

# **Library Management System**

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## DECLARATION

I hereby declare that the work presented in this assignment, titled "Library Management System," is my original work, completed as part of the requirements for the Object-Oriented Programming.

This project has been carried out with sincerity and dedication, adhering to the academic and ethical standards set by the institution. I further affirm that the development, coding, and testing of this system are solely the results of my effort and creativity, and it has not been plagiarized or copied from any other source.

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Date: 2024.11.25

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## 1. INTRODUCTION

This project, a Library Management System, is a Java-based application designed to manage books and members in a library. It uses:

- JFrame and Java Swing for GUI.
- MySQL for database management.
- NetBeans IDE for development.
- The MVC architecture to ensure modularity and separation of concerns.

The system implements key Object-Oriented Programming concepts like inheritance, polymorphism, encapsulation, and abstraction.

## **2. SYSTEM FEATURES**

### **I. Login System**

- Allows Admins and Members to access role-specific functionalities.
- **Admin Role:**
  - Full access to manage members and books.
- **Member Role:**
  - Limited access to view and search books.

### **II. Member Management**

- Add, update, and delete members.
- Each member is associated with a MembershipCard (composition relationship).

### **III. Book Management**

- Add, update, delete, and search books using overloaded methods.
- Books can be borrowed or returned by members.

### **IV. Aggregation**

- Books and Members are linked, enabling borrowing functionality while maintaining low coupling.

### **V. Exception Handling**

- Handles invalid inputs, duplicate records, and access violations.

### 3. DATABASE DESIGN

The system uses the following tables in LibraryDB:

```
mysql> create database LibraryDB;
```

Table – 1: Create Database

```
mysql> show tables;
+-----+
| Tables_in_librarydb |
+-----+
| issuebook            |
| newbooks             |
| newmembers           |
| returnedbooks        |
+-----+
4 rows in set (0.02 sec)
```

Table – 2: SQL Tables

#### 1. newbooks

- Stores book details.
- Key columns: bookID, title, author, yearPublished, price, status.

```
mysql> desc newbooks;
+-----+-----+-----+-----+-----+-----+
| Field          | Type          | Null | Key | Default | Extra          |
+-----+-----+-----+-----+-----+-----+
| bookID         | int(11)       | NO   | PRI | NULL    | auto_increment |
| title          | varchar(100)  | YES  |     | NULL    |                |
| author         | varchar(100)  | YES  |     | NULL    |                |
| yearPublished  | int(11)       | YES  |     | NULL    |                |
| price          | double        | YES  |     | NULL    |                |
| status         | varchar(50)   | YES  |     | NULL    |                |
+-----+-----+-----+-----+-----+-----+
6 rows in set (0.02 sec)
```

Table – 3: Describe NewBooks SQL Table



## 2. newmembers

- Stores member details.
- Key columns: memberID, name, contactInfo, address, cardNumber, expirationDate, membershipStatus.

```
mysql> desc newmembers;
```

Field	Type	Null	Key	Default	Extra
memberID	int(11)	NO	PRI	NULL	auto_increment
name	varchar(100)	YES		NULL	
contactInfo	varchar(100)	YES		NULL	
address	varchar(255)	YES		NULL	
cardNumber	varchar(50)	YES	UNI	NULL	
expirationDate	date	YES		NULL	
membershipStatus	enum('Active','Inactive','Expired')	NO		NULL	

7 rows in set (0.02 sec)

Table – 4: Describe NewMembers SQL Table

## 3. issuebook

- Stores issued book records.
- Key columns: id, bookID, bookName, memberID, memberName, issueDate, dueDate, returnBook.

```
mysql> desc issuebook;
```

Field	Type	Null	Key	Default	Extra
id	int(11)	NO	PRI	NULL	auto_increment
bookID	int(11)	NO	MUL	NULL	
bookName	varchar(255)	YES		Unknown	
memberID	int(11)	NO	MUL	NULL	
memberName	varchar(255)	YES		Unknown	
issueDate	date	NO		NULL	
dueDate	date	NO		NULL	
returnBook	enum('Yes','No')	YES		No	

8 rows in set (0.05 sec)

Table – 5: Describe IssueBook SQL Table

#### 4. returnedbooks

- Stores returned book details.
- Key columns: recordID, bookID, bookName, memberID, memberName, issuedDate, returnedDate, returnedBook.

```
mysql> desc returnedbooks;
```

Field	Type	Null	Key	Default	Extra
recordID	int(11)	NO	PRI	NULL	auto_increment
bookID	int(11)	YES	MUL	NULL	
bookName	varchar(255)	YES		NULL	
memberID	int(11)	YES	MUL	NULL	
memberName	varchar(255)	YES		NULL	
issuedDate	date	YES		NULL	
returnedDate	date	YES		NULL	
returnedBook	enum('Yes','No')	YES		NULL	

8 rows in set (0.03 sec)

