Task Scheduler

You are given an array of CPU `tasks`, each represented by letters A to Z, and a cooling time, `n`. Each cycle or interval allows the completion of one task. Tasks can be completed in any order, but there's a constraint: **identical** tasks must be separated by at least `n` intervals due to cooling time.

Return the *minimum number of intervals* required to complete all tasks.

Example 1:

Input: tasks = ["A","A","A","B","B","B"], n = 2

Output: 8

Explanation: A possible sequence is: A -> B -> idle -> A -> B -> idle -> A -> B.

After completing task A, you must wait two cycles before doing A again. The same applies to task B. In the 3^{rd} interval, neither A nor B can be done, so you idle. By the 4^{th} cycle, you can do A again as 2 intervals have passed.

Example 2:

Input: tasks = ["A","C","A","B","D","B"], n = 1

Output: 6

Explanation: A possible sequence is: A -> B -> C -> D -> A -> B.

With a cooling interval of 1, you can repeat a task after just one other task.

Example 3:

Input: tasks = ["A","A","A", "B","B","B"], n = 3

Output: 10

Explanation: A possible sequence is: A -> B -> idle -> idle -> A -> B -> idle -> idle -> A -> B.

There are only two types of tasks, A and B, which need to be separated by 3 intervals. This leads to idling twice between repetitions of these tasks.

Constraints:

- `1 <= tasks.length <= 10^4`
- `tasks[i]` is an uppercase English letter.
- `0 <= n <= 100`

class Solution { public: int leastInterval(vector& tasks, int n) { } };

Minimum Number of Arrows to Burst Balloons

There are some spherical balloons taped onto a flat wall that represents the XY-plane. The balloons are represented as a 2D integer array `points` where `points[i] = [x_start, x_end]` denotes a balloon whose **horizontal diameter** stretches between x_{start} and x_{end}. You do not know the exact y-coordinates of the balloons.

Arrows can be shot up **directly vertically** (in the positive y-direction) from different points along the x-axis. A balloon with x_{start} and x_{end} is **burst** by an arrow shot at `x` if $x_{start} <= x <= x_{end}$. There is **no limit** to the number of arrows that can be shot. A shot arrow keeps traveling up infinitely, bursting any balloons in its path.

Given the array `points`, return *the **minimum** number of arrows that must be shot to burst all balloons*.

Example 1:

```
Input: points = [[10,16],[2,8],[1,6],[7,12]]
Output: 2
Explanation: The balloons can be burst by 2 arrows:
- Shoot an arrow at x = 6, bursting the balloons [2,8] and [1,6].
- Shoot an arrow at x = 11, bursting the balloons [10,16] and [7,12].
```

Example 2:

```
Input: points = [[1,2],[3,4],[5,6],[7,8]]
Output: 4
Explanation: One arrow needs to be shot for each balloon for a total of 4 arrows.
```

Example 3:

```
Input: points = [[1,2],[2,3],[3,4],[4,5]]
Output: 2
Explanation: The balloons can be burst by 2 arrows:
- Shoot an arrow at x = 2, bursting the balloons [1,2] and [2,3].
- Shoot an arrow at x = 4, bursting the balloons [3,4] and [4,5].
```

Constraints:

- $1 <= points.length <= 10^5$
- `points[i].length == 2`
- $-2^{31} <= x_{start} < x_{end} <= 2^{31} - 1$

class Solution { public: int findMinArrowShots(vector>& points) { } };

Insert Interval

You are given an array of non-overlapping intervals `intervals` where `intervals[i] = [start_i, end_i]` represent the start and the end of the `i^th` interval and `intervals` is sorted in ascending order by `start_i`. You are also given an interval `newInterval = [start, end]` that represents the start and end of another interval.

Insert `newInterval` into `intervals` such that `intervals` is still sorted in ascending order by `start_i` and `intervals` still does not have any overlapping intervals (merge overlapping intervals if necessary).

Return `intervals` *after the insertion*.

Note that you don't need to modify `intervals` in-place. You can make a new array and return it.

