UE22CS352B - Object Oriented Analysis & Design

Mini Project Report

Library Management System

Submitted by:

Name: SRN (Team Members)	
Manas R	**PES1UG22CS328**
Manu Narayan Hegde	**PES1UG22CS335**
Mayank Sharma	**PES1UG22CS338**
Mohammed Furqaan	**PES1UG22CS352**

Semester: 6 Section: F

Priya Badrinath

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
FACULTY OF ENGINEERING
PES UNIVERSITY
(Established under Karnataka Act No. 16 of 2013)
100ft Ring Road, Bengaluru – 560 085, Karnataka, India

Problem Statement:

- Traditional library management involves **manual record-keeping**, leading to inefficiencies such as **book misplacement, slow book searching, and difficulty tracking due dates**.
- The LMS aims to streamline these processes by providing a **centralized digital platform** for managing library activities

Key Features:

1. Book Catalog Management

- Librarians can **add, update, and remove books** from the Catalog.
- Members can **search** books by title, author, subject, and publication date.

2. User Management

- New members can **register**.
- Users can **log in/logout** and view their accounts.
- Membership can be cancelled or updated.

3. Book Transactions

- **Borrowing & Returning**: Members can **checkout** books, and librarians issue books.
- **Reservations**: Members can **reserve** books and cancel reservations.
- **Overdue Fines**: Users must pay fines for late returns.

4. Notifications

- System sends **overdue notifications**.
- Members receive **reservation availability** and **cancellation notifications**.

5. Assumptions & Constraints

Assumptions

1. A **single book copy** can be issued to **only one member at a time**.
2. Members can **reserve a book**
3. Books must be **returned on time**, failing which **fines** are applied.
4. Members need **valid membership** to borrow or reserve books.
5. Only **librarians** can manage the book catalog and issue books.

Constraints

1. The **number of books issued** to a member is **limited (e.g., max 3 books at a time)**.
2. The system should handle **multiple concurrent users** efficiently.
3. **Database storage constraints** may limit the number of books in the system.
4. The **notifications system** should function in real-time for better user experience.

6. Use Case Scenario

Scenario 1: Book Borrowing Process

- A **member logs into** the system and **searches for a book**.
- If the book is available, they **request checkout**.
- The librarian **issues the book**, updating the system.
- If the book is **not returned on time**, an **overdue notification** is sent, and a **fine is imposed**.

Scenario 2: Book Reservation

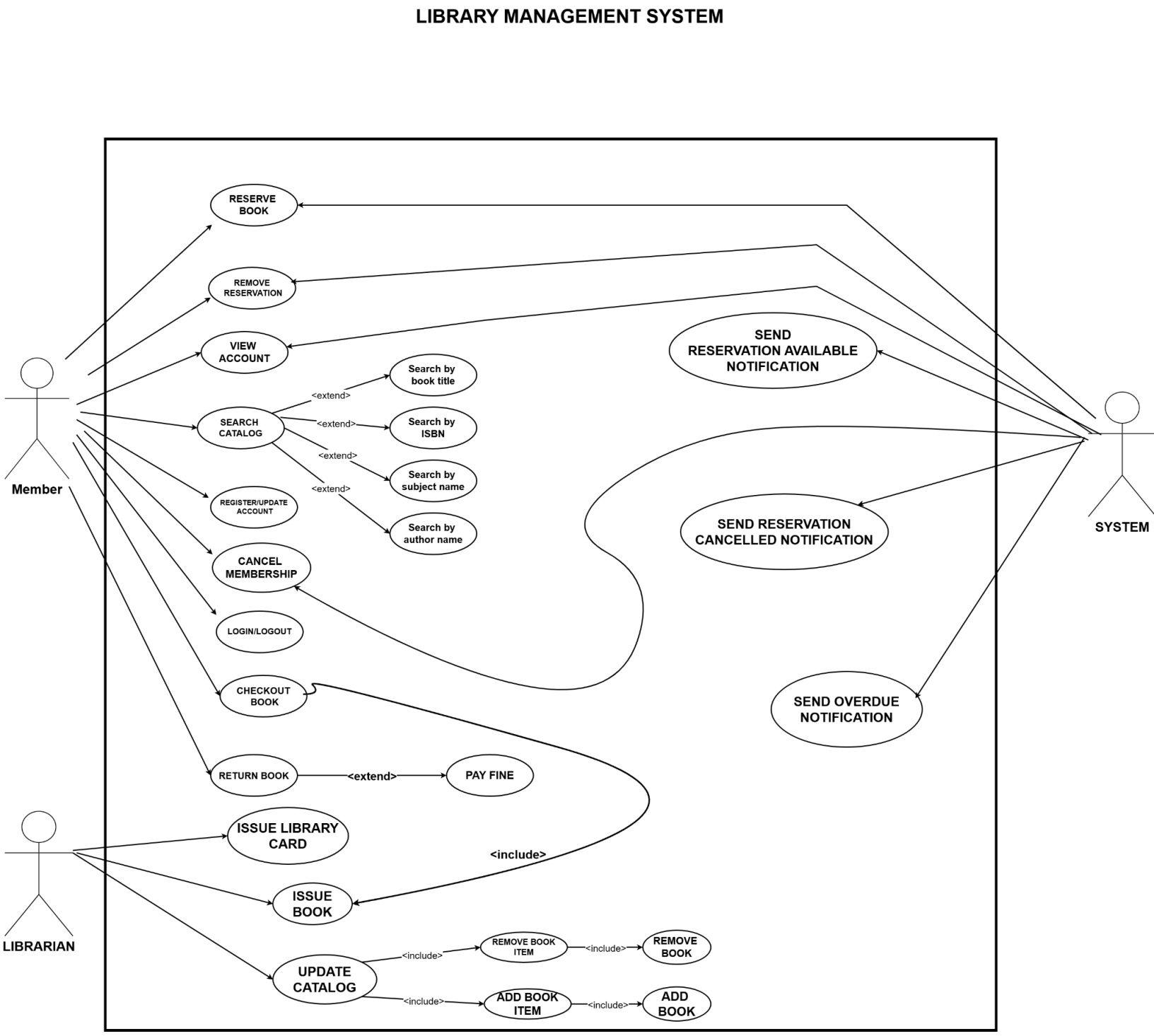
- A book is currently **checked out** by another member.
- A second member places a **reservation** for the book.
- When the book is returned, the system **sends an availability notification**.

Scenario 3: Catalog Management

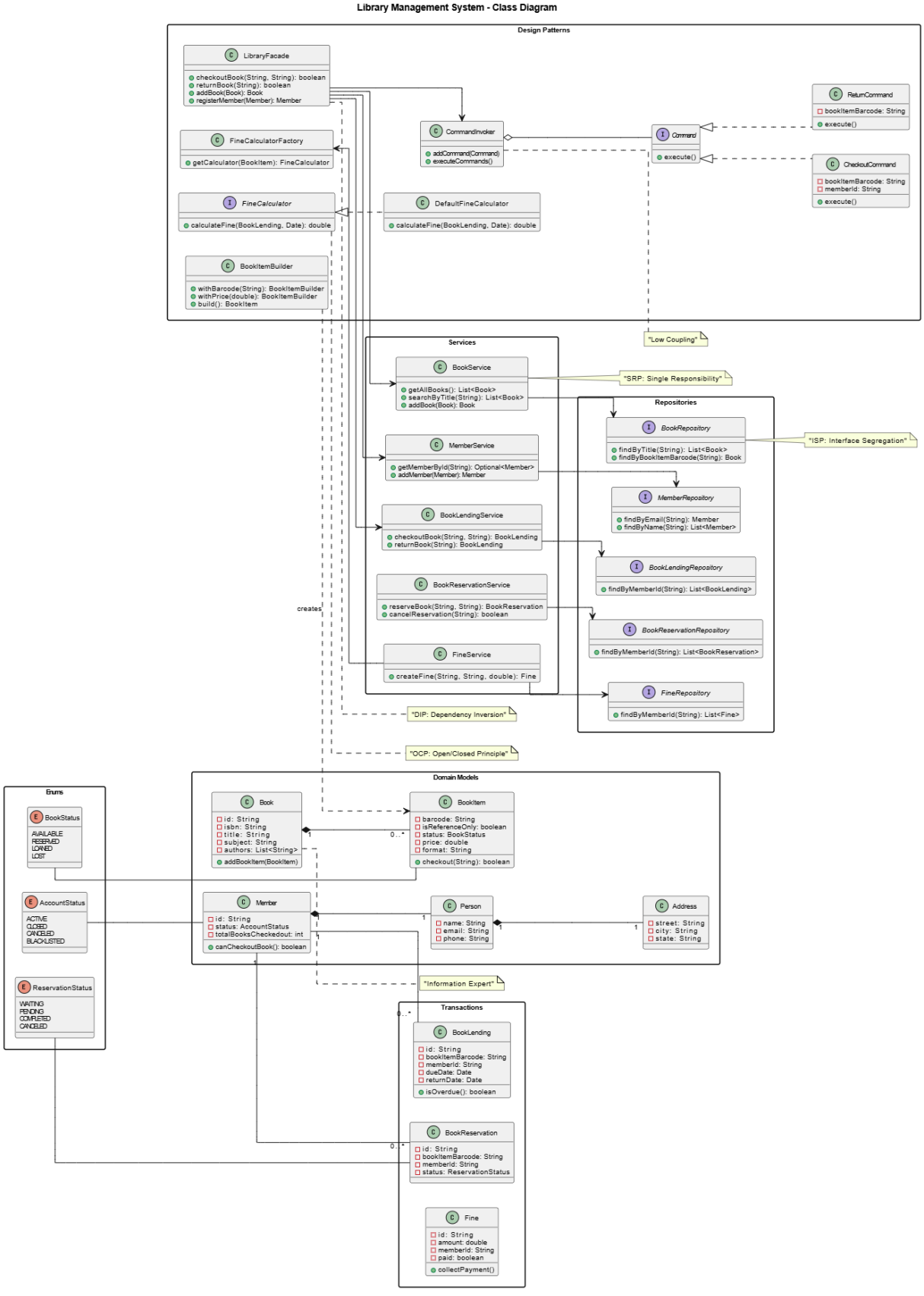
- A librarian logs in and **adds a new book** to the catalog.
- They can also **edit book details** (title, author, year) if needed.
- If a book is no longer in circulation, they can **remove it from the catalog**.