Table – 6: Describe ReturnedBooks SQL Table

## 4. UML DIAGRAMS

### 1) USE CASE DIAGRAM

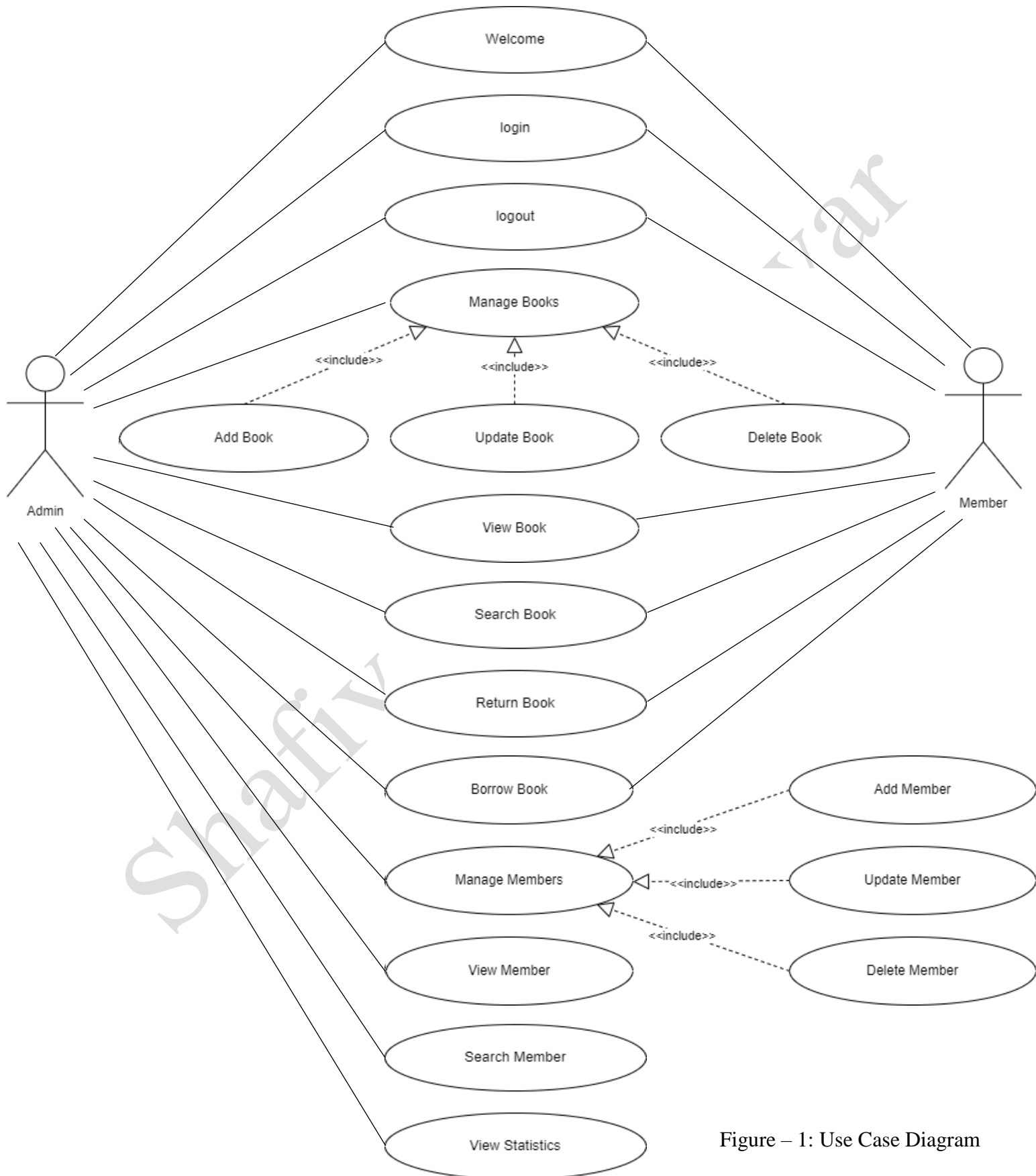


Figure – 1: Use Case Diagram

## 2) CLASS DIAGRAM

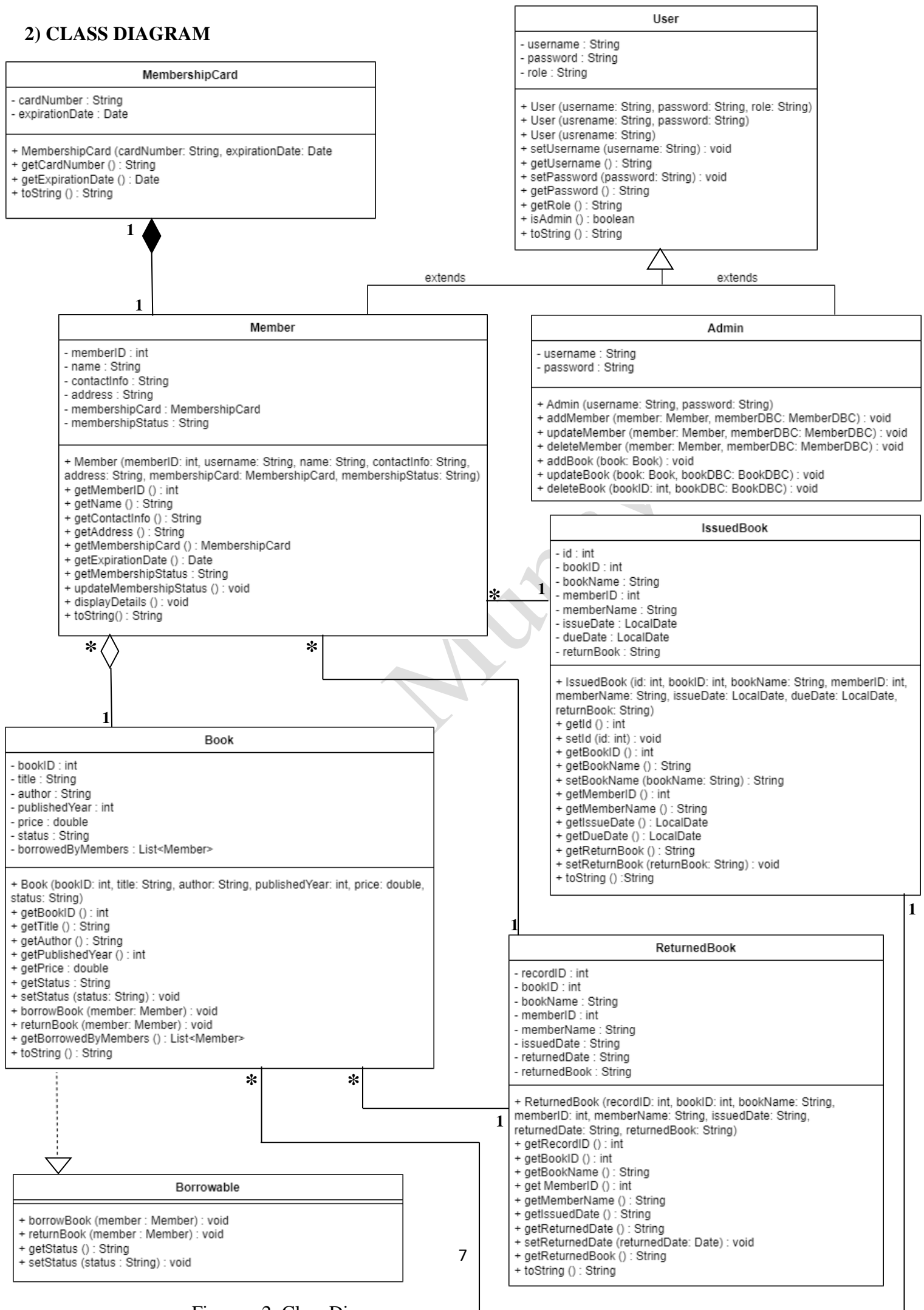


Figure – 2: Class Diagram

## 5. ER DIAGRAM

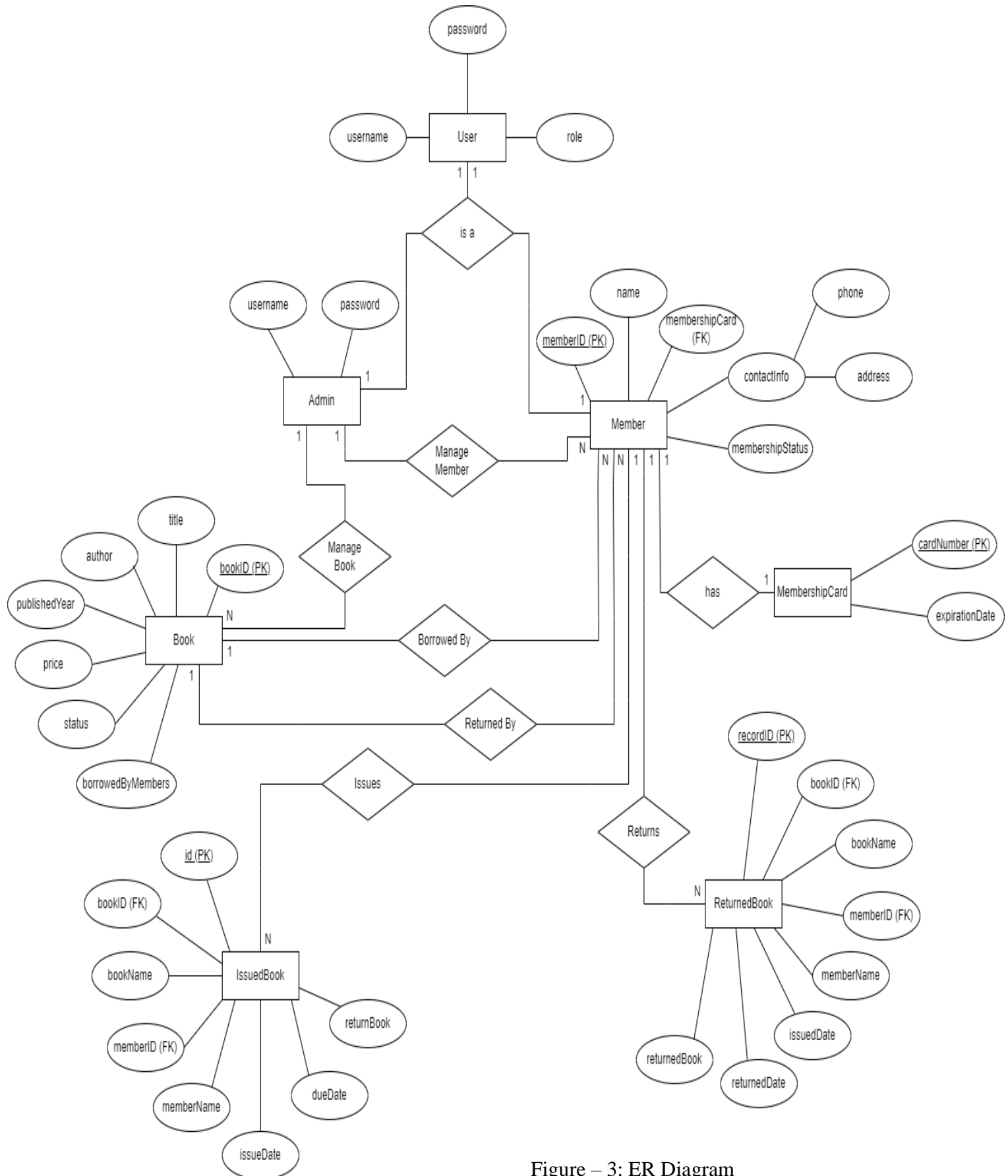


Figure – 3: ER Diagram

## 6. JAVA PACKAGES AND CLASSES OVERVIEW

### 1) Controller Package

- **DBConnection Class**

- **Purpose:** Provides a static method for establishing database connectivity, ensuring the application can interact with the MySQL database.
- **Key Methods:**
  - `getConnection()`: Establishes a connection to the MySQL database using JDBC.

- **BookDBC Class**

- **Purpose:** Manages all database operations related to books. This includes Add, Update, Delete, Search and View operations and handling book borrowing/returning logic.
- **Key Methods:**
  - `addBook(Book book)`: Adds a new book to the database.
  - `updateBook(Book book)`: Updates the details of an existing book.
  - `deleteBook(int bookID)`: Deletes a book record (Mark as inactive).
  - `searchBook(String title, String author)`: Searches for books based on title or author.
  - `borrowBook(int bookID, int memberID)`: Marks a book as borrowed by a member.
  - `returnBook(int bookID, int memberID)`: Marks a borrowed book as returned.

- **MemberDBC Class**

- **Purpose:** Manages all database operations related to members. This includes Add, Update, Delete, Search and View operations for managing member records.
- **Key Methods:**