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].
```

Constraints:

- `0 <= intervals.length <= 10^4`
- `intervals[i].length == 2`
- `0 <= start_i <= end_i <= 10^5`
- `intervals` is sorted by `start_i` in **ascending** order.
- `newInterval.length == 2`
- `0 <= start <= end <= 10^5`

class Solution { public: vector> insert(vector>& intervals, vector& newInterval) { } };

Peak Index in a Mountain Array

You are given an integer **mountain** array `arr` of length `n` where the values increase to a **peak element** and then decrease.

Return the index of the peak element.

Your task is to solve it in `O(log(n))` time complexity.

Example 1:

Input: arr = [0,1,0]

Output: 1

Example 2:

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

Output: 1

Example 3:

Input: arr = [0,10,5,2]

Output: 1

Constraints:

- `3 <= arr.length <= 10^5`
- `0 <= arr[i] <= 10^6`
- `arr` is **guaranteed** to be a mountain array.

class Solution { public: int peakIndexInMountainArray(vector& arr) { } };

Find Minimum in Rotated Sorted Array

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

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

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

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

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

Example 1:

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

Example 2:

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

Example 3:

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

Constraints:

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

class Solution { public: int findMin(vector& nums) { } };

Find Peak Element

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

Given a **0-indexed** integer array `nums`, find a peak element, and return its index. If the array contains multiple peaks, return the index to **any of the peaks**.

You may imagine that `nums[-1] = nums[n] = -∞`. In other words, an element is always considered to be strictly greater than a neighbor that is outside the array.

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

Example 1:

```
Input: nums = [1,2,3,1]
Output: 2
Explanation: 3 is a peak element and your function should return the index number 2.
```

Example 2:

```
Input: nums = [1,2,1,3,5,6,4]
Output: 5
Explanation: Your function can return either index number 1 where the peak element is 2, or
index number 5 where the peak element is 6.
```

Constraints:

- `1 <= nums.length <= 1000`
- `-2^31 <= nums[i] <= 2^31 - 1`
- `nums[i] != nums[i + 1]` for all valid `i`.

class Solution { public: int findPeakElement(vector& nums) { } };

Search in Rotated Sorted Array

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

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

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

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

Example 1:

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

Example 2:

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

Example 3:

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

Constraints:

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

class Solution { public: int search(vector& nums, int target) { } };

Search in Rotated Sorted Array II

There is an integer array `nums` sorted in non-decreasing order (not necessarily with **distinct** values).

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

Given the array `nums` **after** the rotation and an integer `target`, return `true` *if* `target` *is in* `nums`, *or* `false` *if it is not in* `nums`.

You must decrease the overall operation steps as much as possible.

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
```

Constraints:

- `1 <= nums.length <= 5000`
- `-10^4 <= nums[i] <= 10^4`
- `nums` is guaranteed to be rotated at some pivot.
- `-10^4 <= target <= 10^4`

Follow up: This problem is similar to Search in Rotated Sorted Array, but `nums` may contain **duplicates**. Would this affect the runtime complexity? How and why?

class Solution { public: bool search(vector& nums, int target) { } };

Search a 2D Matrix

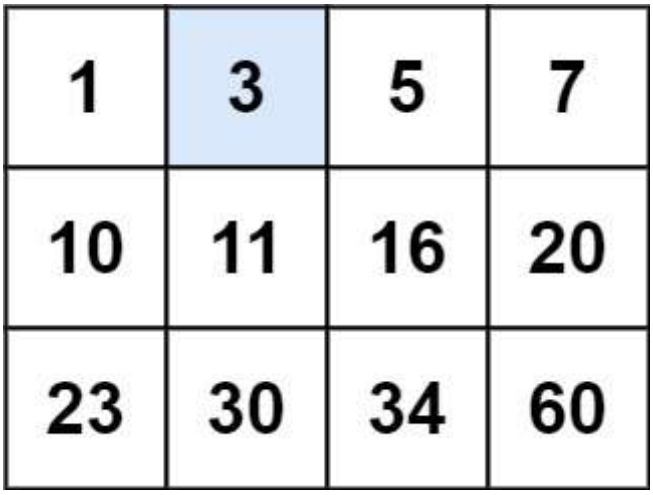
You are given an `m x n` integer matrix `matrix` with the following two properties:

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

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

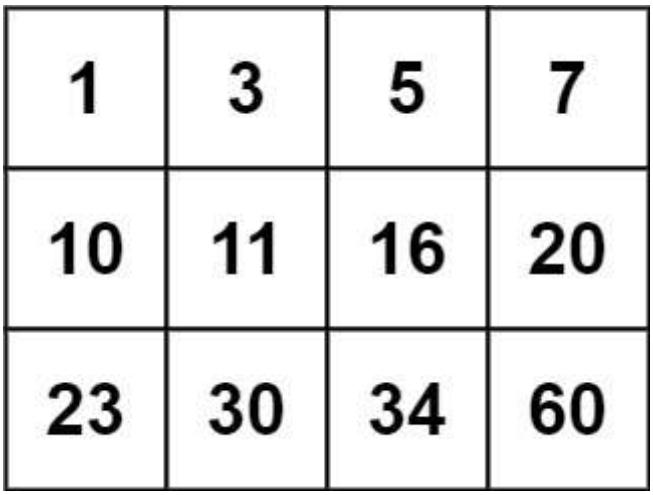
You must write a solution in `O(log(m * n))` time complexity.

Example 1:




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

Example 2:




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

Constraints:

- `m == matrix.length`
- `n == matrix[i].length`
- `1 <= m, n <= 100`

- `-10^4 <= matrix[i][j], target <= 10^4`

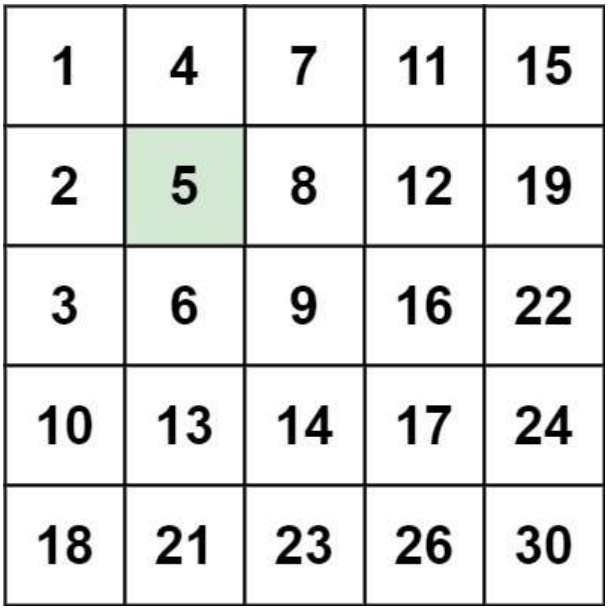
class Solution { public: bool searchMatrix(vector>& matrix, int target) { } };

Search a 2D Matrix II

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

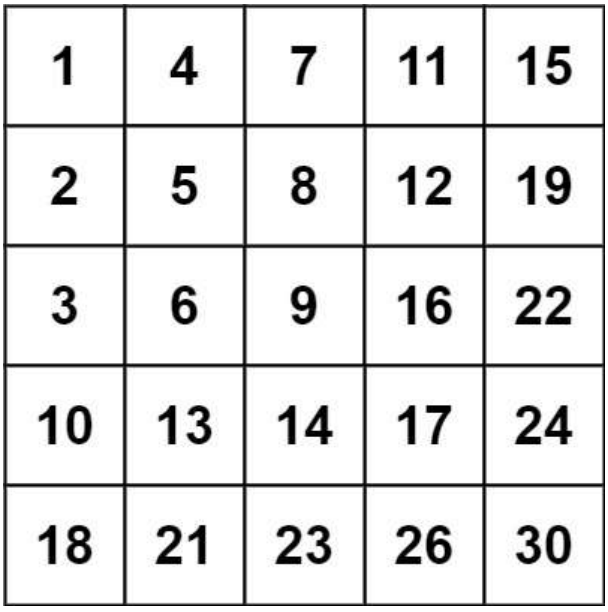
- Integers in each row are sorted in ascending from left to right.
- Integers in each column are sorted in ascending from top to bottom.

