);**

**return** head**;**

**}**

**}**

**};**

## 83. Remove Duplicates from Sorted List

Easy

Given a sorted linked list, delete all duplicates such that each element appear only *once*.

**Example 1:**

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

**Output:** 1->2

**Example 2:**

**Input:** 1->1->2->3->3

**Output:** 1->2->3

/\*\*

\* Definition for singly-linked list.

\* struct ListNode {

\* int val;

\* ListNode \*next;

\* ListNode(int x) : val(x), next(NULL) {}

\* };

\*/

class Solution **{**

public**:**

ListNode**\*** deleteDuplicates**(**ListNode**\*** head**)** **{**

**}**

**};**

class Solution **{**

public**:**

ListNode**\*** deleteDuplicates**(**ListNode**\*** head**)** **{**

**if (!**head**)** **return** head**;**

ListNode **\***p **=** head**,** **\***q **=** p**->**next**;**

**while** **(**q**)** **{**

**if** **(**q**->**val **!=** p**->**val**)** **{**

p**->**next **=** q**;**

p **=** q**;**

**}**

q **=** q**->**next**;**

**}**

p**->**next **=** **nullptr;**

**return** head**;**

**}**

**};**

## 84. Largest Rectangle in Histogram

Hard

Given *n* non-negative integers representing the histogram's bar height where the width of each bar is 1, find the area of largest rectangle in the histogram.

  
Above is a histogram where width of each bar is 1, given height = [2,1,5,6,2,3].

  
The largest rectangle is shown in the shaded area, which has area = 10 unit.

**Example:**

**Input:** [2,1,5,6,2,3]

**Output:** 10

class Solution **{**

public**:**

int largestRectangleArea**(**vector**<**int**>&** heights**)** **{**

**}**

**};**

class Solution **{**

public**:**

int largestRectangleArea**(**vector**<**int**>&** heights**)** **{**

stack**<**int**>** stk**;**

heights**.**push\_back**(**0**);**

int res **=** 0**,** n **=** heights**.**size**();**

**for** **(**int i **=** 0**;** i **<** n**;** i**++)** **{**

**while (!**stk**.**empty**()** **&&** heights**[**i**]** **<=** heights**[**stk**.**top**()])** **{**

int h **=** heights**[**stk**.**top**()];**

stk**.**pop**();**

res **=** max**(**res**,**

h**\*(**stk**.**empty**()** **?** i **:** i**-**stk**.**top**()-**1**));**

**}**

stk**.**push**(**i**);**

**}**

**return** res**;**

**}**

**};**

## 85. Maximal Rectangle★★

Hard

Given a 2D binary matrix filled with 0's and 1's, find the largest rectangle 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:** 6

class Solution **{**

public**:**

int maximalRectangle**(**vector**<**vector**<**char**>>&** matrix**)** **{**

**}**

**};**

class Solution **{**

public**:**

int maximalRectangle**(**vector**<**vector**<**char**>>&** matrix**)** **{**

**if** **(**matrix**.**empty**())** **return** 0**;**

int res **=** 0**,** n **=** matrix**[**0**].**size**(),** m **=** matrix**.**size**();**

vector**<**int**>** v**(**n**+**1**,**0**);**

**for** **(**auto **&**u **:** matrix**)** **{**

**for (**int j **=** 0**;** j **<** n**;** j**++)** **{**

**if** **(**u**[**j**]** **==** '1'**)** v**[**j**]++;**

**else** v**[**j**]** **=** 0**;**

**}**

res **=** max**(**res**,** largestRectangleArea**(**v**));**

**}**

**return** res**;**

**}**

private**:**

int largestRectangleArea**(**vector**<**int**>&** heights**)** **{**

stack**<**int**>** stk**;**

int res **=** 0**,** n **=** heights**.**size**();**

**for** **(**int i **=** 0**;** i **<** n**;** i**++)** **{**

**while (!**stk**.**empty**()** **&&** heights**[**i**]** **<=** heights**[**stk**.**top**()])** **{**

int h **=** heights**[**stk**.**top**()];**

stk**.**pop**();**

res **=** max**(**res**,**

h**\*(**stk**.**empty**()** **?** i **:** i**-**stk**.**top**()-**1**));**

**}**

stk**.**push**(**i**);**

**}**

**return** res**;**

**}**

**};**

## 86. Partition List

Medium

Given a linked list and a value *x*, partition it such that all nodes less than *x* come before nodes greater than or equal to *x*.