  - `addMember(Member member)`: Adds a new member to the database.
  - `updateMember(Member member)`: Updates the details of an existing member.

- deleteMember(int memberID): Deletes a member (Mark as inactive).
  - searchMember(String name): Searches for a member based on their name.
  - getMemberById(int memberID): Retrieves a member's details using their unique member ID.
- **LoginController Class**
    - **Purpose:** Handles the authentication process for both Admin and Member roles.
    - **Key Methods:**
      - validateAdminLogin(String username, String password): Validates Admin credentials during login.
      - validateMemberLogin(String username, String password): Validates Member credentials during login.

## 2) Model Package

- **User Class**

- **Purpose:** Represents a general user (Admin or Member). It holds common attributes like username, password, and role.
- **Key Attributes:**
  - username: Stores the username of the user.
  - password: Stores the password of the user.
  - role: Defines whether the user is an Admin or a Member.

- **Book Class**

- **Purpose:** Represents a book in the library. Implements the **Borrowable** interface to support borrowing and returning functionality.
- **Key Attributes:**
  - bookID: Unique identifier for the book.
  - title: Title of the book.
  - author: Author of the book.
  - yearPublished: Year the book was published.
  - price: Price of the book.
  - status: Availability status of the book (Yes, No).
- **Methods:**
  - borrow(): Marks the book as borrowed.
  - returnBook(): Marks the book as returned.