Example 1:




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

Example 2:




```
Input: matrix = [[1,4,7,11,15],[2,5,8,12,19],[3,6,9,16,22],[10,13,14,17,24],[18,21,23,26,30]],
target = 20
Output: false
```

Constraints:

- `m == matrix.length`
- `n == matrix[i].length`
- `1 <= n, m <= 300`
- `-10^9 <= matrix[i][j] <= 10^9`
- All the integers in each row are **sorted** in ascending order.
- All the integers in each column are **sorted** in ascending order.
- `-10^9 <= target <= 10^9`

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

Find K Closest Elements

Given a **sorted** integer array `arr`, two integers `k` and `x`, return the `k` closest integers to `x` in the array. The result should also be sorted in ascending order.

An integer `a` is closer to `x` than an integer `b` if:

- `|a - x| < |b - x|`, or
- `|a - x| == |b - x|` and `a < b`

Example 1:

```
Input: arr = [1,2,3,4,5], k = 4, x = 3
Output: [1,2,3,4]
```

Example 2:

```
Input: arr = [1,2,3,4,5], k = 4, x = -1
Output: [1,2,3,4]
```

Constraints:

- `1 <= k <= arr.length`
- `1 <= arr.length <= 10^4`
- `arr` is sorted in **ascending** order.
- `-10^4 <= arr[i], x <= 10^4`

class Solution { public: vector findClosestElements(vector& arr, int k, int x) { } };

Minimum Size Subarray Sum

Given an array of positive integers `nums` and a positive integer `target`, return *the **minimal length** of a subarray whose sum is greater than or equal to* `target`. If there is no such subarray, return `0` instead.

Example 1:

```
Input: target = 7, nums = [2,3,1,2,4,3]
Output: 2
Explanation: The subarray [4,3] has the minimal length under the problem constraint.
```

Example 2:

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

Example 3:

```
Input: target = 11, nums = [1,1,1,1,1,1,1,1]
Output: 0
```

Constraints:

- `1 <= target <= 10^9`
- `1 <= nums.length <= 10^5`
- `1 <= nums[i] <= 10^4`

Follow up: If you have figured out the `O(n)` solution, try coding another solution of which the time complexity is `O(n log(n))`.
class Solution { public: int minSubArrayLen(int target, vector& nums) { } };

Fruit Into Baskets

You are visiting a farm that has a single row of fruit trees arranged from left to right. The trees are represented by an integer array `fruits` where `fruits[i]` is the **type** of fruit the i^{th} tree produces.

You want to collect as much fruit as possible. However, the owner has some strict rules that you must follow:

- You only have **two** baskets, and each basket can only hold a **single type** of fruit. There is no limit on the amount of fruit each basket can hold.
- Starting from any tree of your choice, you must pick **exactly one fruit** from **every** tree (including the start tree) while moving to the right. The picked fruits must fit in one of your baskets.
- Once you reach a tree with fruit that cannot fit in your baskets, you must stop.

Given the integer array `fruits`, return *the **maximum** number of fruits you can pick*.

Example 1:

```
Input: fruits = [1,2,1]
Output: 3
Explanation: We can pick from all 3 trees.
```

Example 2:

```
Input: fruits = [0,1,2,2]
Output: 3
Explanation: We can pick from trees [1,2,2].
If we had started at the first tree, we would only pick from trees [0,1].
```

Example 3:

```
Input: fruits = [1,2,3,2,2]
Output: 4
Explanation: We can pick from trees [2,3,2,2].
If we had started at the first tree, we would only pick from trees [1,2].
```

Constraints:

- `1 <= fruits.length <= 10^5`
- `0 <= fruits[i] < fruits.length`

class Solution { public: int totalFruit(vector& fruits) { } };

Permutation in String

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

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

Example 1:

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

Example 2:

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

Constraints:

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

class Solution { public: bool checkInclusion(string s1, string s2) { } };