Exercise 6: Library Management System

1.Understand Search Algorithms:

- Linear Search: Iterates through each element until the desired value is found. Time Complexity: O(n).

- Binary Search: Divides the sorted list and searches by comparing with the middle element. Time Complexity: O(log n). Requires sorted input.

2. Setup:

Creating a class Book with attributes like bookId, title, and author.

```
public class Book {
   private int bookId;
   private String title;
   private String author;

   public Book(int bookId, String title, String author) {
      this.bookId = bookId;
      this.title = title;
      this.author = author;
   }

   public int getBookId() { return bookId; }
   public String getTitle() { return title; }
   public String getAuthor() { return author; }

   @Override
   public String toString() {
      return "Book[ID=" + bookId + ", Title=" + title + ", Author=" + author + "]";
   }
}
```

3. Implementation:

Implement linear search and binary search algorithms to find books by title.

```
public static Book linearSearch(Book[] books, String title) {
   for (Book book : books) {
      if (book.getTitle().equalsIgnoreCase(title)) {
         return book;
      }
   }
   return null;
}
```

```
import java.util.Arrays;
import java.util.Comparator;

public static void sortBooksByTitle(Book[] books) {
   Arrays.sort(books, Comparator.comparing(Book::getTitle,
String.CASE_INSENSITIVE_ORDER));
}

public static Book binarySearch(Book[] books, String title) {
   int left = 0, right = books.length - 1;
   while (left <= right) {
      int mid = left + (right - left) / 2;
      int cmp = books[mid].getTitle().compareToIgnoreCase(title);

      if (cmp == 0) return books[mid];
      else if (cmp < 0) left = mid + 1;
      else right = mid - 1;
   }
   return null;
}
```

4. Analysis:

- Linear Search: O(n), works for unsorted data.

- Binary Search: O(log n), much faster for large, sorted datasets.

Use Linear Search when:

- The dataset is small.

- The data is unsorted and searching is infrequent.

Use Binary Search when:

- The dataset is large.

- The data is sorted or can be sorted ahead of time for multiple searches.