**Exercise 6: Library Management System**

**Scenario:**

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

**Steps:**

1. **Understand Search Algorithms:**
   * **Explain linear search and binary search algorithms.**

**Linear Search:**

* Linear search is a simple algorithm that checks each element in a list one by one until the desired element is found or the list ends.
* **Time Complexity:** O(n), where n is the number of elements in the list.

**Binary Search:**

* Binary search is a more efficient algorithm that works on sorted lists. It repeatedly divides the search interval in half. If the value of the search key is less than the item in the middle of the interval, narrow the interval to the lower half. Otherwise, narrow it to the upper half. Repeat until the value is found or the interval is empty.
* **Time Complexity:** O(log n), where n is the number of elements in the list.

1. **Setup:**
   * **Create a class Book with attributes like bookId, title, and author.**
2. **Implementation:**
   * **Implement linear search to find books by title.**

import java.util.List;

public class Library {

public static Book linearSearchByTitle(List<Book> books, String title) {

for (Book book : books) {

if (book.getTitle().equalsIgnoreCase(title)) {

return book;

}

}

return null; // Book not found

}

}

* + **Implement binary search to find books by title (assuming the list is sorted).**

import java.util.List;

import java.util.Collections;

import java.util.Comparator;

public class Library {

public static Book binarySearchByTitle(List<Book> books, String title) {

Collections.sort(books, Comparator.comparing(Book::getTitle));

int left = 0;

int right = books.size() - 1;

while (left <= right) {

int mid = left + (right - left) / 2;

int compare = books.get(mid).getTitle().compareToIgnoreCase(title);

if (compare == 0) {

return books.get(mid);

} else if (compare < 0) {

left = mid + 1;

} else {

right = mid - 1;

}

}

return null; // Book not found

}

}

1. **Analysis:**
   * **Compare the time complexity of linear and binary search.**

**Time Complexity Comparison:**

* **Linear Search:** O(n)
* **Binary Search:** O(log n)
  + **Discuss when to use each algorithm based on the data set size and order.**

**When to Use Each Algorithm:**

* **Linear Search:** Use this algorithm when the list is unsorted or the list is small.
* **Binary Search:** Use this algorithm when the list is sorted and the list is large, as it is more efficient for large datasets.