Project # 04

CS210
04/29/2025

Introduction

In this project, you will develop a Library Management System in Java that manages books, members, and book lending processes. The system should allow adding books and members, searching for books, issuing and returning books, and tracking the availability of each book's copies. Importantly, all data will be stored and managed in memory. You will need to carefully select appropriate data structures (such as lists, sets, or maps) to efficiently handle the storage and retrieval of books, members, and borrowing records.

Library System

The library system is designed to manage books and members efficiently. Each **Book** in the system should store information such as its title, author, and a unique identifier (e.g., ISBN). The system should track the number of copies available for borrowing for each book and update the availability when a copy is borrowed or returned, ensuring that the number of available copies remains accurate.

Each **Member** in the library system is identified by a unique member ID (e.g., M1, M2, etc.) and stores personal details such as their name. The system should track the books borrowed by each member, ensuring that members can only borrow books that are available and that they haven't already borrowed the same book. When a book is returned by a member, the system updates the list of borrowed books for that member and reflects the change in book copies' availability.

The Library Management System as a whole is responsible for managing collections of books and members based on the following constraints.

- A new book can be added to the library by specifying its title, ISBN, author, and the number of copies. If a book with the same title, author and ISBN already exists in the library collection, it should not be added as a new entry; instead, the number of copies for the existing book should be updated.
- Searching for books can be done by title, ISBN, or author. The result should show the book title and the author name.

- A book cannot be issued if no copies are available (All copies are borrowed).
- A new member can be added to the system by providing their name. The system should automatically generate and assign a unique Member ID to each new member.
- A member cannot borrow more than one copy of the same book.
- A member can only return books they have borrowed.
- The system should allow retrieving the list of books currently borrowed by each member.
- The system always informs users of the results of their actions, as described in the expected input/output section.

User Interaction

Provide a ***continuous*** menu loop that presents the user with the following options until the user chooses to exit. Make sure to handle invalid choices by providing appropriate feedback.

1. Add Book:
    a. Enter book title:
    b. Enter book author:
    c. Enter book ISBN:
    d. Enter number of copies:
2. Add Member:
    a. Enter member name:
3. Search Book:
    a. Search book by:
    b. Title
        i. Enter the book title:
    c. ISBN
        i. Enter book ISBN:
    d. Author
        i. Enter the author name:
4. Issue Book:
    a. Enter member ID:
    b. Enter book title to borrow:
5. Return Book: Return a borrowed book.
    a. Enter member ID:
    b. Enter book title to return:
6. List Borrowed Books:

    a. Enter member ID to list borrowed books:
7. Exit:

Project Structure

In real-world applications, a Library Management System would typically use a database to store and manage data like books, members, and borrow records. However, for this project, you will manage all data in memory without using any external database. Choosing the right data structures is important to keep your system organized, efficient, and easy to work with. You are encouraged to use Java's Collection Framework classes such as `ArrayList`, `HashMap` or `HashSet`. ***You are not permitted to use any other libraries or advanced data structures.***

Before you start coding, take time to think about:

- What are the main entities of the system and how many classes do you need to represent them?
- What are the important properties that describe each class and what methods should the class provide?
- How will the different classes interact with each other?
- What are the main operations your system must support, and what rules or constraints must be enforced?
- Which data structures will you use to make these operations efficient?

A good design will make the rest of your project much smoother!

Brightspace Submission and Grading

All projects are graded out of 100 points. Programs that do not compile will receive a grade of zero. You must make absolutely certain your program compiles before submitting, and you must thoroughly test your program with many different inputs to verify that it is working correctly. This project will be graded for correctness and adherence to all instructions - Some Example - ***Non Comprehensive*** - I/O is provided at the end of this document.