- **Member Class**

- **Purpose:** Represents a library member. It holds personal information and references a **MembershipCard** object.
- **Key Attributes:**
  - memberID: Unique identifier for the member.
  - name: Name of the member.
  - contactInfo: Contact information for the member.
  - address: Member's residential address.
  - membershipCard: A **MembershipCard** object associated with the member.
- **Methods:**
  - borrowBook(Book book): Allows the member to borrow a book.



- `returnBook(Book book)`: Allows the member to return a borrowed book.
- **MembershipCard Class**
  - **Purpose:** Stores details of a member's membership card, including its expiration date.
  - **Key Attributes:**
    - `cardNumber`: Unique identifier for the membership card.
    - `expirationDate`: Date when the membership card expires.
- **IssuedBook Class**
  - **Purpose:** Tracks the details of books that have been issued to members.
  - **Key Attributes:**
    - `recordID`: Unique record identifier for the issued book.
    - `bookID`: The ID of the borrowed book.
    - `memberID`: The ID of the member who borrowed the book.
    - `issueDate`: Date when the book was issued.
    - `dueDate`: Date by which the book should be returned.
  - **Methods:**
    - `extendDueDate()`: Extends the due date for book return.
- **ReturnedBook Class**
  - **Purpose:** Tracks the details of books that have been returned.
  - **Key Attributes:**
    - `recordID`: Unique identifier for the returned book.
    - `bookID`: The ID of the returned book.
    - `memberID`: The ID of the member who returned the book.
    - `returnedDate`: Date when the book was returned.

### 3) View Package

- **Login (JFrame Class)**
  - **Purpose:** Provides the login interface for both Admin and Member. This frame allows users to input their credentials and authenticate.
  - **Key Features:**
    - Login fields for username and password.
- **Home (JFrame Class)**
  - **Purpose:** Displays the dashboard after successful login, tailored for either Admin or Member role.
  - **Key Features:**
    - Admin dashboard: Options to manage books, members, and view reports.
    - Member dashboard: Options to view and search books.
- **BookManagementView (JFrame Classes)**
  - **Purpose:** Interfaces for Admin to manage books. Admin can add, update, and delete books.
  - **Key Features:**
    - Form fields to enter book details.
    - Buttons to add, update, and delete the book information in the database.
- **MemberManagementView (JFrame Class)**
  - **Purpose:** Interface for Admins to manage library members. Admins add, update and delete members from this view.
  - **Key Features:**
    - Form to enter and manage member details.
    - A table displaying all members with options for editing and deleting.

## 7. USER MANUAL

### 1) Admin Role

- **Welcome**

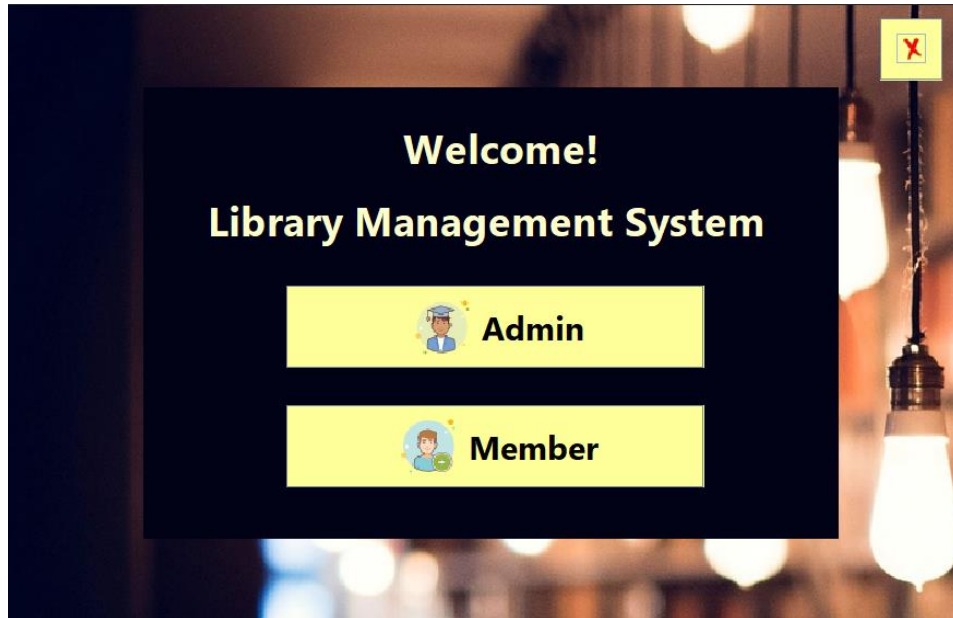


Figure 4 – Welcome GUI

- **Login:** Admin credentials required.

