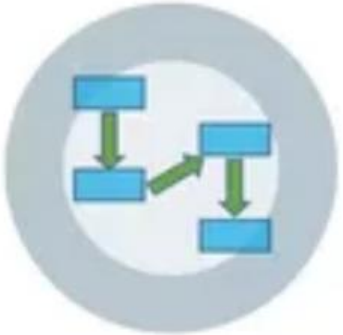
Searching

Algorithms

Unsorted Array (Linear Search)

Sorted Array (Binary Search)



Data Structures and Algorithms – CSI 401

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Data Structures and Algorithms
Course Contents:
Abstract data types, complexity analysis, Big Oh notation, Stacks (linked lists and array implementations), Recursion and analyzing recursive algorithms, divide and conquer algorithms, Sorting algorithms (selection, insertion, merge, quick, bubble, heap, shell, radix, bucket), queue, dequeuer, priority queues (linked and array implementations of queues), linked list & its various types, sorted linked list, searching an unsorted array, binary search for sorted arrays, hashing and indexing, open addressing and chaining, trees and tree traversals, binary search trees, heaps, M-way tress, balanced trees, graphs, breadth-first and depth-first traversal, topological order, shortest path, adjacency matrix and adjacency list implementations, memory management and garbage collection

Searching Algorithms

- Searching is the process of finding some particular element in the list.
- If the element is present in the list, then the process is called successful, and the process returns the location of that element; otherwise, the search is called unsuccessful.
- Two popular search methods are Linear Search and Binary Search.

Searching Algorithms cont…
linear Search

- Linear search is also called as sequential search algorithm.
- It is the simplest searching algorithm.
- In Linear search, we simply traverse the list completely and match each element of the list with the item whose location is to be found.
- If the match is found, then the location of the item is returned; otherwise, the algorithm returns NULL.

Searching Algorithms cont…
linear Search

- It is widely used to search an element from the unordered list, i.e., the list in which items are not sorted.
- The worst-case time complexity of linear search is O(n).

Searching Algorithms cont…
linear Search

1. First, we have to traverse the array elements using a for loop.
2. In each iteration of for loop, compare the search element with the current array element, and:
   a) If the element matches, then return the index of the corresponding array element.
   b) If the element does not match, then move to the next element.

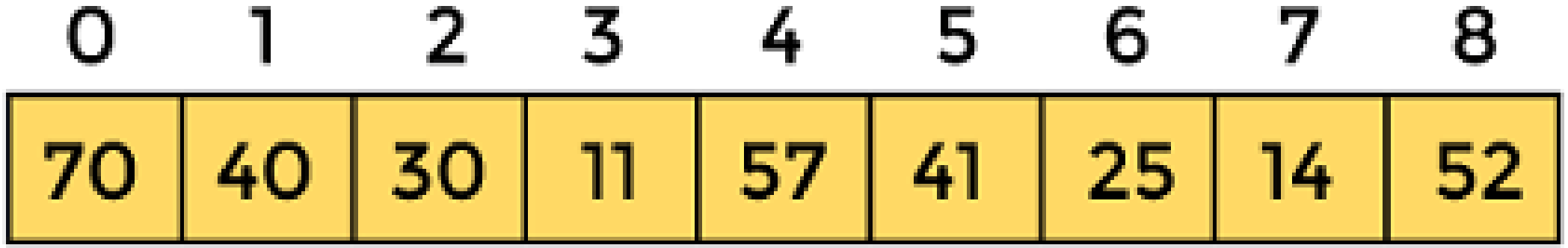
Searching Algorithms cont…
linear Search

3. If there is no match or the search element is not present in the given array, return -1.

Searching Algorithms cont...
Working of linear Search

- Now, let's see the working of the linear search Algorithm.
- To understand the working of linear search algorithm, let's take an unsorted array. It will be easy to understand the working of linear search with an example.
- Let the elements of array are:

