Q.1] A permutation perm of n + 1 integers of all the integers in the range [0, n] can be represented as a string s of length n where:

* s[i] == 'I' if perm[i] < perm[i + 1], and
* s[i] == 'D' if perm[i] > perm[i + 1].

Given a string s, reconstruct the permutation perm and return it. If there are multiple valid permutations perm, return **any of them**.

**Example 1:**

**Input:** s = "IDID"

**Output:**

[0,4,1,3,2]

**Solution :**

def reconstruct\_permutation(s):

n = len(s)

perm = []

low, high = 0, n

for c in s:

if c == 'I':

perm.append(low)

low += 1

else:

perm.append(high)

high -= 1

perm.append(low) # or perm.append(high), both have the same value

return perm

Q.2] You are given an m x n integer matrix matrix with the following two properties:

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

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

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

<aside> 💡 **Question 2**

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

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

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

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

**Example 1:**

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

**Output:** true

**Solution :**

def searchMatrix(matrix, target):

if not matrix or not matrix[0]:

return False

m, n = len(matrix), len(matrix[0])

left, right = 0, m \* n - 1

while left <= right:

mid = (left + right) // 2

row = mid // n

col = mid % n

if matrix[row][col] == target:

return True

elif matrix[row][col] < target:

left = mid + 1

else:

right = mid - 1

return False

Q.3] Given an array of integers arr, return *true if and only if it is a valid mountain array*.

Recall that arr is a mountain array if and only if:

* arr.length >= 3
* There exists some i with 0 < i < arr.length - 1 such that:
  + arr[0] < arr[1] < ... < arr[i - 1] < arr[i]
  + arr[i] > arr[i + 1] > ... > arr[arr.length - 1]
* **Example 1:**
* **Input:** arr = [2,1]
* **Output:**
* False

**Solution :**

def validMountainArray(arr):

n = len(arr)

# Check if the array has at least 3 elements

if n < 3:

return False

# Find the peak index

peak\_index = arr.index(max(arr))

# Check if the peak is not at the start or end of the array

if peak\_index == 0 or peak\_index == n - 1:

return False

# Check if the elements before the peak are strictly increasing

for i in range(peak\_index):

if arr[i] >= arr[i+1]:

return False

# Check if the elements after the peak are strictly decreasing

for i in range(peak\_index, n - 1):

if arr[i] <= arr[i+1]:

return False

return True

Q.4] Given a binary array nums, return *the maximum length of a contiguous subarray with an equal number of* 0 *and* 1.

**Example 1:**

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

**Output:** 2

**Explanation:**

[0, 1] is the longest contiguous subarray with an equal number of 0 and 1.

**Solution :**

def findMaxLength(nums):

prefix\_sums = {0: -1}

max\_length = 0

prefix\_sum = 0

for index, num in enumerate(nums):

if num == 0:

prefix\_sum -= 1

else:

prefix\_sum += 1

if prefix\_sum in prefix\_sums:

max\_length = max(max\_length, index - prefix\_sums[prefix\_sum])

else:

prefix\_sums[prefix\_sum] = index

return max\_length

Q.5] The **product sum** of two equal-length arrays a and b is equal to the sum of a[i] \* b[i] for all 0 <= i < a.length (**0-indexed**).

* For example, if a = [1,2,3,4] and b = [5,2,3,1], the **product sum** would be 1*5 + 2*2 + 3*3 + 4*1 = 22.

Given two arrays nums1 and nums2 of length n, return *the* ***minimum product sum*** *if you are allowed to* ***rearrange*** *the* ***order*** *of the elements in* nums1.

**Example 1:**

**Input:** nums1 = [5,3,4,2], nums2 = [4,2,2,5]

**Output:** 40

**Explanation:**

We can rearrange nums1 to become [3,5,4,2]. The product sum of [3,5,4,2] and [4,2,2,5] is 3*4 + 5*2 + 4*2 + 2*5 = 40.

**Solution :**

def minProductSum(nums1, nums2):

nums1.sort()

nums2.sort(reverse=True)

min\_product\_sum = 0

for i in range(len(nums1)):

min\_product\_sum += nums1[i] \* nums2[i]

return min\_product\_sum

Q.6] An integer array original is transformed into a **doubled** array changed by appending **twice the value** of every element in original, and then randomly **shuffling** the resulting array.

Given an array changed, return original *if* changed *is a* ***doubled*** *array. If* changed *is not a* ***doubled*** *array, return an empty array. The elements in* original *may be returned in* ***any*** *order*.

**Example 1:**

**Input:** changed = [1,3,4,2,6,8]

**Output:** [1,3,4]

**Explanation:** One possible original array could be [1,3,4]:

* Twice the value of 1 is 1 \* 2 = 2.
* Twice the value of 3 is 3 \* 2 = 6.
* Twice the value of 4 is 4 \* 2 = 8.

Other original arrays could be [4,3,1] or [3,1,4].

**Solution :**

from collections import Counter

def findOriginalArray(changed):

n = len(changed)

if n % 2 != 0: # If the length is odd, there can't be a valid original array

return []

counter = Counter(changed)

original = []

for num in changed:

if counter[num] == 0: # If the element is already used or doesn't exist

continue

if counter[num \* 2] == 0: # If the doubled element doesn't exist

return []

original.append(num)

counter[num] -= 1

counter[num \* 2] -= 1

# Check if the resulting original array contains duplicate elements

if len(original) != n // 2 or len(set(original)) != len(original):

return []

return original

Q.7] Given a positive integer n, generate an n x n matrix filled with elements from 1 to n2 in spiral order.

**Input:** n = 3

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

**Solution :**

def generateMatrix(n):

matrix = [[0] \* n for \_ in range(n)]

start\_row, end\_row = 0, n - 1

start\_col, end\_col = 0, n - 1

num = 1

while num <= n \* n:

for i in range(start\_col, end\_col + 1):

matrix[start\_row][i] = num

num += 1

start\_row += 1

for i in range(start\_row, end\_row + 1):

matrix[i][end\_col] = num

num += 1

end\_col -= 1

for i in range(end\_col, start\_col - 1, -1):

matrix[end\_row][i] = num

num += 1

end\_row -= 1

for i in range(end\_row, start\_row - 1, -1):

matrix[i][start\_col] = num

num += 1

start\_col += 1

return matrix

Q.8] Given two [sparse matrices](https://en.wikipedia.org/wiki/Sparse_matrix) mat1 of size m x k and mat2 of size k x n, return the result of mat1 x mat2. You may assume that multiplication is always possible.

**Input:** mat1 = [[1,0,0],[-1,0,3]], mat2 = [[7,0,0],[0,0,0],[0,0,1]]

**Output:**

[[7,0,0],[-7,0,3]]

**Solution :**

def multiply(mat1, mat2):

m, k = len(mat1), len(mat1[0])

k2, n = len(mat2), len(mat2[0])

result = [[0] \* n for \_ in range(m)]

for i in range(m):

for j in range(n):

temp = 0

for p in range(k):

if mat1[i][p] != 0 and mat2[p][j] != 0:

temp += mat1[i][p] \* mat2[p][j]

result[i][j] = temp

return result