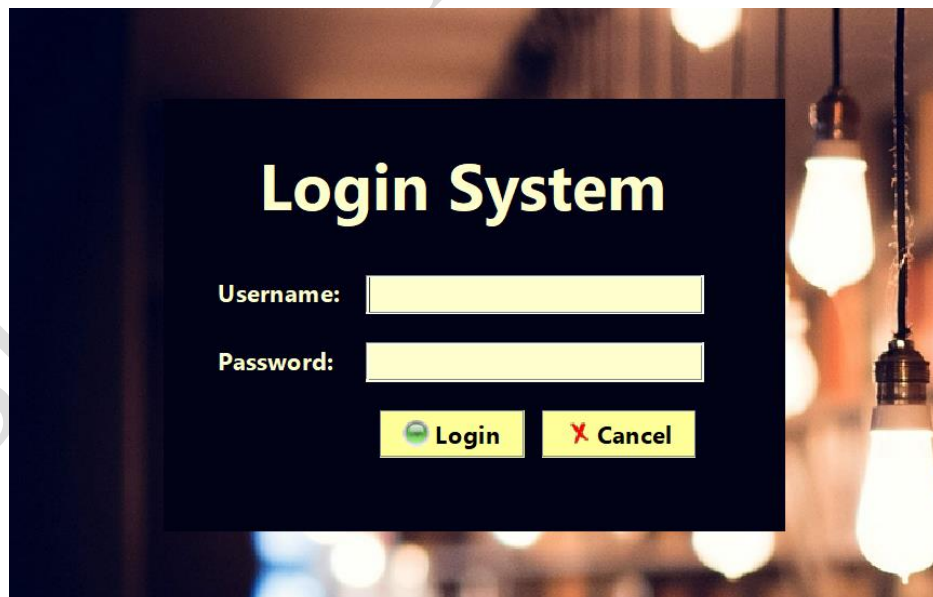


Figure – 5: Login GUI

- **Home**

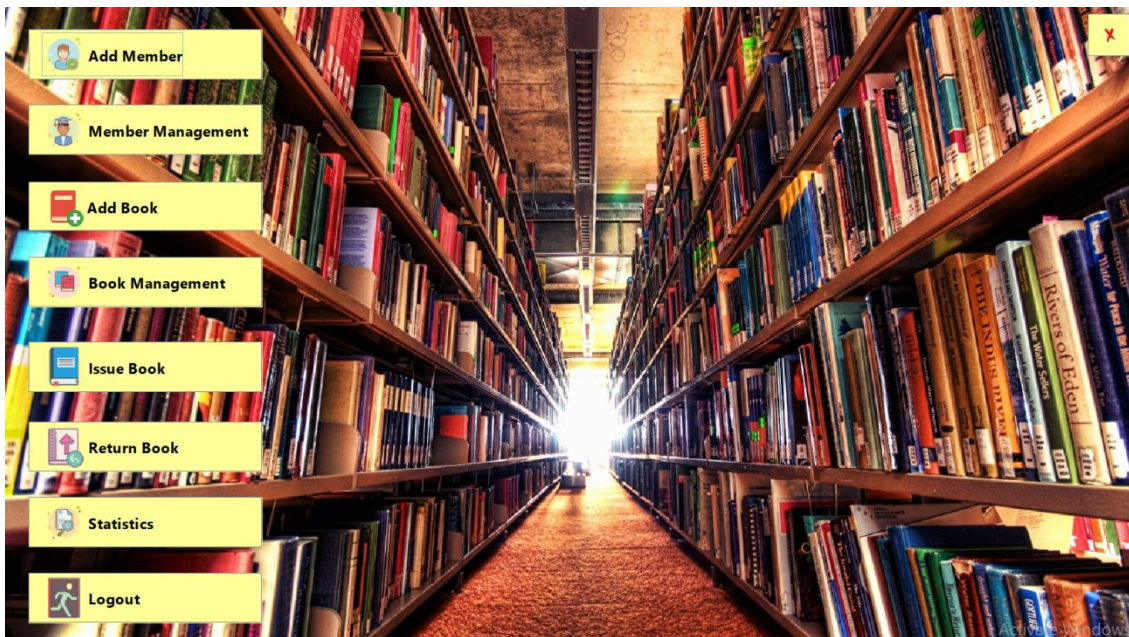


Figure – 6: Home GUI

- **Manage Books:**
  - Add, edit, delete books.
  - Search books by title, author, or book ID.
  - View book details

The image displays the 'Add Book' form. It has a dark blue background. The form contains five input fields, each with a label to its left: 'Book ID:', 'Book Name:', 'Author Name:', 'Price:', and 'Published Year:'. The 'Published Year' field is a dropdown menu currently showing '2024'. At the bottom of the form are two buttons: a blue 'Save' button with a floppy disk icon and a yellow 'Cancel' button with a red 'X' icon.

Figure – 7: Add Book GUI

Book Details						Search
Book ID	Book Name	Author	Published Year	Price	Status	
1	Java	John Smith	2019	1980.0	Available	
2	Information Technology	Albert	2022	1500.0	Unavailable	
3	PHP	Philip	2020	1900.0	Available	
4	Women's Rights	S.M.R.Bandara	2024	550.0	Available	
5	Kids Stories	Leela	2021	200.0	Available	
6	Artificial Intelligence	Amith	2009	2000.0	Available	
7	Statistics	Wizard	2024	600.0	Available	
8	Photoshop	Philip	2024	500.0	Available	
9	PHP Part - 2	nimal	2019	1400.0	Unavailable	
10	Stories	Johnson	2018	800.0	Available	
11	Love Novel	Leela	2024	900.0	Available	
12	History	Gunathilaka	2024	800.0	Available	
13	Science	Albert	2007	1000.0	Available	
14	Stories	Ramani	2010	2000.0	Unavailable	
15	History of SriLanka	C.K.Bandara	2023	550.0	Available	
16	Novel	Kalki	2005	1999.0	Available	
17	Folks	John	2024	800.0	Available	
18	Networking	Donald	2021	1900.0	Available	
19	Basic Programming	John Doe	2024	890.0	Available	
20	Fun Facts	John Doe	2016	700.0	Unavailable	
21	Jokes	Smith Fernando	2023	1000.0	Available	
22	Love	Don Doe	2015	980.0	Available	
23	Political Science	Peries	2024	1800.0	Available	

Edit

Delete

Cancel

Figure – 8: Book Management GUI

Book ID:

1

Book Name:

Java

Author Name:

John Smith

Price:

1980.0

Published Year:

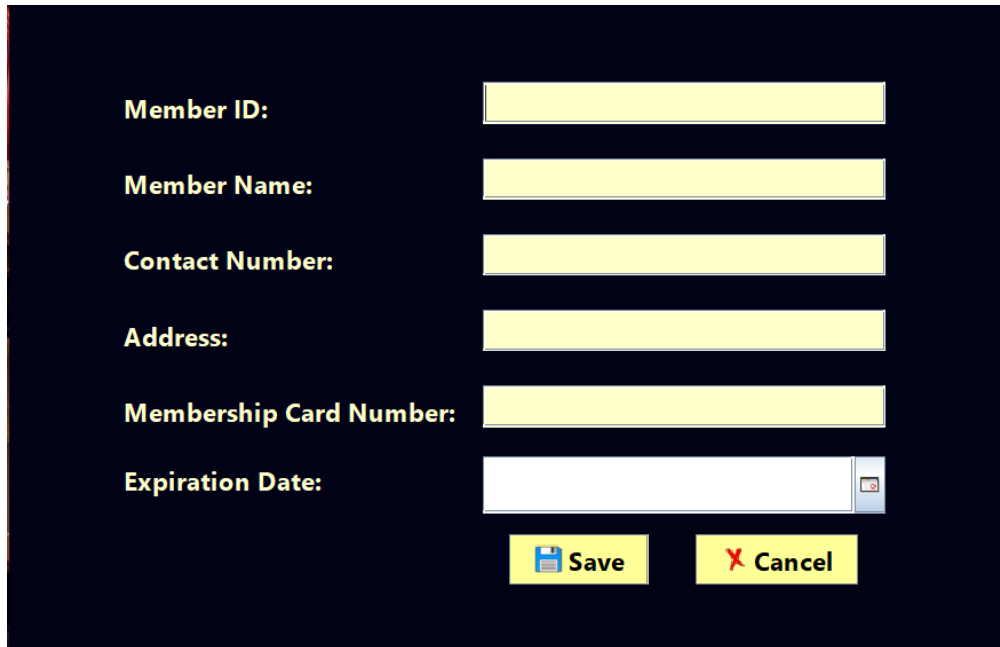
2019

Save

Cancel

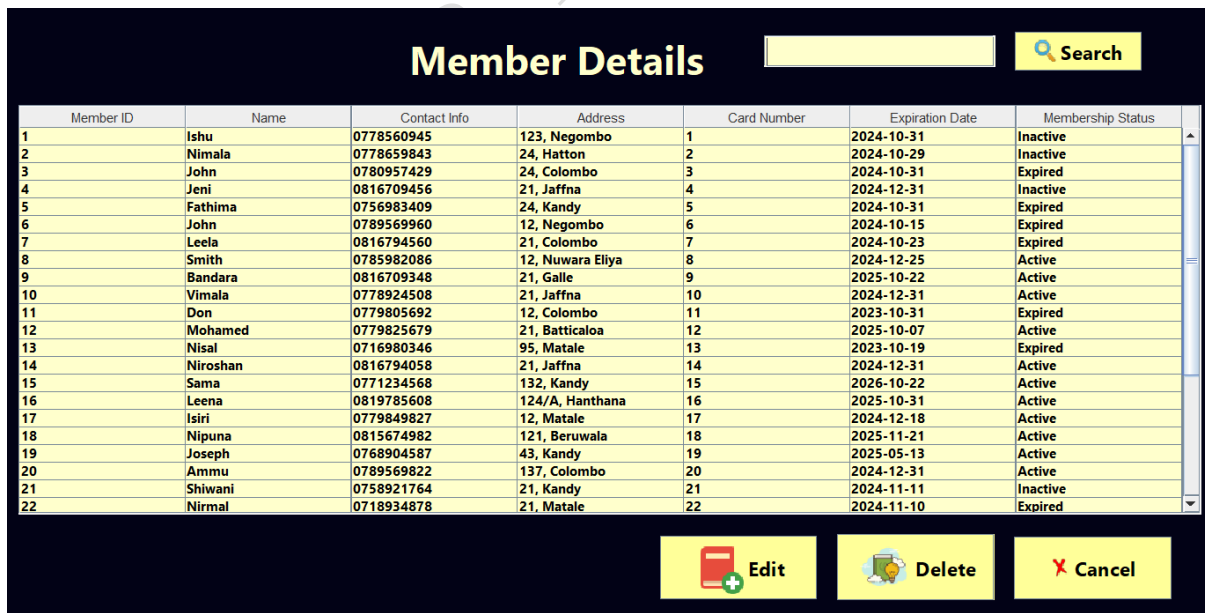
Figure – 9: Edit / Update Book GUI

- **Manage Members:**
  - Add, edit, delete members.
  - Update membership status.
  - Search member details.
  - View member details.



The 'Add Member GUI' is a form with a dark blue background. It contains six input fields with yellow text labels: 'Member ID:', 'Member Name:', 'Contact Number:', 'Address:', 'Membership Card Number:', and 'Expiration Date:'. The 'Expiration Date' field includes a calendar icon. At the bottom, there are two buttons: a blue 'Save' button with a floppy disk icon and a red 'Cancel' button with a red 'X' icon.

Figure – 10: Add Member GUI



The 'Member Management GUI' features a table titled 'Member Details' with a search bar and a 'Search' button. The table has seven columns: Member ID, Name, Contact Info, Address, Card Number, Expiration Date, and Membership Status. It contains 22 rows of member data. At the bottom, there are three buttons: a red 'Edit' button with a plus icon, a green 'Delete' button with a trash icon, and a red 'Cancel' button with a red 'X' icon.

Member ID	Name	Contact Info	Address	Card Number	Expiration Date	Membership Status
1	Ishu	0778560945	123, Negombo	1	2024-10-31	Inactive
2	Nimala	0778659843	24, Hattton	2	2024-10-29	Inactive
3	John	0780957429	24, Colombo	3	2024-10-31	Expired
4	Jeni	0816709456	21, Jaffna	4	2024-12-31	Inactive
5	Fathima	0756983409	24, Kandy	5	2024-10-31	Expired
6	John	0789569960	12, Negombo	6	2024-10-15	Expired
7	Leela	0816794560	21, Colombo	7	2024-10-23	Expired
8	Smith	0785982086	12, Nuwara Eliya	8	2024-12-25	Active
9	Bandara	0816709348	21, Galle	9	2025-10-22	Active
10	Vimala	0778924508	21, Jaffna	10	2024-12-31	Active
11	Don	0779805692	12, Colombo	11	2023-10-31	Expired
12	Mohamed	0779825679	21, Batticaloa	12	2025-10-07	Active
13	Nisal	0716980346	95, Mattale	13	2023-10-19	Expired
14	Niroshan	0816794058	21, Jaffna	14	2024-12-31	Active
15	Sama	0771234568	132, Kandy	15	2026-10-22	Active
16	Leena	0819785608	124/A, Hanthana	16	2025-10-31	Active
17	Isiri	0779849827	12, Mattale	17	2024-12-18	Active
18	Nipuna	0815674982	121, Beruwala	18	2025-11-21	Active
19	Joseph	0768904587	43, Kandy	19	2025-05-13	Active
20	Ammu	0789569822	137, Colombo	20	2024-12-31	Active
21	Shiwani	0758921764	21, Kandy	21	2024-11-11	Inactive
22	Nirmal	0718934878	21, Mattale	22	2024-11-10	Expired

Figure – 11: Member Management GUI

The screenshot displays a form for editing or updating a member's information. The form is set against a dark blue background. It includes the following fields and values:

Field	Value
Member ID:	1
Member Name:	Nila
Contact Number:	0778560945
Address:	123, Negombo
Membership Card Number:	1
Expiration Date:	Oct 31, 2024

At the bottom of the form, there are two buttons: a blue 'Save' button with a floppy disk icon and a red 'Cancel' button with a red 'X' icon.