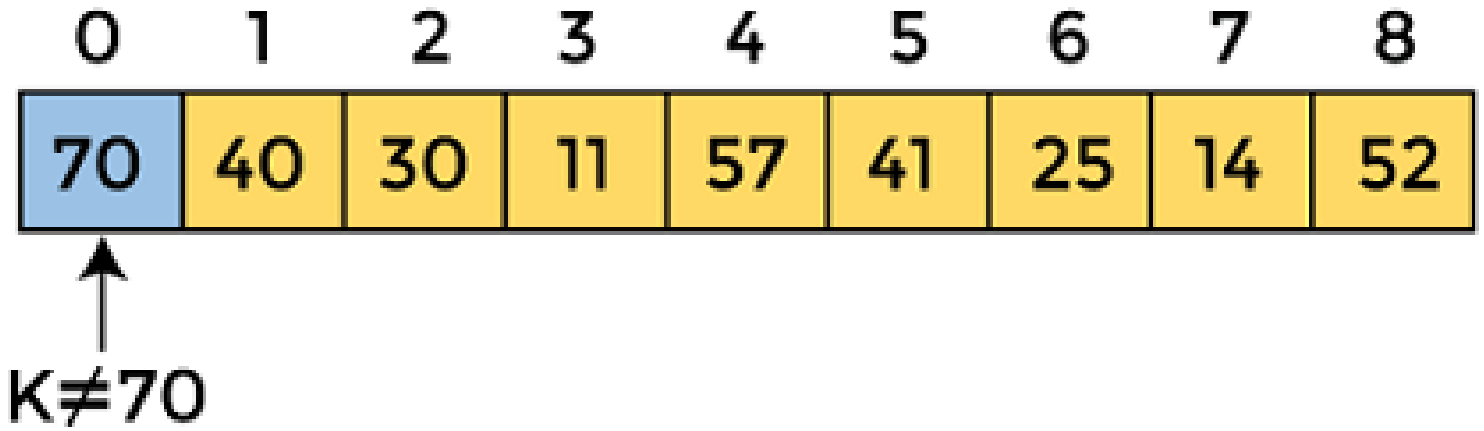
Searching Algorithms cont...
Working of linear Search



Let the element to be searched is **K = 41**

Searching Algorithms cont…
Working of linear Search

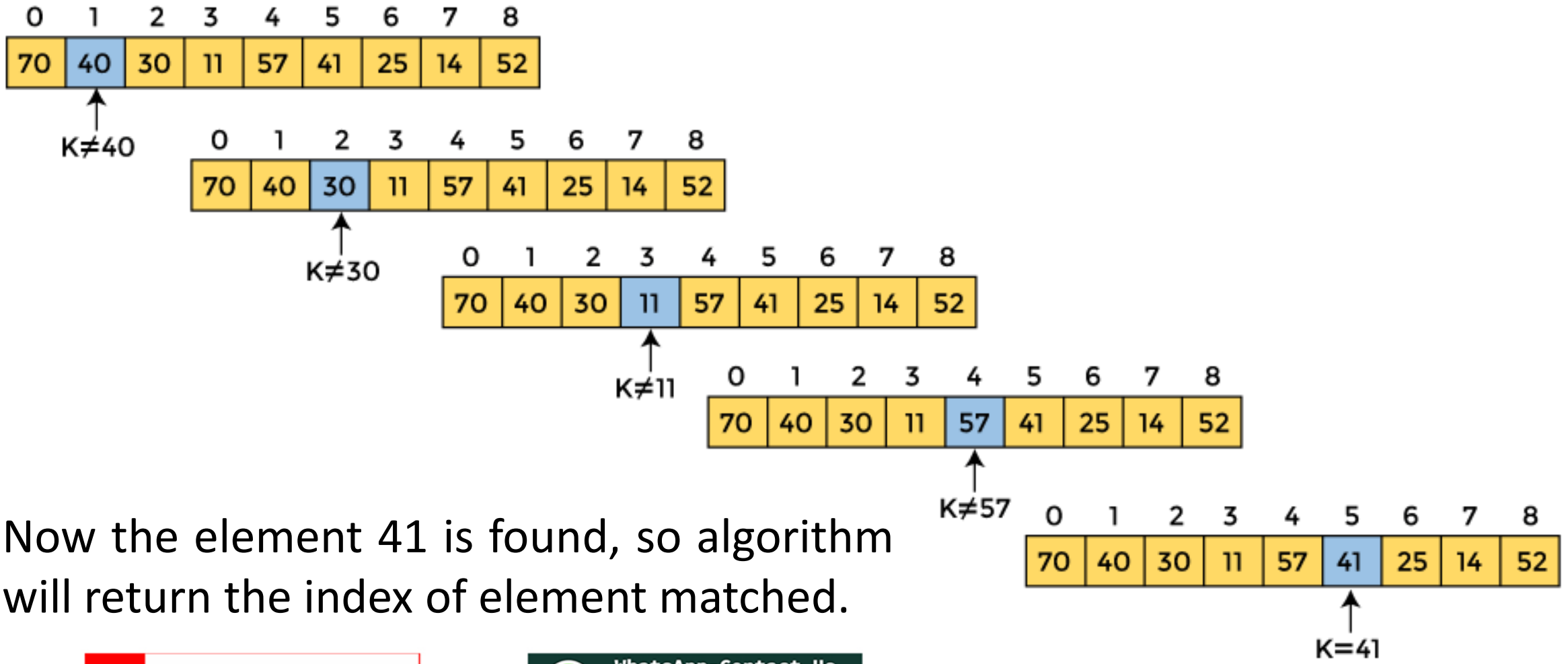
- Now, start from the first element and compare **K** with each element of the array.



