Binary Search

Presented by Alexander Mak

Binary Search?

- Binary search is an extremely efficient searching algorithm.
- It is one of the few algorithms that can reach O(log(n)) runtime.
- The prerequisite for binary search is usually to have sorted array.
    - However there are some exceptions where you can binary search on things that aren't simply sorted arrays.

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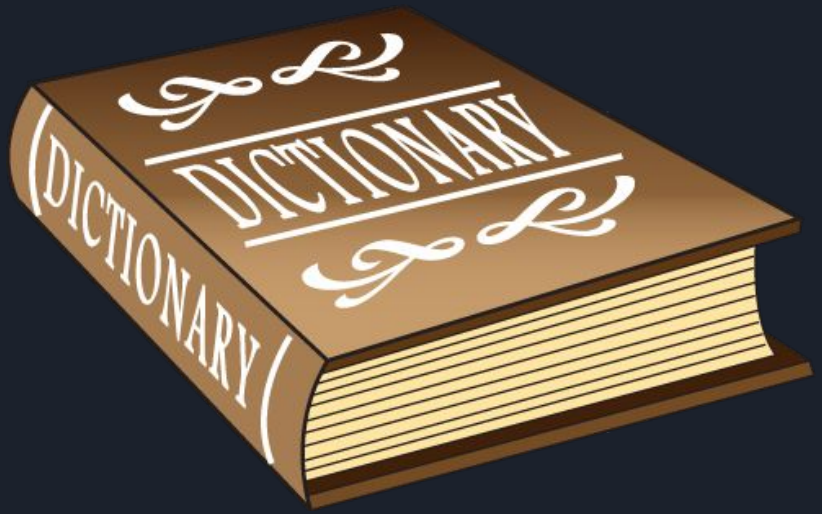
Binary Search Analogy

Imagine you are searching for a word in a physical dictionary book. You open the book to the middle page and check whether your word is there. If it isn't, you can eliminate either the first or second half of the book depending on where your word lies alphabetically and the repeat the process on the half where you know it exists.



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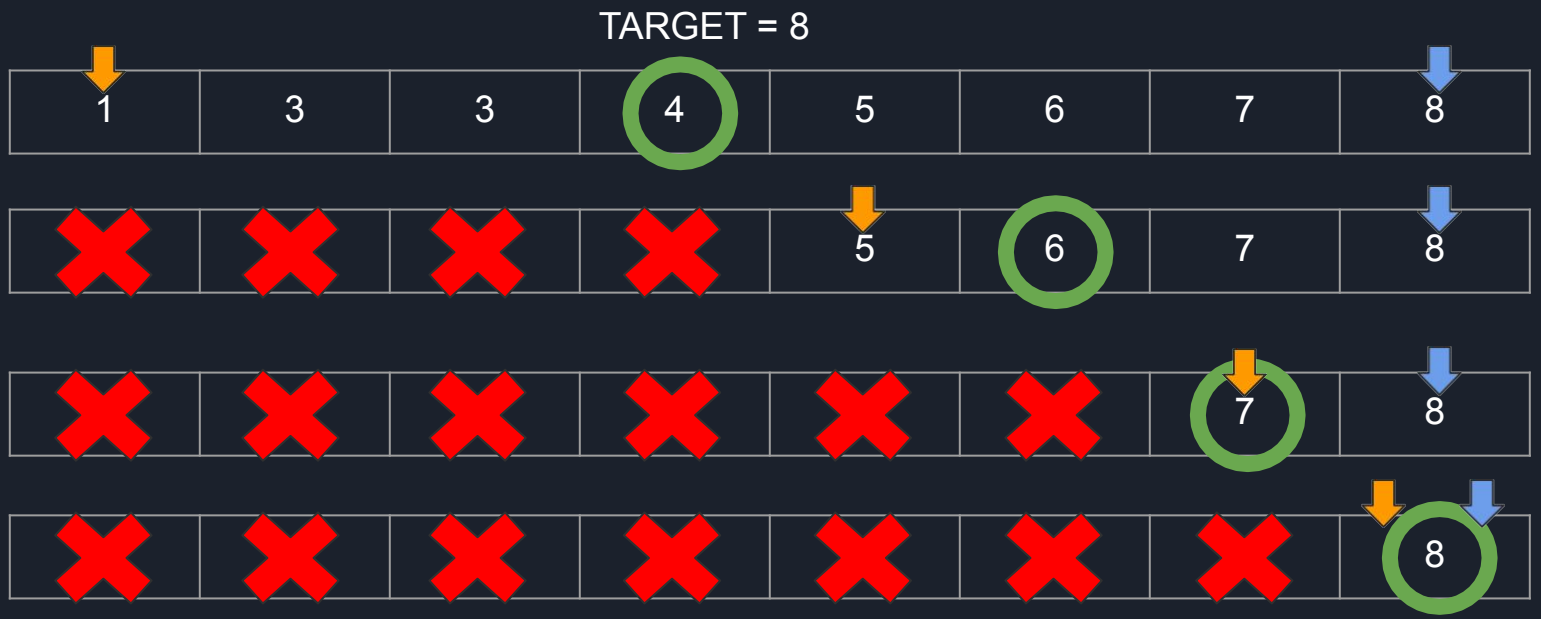
Binary search