Figure – 12: Edit / Update Member GUI

- **Issue Book:**
  - Issue book to the member.

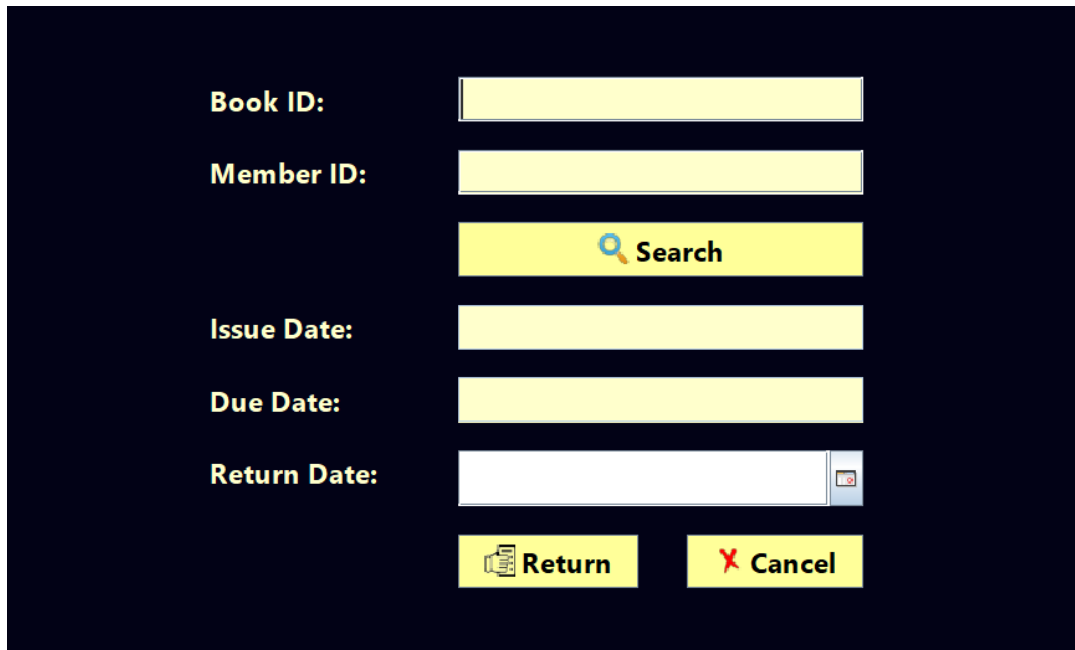
The screenshot displays a form for issuing a book to a member. The form is set against a dark blue background. It includes the following fields and values:

Field	Value
Book ID:	
Member ID:	
Issue Date:	
Due Date:	

At the bottom of the form, there are two buttons: a blue 'Issue' button with a book icon and a red 'Cancel' button with a red 'X' icon.

Figure – 13: Issue Book GUI

- **Return Book:**
  - Return book from member.



The Return Book GUI is a dark-themed form with yellow input fields and buttons. It contains the following elements:

- Book ID:** A yellow text input field.
- Member ID:** A yellow text input field.
- Search:** A yellow button with a magnifying glass icon and the text "Search".
- Issue Date:** A yellow text input field.
- Due Date:** A yellow text input field.
- Return Date:** A white text input field with a calendar icon on the right.
- Return:** A yellow button with a book icon and the text "Return".
- Cancel:** A yellow button with a red "X" icon and the text "Cancel".

Figure 14 – Return Book GUI

- **Statistics View:**
  - View issued and returned book details.



The Statistics View GUI is a dark-themed interface with a search bar at the top right and two tables below. The search bar has a yellow input field and a yellow "Search" button with a magnifying glass icon.

**Issued Book Details**

Number	Book ID	Book Name	Member ID	Member Name	Issued Date	Due Date	Return Book
1	17	Folks	8	Smith	2024-10-27	2024-11-10	Yes
2	1	Java Programming	1	Nila	2024-10-16	2024-10-29	Yes
3	10	Stories	7	Leela	2024-10-28	2024-11-13	Yes
4	5	Kids Stories	6	John	2024-10-01	2024-10-30	Yes
5	2	Information Technology	10	Vimala	2024-10-15	2024-10-31	Yes
6	9	PHP - 2	10	Vimala	2024-10-02	2024-10-23	Yes
7	18	Networking	6	John	2024-10-15	2024-10-31	Yes
8	20	Fun Facts	10	Vimala	2024-10-30	2024-11-14	Yes
9	19	Basic Programming	1	Nila	2024-10-31	2024-12-31	Yes
10	1	Java	1	Nila	2024-10-11	2024-10-31	Yes
11	14	Stories	15	Sama	2024-10-10	2024-10-31	Yes
12	4	Women's Rights	5	Fathima	2024-10-24	2024-10-31	Yes

**Returned Book Details**

Number	Book ID	Book Name	Member ID	Member Name	Issued Date	Returned Date	Return Book
1	1	Java	1	Nila	2024-10-16	2024-10-29	Yes
2	17	Folks	8	Smith	2024-10-27	2024-10-31	Yes
3	4	Women's Rights	5	Fathima	2024-10-24	2024-10-31	Yes
4	1	Java	1	Nila	2024-10-11	2024-10-30	Yes
5	5	Kids Stories	6	John	2024-10-01	2024-10-29	Yes
6	2	Information Technology	10	Vimala	2024-10-15	2024-10-31	Yes
7	9	PHP - 2	10	Vimala	2024-10-02	2024-10-22	Yes
8	18	Networking	6	John	2024-10-15	2024-10-31	Yes
9	14	Stories	15	Sama	2024-10-10	2024-10-29	Yes
10	17	Folks	1	Nila	2024-10-24	2024-10-29	Yes
11	21	Jokes	16	Leena	2024-10-17	2024-10-27	Yes
12	1	Java	9	Bandara	2024-10-09	2024-10-23	Yes

At the bottom right of the interface is a yellow button with a red "X" icon and the text "Cancel".