Models:

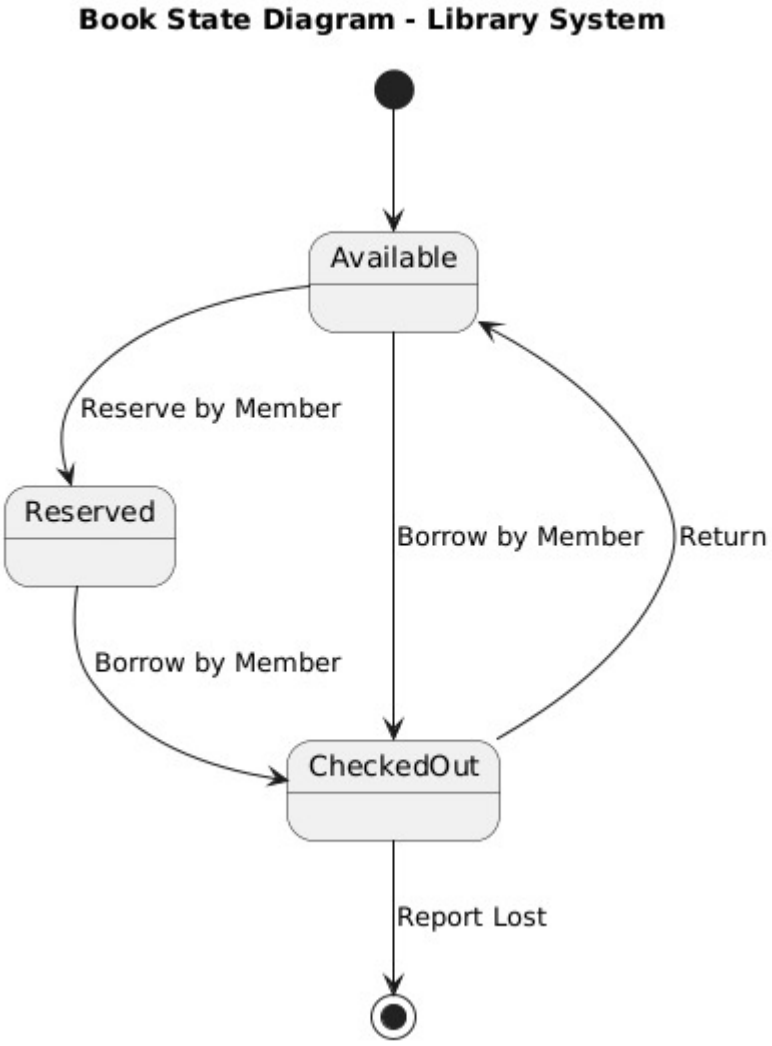
Use Case Diagram:

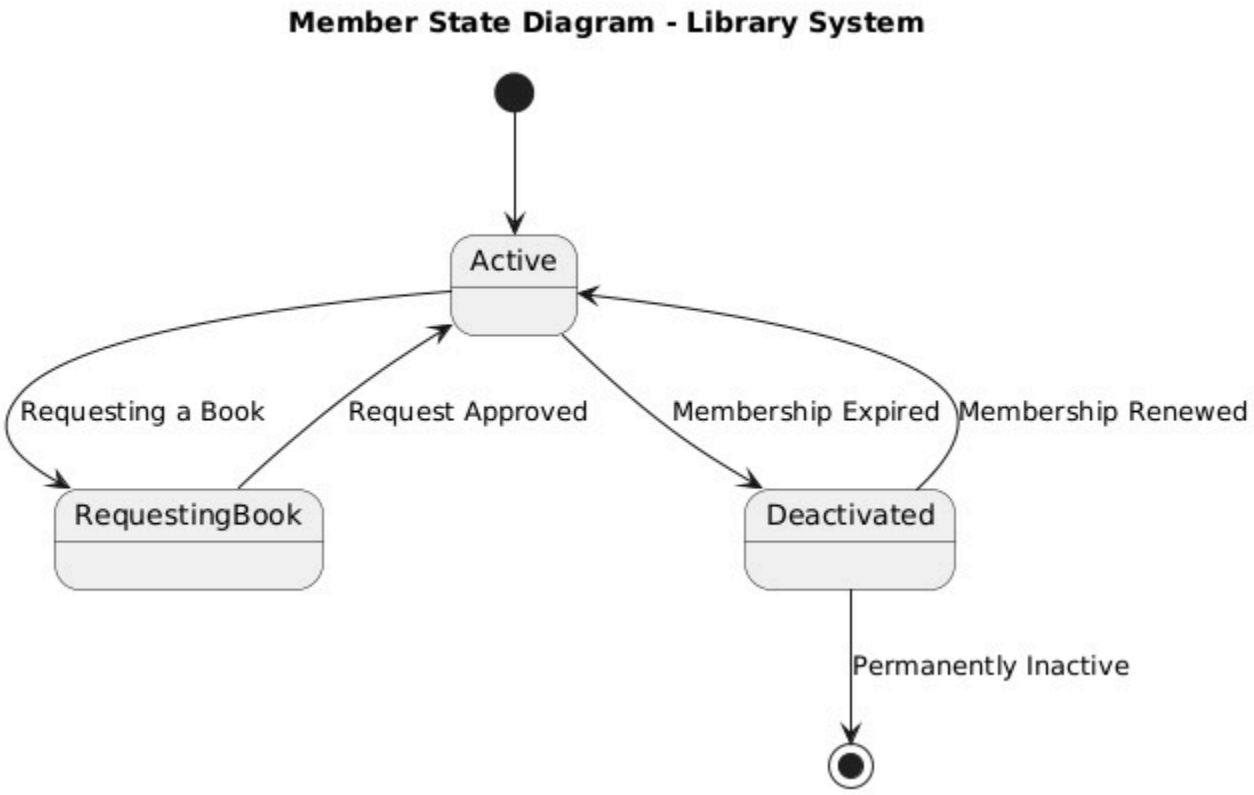


Class Diagram:

