ANALYSIS OF ALGORITHM

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Concepts:

- Searching

- Linear Search

- Binary Search

Searching

- We all are familiar with the word search. It is to find a particular thing or item from a group of items. It is one of the most commonly used programming concepts in everyday life.

- we are going to understand searching, its features, various types of searching algorithms, etc.

What is Searching in Data Structures?

- Searching is the fundamental process of locating a specific element or item within a collection of data.

- This collection of data can be arrays, lists, trees, or other structured representations.

- Data structures are complex systems designed to organize vast amounts of information.

- The goal is to find the desired information with its precise location quickly and with minimal computational resources. It plays an important role in various computational tasks and real-world applications, including information retrieval, data analysis, decision-making processes, etc.

Characteristics of Searching

- **Target Element/Key:** It is the element or item that you want to find within the data collection. This target could be a value, a record, a key, or any other data entity of interest.

- **Search Space:** It refers to the entire collection of data within which you are looking for the target element. Depending on the data structure used, the search space may vary in size and organization.

- **Complexity:** Searching can have different levels of complexity depending on the data structure and the algorithm used.

- **Deterministic vs. Non-deterministic:** The algorithms that follow a clear, systematic approach, like binary search, are deterministic. Others, such as linear search, are non-deterministic, as they may need to examine the entire search space in the worst case.

Linear Search Algorithm:

- 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.

- Linear search is also called as **sequential search 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.

The steps used in the implementation of Linear Search are listed as follows:

- First, we have to traverse the array elements using a for loop.

- In each iteration of for loop, compare the search element with the current array element, and -

- If the element matches, then return the index of the corresponding array element.

- If the element does not match, then move to the next element.

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

Working of Linear search:

- elements of array are -

0	1	2	3	4	5	6	7	8
70	40	30	11	57	41	25	14	52

- Let the element to be searched is K = 41

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

0	1	2	3	4	5	6	7	8
70	40	30	11	57	41	25	14	52

K≠70

- Linear Search A

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.
- Now, the element to be searched is found. So algorithm will return the index of the element matched.
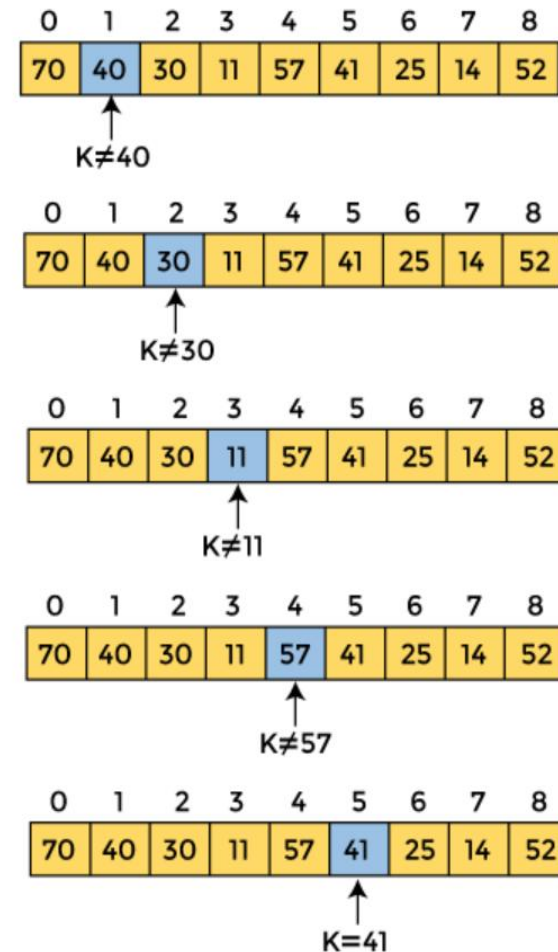
Binary Search Algorithm:

- Binary search is the search technique that works efficiently on sorted lists.

- 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.

Implementation of Binary search:

The Binary Search Algorithm can be implemented in the following two ways

- Iterative Binary Search Algorithm

- Recursive Binary Search Algorithm

Iterative Binary Search Algorithm:

- A certain set of statements are repeated a certain number of time.

- An Iterative algorithm will use looping statements such as for loop, while loop or do-while loop to repeat the same steps number of time.

- The iterative binary search starts with two pointers, left and right.

- It enters a "while" loop that continues till "left" is less than or equal to "right."

- Inside the loop, it calculates the "mid" index and checks whether or not the value at "mid" is equal to the target.

Recursive Binary Search Algorithm:

- The recursive solution utilizes a helper function to keep track of pointers to the section of the list we are currently examining.
- The recursive binary search takes "left" and "right" to define the current search range.
- It checks if "left" is less than or equal to "right."
- It calculates the "mid" index and compares the element at "mid" with the target.
- If the target is found, it returns the index.