You should preserve the original relative order of the nodes in each of the two partitions.

**Example:**

**Input:** head = 1->4->3->2->5->2, *x* = 3

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

/\*\*

\* Definition for singly-linked list.

\* struct ListNode {

\* int val;

\* ListNode \*next;

\* ListNode(int x) : val(x), next(NULL) {}

\* };

\*/

class Solution **{**

public**:**

ListNode**\*** partition**(**ListNode**\*** head**,** int x**)** **{**

**}**

**};**

class Solution **{**

public**:**

ListNode**\*** partition**(**ListNode**\*** head**,** int x**)** **{**

ListNode **\***L\_dummy **=** **new** ListNode**(-**1**),** **\***R\_dummy **=** **new** ListNode**(-**1**);**

ListNode **\***l **=** L\_dummy**,** **\***r **=** R\_dummy**,** **\***p **=** head**;**

**while** **(**p**)** **{**

**if** **(**p**->**val **<** x**)** **{**

l**->**next **=** p**;**

l **=** p**;**

**}** **else** **{**

r**->**next **=** p**;**

r **=** p**;**

**}**

p **=** p**->**next**;**

**}**

l**->**next **=** R\_dummy**->**next**;**

r**->**next **=** **NULL;**

**return** L\_dummy**->**next**;**

**}**

**};**

## 87. Scramble String★★

Hard

Given a string *s1*, we may represent it as a binary tree by partitioning it to two non-empty substrings recursively.

Below is one possible representation of *s1* = "great":

great

/ \

gr eat

/ \ / \

g r e at

/ \

a t

To scramble the string, we may choose any non-leaf node and swap its two children.

For example, if we choose the node "gr" and swap its two children, it produces a scrambled string "rgeat".

rgeat

/ \

rg eat

/ \ / \

r g e at

/ \

a t

We say that "rgeat" is a scrambled string of "great".

Similarly, if we continue to swap the children of nodes "eat" and "at", it produces a scrambled string "rgtae".

rgtae

/ \

rg tae

/ \ / \

r g ta e

/ \

t a

We say that "rgtae" is a scrambled string of "great".

Given two strings *s1* and *s2* of the same length, determine if *s2* is a scrambled string of *s1*.

**Example 1:**

**Input:** s1 = "great", s2 = "rgeat"

**Output:** true

**Example 2:**

**Input:** s1 = "abcde", s2 = "caebd"

**Output:** false

class Solution**{**

public**:**

bool isScramble**(**string s1**,** string s2**)** **{**

**if** **(**s1**.**length**()** **!=** s2**.**length**())** **return** **false;**

int len **=** s1**.**length**();**

vector**<**vector**<**vector**<**bool**>>>** dp

dp.**resize(**len**,** vector**<**vector**<**bool**>>(**len**,**vector**<**bool**>(**len**+**1**,** **false)));**