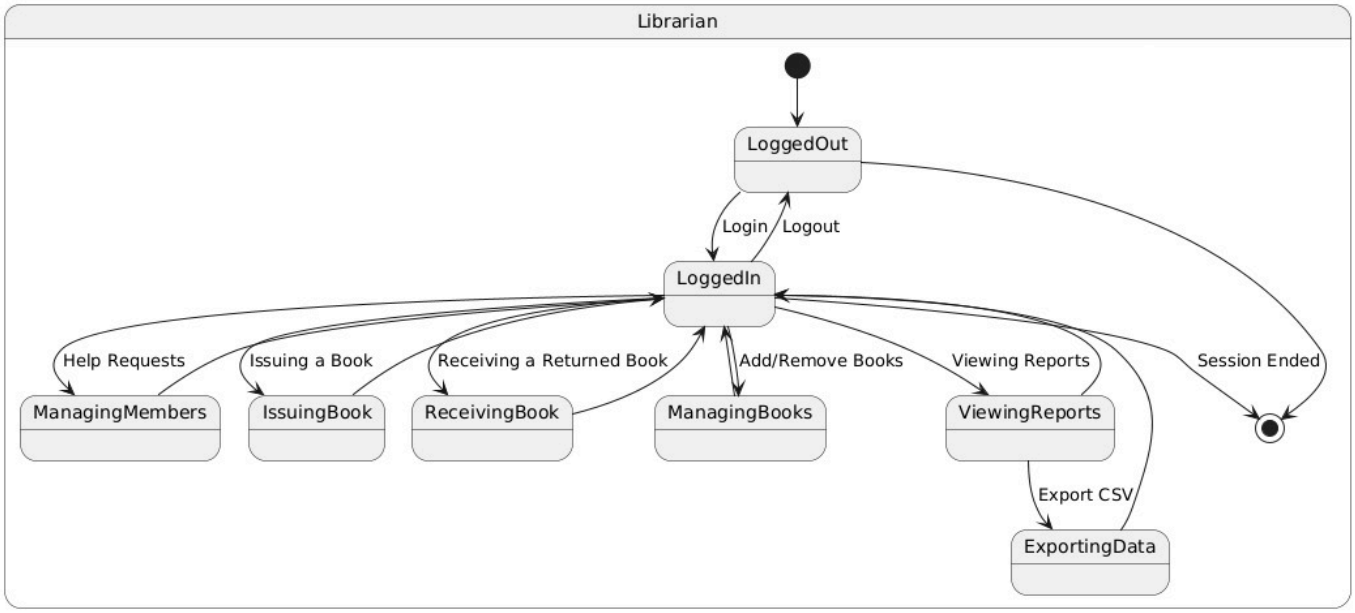


State Diagram:

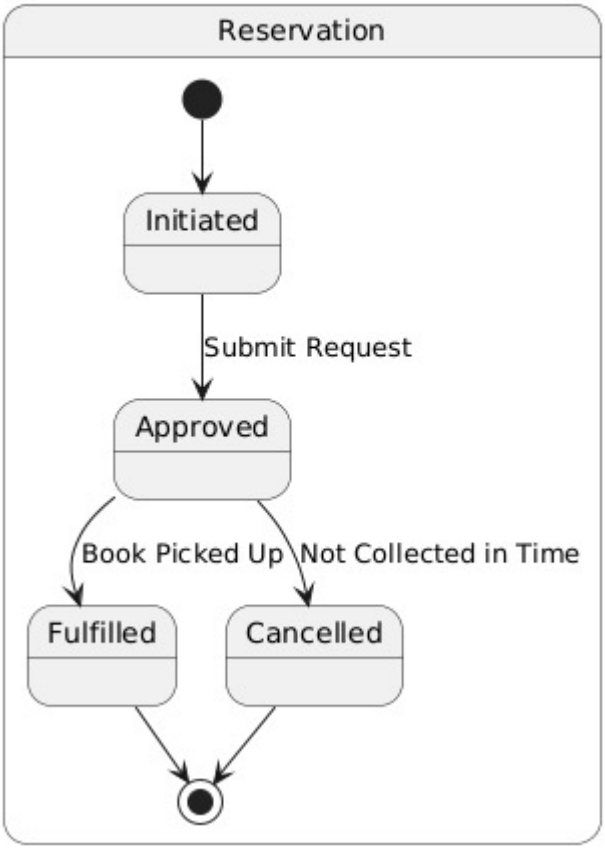




Librarian State diagram

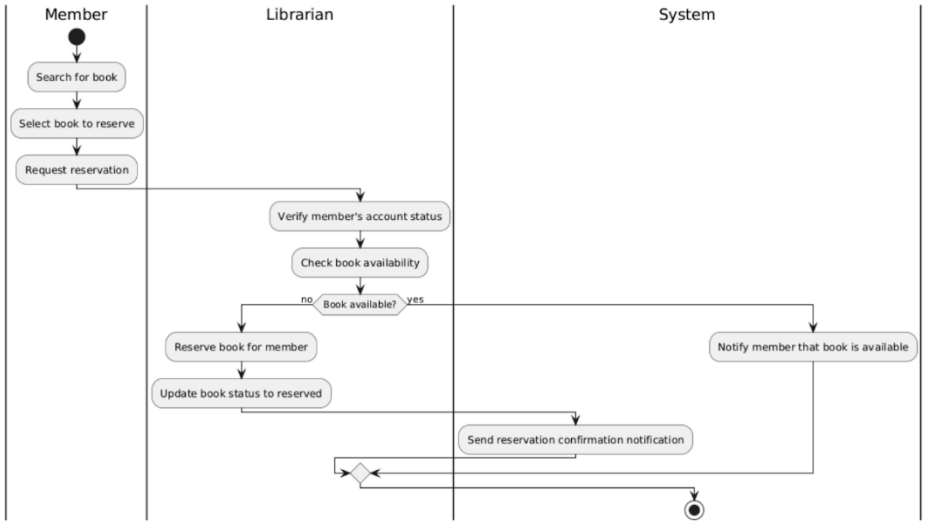


Reservation State Diagram

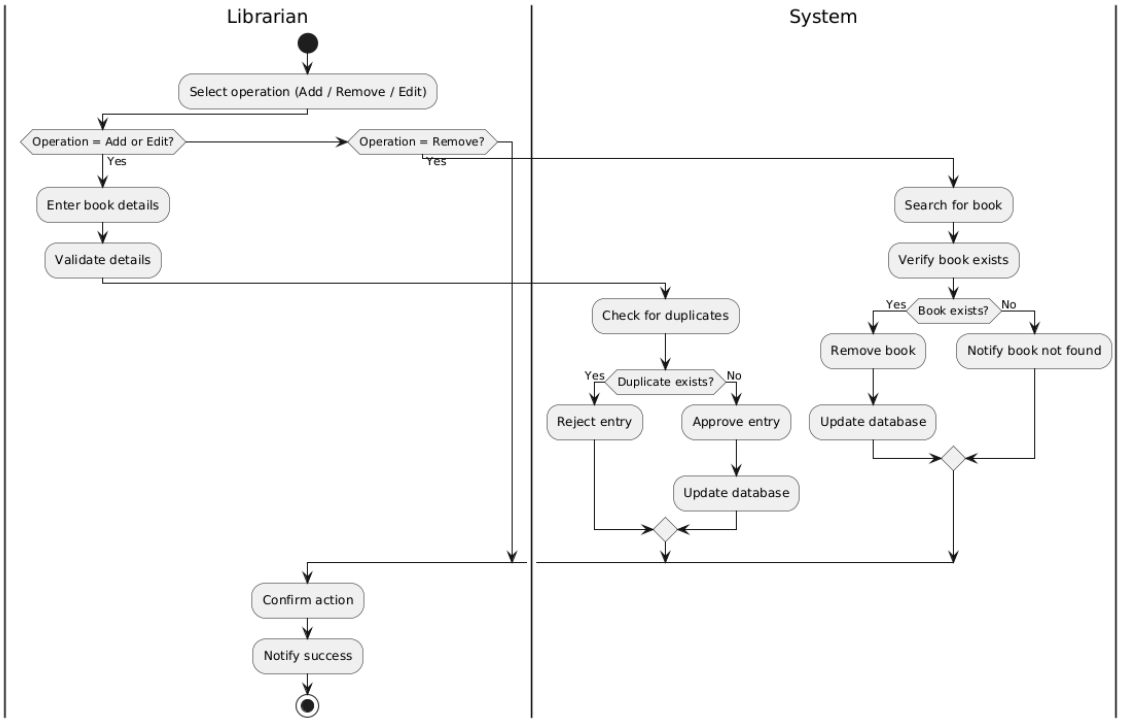


Activity Diagrams:

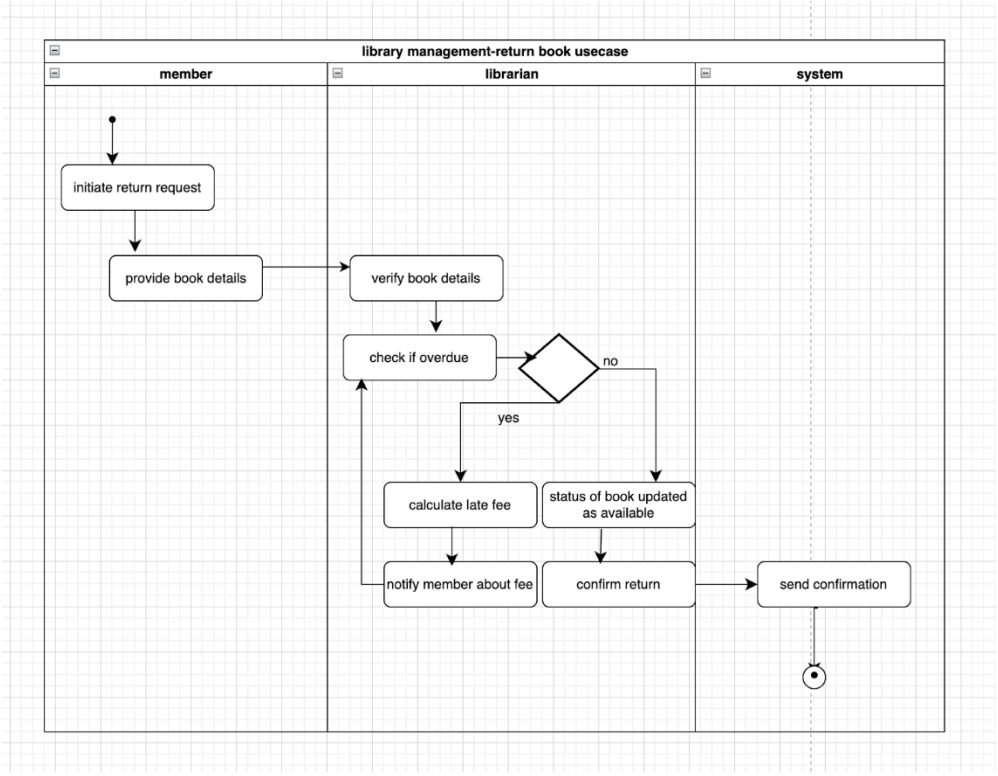
- **Reserve book:**



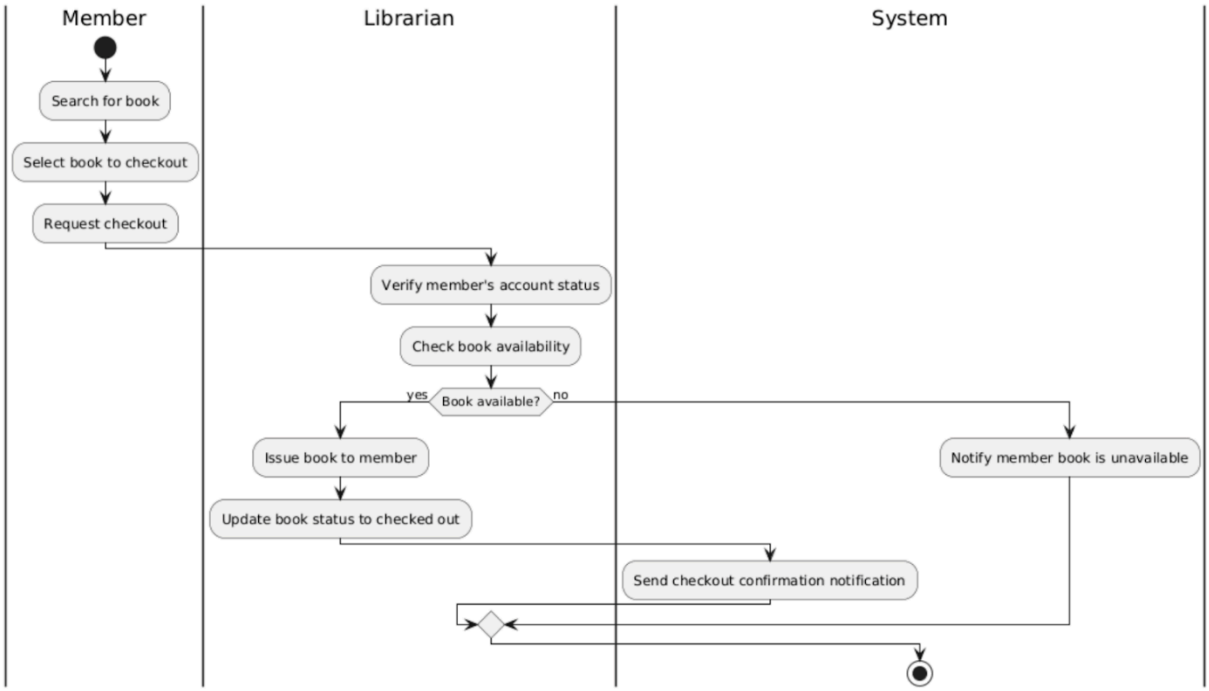
- **Add or Remove book**



- **Return book:**



- **Checkout book**



Architecture Patterns, Design Principles, and Design Patterns:

Architecture Patterns

Model – View – Controller Pattern (MVC)

Design Principles

1. **Single Responsibility Principle (SRP)**
   - *Implementation:* Each service class has a specific responsibility (BookService, MemberService, FineService)
   - *Example:* FineService only handles fine-related operations, not book or member operations
   - *Benefits:* Focused classes, easier maintenance, better testability

2. **Open/Closed Principle (OCP)**
   - *Implementation:* Extension of functionality without modifying existing code
   - *Example:* The status enum system (BookStatus, AccountStatus, ReservationStatus) allows adding new statuses without changing the behavior of existing code
   - *Benefits:* Reduced risk of breaking existing functionality, ease of extending features

3. **Dependency Inversion Principle (DIP)**
   - *Implementation:* High-level modules depend on abstractions, not concrete implementations
   - *Example:* Controllers depend on service interfaces, not implementations
   - *Benefits:* Loosely coupled code, easier unit testing with mock implementations

4. **Interface Segregation Principle (ISP)**
   - *Implementation:* Clients only depend on methods they use
   - *Example:* Repository interfaces that define specific query methods
   - *Benefits:* Avoids forcing clients to depend on methods they don't need

Design Patterns

1. **Facade Pattern**
   - *Implementation:* LibraryFacade simplifies complex operations by providing a unified interface to multiple subsystems.
   - *Benefits:* Provides simplified interface, reduces dependencies between client code and subsystems

2. **Builder Pattern**
   - *Implementation:* BookItemBuilder for constructing complex BookItem objects step-by-step
   - *Benefits:* Improves readability, step-by-step construction, encapsulates complex construction

3. Command Pattern

- *Implementation:* CommandInvoker, CheckoutCommand, ReturnCommand for encapsulating operations
- *Benefits:* Decouples operations ,supports operation queueing

4. Adapter Pattern

- The adapter pattern has been implemented for fine calculation in the Library Management System to separate the fine calculation logic from the lending process.
- This pattern is particularly useful when:
- You want to use an existing class, but its interface doesn't match what you need
- You want to create a reusable class that cooperates with classes that don't necessarily have compatible interfaces
- You need to integrate classes that couldn't otherwise work together due to incompatible interfaces

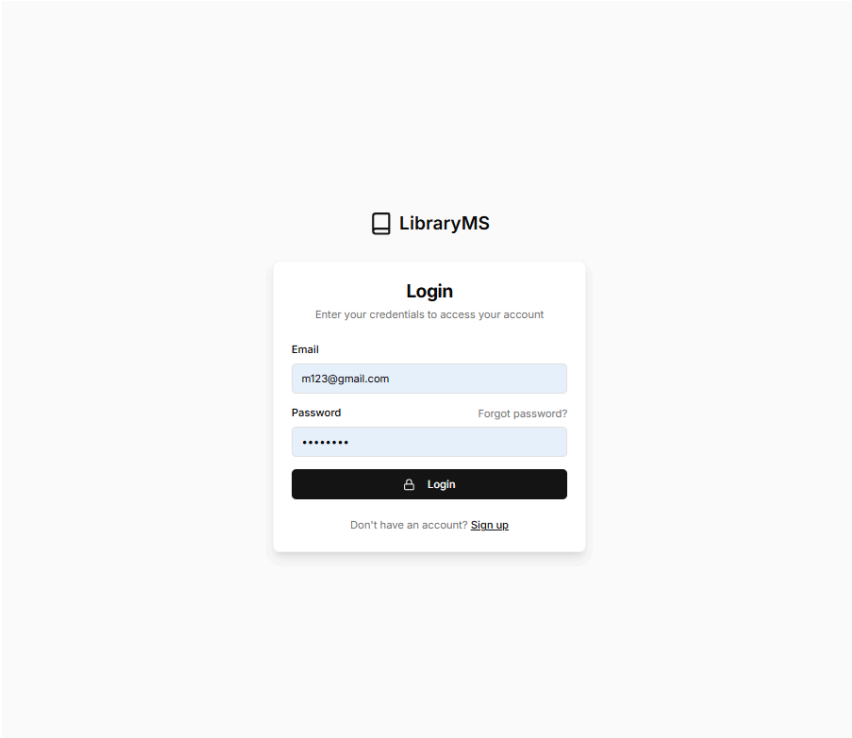
GitHub link to the Codebase:

