

Exercise 6: Library Management System

a. Understand Search Algorithms:

1. Explain linear search and binary search algorithms.

Linear search is the simplest search algorithm and it is mainly used to find the element from an unordered list. It is also known by another name called sequential search algorithm. In linear search, the list is simply traversed, and each element in the list is matched with the element whose location needs to be found.

Whereas Binary search is an efficient algorithm for finding an item from a sorted list of items. It works by repeatedly dividing in half the portion of the list that could contain the item, until you've narrowed down the possible locations to just one.

b. Analysis:

1. Compare the time complexity of linear and binary search.

Binary search has a time complexity of $O(\log n)$, while linear search has a time complexity of $O(n)$. Binary Search requires sorted data, whereas Linear Search does not require sorted data. Binary Search is more complex to implement as compared to Linear Search.

2. Discuss when to use each algorithm based on the data set size and order.

When to Use Each Algorithm based on their data set size:

we use Linear Search When:

- The dataset is small to medium-sized.
- The list is unsorted, and sorting is not feasible or necessary.
- The overhead of sorting is not justified by the search frequency.

we use Binary Search When:

- The dataset is large.
- The list is already sorted or can be sorted.
- The search operation is frequent, making the initial sorting worthwhile.