**for** **(**size\_t i **=** 0**;** i **<** len**;** **++**i**)** **{**

**for** **(**size\_t j **=** 0**;** j **<** len**;** **++**j**)** **{**

dp**[**i**][**j**][**1**]** **=** **(**s1**[**i**]** **==** s2**[**j**]);**

**}**

**}**

**for** **(**int subLen **=** 2**;** subLen **<=** len**;** **++**subLen**)** **{**

int len0 **=** len **-** subLen**;**

**for** **(**int i **=** 0**;** i **<=** len0**;** **++**i**)** **{**

**for** **(**int j **=** 0**;** j **<=** len0**;** **++**j**)** **{**

**for** **(**int k **=** 0**;** k **<** subLen**-**1 **&&** **!**dp**[**i**][**j**][**subLen**];** **++**k**){**

int len1 **=** k **+** 1**,** len2 **=** subLen **-** len1**;**

dp**[**i**][**j**][**subLen**]** **=** **(**dp**[**i**][**j**][**len1**]**

**&&** dp**[**i **+** len1**][**j **+** len1**][**len2**])**

**||** **(**dp**[**i**][**j **+** len2**][**len1**]**

**&&** dp**[**i **+** len1**][**j**][**len2**]);**

**}**

**}**

**}**

**}**

**return** dp**[**0**][**0**][**len**];**

**}**

**};**

class Solution **{**

public**:**

bool isScramble**(**string s1**,** string s2**)** **{**

**if** **(**s1 **==** s2**)** **return** **true;**

int len **=** s1**.**length**();**

int cnt**[**26**]** **=** **{**0**};**

**for(**int i **=** 0**;** i **<** len**;** i**++)** **{**

cnt**[**s1**[**i**]-**'a'**]++;**

cnt**[**s2**[**i**]-**'a'**]--;**

**}**

**for** **(**int i **:** cnt**)** **{**

**if** **(**i **!=** 0**)**

**return** **false;**

**}**

**for(**int i **=** 1**;** i **<** len**;** i**++)** **{**

**if** **(**isScramble**(**s1**.**substr**(**0**,**i**),** s2**.**substr**(**0**,**i**))**

**&&** isScramble**(**s1**.**substr**(**i**),** s2**.**substr**(**i**)))**

**return** **true;**

**if** **(**isScramble**(**s1**.**substr**(**0**,**i**),** s2**.**substr**(**len**-**i**))**

**&&** isScramble**(**s1**.**substr**(**i**),** s2**.**substr**(**0**,**len**-**i**)))**

**return** **true;**

**}**

**return** **false;**

**}**

**};**

## 88. Merge Sorted Array

Easy

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

**Note:**

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

**Example:**

**Input:**

nums1 = [1,2,3,0,0,0], m = 3

nums2 = [2,5,6], n = 3

**Output:** [1,2,2,3,5,6]

class Solution **{**

public**:**

void merge**(**vector**<**int**>&** nums1**,** int m**,** vector**<**int**>&** nums2**,** int n**)** **{**

**}**

**};**

class Solution **{**

public**:**

void merge**(**vector**<**int**>&** nums1**,** int m**,** vector**<**int**>&** nums2**,** int n**)** **{**

int t **=** m**+**n**-**1**,** p **=** m**-**1**,** q **=** n**-**1**;**

**while** **(**p **>=** 0 **||** q **>=** 0**)** **{**

**if** **(**p **>=** 0 **&&** q **>=** 0**)** **{**

**if** **(**nums1**[**p**]** **>** nums2**[**q**])** nums1**[**t**--]** **=** nums1**[**p**--];**

**else** nums1**[**t**--]** **=** nums2**[**q**--];**

**}**

**else** **if** **(**q **>=** 0**)** **{**

**while** **(**q **>=** 0**)** nums1**[**t**--]** **=** nums2**[**q**--];**

**}**

**else** **break;**

**}**

**}**

**};**

## 89. Gray Code

Medium

The gray code is a binary numeral system where two successive values differ in only one bit.

Given a non-negative integer *n* representing the total number of bits in the code, print the sequence of gray code. A gray code sequence must begin with 0.

**Example 1:**

**Input:** 2

**Output:** [0,1,3,2]

**Explanation:**

00 - 0

01 - 1

11 - 3

10 - 2

For a given *n*, a gray code sequence may not be uniquely defined.

For example, [0,2,3,1] is also a valid gray code sequence.