https://github.com/Manuhegde1309/Library_Management_System

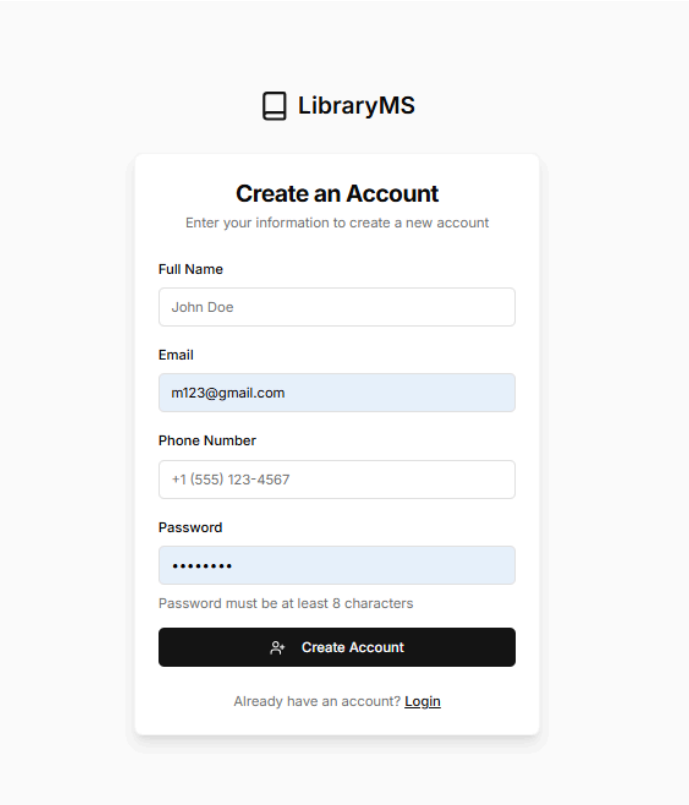
Screenshots

UI:

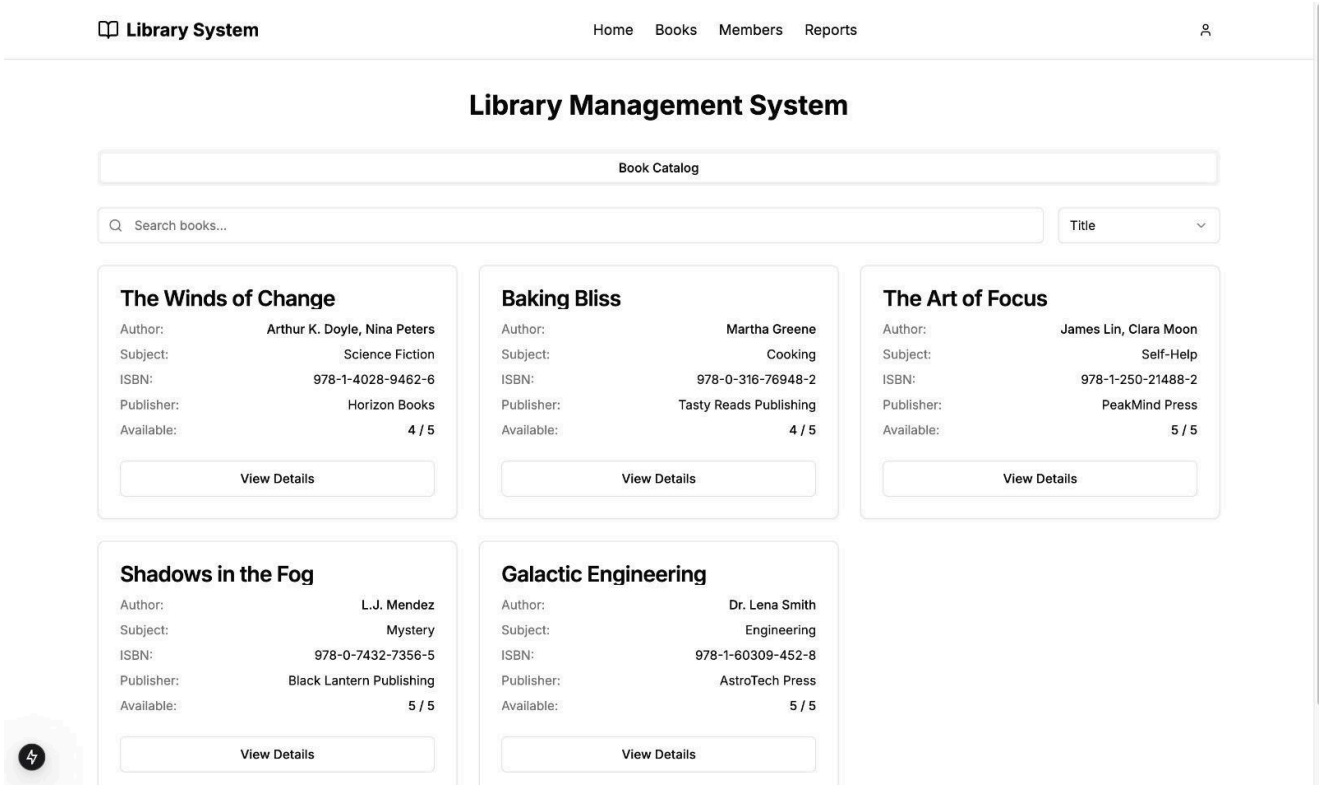
- Login Page

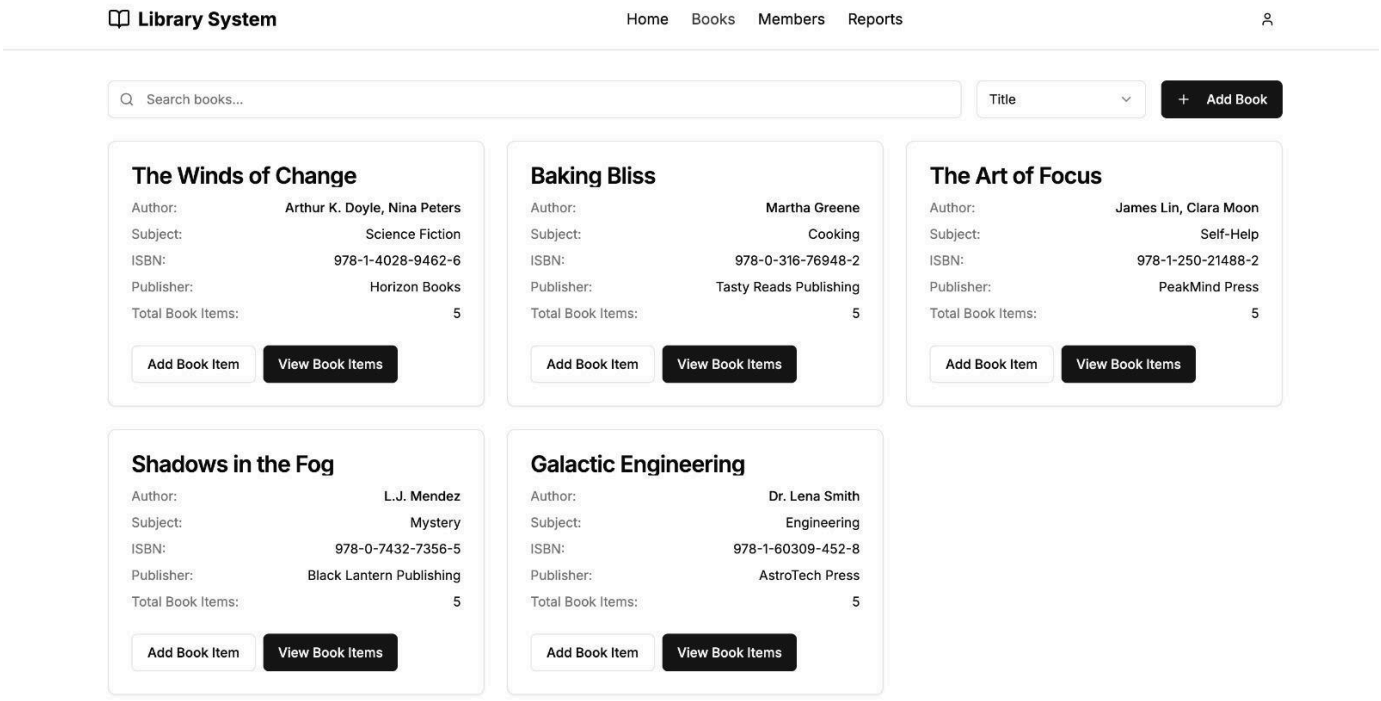


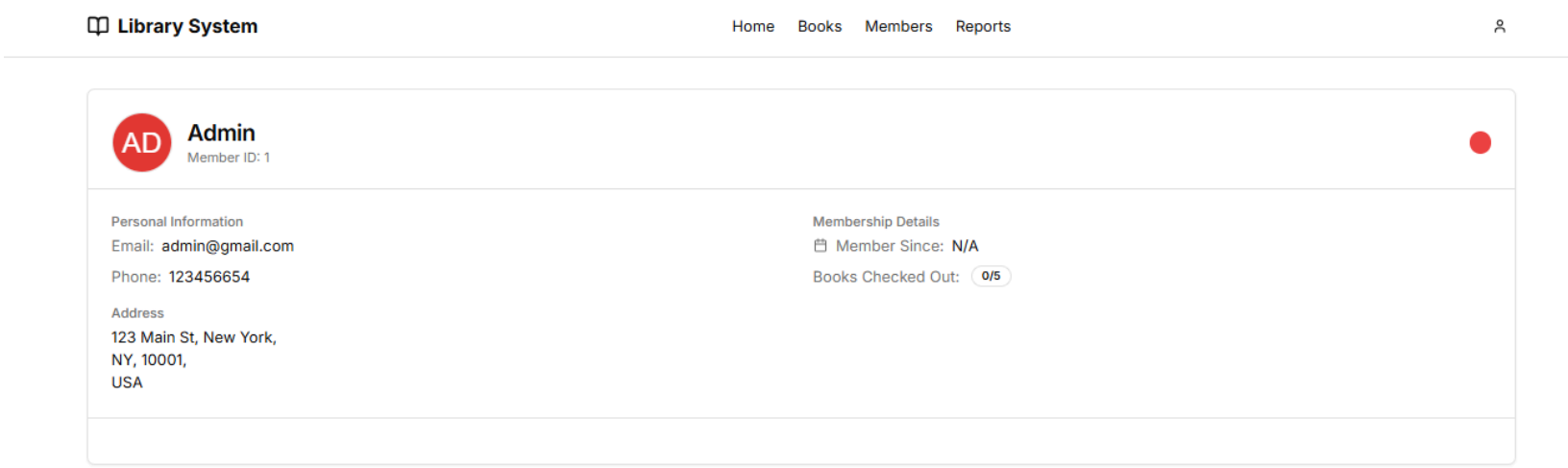
- Sign Up page



- UI for Admin Page






Library System
Home
Books
Members
Reports
AD
Admin
Member ID: 1
Personal Information
Email: admin@gmail.com
Phone: 123456654
Address
123 Main St, New York,
NY, 10001,
USA
Membership Details
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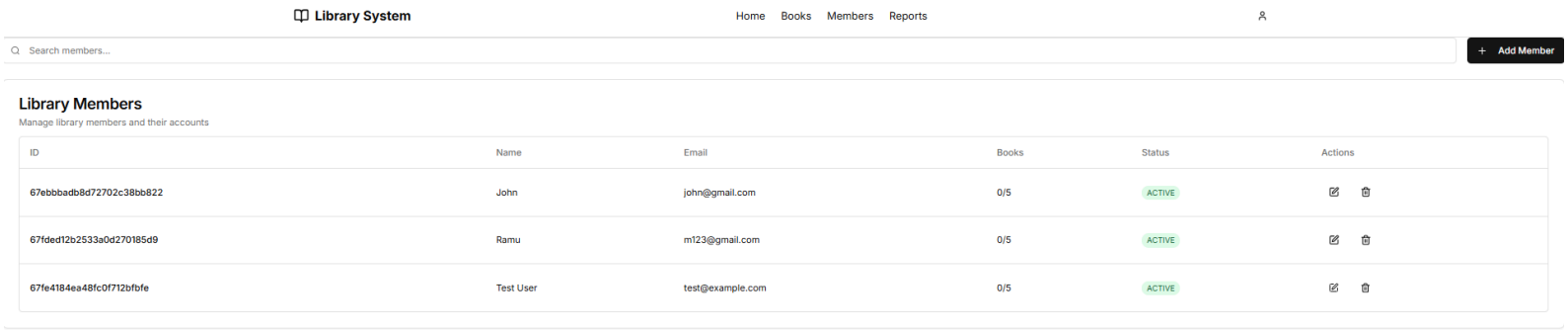
Books Checked Out: 0/5
Current Borrowings
Borrowing History
Currently Borrowed Books
Books you currently have checked out from the library
You currently have no books checked out.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Home
Books
Members
Reports
Search members...
Add Member
Library Members
Manage library members and their accounts
ID
Name
Email
Books
Status
Actions
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John
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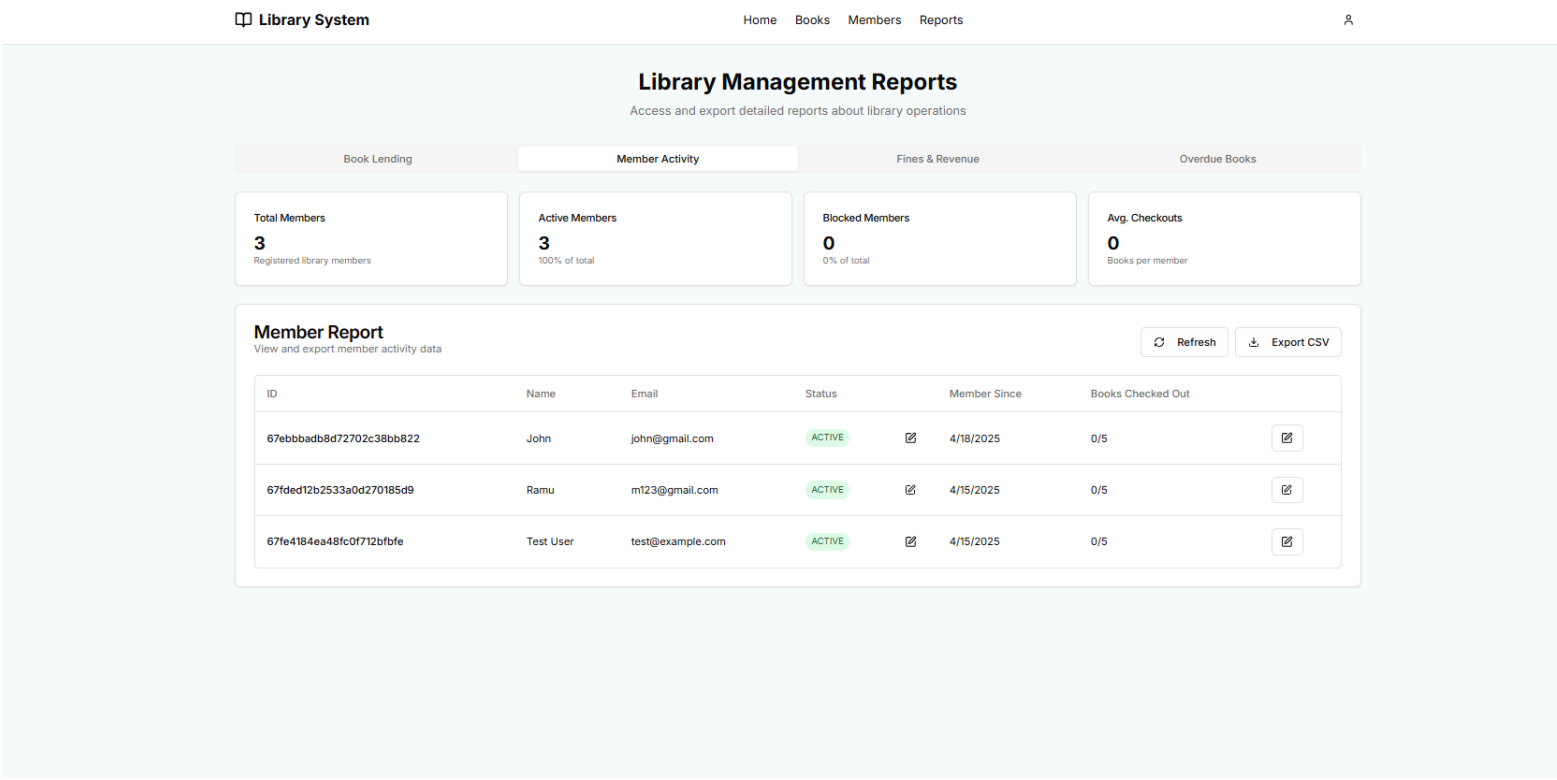
Library System
Home
Books
Members
Reports
Library Management Reports
Access and export detailed reports about library operations
Book Lending
Member Activity
Fines & Revenue