Searching Algorithms cont…
Working of linear Search

- The value of **K,** i.e., **41,** is not matched with the first element of the array.
- So, move to the next element.
- And follow the same process until the respective element is found.

Searching Algorithms cont…
Working of linear Search



Now the element 41 is found, so algorithm will return the index of element matched.

Searching Algorithms cont...
Linear Search – Complexity

- **Time Complexity:**
- Now, let's see the time complexity of linear search in the best case, average case, and worst case.

Case	Time Complexity
Best Case	O(1)
Average Case	O(n)
Worst Case	O(n)

Searching Algorithms cont…
Linear Search – Complexity

- **Best Case Complexity:** In Linear search, best case occurs when the element we are finding is at the first position of the array. The best-case time complexity of linear search is **O(1)**.
- **Average Case Complexity:** The average case time complexity is **O(n)**.

Searching Algorithms cont…
Linear Search – Complexity

- **Worst Case Complexity:** In Linear search, the worst case occurs when the element we are looking is present at the end of the array.
- The worst-case in linear search could be when the target element is not present in the given array, and we have to traverse the entire array.
- The worst-case time complexity of linear search is O(n).

Searching Algorithms cont…
Binary Search

- Binary search follows the divide and conquer approach in which the list is divided into two halves, and the item is compared with the middle element of the list.
- If the match is found then, the location of the middle element is returned.
- Otherwise, we search into either of the halves depending upon the result produced through the match.

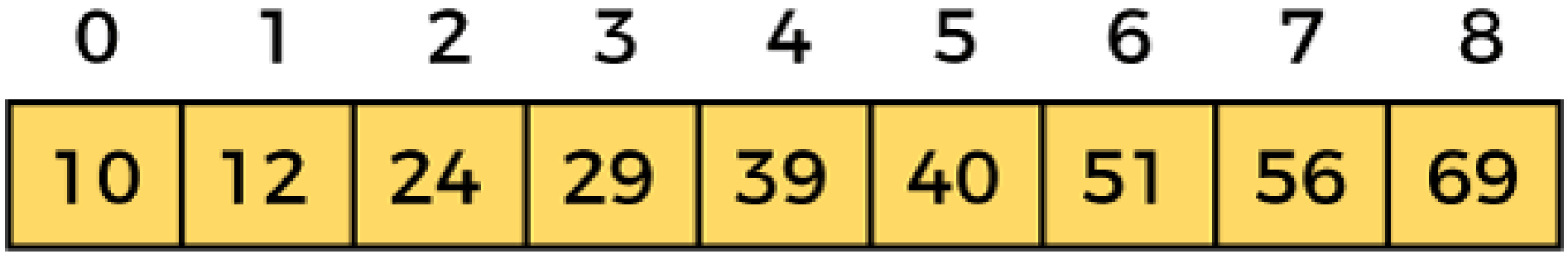
Searching Algorithms cont...
Working of Binary Search