00 - 0

10 - 2

11 - 3

01 - 1

**Example 2:**

**Input:** 0

**Output:** [0]

**Explanation:** We define the gray code sequence to begin with 0.

  A gray code sequence of *n* has size = 2n, which for *n* = 0 the size is 20 = 1.

  Therefore, for *n* = 0 the gray code sequence is [0].

class Solution **{**

public**:**

vector**<**int**>** grayCode**(**int n**)** **{**

vector**<**int**>** res**{**0**};**

**if** **(**n **==** 0**)** **return** res**;**

**for (**int i **=** 0**;** i **<** n**;** i**++)** **{**

int bit **=** 1**<<**i**;**

**for(**int j **=** res**.**size**()-**1**;** j **>=** 0**;** j**--)**

res**.**push\_back**(**res**[**j**]** **|** bit**);**

**}**

**return** res**;**

**}**

**};**

## 90. Subsets II(●ˇ∀ˇ●)

Medium

Given a collection of integers that might contain duplicates, ***nums***, return all possible subsets (the power set).

**Note:** The solution set must not contain duplicate subsets.

**Example:**

**Input:** [1,2,2]

**Output:**

[

[2],

[1],

[1,2,2],

[2,2],

[1,2],

[]

]

class Solution **{**

public**:**

vector**<**vector**<**int**>>** subsetsWithDup**(**vector**<**int**>&** nums**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**vector**<**int**>>** res**;**

vector**<**vector**<**int**>>** subsetsWithDup**(**vector**<**int**>&** nums**)** **{**

sort**(**nums**.**begin**(),** nums**.**end**()); //不同之处1**

vector**<**int**>** v**;**

dfs**(**0**,** nums**,** v**);**

**return** res**;**

**}**

private**:**

void dfs**(**int start**,** vector**<**int**>** **&**nums**,** vector**<**int**>** **&**v**)** **{**

res**.**push\_back**(**v**);**

**for** **(**int i **=** start**;** i **<** nums**.**size**();** i**++)** **{**

**if** **(**i **!=** start **&&** nums**[**i**]** **==** nums**[**i**-**1**])** **continue;//不同之处2**

v**.**push\_back**(**nums**[**i**]);**

dfs**(**i**+**1**,** nums**,** v**);**

v**.**pop\_back**();**

**}**

**}**

**};**

class Solution **{**

public**:**

vector**<**vector**<**int**>>** res**;**

vector**<**vector**<**int**>>** subsetsWithDup**(**vector**<**int**>&** nums**)** **{**

unordered\_map**<**int**,** int**>** My\_map**;**

**for** **(**auto **&**i **:** nums**)** My\_map**[**i**]++;**

vector**<**pair**<**int**,** int**>>** Nums**;**

**for** **(**auto **&**i **:** My\_map**)** Nums**.**push\_back**({**i**.**first**,** i**.**second**});**

vector**<**int**>** v**;**

dfs**(**0**,** Nums**,** v**);**

**return** res**;**

**}**

private**:**

void dfs**(**int cur**,** vector**<**pair**<**int**,** int**>>** **&**Nums**,** vector**<**int**>** **&**v**)** **{**

**if** **(**cur **==** Nums**.**size**())** **{**

res**.**push\_back**(**v**);**

**return;**

**}**

int x **=** Nums**[**cur**].**first**,** n **=** Nums**[**cur**].**second**;**

dfs**(**cur**+**1**,** Nums**,** v**);**

**for** **(**int i **=** 0**;** i **<** n**;** i**++)** **{**

v**.**push\_back**(**x**);**

dfs**(**cur**+**1**,** Nums**,** v**);**

**}**

**while** **(**n**--)** v**.**pop\_back**();**

**}**

**};**

## 91. Decode Ways

Medium

A message containing letters from A-Z is being encoded to numbers using the following mapping:

'A' -> 1

'B' -> 2

...

'Z' -> 26

Given a **non-empty** string containing only digits, determine the total number of ways to decode it.

