Binary Search

704. Binary Search

Given an array of integers `nums` which is sorted in ascending order, and an integer `target`, write a function to search `target` in `nums`. If `target` exists, then return its index. Otherwise, return `-1`.

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

Example 1:

```
Input: nums = [-1,0,3,5,9,12], target = 9
Output: 4
Explanation: 9 exists in nums and its index is 4
```

Example 2:

```
Input: nums = [-1,0,3,5,9,12], target = 2
Output: -1
Explanation: 2 does not exist in nums so return -1
```

Constraints:

- `1 <= nums.length <= 104`
- `104 < nums[i], target < 104`
- All the integers in `nums` are **unique**.
- `nums` is sorted in ascending order.

74. Search a 2D Matrix

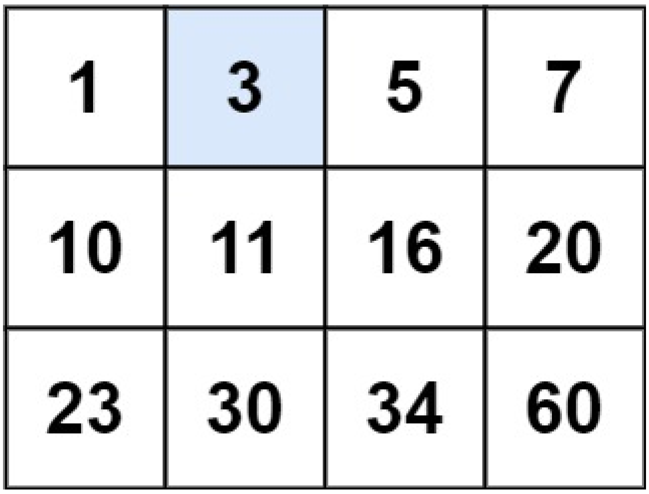
You are given an `m x n` integer matrix `matrix` with the following two properties:

- 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.

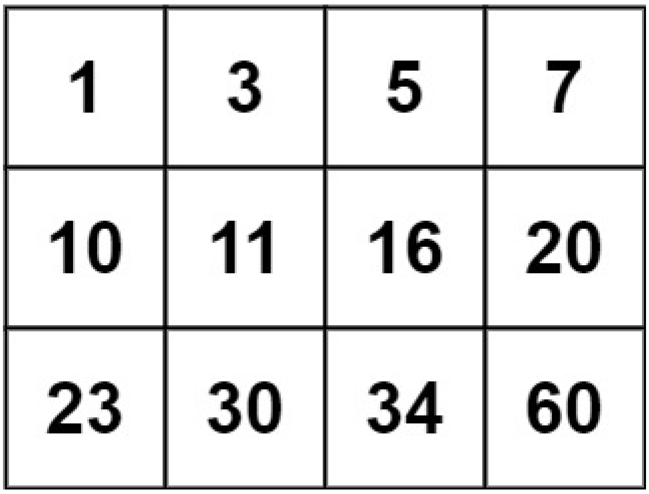
Example 1:



1	3	5	7
10	11	16	20
23	30	34	60

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

Example 2:



1	3	5	7
10	11	16	20
23	30	34	60

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

Constraints:

- `m == matrix.length`
- `n == matrix[i].length`
- `1 <= m, n <= 100`
- `104 <= matrix[i][j], target <= 104`

875. Koko Eating Bananas

Koko loves to eat bananas. There are `n` piles of bananas, the `ith` pile has `piles[i]` bananas. The guards have gone and will come back in `h` hours.

Koko can decide her bananas-per-hour eating speed of `k`. Each hour, she chooses some pile of bananas and eats `k` bananas from that pile. If the pile has less than `k` bananas, she eats all of them instead and will not eat any more bananas during this hour.

Koko likes to eat slowly but still wants to finish eating all the bananas before the guards return.

Return *the minimum integer* `k` *such that she can eat all the bananas within* `h` *hours*.

Example 1:

```
Input: piles = [3,6,7,11], h = 8
Output: 4
```

Example 2:

```
Input: piles = [30,11,23,4,20], h = 5
```

```
Output: 30
```

Example 3:

```
Input: piles = [30,11,23,4,20], h = 6
Output: 23
```

Constraints:

- `1 <= piles.length <= 104`
- `piles.length <= h <= 109`
- `1 <= piles[i] <= 109`

153. 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.

33. 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`
- `104 <= nums[i] <= 104`
- All values of `nums` are **unique**.
- `nums` is an ascending array that is possibly rotated.
- `104 <= target <= 104`

981. Time Based Key-Value Store

Medium

Topics

Companies

Design a time-based key-value data structure that can store multiple values for the same key at different time stamps and retrieve the key's value at a certain timestamp.

Implement the `TimeMap` class:

- `TimeMap()` Initializes the object of the data structure.
- `void set(String key, String value, int timestamp)` Stores the key `key` with the value `value` at the given time `timestamp`.
- `String get(String key, int timestamp)` Returns a value such that `set` was called previously, with `timestamp_prev <= timestamp`. If there are multiple such values, it returns the value associated with the largest `timestamp_prev`. If there are no values, it returns `""`.

Example 1:

```
Input
["TimeMap", "set", "get", "get", "set", "get", "get"]
[[], ["foo", "bar", 1], ["foo", 1], ["foo", 3], ["foo", "bar2", 4], ["foo", 4], ["foo", 5]]
Output
[null, null, "bar", "bar", null, "bar2", "bar2"]

Explanation
TimeMap timeMap = new TimeMap();
timeMap.set("foo", "bar", 1);  // store the key "foo" and value "bar" along with timestamp = 1.
timeMap.get("foo", 1);         // return "bar"
timeMap.get("foo", 3);         // return "bar", since there is no value corresponding to foo at timestamp 3 and timestamp 2, then the only value is at timestamp 1 is "bar".
timeMap.set("foo", "bar2", 4); // store the key "foo" and value "bar2" along with timestamp = 4.
timeMap.get("foo", 4);         // return "bar2"
timeMap.get("foo", 5);         // return "bar2"
```

Constraints:

- `1 <= key.length, value.length <= 100`
- `key` and `value` consist of lowercase English letters and digits.
- `1 <= timestamp <= 107`

- All the timestamps `timestamp` of `set` are strictly increasing.
- At most `2 * 105` calls will be made to `set` and `get`.

4. Median of Two Sorted Arrays

Given two sorted arrays `nums1` and `nums2` of size `m` and `n` respectively, return **the median** of the two sorted arrays.

The overall run time complexity should be `O(log (m+n))`.

Example 1:

```
Input: nums1 = [1,3], nums2 = [2]
Output: 2.00000
Explanation: merged array = [1,2,3] and median is 2.
```

Example 2:

```
Input: nums1 = [1,2], nums2 = [3,4]
Output: 2.50000
Explanation: merged array = [1,2,3,4] and median is (2 + 3) / 2 = 2.5.
```

Constraints:

- `nums1.length == m`
- `nums2.length == n`
- `0 <= m <= 1000`
- `0 <= n <= 1000`
- `1 <= m + n <= 2000`
- `106 <= nums1[i], nums2[i] <= 106`