

Library Management System

Object Oriented Programming in Java- HNDIT 3012

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1. Introduction

The **Library Management System (LMS)** is an automated platform designed to streamline library functions such as book issuance, returns, member management, and database handling. This system uses Java Swing for its graphical user interface (GUI), MySQL for data persistence, and follows the **MVC (Model-View-Controller)** architectural pattern for separation of concerns.

2. System Objectives

- **Automation of Library Functions:** Efficiently manage operations like book issuance, returns, member management, and more.
 - **User-Friendly Interface:** Simplify the user experience for both library members and administrators.
 - **Data Integrity:** Maintain accurate records for books, members, and transactions
-

3. Project Scope

The Library Management System covers the following functionalities:

1. **Book Management:**

- **Add, Update, Remove, Search** books..
- View books and track their availability (Issued/Returned status).

2. **Member Management:**

- Add new members, deactivate existing ones.
- View member details such as contact information and borrowed details.

3. **Login System:**

- Secure login system for both library administrators and regular members.

4. **Database Integration:**

- All system data (books, members, transactions) is stored in a **MySQL database** for persistent storage.

4. System Design

4.1 Architecture

The system is based on the **MVC architecture**, which consists of Three main components:

- **Model:** Represents the data and logic. It includes:
 - Book class (manages book details)
 - Member class (manages member data)
 - Transaction class (manages book borrowing and returning details)
- **View:** Represents the user interface using Java Swing:
 - GUI Components like LoginForm, BookManagementPanel, MemberDetailsPanel.
- **Controller or DAO:** Contains the business logic and database interaction:
 - BookDAO (handles operations related to books)
 - MemberDAO (handles member-related operations)
 - IssueDAO & ReturnDAO (manages borrow/return operations)

4.2 Packages

1. Model Package:

- **Classes:** Admin, Book, Member, MembershipCard, User, IssueBook, ReturnBook.

Represents Constructors and Variable declaration .

- **2. View Package:**
 - **JFrames:** Welcome, LoginView, Menu, AddMembers, AddBooks, MemberManagement, BookManagement, Issuebooks, Returnbooks, Statistics.

- Provides graphical user interface (GUI) for the system.

3. Controller or DAO Package:

- **Classes:** BookDAO, MemberDAO, IssueBookDAO, ReturnDAO, StatisticsDAO
LoginController.
 - Manages database operations and authentication logic.
-

5. Database Design

Table	Action	Rows	Type	Collation	Size	Overhead
<input type="checkbox"/> books	★ Browse Structure Search Insert Empty Drop	11	InnoDB	utf8mb4_general_ci	48.0 KiB	-
<input type="checkbox"/> issuedbooks	★ Browse Structure Search Insert Empty Drop	10	InnoDB	utf8mb4_general_ci	16.0 KiB	-
<input type="checkbox"/> members	★ Browse Structure Search Insert Empty Drop	9	InnoDB	utf8mb4_general_ci	32.0 KiB	-
<input type="checkbox"/> return_book	★ Browse Structure Search Insert Empty Drop	7	InnoDB	utf8mb4_general_ci	16.0 KiB	-
<input type="checkbox"/> users	★ Browse Structure Search Insert Empty Drop	0	InnoDB	utf8mb4_general_ci	16.0 KiB	-
5 tables	Sum	37	InnoDB	utf8mb4_general_ci	128.0 KiB	0 B

Server: 127.0.0.1 » Database: librarydatabase » Table: users

Browse Structure SQL Search Insert Export

Table structure Relation view

#	Name	Type	Collation	Attributes	Null	Default
<input type="checkbox"/> 1	userId	varchar(50)	utf8mb4_general_ci		No	None
<input type="checkbox"/> 2	name	varchar(255)	utf8mb4_general_ci		No	None
<input type="checkbox"/> 3	password	varchar(255)	utf8mb4_general_ci		No	None
<input type="checkbox"/> 4	role	varchar(255)	utf8mb4_general_ci		No	None
<input type="checkbox"/> 5	email	varchar(255)	utf8mb4_general_ci		No	None
<input type="checkbox"/> 6	contactNo	varchar(255)	utf8mb4_general_ci		No	None
<input type="checkbox"/> 7	cardNumber	varchar(255)	utf8mb4_general_ci		No	None
<input type="checkbox"/> 8	expiryDate	date			No	None

Server: 127.0.0.1 » Database: librarydatabase » Table: books

Browse Structure SQL Search Insert Export

Table structure Relation view

#	Name	Type	Collation	Attributes	Null	Default
<input type="checkbox"/> 1	bookID	varchar(50)	utf8mb4_general_ci		No	None
<input type="checkbox"/> 2	title	varchar(255)	utf8mb4_general_ci		No	None
<input type="checkbox"/> 3	author	varchar(255)	utf8mb4_general_ci		No	None
<input type="checkbox"/> 4	yearPublished	int(4)			No	None
<input type="checkbox"/> 5	genre	varchar(100)	utf8mb4_general_ci		No	None
<input type="checkbox"/> 6	isActive	tinyint(1)			No	None