**Example 1:**

**Input:** "12"

**Output:** 2

**Explanation:** It could be decoded as "AB" (1 2) or "L" (12).

**Example 2:**

**Input:** "226"

**Output:** 3

**Explanation:** It could be decoded as "BZ" (2 26), "VF" (22 6), or "BBF" (2 2 6).

class Solution **{**

public**:**

int numDecodings**(**string s**)** **{**

}

**};**

class Solution **{**

public**:**

int numDecodings**(**string s**)** **{**

int f\_0 **=** 0**,** f\_1 **=** 1**,** n **=** s**.**size**();**

**for** **(**int i **=** 0**;** i **<** n**;** i**++)** **{**

int f\_2 **=** s**[**i**]** **==** '0' **?** 0 **:** f\_1**;**

**if** **(!**i **&&** **(**s**[**i**-**1**]==**'1' **||** s**[**i**-**1**]==**'2' **&&** s**[**i**]<**'7'**))** f\_2 **+=** f\_0**;**

f\_0 **=** f\_1**;**

f\_1 **=** f\_2**;**

**}**

**return** f\_1**;**

**}**

**};**

## 92. Reverse Linked List II

Medium

Reverse a linked list from position *m* to *n*. Do it in one-pass.

**Note:**1 ≤ *m* ≤ *n* ≤ length of list.

**Example:**

**Input:** 1->2->3->4->5->NULL, *m* = 2, *n* = 4

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

class Solution **{**

public**:**

ListNode**\*** reverseBetween**(**ListNode**\*** head**,** int m**,** int n**)** **{**

**}**

**};**

class Solution **{**

public**:**

ListNode**\*** reverseBetween**(**ListNode**\*** head**,** int m**,** int n**)** **{**

ListNode **\***dummy **=** **new** ListNode**(-**1**),** **\***post**,** **\***cur**,** **\***last**;**

dummy**->**next **=** head**;**

head **=** dummy**;**

**for** **(**int i **=** 0**;** i **<** m**-**1**;** i**++)** head **=** head**->**next**;**

last **=** cur **=** head**->**next**;**

**for** **(**int i **=** m**;** i **<=** n**;** i**++)** **{**

post **=** cur**->**next**;**

cur**->**next **=** head**->**next**;**

head**->**next **=** cur**;**

cur **=** post**;**

**}**

last**->**next **=** cur**;**

**return** dummy**->**next**;**

**}**

**};**

## 93. Restore IP Addresses

Medium

Given a string containing only digits, restore it by returning all possible valid IP address combinations.

**Example:**

**Input:** "25525511135"

**Output:** ["255.255.11.135", "255.255.111.35"]

class Solution **{**

public**:**

vector**<**string**>** restoreIpAddresses**(**string s**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**string**>** restoreIpAddresses**(**string s**)** **{**

vector**<**string**>** res**;**

string t**;**

dfs**(**0**,** s **,** t**,** 4**,** res**);**

**return** res**;**

**}**

private**:**

void dfs**(**int cur**,** string **&**s**,** string t**,** int cnt**,** vector**<**string**>** **&**res**)** **{**

**if** **(**cnt **==** 1**)** **{**

string a **=** s**.**substr**(**cur**);**

**if (**a**.**length**()** **>** 3 **||** **(**a**[**0**]** **==** '0' **&&** a **!=** "0"**))** **return;**

**if** **(**stoi**(**a**)** **<** 256**)** res**.**push\_back**(**t **+** a**);**

**}**

**else** **for(**int k **=** 1**;** k **<=** 3 **&&** cur**+**k **<** s**.**length**();** k**++)** **{**

string a **=** s**.**substr**(**cur**,** k**);**

**if** **(**k **!=** 3 **||** stoi**(**a**)** **<** 256**)** dfs**(**cur**+**k**,** s**,** t**+**a**+**'.'**,** cnt**-**1**,** res**);**

**if** **(**a**[**0**]** **==** '0'**)** **break;**

**}**

**}**

**};**

## 94. Binary Tree Inorder Traversal

Medium

Given a binary tree, return the *inorder* traversal of its nodes' values.