- To understand the working of the Binary search algorithm, let's take a sorted array.
- It will be easy to understand the working of Binary search with an example.
- There are two methods to implement the binary search algorithm: Iterative method, Recursive method

Searching Algorithms cont...
Working of Binary Search

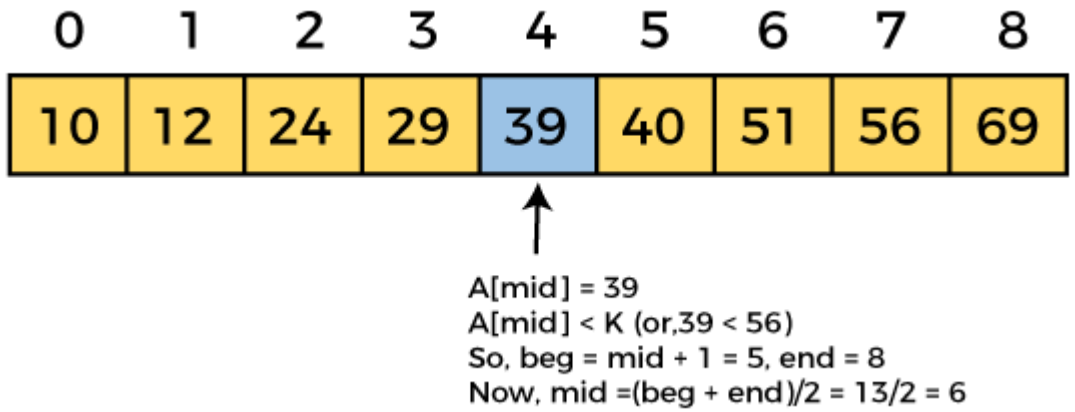
- The recursive method of binary search follows the divide and conquer approach.
- Let the elements of array are -