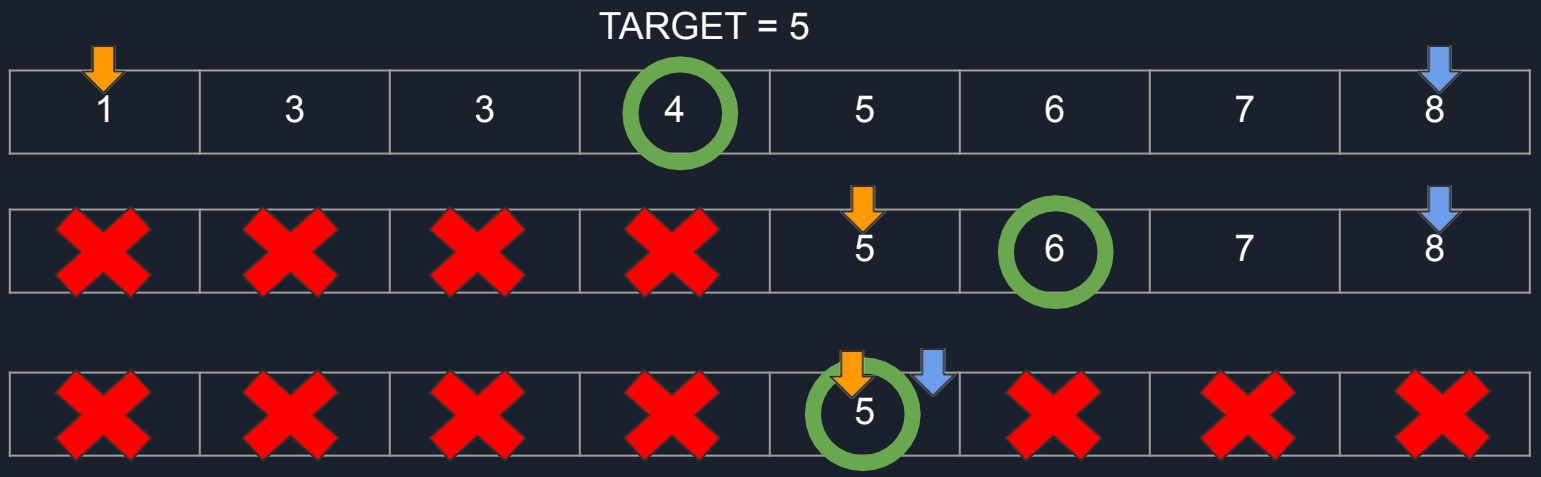
TARGET = 8

1	3	3	4	5	6	7	8

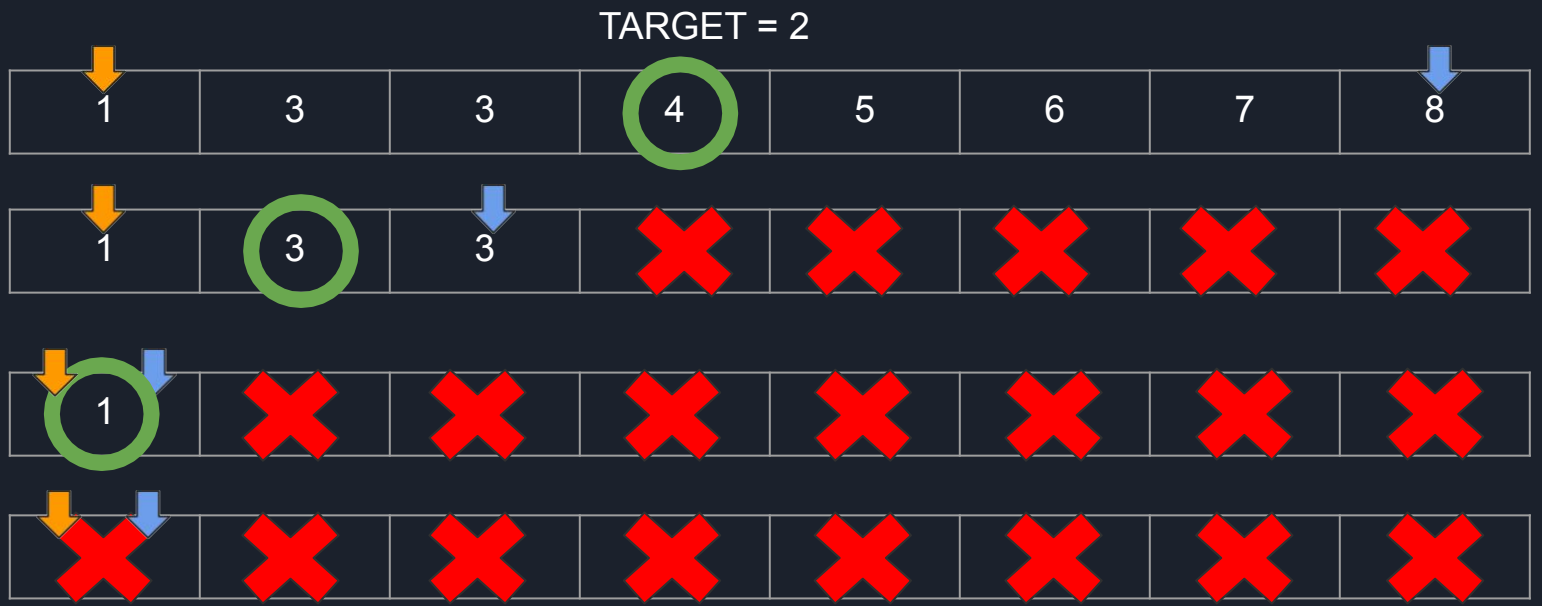
Binary search example (found at extreme)



Binary search example (found in middle)



Binary search example (not found)



Recursive binary search

```python
def search(nums, target):
    def recurse(left, right):
        if left >= right:
            return right if nums[right] == target else -1 pivot = left + (right - left)//2
        if nums[pivot] == target:
            return pivot
        elif target < nums[pivot]:
            return recurse(left, pivot - 1)
        else:
            return recurse(pivot + 1, right)

    return recurse(0, len(nums)-1)
```

- There isn't really much benefit to doing binary search recursively since it uses extra memory via the call stack and doesn't really make the code any more concise. However this is good recursion practice!

Iterative binary search

```python
def search(nums, target):
    left, right = 0, len(nums)-1

    while left <= right:
        mid = left + (right - left) // 2
        if nums[mid] == target:
            return mid
        elif nums[mid] > target:
            right = mid-1
        else:
            left = mid+1
    return -1
```

Questions?

Let’s practice!

https://github.com/Dijkstra-LLC/dsa_live_pro/tree/main/W03D01/classwork