**Example:**

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

1

\

2

/

3

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

**Follow up:** Recursive solution is trivial, could you do it iteratively?

class Solution **{**

public**:**

vector**<**int**>** inorderTraversal**(**TreeNode**\*** root**)** **{**

**}**

**};**

class Solution **{**

public**:**

vector**<**int**>** inorderTraversal**(**TreeNode**\*** root**)** **{**

vector**<**int**>** res**;**

stack**<**TreeNode**\*>** stk**;**

TreeNode **\***p **=** root**;**

**while** **(!**stk**.**empty**()** **||** p**)** **{**

**while** **(**p**)** **{**

stk**.**push**(**p**);**

p **=** p**->**left**;**

**}**

p **=** stk**.**top**();**

stk**.**pop**();**

res**.**push\_back**(**p**->**val**);**

p **=** p**->**right**;**

**}**

**return** res**;**

**}**

**};**

## 95. Unique Binary Search Trees II★★

Medium

Given an integer *n*, generate all structurally unique **BST's** (binary search trees) that store values 1 ... *n*.

**Example:**

**Input:** 3

**Output:**

[

  [1,null,3,2],

  [3,2,null,1],

  [3,1,null,null,2],

  [2,1,3],

  [1,null,2,null,3]

]

**Explanation:**

The above output corresponds to the 5 unique BST's shown below:

1 3 3 2 1

\ / / / \ \

3 2 1 1 3 2

/ / \ \

2 1 2 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**<**TreeNode**\*>** generateTrees**(**int n**)** **{**

**if** **(**n **==** 0**)** **return** vector**<**TreeNode**\*>** **();**

dp.resize**(**n**+**1**,** vector**<**vector**<**TreeNode**\*>> (**n**+**1**));**

**return** generateTrees**(**1**,** n**);**

**}**

private**:**

vector**<**vector**<**vector**<**TreeNode**\*>>>**dp**;**

vector**<**TreeNode**\*>** generateTrees**(**int start**,** int end**)** **{**

vector**<**TreeNode**\*>** subTree**;**

**if** **(**start **>** end**)** **{**

subTree**.**push\_back**(nullptr);**

**return** subTree**;**

**}**

**else** **if** **(!**dp**[**start**][**end**].**empty**())** **return** dp**[**start**][**end**];**

**else** **for** **(**int k **=** start**;** k **<=** end**;** **++**k**)** **{**

vector**<**TreeNode**\*>** leftsubTree **=** generateTrees**(**start**,** k**-**1**);**

vector**<**TreeNode**\*>** rightsubTree **=** generateTrees**(**k**+**1**,** end**);**

**for** **(**auto **&**i **:** leftsubTree**)** **{**

**for** **(**auto **&**j **:** rightsubTree**)** **{**

TreeNode **\***t **=** **new** TreeNode**(**k**);**

t**->**left **=** i**;**

t**->**right **=** j**;**

subTree**.**push\_back**(**t**);**

**}**

**}**

**}**

**return** dp**[**start**][**end**]** **=** subTree**;**

**}**

**};**

## 96. Unique Binary Search Trees

Medium

Given *n*, how many structurally unique **BST's** (binary search trees) that store values 1 ... *n*?