After you have completed and thoroughly tested your code on many test cases (Including ones provided in this document and many other test cases you create yourself), submit your project as a single ***Library.zip*** file to ***Brightspace*** in order to receive credit for the project. **This project is due on Sunday, May 8th - 11:59 PM.**

Sample Input/Output

```
// Assume the following books were added to start with
Book added: 1984 by George Orwell (ISBN: 9780451524935)
Book added: To Kill a Mockingbird by Harper Lee (ISBN: 9780060935467)
```

Expected Behavior Examples:

```
Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 1
Enter book title: 1984
Enter book author: George Orwell
Enter book ISBN: 9780451524935
Enter number of copies: 3
```
Book already exists. Updated the number of copies in the library. Copies available for borrowing: 4

```
Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 1
Enter book title: Tale of Two Cities
Enter book author: Charles Dickens
Enter book ISBN: 2473743848394
Enter number of copies: 2
```
Book added: Tale of Two Cities by Charles Dickens (ISBN: 2473743848394). Copies available for borrowing: 2

```
Library Management System
1. Add Book
```

2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 2
Enter member name: Natalie
Member added: Natalie (Member ID: M1)

Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 1
Enter book title: Great Expectations
Enter book author: Charles Dickens
Enter book ISBN: 4884930394034
Enter number of copies: 2
Book added: Great Expectations by Charles Dickens (ISBN: 4884930394034).
Copies available for borrowing: 2

Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 3
Search book by:
1. Title
2. ISBN
3. Author
Choose an option: 3
Enter the author name: Charles Dickens
Books by Charles Dickens:

Tale of Two Cities (ISBN: 2473743848394). Copies available for borrowing: 2
Great Expectations (ISBN: 4884930394034). Copies available for borrowing: 2

Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 3
Search book by:
1. Title
2. ISBN
3. Author
Choose an option: 1
Enter the book title: Great Expectations
Book found: Great Expectations by Charles Dickens (ISBN: 4884930394034). Copies available for borrowing: 2

Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 2
Enter member name: Adrian
Member added: Adrian (Member ID: M2)

Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 4

Enter member ID: M2
Enter book title to borrow: Tale of Two Cities
Book issued: Tale of Two Cities to M2.

Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 4
Enter member ID: M2
Enter book title to borrow: Tale of Two Cities
M2 have already borrowed this book: Tale of Two Cities
Could not issue the book.

Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 4
Enter member ID: M1
Enter book title to borrow: Tale of Two Cities
Book issued: Tale of Two Cities to M1

Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 6
Enter member ID to list borrowed books: M1
M1 borrowed books:

Tale of Two Cities (ISBN: 2473743848394).

Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 6
Enter member ID to list borrowed books: M2
M2 borrowed books:
Tale of Two Cities (ISBN: 2473743848394).

Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 5
Enter member ID: M1
Enter book title to return: 1984
M1 has not borrowed this book: 1984 by George Orwell.

Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 3
Search book by:
1. Title
2. ISBN
3. Author
Choose an option: 1

Enter the book title: Tale of Two Cities
Book found: Tale of Two Cities by Charles Dickens (ISBN: 2473743848394).
Copies available for borrowing: 0

Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 2
Enter member name: Tom
Member added: Tom (Member ID: M3)

Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 4
Enter member ID: M3
Enter book title to borrow: Tale of Two Cities
This book is currently unavailable. Could not issue the book.

Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 5
Enter member ID: M1
Enter book title to return: Tale of Two Cities
Book returned: Tale of Two Cities by Charles Dickens (ISBN: 2473743848394).

Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 3
Search book by:
1. Title
2. ISBN
3. Author
Choose an option: 2
Enter the book ISBN: 2473743848394
Book found: Tale of Two Cities by Charles Dickens (ISBN: 2473743848394).
Copies available for borrowing: 1

Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 4
Enter member ID: M3
Enter book title to borrow: Tale of Two Cities
Book issued: Tale of Two Cities to M3

Library Management System
1. Add Book
2. Add Member
3. Search Book
4. Issue Book
5. Return Book
6. List Borrowed Books
7. Exit
Choose an option: 7
Exiting. . .