Figure 15 – Statistics View GUI



## 2) Member Role

- Welcome

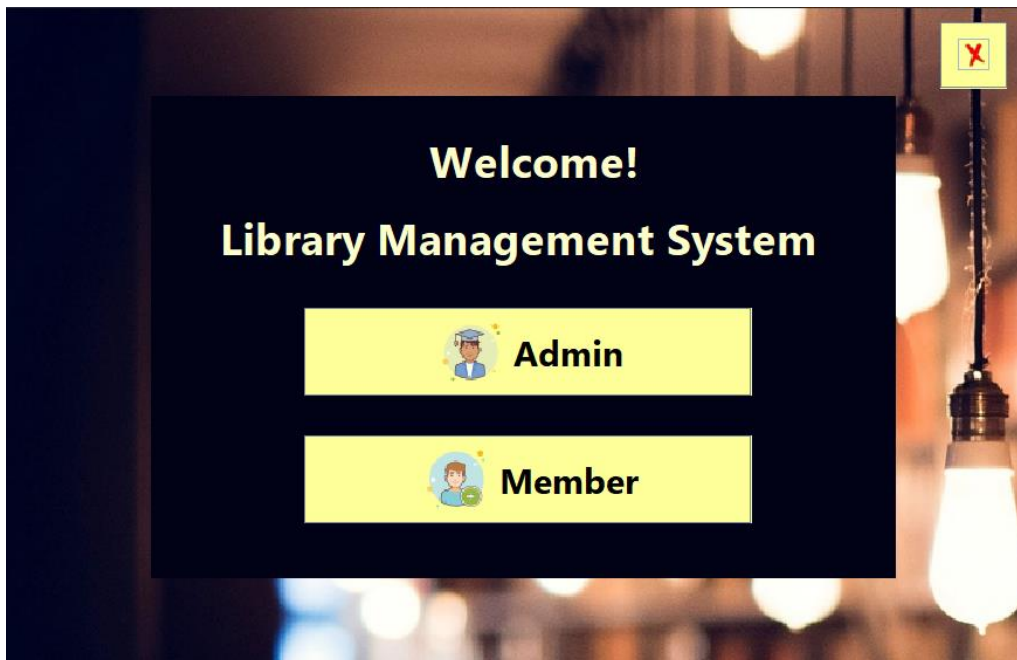


Figure 16 – Welcome GUI

- **Login:** Member credentials required.

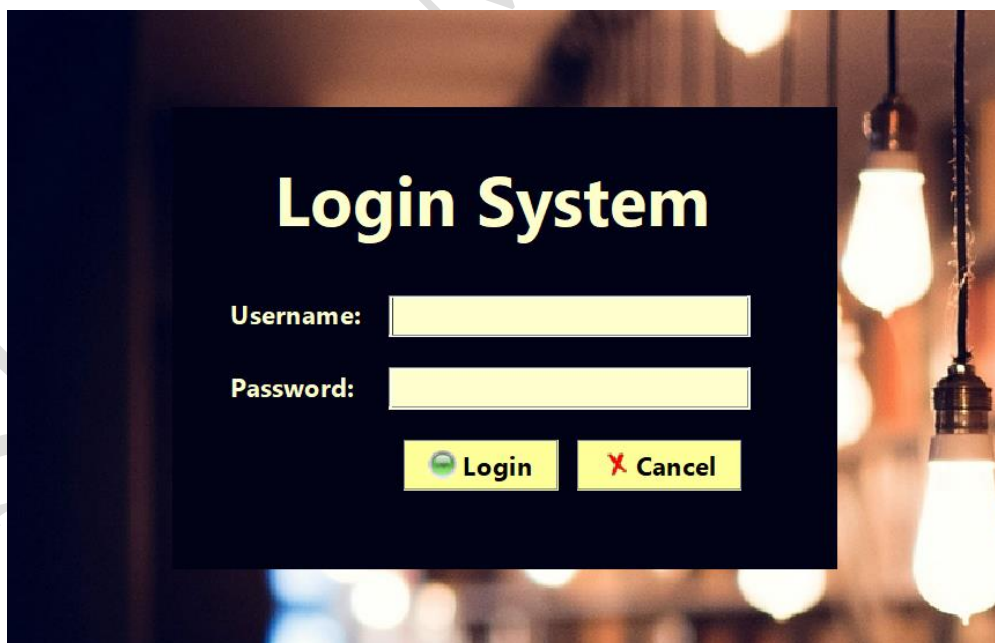


Figure 17 – Login GUI

- **View/Search Books:** Members can access and search the book database.

Search:  **Search**

**Book Details**

Book ID	Book Name	Author Name	Published Year	Price	Status
1	Java	John Smith	2019	1980.0	Available
2	Information Techn...	Albert	2022	1500.0	Unavailable
3	PHP	Philip	2020	1900.0	Available
4	Women's Rights	S.M.R.Bandara	2024	550.0	Available
5	Kids Stories	Leela	2021	200.0	Available
6	Artificial Intelligence	Amith	2009	2000.0	Available
7	Statistics	Wizard	2024	600.0	Available
8	Photoshop	Philip	2024	500.0	Available
9	PHP Part - 2	nimal	2019	1400.0	Unavailable
10	Stories	Johnson	2018	800.0	Available
11	Love Novel	Leela	2024	900.0	Available
12	History	Gunathilaka	2024	800.0	Available
13	Science	Albert	2007	1000.0	Available
14	Stories	Ramani	2010	2000.0	Unavailable
15	History of SriLanka	C.K.Bandara	2023	550.0	Available
16	Novel	Kalki	2005	1999.0	Available
17	Folks	John	2024	800.0	Available
18	Networking	Donald	2021	1900.0	Available
19	Basic Programming	John Doe	2024	890.0	Available
20	Fun Facts	John Doe	2016	700.0	Unavailable

**Logout**

**Cancel**

Figure 18 – View & Search Books GUI

## 8. TESTING AND VALIDATION

- **Login**
  - Test successful and unsuccessful logins with Admin and Member credentials.
- **Book Management:**
  - Test adding, updating, and deleting books.
  - Ensure books are listed and searched properly.
- **Member Management:**
  - Test adding, updating, and deleting members
  - Ensure member information is correctly saved and displayed.
- **Borrowing and Returning Books:**
  - Test the borrowing and returning of books.
  - Ensure books are marked as returned when they are returned by members.
- **Exception Handling:**
  - Test invalid inputs (Duplicate bookIDs, member IDs).
  - Ensure the system properly handles errors.

## **9. CONCLUSION**

The Library Management System offers a comprehensive solution for managing library books and members. It follows the MVC pattern and adheres to OOP principles, ensuring modularity, reusability, and maintainability. The system can be further enhanced by integrating features for book identification or implementing mobile compatibility for easier access.

The system is well-tested and validated, ensuring robustness and functionality for managing both books and members in a library setting.