**Example:**

**Input:** 3

**Output:** 5

**Explanation:**

Given *n* = 3, there are a total of 5 unique BST's:

1 3 3 2 1

\ / / / \ \

3 2 1 1 3 2

/ / \ \

2 1 2 3

class Solution **{**

public**:**

int numTrees**(**int n**)** **{**

**}**

**};**

class Solution **{**

public**:**

int numTrees**(**int n**)** **{**

vector**<**int**>** f**(**n**+**1**,** 0**);**

f**[**0**]** **=** f**[**1**]** **=** 1**;**

**for** **(**int i **=** 2**;** i **<=** n**;** i**++)** **{**

**for** **(**int k **=** 0**;** k **<=** i**;** k**++)** **{**

f**[**i**]** **+=** f**[**k**]\***f**[**i**-**1**-**k**];**

**}**

**}**

**return** f**[**n**];**

**}**

**};**

## 97. Interleaving String

Hard

Given *s1*, *s2*, *s3*, find whether *s3* is formed by the interleaving of *s1* and *s2*.

**Example 1:**

**Input:** s1 = "aabcc", s2 = "dbbca", *s3* = "aadbbcbcac"

**Output:** true

**Example 2:**

**Input:** s1 = "aabcc", s2 = "dbbca", *s3* = "aadbbbaccc"

**Output:** false

class Solution **{**

public**:**

bool isInterleave**(**string s1**,** string s2**,** string s3**)** **{**

int n **=** s1**.**length**(),** m **=** s2**.**length**(),** l **=** s3**.**length**();**

**if** **(**n**+**m **!=** l**)** **return** **false;**

**else** **if** **(**n **<** m**)** **return** isInterleave**(**s2**,** s1**,** s3**);**

vector**<**bool**>** f**(**m**+**1**,** **false);**

f**[**0**]** **=** **true;**

**for** **(**int k **=** 1**;** k **<=** l**;** k**++)** **{**

**for** **(**int j **=** min**(**m**,** k**);** j **>=** max**(**0**,** k**-**n**);** j**--)** **{**

int i **=** k**-**j**;**

f**[**j**]** **=** **(**j **>=** 1 **&&** s2**[**j**-**1**]** **==** s3**[**i**+**j**-**1**]** **&&** f**[**j**-**1**])**

**||** **(**i **>=** 1 **&&** s1**[**i**-**1**]** **==** s3**[**i**+**j**-**1**]** **&&** f**[**j**]);**

**}**

**}**

**return** f**[**m**];**

**}**

**};**

## 98. Validate Binary Search Tree

Medium

Given a binary tree, determine if it is a valid binary search tree (BST).

Assume a BST is defined as follows:

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

**Example 1:**

**Input:**

2

/ \

1 3

**Output:** true

**Example 2:**

5

/ \

1 4

  / \

  3 6

**Output:** false

**Explanation:** The input is: [5,1,4,null,null,3,6]. The root node's value

  is 5 but its right child's value is 4.

class Solution **{**

public**:**

bool isValidBST**(**TreeNode**\*** root**)** **{**

**}**

**};**

class Solution **{**

public**:**

bool isValidBST**(**TreeNode**\*** root**)** **{**

**return** isValidBST**(**root**,** LONG\_MIN**,** LONG\_MAX**);**

**}**

private**:**

bool isValidBST**(**TreeNode**\*** root**,** long long Min**,** long long Max**)** **{**

**if (**root **==** **nullptr)** **return** **true;**

**return** root**->**val **<** Max **&&** root**->**val **>** Min

**&&** isValidBST**(**root**->**left**,** Min**,** root**->**val**)**

**&&** isValidBST**(**root**->**right**,** root**->**val**,** Max**);**

**}**

**};**

class Solution **{**

public**:**

bool isValidBST**(**TreeNode**\*** root**)** **{**

**return** isValidBST**(**root**,** **nullptr,** **nullptr);**

**}**

private**:**

bool isValidBST**(**TreeNode **\***root**,** TreeNode **\***Min**,** TreeNode **\***Max**)** **{**

**if** **(!**root**)** **return** **true;**

**else if** **(**Min **&&** root**->**val **<=** Min**->**val **||** Max **&&** root**->**val **>=** Max**->**val**)**

**return** **false;**

**else return** isValidBST**(**root**->**left**,** Min**,** root**)**

**&&** isValidBST**(**root**->**right**,** root**,** Max**);**

**}**

**};**

## 99. Recover Binary Search Tree★★

Hard

Two elements of a binary search tree (BST) are swapped by mistake.

