**Exercise 6: Library Management System**

Scenario:

You are developing a library management system where users can search for books by title or author.

**Step 1: Understand Search Algorithms**

**Linear Search**

* Concept: Linear search is the simplest search algorithm. It sequentially checks each element in the list until it finds the target element or reaches the end of the list.
* Time Complexity: The time complexity is O(n) where n is the number of elements in the list. In the worst case, it needs to check every element.
* Use Case: Linear search is useful for small or unsorted datasets.

**Binary Search**

* Concept: Binary search is an efficient search algorithm that works on sorted lists. It repeatedly divides the search interval in half. If the target value is less than the middle element, it searches the left half; otherwise, it searches the right half.
* Time Complexity: The time complexity is O(logn) where nis the number of elements in the list. It significantly reduces the number of comparisons needed.
* Use Case: Binary search is ideal for large, sorted datasets.

**Step 2: Setup**

Create a Book Class**:** Define a Book class with attributes bookId, title, and author.

**Step 3: Implementation**

1. Implement Linear Search to Find Books by Title

Implement Binary Search to Find Books by Title (Assuming the List is Sorted)

**Step 4: Analysis**

**Time Complexity**

* Linear Search: The time complexity is O(n)where n is the number of books. It checks each book sequentially until it finds the target or reaches the end.
* Binary Search: The time complexity is O(logn) where n is the number of books. It divides the search interval in half with each step, making it much faster for large datasets.

**When to Use Each Algorithm**

* Linear Search: Use linear search when the dataset is small or unsorted. It is simple to implement and does not require preprocessing (like sorting the list).
* Binary Search: Use binary search when the dataset is large and sorted. It is more efficient in terms of time complexity, making it suitable for large datasets. However, it requires the list to be sorted, which may add preprocessing time if the list isn't already sorted.

In conclusion, choose the search algorithm based on the size of the dataset and whether it is sorted. Linear search is straightforward and works for small or unsorted datasets, while binary search is efficient for large, sorted datasets.