Let the element to search is, **K = 56**

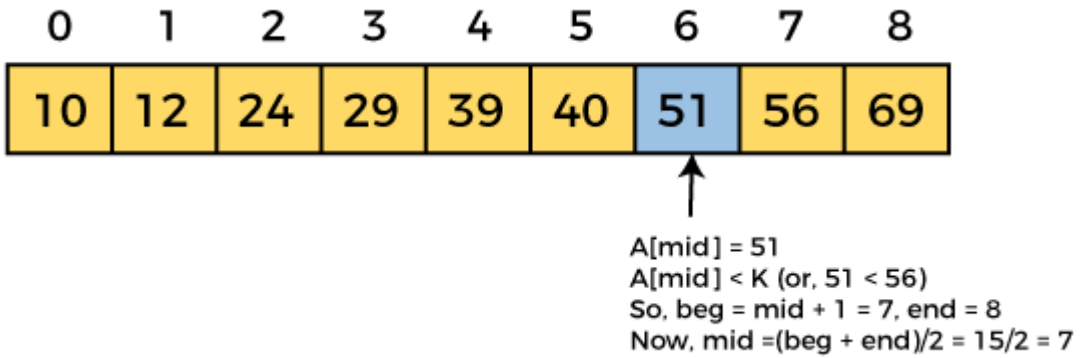


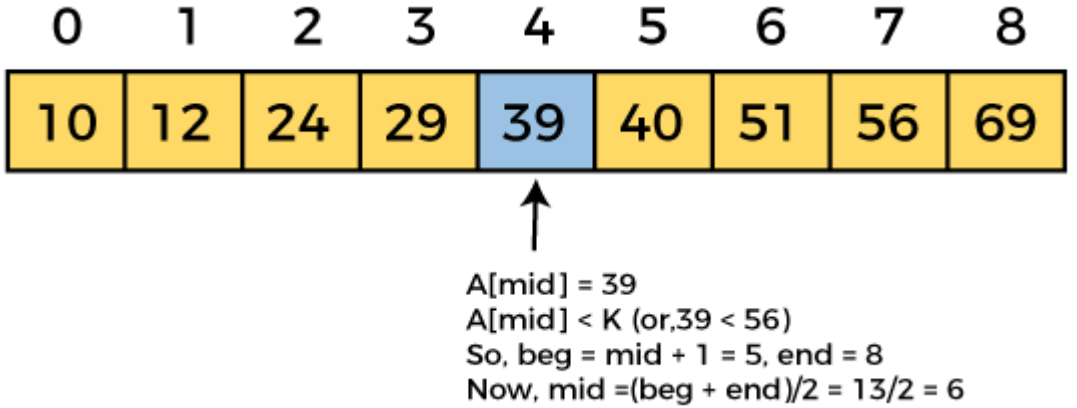
Searching Algorithms cont...
Working of Binary Search

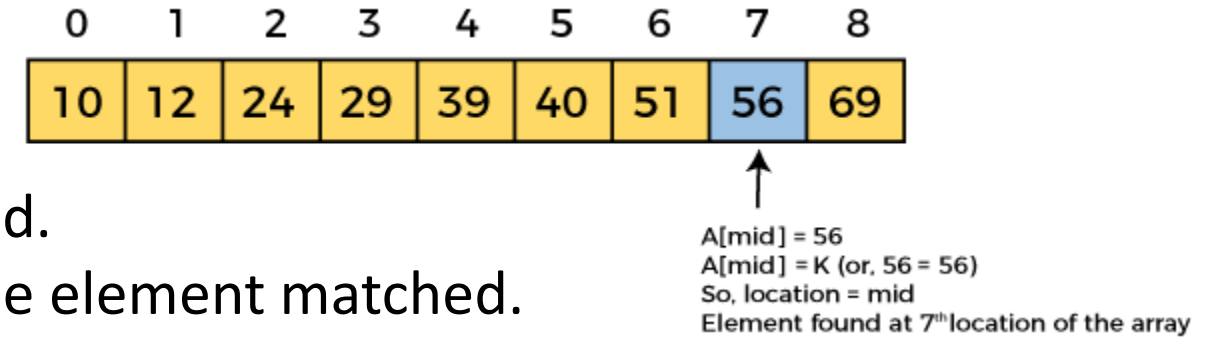
- We have to use the below formula to calculate the **mid** of the array:
- **mid = (beg + end)/2**
- So, in the given array:
- **beg** = 0, **end** = 8
- **mid** = (0 + 8)/2 = 4. So, 4 is the mid of the array.



Searching Algorithms cont…
Working of Binary Search







- Now, the element to search is found.
- So algorithm will return index of the element matched.

Searching Algorithms cont...
Complexity of Binary Search

- **Time Complexity:**

- Now, let's see the time complexity of Binary search in the best case, average case, and worst case:

Case	Time Complexity
Best Case	O(1)
Average Case	O(logn)
Worst Case	O(logn)

Searching Algorithms cont…
Complexity of Binary Search

- **Best Case Complexity:** In Binary search, best case occurs when the element to search is found in first comparison, i.e., when the first middle element itself is the element to be searched. The best-case time complexity of Binary search is **O(1)**.
- **Average Case Complexity:** The average case time complexity of Binary search is **O(log n)**.

Searching Algorithms cont…
Complexity of Binary Search

- **Worst Case Complexity:** In Binary search, the worst case occurs, when we have to keep reducing the search space till it has only one element.
- The worst-case time complexity of Binary search is **O(log n)**.

Searching Algorithms cont…
Complexity of Binary Search

- **Worst Case Complexity:** In Binary search, the worst case occurs, when we have to keep reducing the search space till it has only one element.
- The worst-case time complexity of Binary search is **O(log n)**.