Recover the tree without changing its structure.

**Example 1:**

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

  1

  /

 3

  \

  2

**Output:** [3,1,null,null,2]

  3

  /

 1

  \

  2

**Example 2:**

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

3

/ \

1 4

  /

  2

**Output:** [2,1,4,null,null,3]

2

/ \

1 4

  /

 3

**Follow up:**

* A solution using O(*n*) space is pretty straight forward.
* Could you devise a constant space solution?

/\*\*

\* 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**:**

void recoverTree**(**TreeNode**\*** root**)** **{**

**}**

**};**

/\*\*

\* 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**:**

void recoverTree**(**TreeNode**\*** root**)** **{**

inorder**(**root**);**

swap**(**p**->**val**,** q**->**val**);**

**}**

private**:**

TreeNode **\***p **=** **nullptr,** **\***q **=** **nullptr,** **\***prev **=** **nullptr;**

void inorder**(**TreeNode **\***root**)** **{**

stack**<**TreeNode**\*>** stk**;**

**while** **(!**stk**.**empty**()** **||** root**)** **{**

**while** **(**root**)** **{**

stk**.**push**(**root**);**

root **=** root**->**left**;**

**}**

root **=** stk**.**top**();**

stk**.**pop**();**

**if** **(**prev **&&** root**->**val **<** prev**->**val**)** **{**

**if** **(!**p**)** p **=** prev**;**

q **=** root**;**

**}**

prev **=** root**;**

root **=** root**->**right**;**

**}**

**}**

**};**

## 100. Same Tree

Easy

Given two binary trees, write a function to check if they are the same or not.

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

**Example 1:**

**Input:** 1 1

/ \ / \

2 3 2 3

[1,2,3], [1,2,3]

**Output:** true

**Example 2:**

**Input:** 1 1

/ \

2 2

[1,2], [1,null,2]

**Output:** false

**Example 3:**

**Input:** 1 1

/ \ / \

2 1 1 2

[1,2,1], [1,1,2]

**Output:** false

class Solution **{**

public**:**

bool isSameTree**(**TreeNode**\*** p**,** TreeNode**\*** q**)** **{**

**}**

**};**

class Solution **{**

public**:**

bool isSameTree**(**TreeNode**\*** p**,** TreeNode**\*** q**)** **{**

**if (**p **==** **nullptr** **||** q **==** **nullptr)** **return** p **==** q**;**

stack**<**TreeNode**\*>** s**;**

s**.**push**(**p**);** s**.**push**(**q**);**

**while** **(!**s**.**empty**())** **{**

TreeNode **\***p **=** s**.**top**();** s**.**pop**();**

TreeNode **\***q **=** s**.**top**();** s**.**pop**();**

**if (**p**->**val **!=** q**->**val**)** **return** **false;**

**if** **(**p**->**left **||** q**->**left**)** **{**

**if** **(!(**q**->**left **&&** q**->**left**))** **return** **false;**

s**.**push**(**p**->**left**);**

s**.**push**(**q**->**left**);**

**}**

**if** **(**p**->**right **||** q**->**right**)** **{**

**if** **(!(**p**->**right **&&** q**->**right**))** **return** **false;**

s**.**push**(**p**->**right**);**

s**.**push**(**q**->**right**);**

**}**

**}**

**return** **true;**

**}**

**};**

class Solution **{**

public**:**

bool isSameTree**(**TreeNode **\***p**,** TreeNode **\***q**)** **{**

**if** **(**p **==** **nullptr** **||** q **==** **nullptr)** **return** p **==** q**;**

**return** p**->**val **==** q**->**val **&&** isSameTree**(**p**->**left**,** q**->**left**)**

**&&** isSameTree**(**p**->**right**,** q**->**right**);**

**}**

**};**