Binary Search

```
#### binary search center match(x) ####
while l <= r:
    mid = l + (r-l)//2
    direction = match(mid)
    if direction == FOUND:   return mid
    elif direction == LEFT:  r = mid - 1
    elif direction == RIGHT: l = mid + 1
return NotFound

#### binary search leftmost match(x) ####
#### 元素越右越正确，找最左
while l < r:
    mid = l + (r-l)//2       # mid 偏左
    if match(mid): r = mid
    else: l = mid + 1
if match(l): return l; else: ?  # 可能没有正确元素，需要检查

#### binary search rightmost match(x) ####
#### 元素越左越正确，找最右
while l < r:
    mid = l + (r-l+1)//2     # mid 偏右
    if match(mid): l = mid
    else: r = mid - 1
if match(r): return r; else: ?  # 可能没有正确元素，需要检查

# bisect.bisect_left;  bisect.bisect_right
# bisect.insort_left;  bisect.insort_right
```

search center

Peak Index in a Mountain Array
Find Peak Element
Guess Number Higher or Lower
Binary Search Target
Valid Perfect Square
Search in a Sorted Array of Unknown Size `find right first`

search leftmost/rightmost

Find Smallest Letter Greater Than Target `leftmost`
First Bad Version `leftmost`
Search Insert Position `leftmost` `rightmost`
Find First and Last Position of Element in Sorted Array
Sqrt(x) `rightmost`

Single Element in a Sorted Array `(1 1)(2 2)(3 4)(4 5) 5` 找最左的不配对
Find the Duplicate Number 二分查找最左 `count_le(x) > x`
Heaters (min radius) `heater排序,每个house二分查找左右heater`

H-Index I `sort in descending order`
H-Index II (ascending) `Binary Search`

rotated sorted array

Search in Rotated Sorted Array I `binary search`
Search in Rotated Sorted Array II (duplicate)
Find Minimum in Rotated Sorted Array I `binary search`
Find Minimum in Rotated Sorted Array II (duplicate)

```python
def search_rotated_sorted_array(self, nums, target):
    l, r = 0, len(nums) - 1
    while l <= r:
        m = l + (r - l)//2
        if target == nums[m]: return m
        if nums[m] <= nums[l]:
            if nums[l] <= target <= nums[m]: r = m - 1
            else: l = m + 1
        else:
            if nums[m] <= target <= nums[r]: l = m + 1
            else: r = m - 1
    return -1

def min_rotated_sorted_array(self, nums):
    l, r = 0, len(nums) - 1
    while l < r:
        m = l + (r - l) // 2
        if nums[m] > nums[r]: l = m + 1
        else: r = m
    return nums[l]
```

two arrays

Intersection of Two Arrays I
Intersection of Two Arrays II
Median of Two Sorted Arrays `二分查找最左 m1: A[m1]>=B[k-m1-1]`

还没做

Smallest Good Base

Valid Perfect Square

Arranging Coins

4Sum II
Kth Smallest Element in a BST
Kth Smallest Element in a Sorted Matrix
Find the Duplicate Number with O(1) space
Maximum Length of Repeated Subarray
Koko Eating Bananas
Find Right Interval

Search a 2D Matrix
Search a 2D Matrix II

Longest Increasing Subsequence

Find K Closest Elements

Minimum Size Subarray Sum

Count Complete Tree Nodes
Pow(x, n)
Divide Two Integers
Split Array Largest Sum
Preimage Size of Factorial Zeroes Function
Kth Smallest Number in Multiplication Table

Minimize Max Distance to Gas Station
K-th Smallest Prime Fraction
Max Sum of Rectangle No Larger Than K

Russian Doll Envelopes
Random Pick with Blacklist
Find K-th Smallest Pair Distance
Maximum Average Subarray II
Dungeon Game

Nth Magical Number
Super Egg Drop