

Data Structures and Algorithms

Exercise 6:

Library Management System

This project implements a Library Management System using Java to search books by title. It demonstrates linear and binary search algorithms and compares their efficiency in different scenarios. Here's a detailed explanation:

Step 1: Understand Search Algorithms

- **Linear Search:** Scans each item in order; works on **unsorted** data.
 - Time Complexity: $O(n)$
 - **Binary Search:** Divides search space in half each time; requires **sorted** data.
 - Time Complexity: $O(\log n)$
-

Step 2: Setup

- *Book* class with *bookId*, *title*, and *author*.
-

Step 3: Implementation

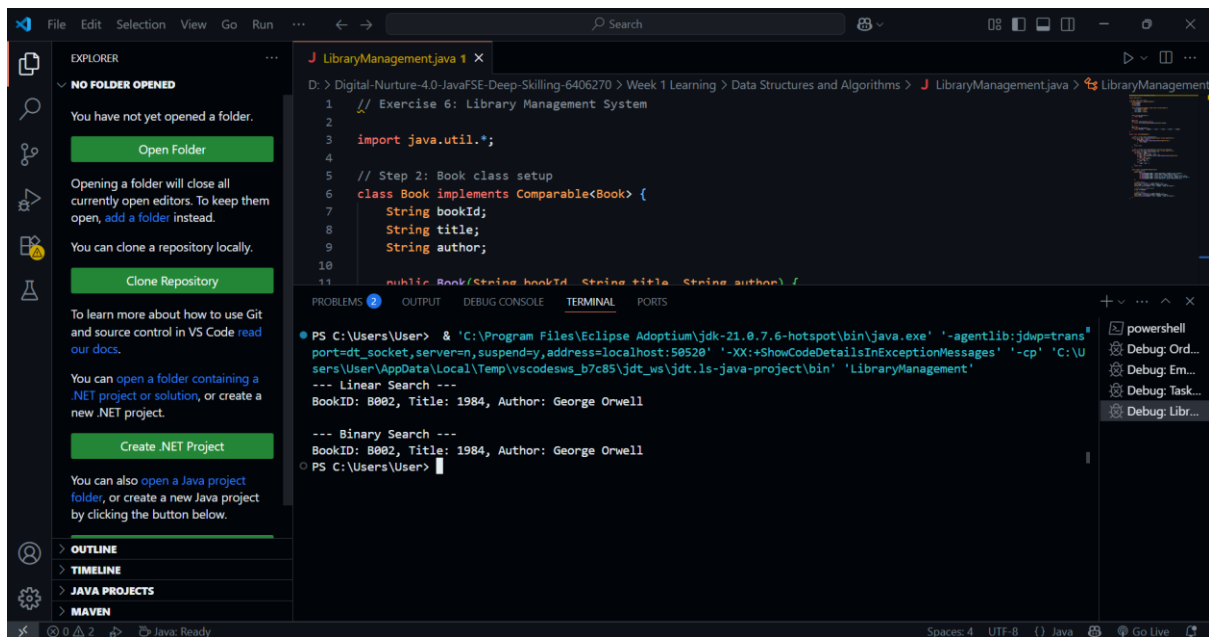
- *linearSearch()* - direct search through array.
 - *binarySearch()* - binary search on sorted array.
 - Books are stored in an array and sorted before binary search.
-

Step 4: Time Complexity Analysis

Search Type	Time Complexity	Requirement
Linear Search	$O(n)$	Unsorted list
Binary Search	$O(\log n)$	Sorted list

- Use **Linear Search** for small or unsorted data.
- Use **Binary Search** for large, sorted datasets to improve performance.

Output



The screenshot shows the Visual Studio Code editor with a Java file named `LibraryManagement.java` open. The code implements a `Book` class that implements the `Comparable<Book>` interface. The class has attributes `bookId`, `title`, and `author`. The `main` method demonstrates both linear and binary search algorithms on an array of `Book` objects.

```
1 // Exercise 6: Library Management System
2
3 import java.util.*;
4
5 // Step 2: Book class setup
6 class Book implements Comparable<Book> {
7     String bookId;
8     String title;
9     String author;
10
11     public Book(String bookId, String title, String author) {
```

The terminal output shows the execution of the program. It first performs a linear search for a book with ID "B002", finding it with title "1984" and author "George Orwell". Then it performs a binary search for the same book, also finding it with the same details.

```
PS C:\Users\User> & 'C:\Program Files\Eclipse Adoptium\jdk-21.0.7.6-hotspot\bin\java.exe' '-agentlib:jdwp=transport=dt_socket,server=n,suspend=y,address=localhost:50520' '-XX:+ShowCodeDetailsInExceptionMessages' '-cp' 'C:\Users\User\AppData\Local\Temp\vscodesws_b7c85\jdt_ws\jdt.ls-java-project\bin' 'LibraryManagement'
--- Linear Search ---
BookID: B002, Title: 1984, Author: George Orwell

--- Binary Search ---
BookID: B002, Title: 1984, Author: George Orwell
PS C:\Users\User>
```