BinarySearch 二分查找

ALL IN ONE

When: search an index or an element in a regular range
Time complexity: log (n)

Template: https://github.com/MagicienDeCode/LeetCode_Solution/blob/master/src/BinarySearch.md

⇒ left right ?
⇒ while(left + 1 < right)   // avoid dead loop
⇒ conditions
⇒ right first or left first ?
⇒ left = mid / right = mid

1. search the (exact) (position / element)
2. search the (first / last) (position / element)
3. search with complex conditions
4. binary search the result range with a verification function

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

```kotlin
fun searchFirstPosition(nums: IntArray, target: Int): Int {
    if (nums.isEmpty()) {
        return -1
    }
    var left = 0
    var right = nums.size - 1
    while (left + 1 < right) {
        val mid = left + (right - left) / 2
        when {
            nums[mid] == target -> right = mid
            nums[mid] < target -> left = mid
            nums[mid] > target -> right = mid
        }
    }
    return when (target) {
        nums[left] -> left
        nums[right] -> right
        else -> -1
    }
}
```

```kotlin
fun searchLastPosition(nums: IntArray, target: Int): Int {
    if (nums.isEmpty()) {
        return -1
    }
    var left = 0
    var right = nums.size - 1
    while (left + 1 < right) {
        val mid = left + (right - left) / 2
        when {
            nums[mid] == target -> left = mid
            nums[mid] < target -> left = mid
            nums[mid] > target -> right = mid
        }
    }
    return when (target) {
        nums[right] -> right
        nums[left] -> left
        else -> -1
    }
}
```

1. search the (exact) (position / element)

704. Binary Search   (exact element)
167. Two Sum II - Input array is sorted (exact element)
35. Search Insert Position ([first index] <= target)
374. Guess Number Higher or Lower
392. Is Subsequence (follow up using a hashmap to store index of char, then binary search in list)
852. Peak Index in a Mountain Array
162. Find Peak Element
74. Search a 2D Matrix (binary search x 2)
240. Search a 2D Matrix II (foreach then search)
475. Heaters

2. search the (first / last) (position / element)

69. Sqrt(x) (last element ^2 <= target)
34. Find First and Last Position of Element in Sorted Array
278. First Bad Version
350. Intersection of Two Arrays II (first & last then count the total)
1337. The K Weakest Rows in a Matrix (first or last then count)
1351. Count Negative Numbers in a Sorted Matrix
300. Longest Increasing Subsequence (LIS)
441. Arranging Coins
454. 4Sum II

528. Random Pick with Weight (transform then binary search)
497. Random Point in Non-overlapping Rectangles
911. Online Election
981. Time Based Key-Value Store

315. Count of Smaller Numbers After Self
327. Count of Range Sum
354. Russian Doll Envelopes (LIS)
862. Shortest Subarray with Sum at Least K (Deque)
887. Super Egg Drop (Math, also DP)

3. search with complex conditions

33. Search in Rotated Sorted Array
81. Search in Rotated Sorted Array II
153. Find Minimum in Rotated Sorted Array & 154
275. H-Index II
658. Find K Closest Elements

710. Random Pick with Blacklist

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4. binary search the result range with a verification function

378. Kth Smallest Element in a Sorted Matrix
718. Maximum Length of Repeated Subarray [DP]

875. Koko Eating Bananas
1011. Capacity To Ship Packages Within D Days
1482. Minimum Number of Days to Make m Bouquets

1201. Ugly Number III
1283. Find the Smallest Divisor Given a Threshold
1300. Sum of Mutated Array Closest to Target
1292. Maximum Side Length of a Square with Sum Less than or Equal to Threshold
540. Single Element in a Sorted Array

410. Split Array Largest Sum
668. Kth Smallest Number in Multiplication Table
778. Swim in Rising Water (DFS)
1044. Longest Duplicate Substring (Rabin-Karp)