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A REVIEW ON COMPARISON OF BINARY SEARCH AND LINEAR SEARCH

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ABSTRACT

After the years of research done by scientists, it is found that binary search is more efficient than the linear search. Earlier, the sorting time of linear search before the application of binary search appeared not to have been considered. In Linear search algorithm searching begins with searching every element of the list till the required record is found and if the list is quite huge, then this approach is not optimal. The drawbacks of sequential search can be eliminated by using Binary search algorithm. This paper analyzes both the algorithms at some extent for the applicability and execution efficiency.

KEYWORDS: Complexity, Search algorithms, Linear search, Binary search.

INTRODUCTION

We always use searching techniques to search information. We look for specific topic using keywords from a specific book by use of the index given in the book, we look for numbers in mobile phone and we search the English spelling from dictionary. Search operation is involved in day to day life.

In searching algorithm we find a specific item from the collection of data. It answers the user whether the item we are looking for is present or not. Computer systems are often used to store large amounts of data from which individual records can be retrieved according to some search criterion so, it is our need to search and fetch the data in that manner so that it will take lesser time and will be efficient. For this motive we need an algorithm which not only takes less time but also fulfills our needs efficiently. Therefore, in this paper we will discuss linear and binary search algorithms on the basis of their efficiency and time complexity so that we can have our result in a productive way.

SEARCHING TYPES

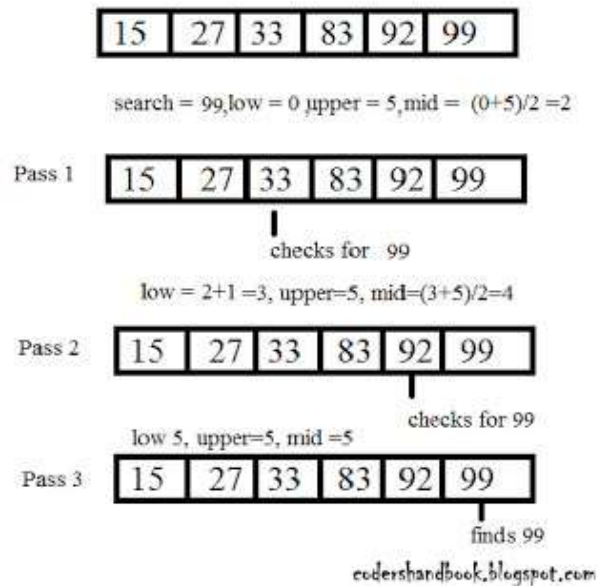
Searching is of two types:

1. External searching: External searching searches the records using keys where the number of records are more, which resides in the files stored on disks. This is the type of searching in which the data on which searching is done resides in the secondary memory storage like hard disk or any other external storage peripheral device.
2. Internal searching: Internal searching hunt for that type of record in which there is less amount of data also which resides entirely within the computer. In this technique data resides within the main memory.

Linear search: In Linear Search, the data to be searched is been compared with each element present in the record till the data matches and if that data is not present then also it will do every comparison. This method, which traverses the array sequentially to locate the desired item, hence it is called sequential search or linear search. Linear search is the least efficient search technique among the quantity dependent search techniques. This technique do not concern about the order of the data.



6. If (A[mid] == item)
 - Print "Item is found"
 - Else
 - Print "Item is not found"
7. End.



NOTION BEHIND SEARCHING PROCESS

In this section we will study about the processes/notion followed by the two searches. In linear search, each element of an array is read one by one sequentially and it is compared with the desired element. A search will not be successful if all the elements are read and the desired element is not found. Where Binary search is an extremely efficient algorithm when it is compared to linear search. Binary search technique searches data in minimum possible comparisons. Suppose the given array is a sorted one, otherwise first we have to sort the array elements. Then apply the following conditions to search a data.

- 1) Find the middle element of the array (*i.e.* $n/2$ is the middle element if the array or the sub-array contains n elements).
- 2) Compare the middle element with the data to be searched and then there are following three cases.
 - a) If it is a desired element, then search is successful.
 - b) If it is less than desired data, then search only the first half of the array, *i.e.*, the elements which come to the left side of the middle element.
 - c) If it is greater than the desired data, then search only these half of the array, *i.e.*, the elements which come to the right side of the middle element.

Repeat the same steps until an element is found or exhaust these arch area.

COMPLEXITY ANALYSIS

Linear Search: Record with n number of items, the best case is when the value of item to be searched is equal to the first element of the list, in this case only one comparison is needed. Worst case is when the value is not in the list or occurs only once at the end of the list, in this case n comparisons are needed.

If the value to be searched occurs k times in the list, the expected number of comparisons to take place is



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$$\begin{matrix} n & \text{if } k=0 \\ n+1 \\ k+1 \end{matrix}$$

For example, if the value occurs once in the list, and all orderings of list are equally likely, the expected number of comparisons is $\frac{n+1}{2}$.

However, if it is known that it occurs once, then at most $n-1$ comparisons are needed and the expected number of comparisons is

$$\frac{(n+1)(n-1)}{2}$$

Binary search: List with n number of records, the best in binary search algorithm is when the item to be searched is found in first comparison only. The worst case is same as the linear search when the value is not in the list (or is found in the last comparison).

COMPARATIVE STUDY

TABLE 1.1: Comparison on the basis of various parameters

Parameter	Linear search	Binary search
Searching approach	Sequential	Divide and conquer
Time complexity		
Best case	$O(1)$	$O(1)$
Worst case	$O(n)$	$O(\log_2 n)$
Average case	$O(n)$	$O(\log_2 n)$
Sorting Required	No	Yes
Searching type	Linear search	Binary Search
Advantages	Simple, easy to understand and easy to implement. It searches the element in the list, no matter whether the list is sorted or not.	It is comparatively fast than linear search. It can be used for large amount of data. It takes lesser amount of time.
Disadvantages	It is a slow process. It is used for small amount of data. It is a very time consuming method.	Binary search requires that the items in the array should be sorted. Binary search cannot be used where there are many insertions or deletions.

CONCLUSION

As we have already discussed about the importance of searching it is very important for huge application such as database management system. So now, we have to focus on achieving it in an efficient way. According to the whole analysis, we concluded that Binary Search is more efficient than Linear Search.



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Binary Search takes less time in searching, the only condition is, the data should be sorted. If we apply any sorting algorithm on our data before starting the process then also the time and space taken by the binary search is lesser than the linear search.

The time complexity of binary search is less as compared to linear search. The linear search algorithm is suitable only for that type of list which is small and is not sorted while the binary search can be used for large amount of data needed the data must be in sorted form.

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