Overdue Books
Total Members
3
Registered library members
Active Members
3
100% of total
Blocked Members
0
0% of total
Avg. Checkouts
0
Books per member
Member Report
View and export member activity data
Refresh
Export CSV
ID
Name
Email
Status
Member Since
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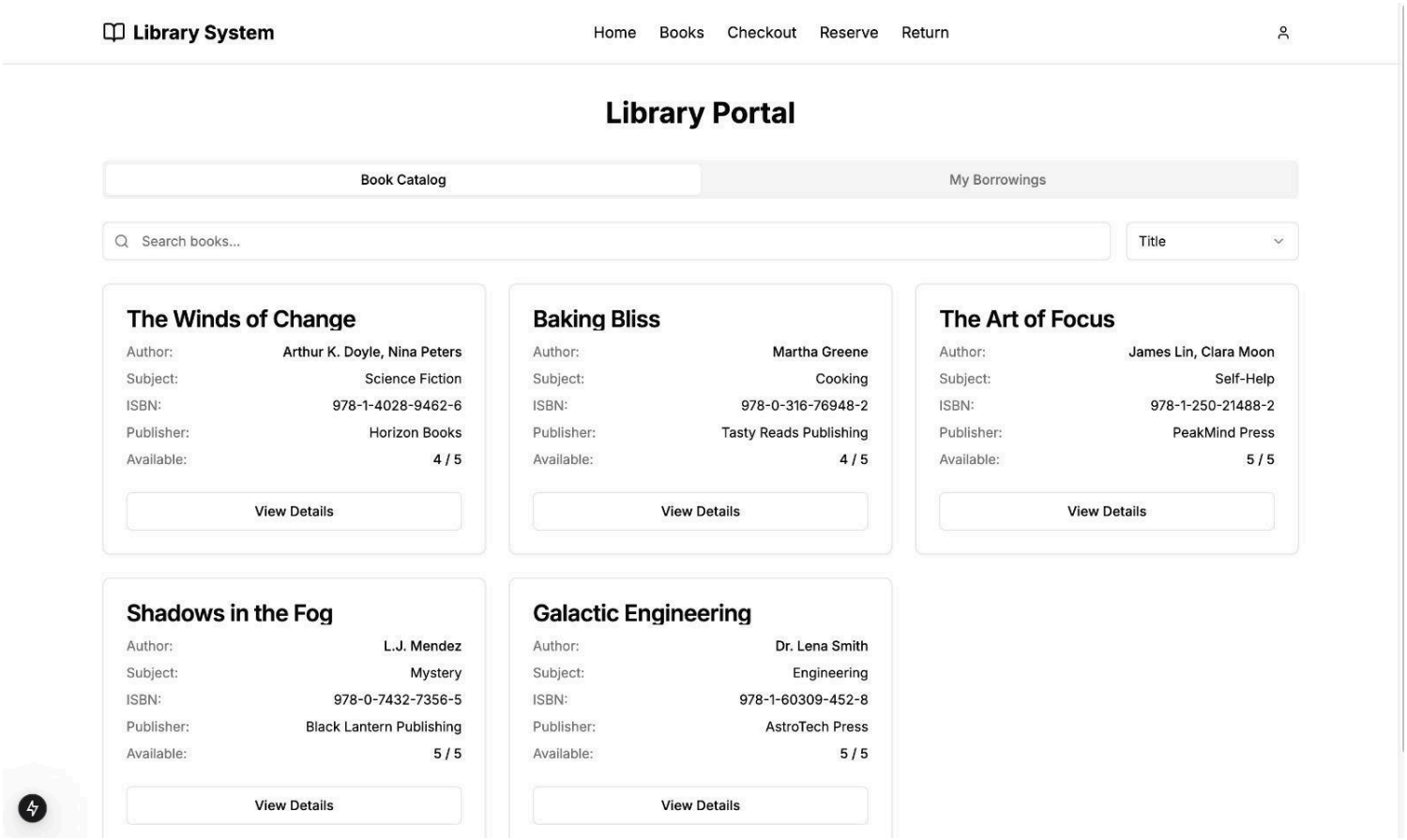
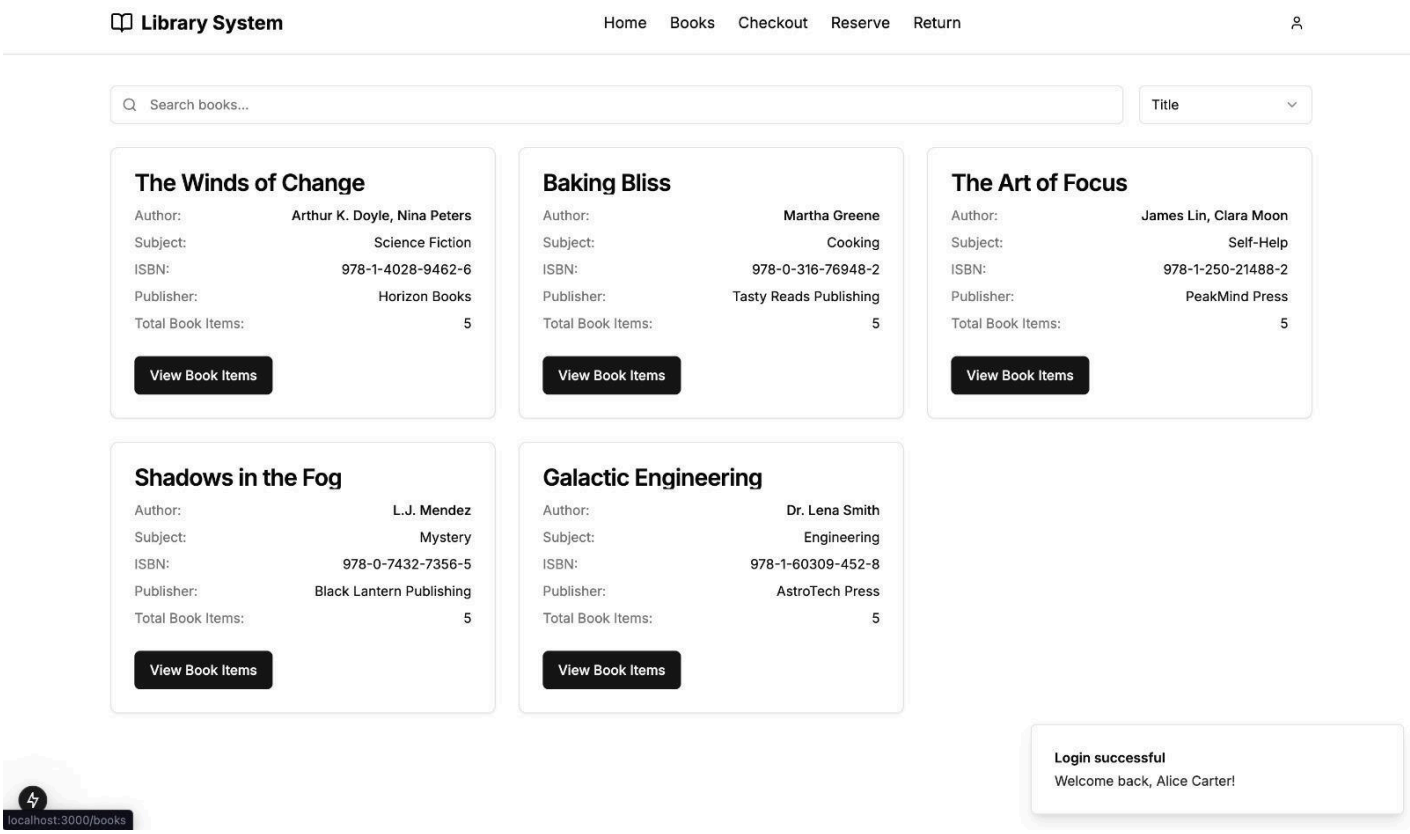
- UI for User Page




Library System
Home
Books
Checkout
Reserve
Return
Search books...
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The Winds of Change
Author: Arthur K. Doyle, Nina Peters
Subject: Science Fiction
ISBN: 978-1-4028-9462-6
Publisher: Horizon Books
Total Book Items: 5
View Book Items
Baking Bliss
Author: Martha Greene
Subject: Cooking
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Publisher: Tasty Reads Publishing
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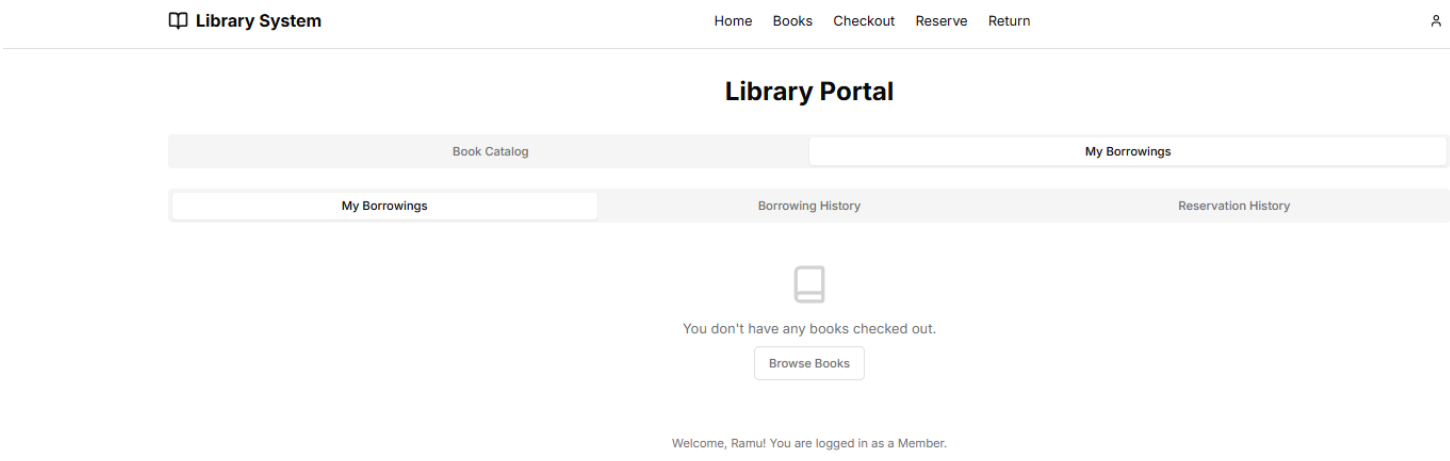

Library System
Home
Books
Checkout
Reserve
Return
Library Portal
Book Catalog
My Borrowings
My Borrowings
Borrowing History
Reservation History
You don't have any books checked out.
Browse Books
Welcome, Ramu! You are logged in as a Member.

