DAILY DSA | DAY-19 | Searching algorithms – Binary search|
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Binary search is a versatile technique for finding an element within a sorted list by **repeatedly dividing the search interval in half** (divide & conquer strategy) and can speed up naive algorithms (like linear search) from O(n) to O(log n) which is a huge improvement.

Pre-requisites to apply Binary search algorithm (BSA) in array/lists:

- A BSA will only work when it runs against a **sorted** list.

Implementation of BSA:
We start with two-pointers, called Low & high, which represent the lowest and highest index (pointer). Initially, we can set lowest low=0 and high=len(array)-1
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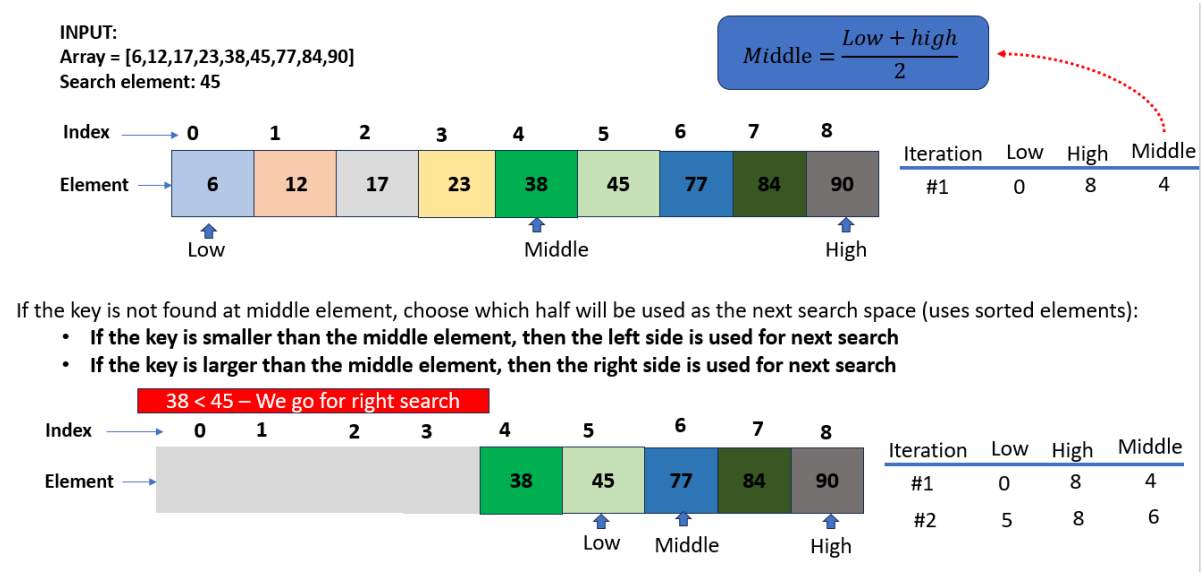
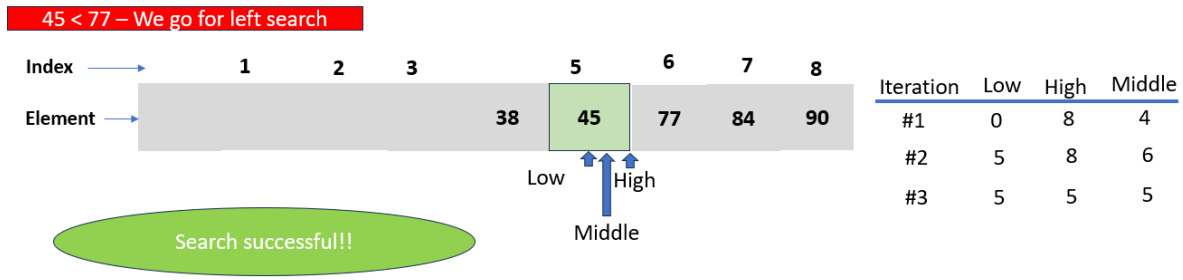


If the key is not found at middle element, choose which half will be used as the next search space (uses sorted elements):

- **If the key is smaller than the middle element, then the left side is used for next search**
- **If the key is larger than the middle element, then the right side is used for next search**

Repeat the steps



The BSA will repeat this process until the middle number is equal to the target/search number or the array is empty

Ways to implement Binary search:

1. **Iterative binary search algorithm**: We use a while loop to continue the process of comparing the key and splitting the search space into two halves.

2. **Recursive binary search algorithm**: Create a recursive function and compare the mid of the search space with the key. based on the result either return the index where the key is found or call the recursive function for the next search space.

The time complexity:

- Best case: O(1)
- Average case: O(log N)
- Worst case: O(log N)

Advantages:

- Binary search is faster than linear search, especially for larger arrays
- More efficient than other searching algorithms with similar time complexity, such as interpolation search, or exponential search
- Binary search is well-suited for searching large datasets that are stored in external memory, such as on a hard drive or in the cloud.

Drawbacks:

- The array should be sorted

Applications:

- Used for searching in a database
- Used for searching in computer graphics such as algorithms for ray tracing or texture mapping.