Book Checkout

Book Checkout

Scan member and book barcodes to checkout a book

Member ID

Enter member ID

Find

Book Barcode

Scan or enter book barcode

Find

Checkout Book

Available Books

Quick access to book barcodes and member information

Member ID: PES1LIB5106

Title	Author	Available	Barcode
qhbdbiwq	uiqwub	5 / 5	bivqebucqwoubwcqub-1744972824074-208
Computer Networks		3 / 3	-1744972833212-295

Library System

Home Books Checkout Reserve Return

Book Reservation

Book Reservation

Reserve books that are currently checked out by other members

Member ID

Enter member ID

Find

Book Barcode

Enter book barcode

Find

Reserve Book

Available Books

Quick access to book barcodes and member information

Member ID: PES1LIB5106

Title	Author	Available	Barcode
qhbdbiwq	uiqwub	5 / 5	bivqebucqwoubwcqub-1744972824074-208
Computer Networks		3 / 3	-1744972833212-295

Library System

Home Books Checkout Reserve Return

Ramu

m123@gmail.com

My Profile

Manage Membership

Dark Mode

Log out

Book Return

Book Return

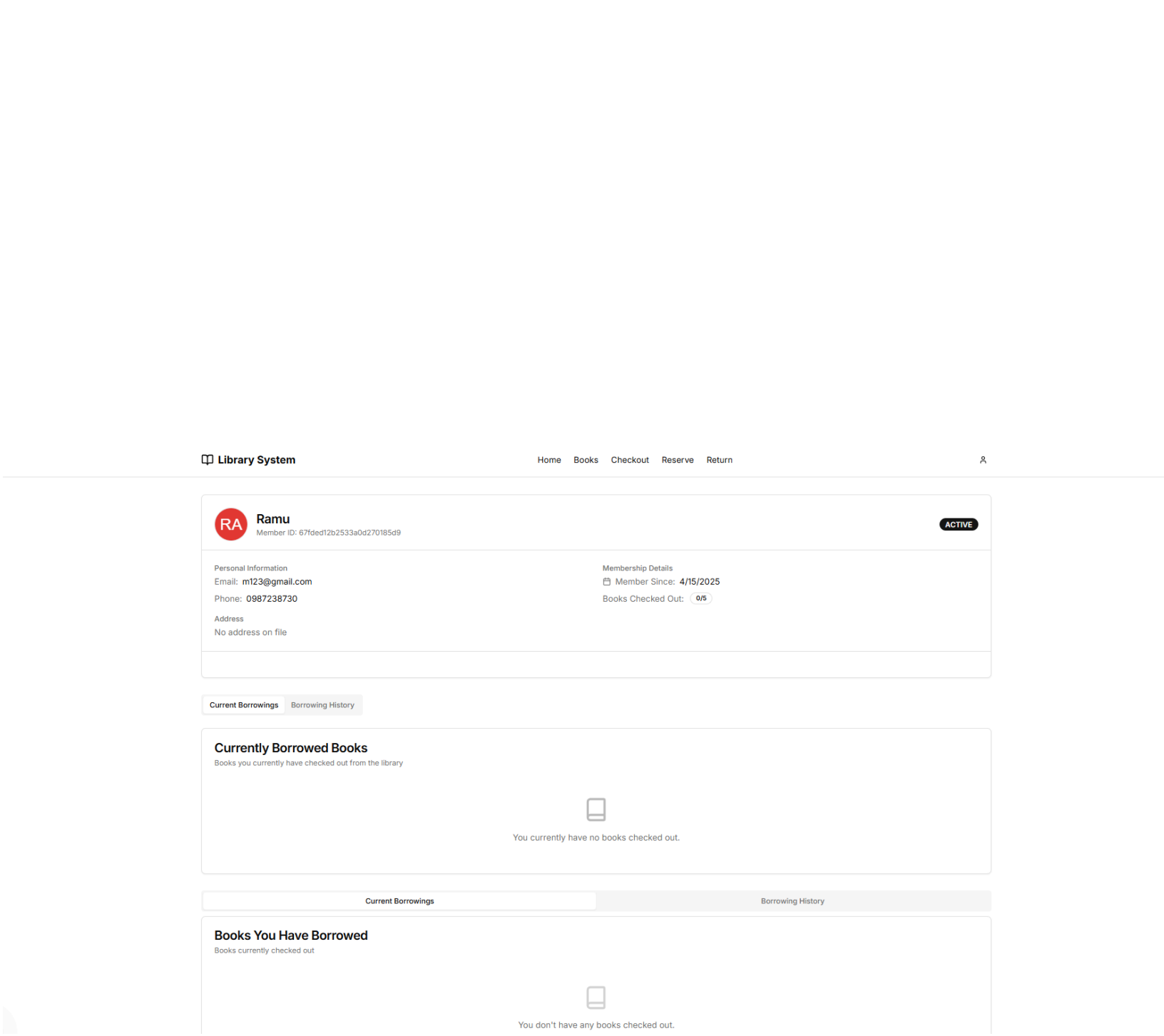
Scan book barcode to return a book

Book Barcode

Scan or enter book barcode

Find

Return Book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Reserve
Return
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Borrowing History
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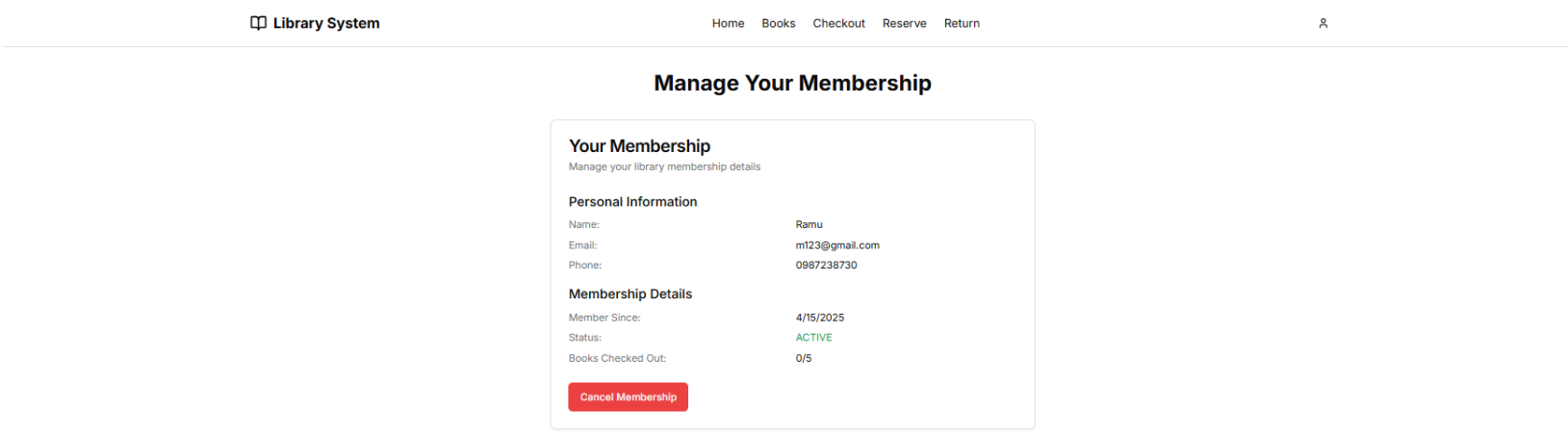

Individual contributions of the team members:

Name	**Module worked on**
Manas R	book creation functionality,command pattern
Manu Narayan Hegde	reservation functionality,builder pattern
Mayank Sharma	member functionality,facade pattern
Mohammed Furqaan	fines,checkout logic,adapter pattern