Server: 127.0.0.1 » Database: librarydatabase » Table: members

Browse Structure SQL Search Insert Export

Table structure Relation view

#	Name	Type	Collation	Attributes	Null	Default
<input type="checkbox"/> 1	memberId	varchar(50)	utf8mb4_general_ci		No	None
<input type="checkbox"/> 2	name	varchar(100)	utf8mb4_general_ci		No	None
<input type="checkbox"/> 3	contactNo	varchar(20)	utf8mb4_general_ci		No	None
<input type="checkbox"/> 4	email	varchar(100)	utf8mb4_general_ci		No	None
<input type="checkbox"/> 5	membershipCardNo	varchar(50)	utf8mb4_general_ci		No	None
<input type="checkbox"/> 6	expiryDate	date			No	None
<input type="checkbox"/> 7	active	tinyint(1)			No	None
<input type="checkbox"/> 8	isActive	tinyint(1)			Yes	1

Server: 127.0.0.1 » Database: librarydatabase » Table: issuedbooks

Browse Structure SQL Search Insert Export

Table structure Relation view

#	Name	Type	Collation	Attributes	Null	Default	Comm
<input type="checkbox"/> 1	issueid	int(11)			No	None	
<input type="checkbox"/> 2	memberid	varchar(11)	utf8mb4_general_ci		No	None	
<input type="checkbox"/> 3	bookid	varchar(11)	utf8mb4_general_ci		No	None	
<input type="checkbox"/> 4	quantity	int(11)			No	None	
<input type="checkbox"/> 5	getdate	date			No	None	
<input type="checkbox"/> 6	returndate	date			No	None	

Server: 127.0.0.1 » Database: librarydatabase » Table: return_book

Browse Structure SQL Search Insert Export

Table structure Relation view

#	Name	Type	Collation	Attributes	Null	Default	Con
<input type="checkbox"/> 1	returnid	int(11)			No	None	
<input type="checkbox"/> 2	memberid	varchar(255)	utf8mb4_general_ci		Yes	NULL	
<input type="checkbox"/> 3	bookid	varchar(11)	utf8mb4_general_ci		No	None	
<input type="checkbox"/> 4	quantity	int(11)			No	None	
<input type="checkbox"/> 5	returndate	date			No	None	

6. Testing

.1. Unit Testing:

Ensure the individual functionalities such as adding books, issuing books, etc., work as intended.

.2. Integration Testing:

Verify that the database operations (CRUD) interact seamlessly with the GUI components.

.3. Performance Testing:

Monitor the system for speed, especially during queries or user actions, ensuring efficient performance.

OOP Concepts Applied

The Library Management System (LMS) is designed using key Object-Oriented Programming (OOP) principles, ensuring modularity, scalability, and maintainability. These principles are applied as follows:

1. Encapsulation

- The system's classes (e.g., Book, Member, Transaction) encapsulate their internal logic and data, exposing only the necessary methods and properties.
- For instance, getter and setter methods are used to access and modify private fields, ensuring data integrity.

2. Inheritance

- The LMS leverages inheritance to promote code reuse and hierarchical relationships.
- The Admin and Member classes inherit common properties and methods (e.g., username, password, and login()) from the base User class.
- Specialized methods unique to Admin (e.g., addBook()) and Member (e.g., borrowBook()) are implemented, showcasing polymorphism.

3. Polymorphism

- Method overloading is used for handling multiple operations with the same method name but different parameters, such as in the addBook() method for handling different book types.
- Method overriding is demonstrated in the Admin and Member classes, where the login() method is customized based on the user's role.

4. Abstraction

- Abstract classes and interfaces are used to define core functionalities without exposing implementation details.
- For example, an abstract Transaction class defines operations like issueBook() and returnBook(), which are implemented in specific subclasses.

5. Composition

- The MembershipCard class is composed within the Member class, establishing a "has-a" relationship.

- This ensures that a membership card cannot exist independently without an associated member.

6. **Aggregation**

- The Library class aggregates Book and Member objects, signifying a whole-part relationship where the existence of the Library is independent of individual books or members.

By applying these OOP principles, the LMS achieves a flexible and robust design, making it easy to extend, maintain, and adapt for future development.

7. **Results**

The Library Management System successfully provides:

1 **User-Friendly Interface:**

The interface is designed for ease of use, allowing administrators to manage books, members, and transactions effortlessly.

2 **Data Persistence:**

All data is stored securely in the MySQL database.

3 **Security:** User authentication ensures only authorized access to sensitive operations.

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8. **Future Enhancements**

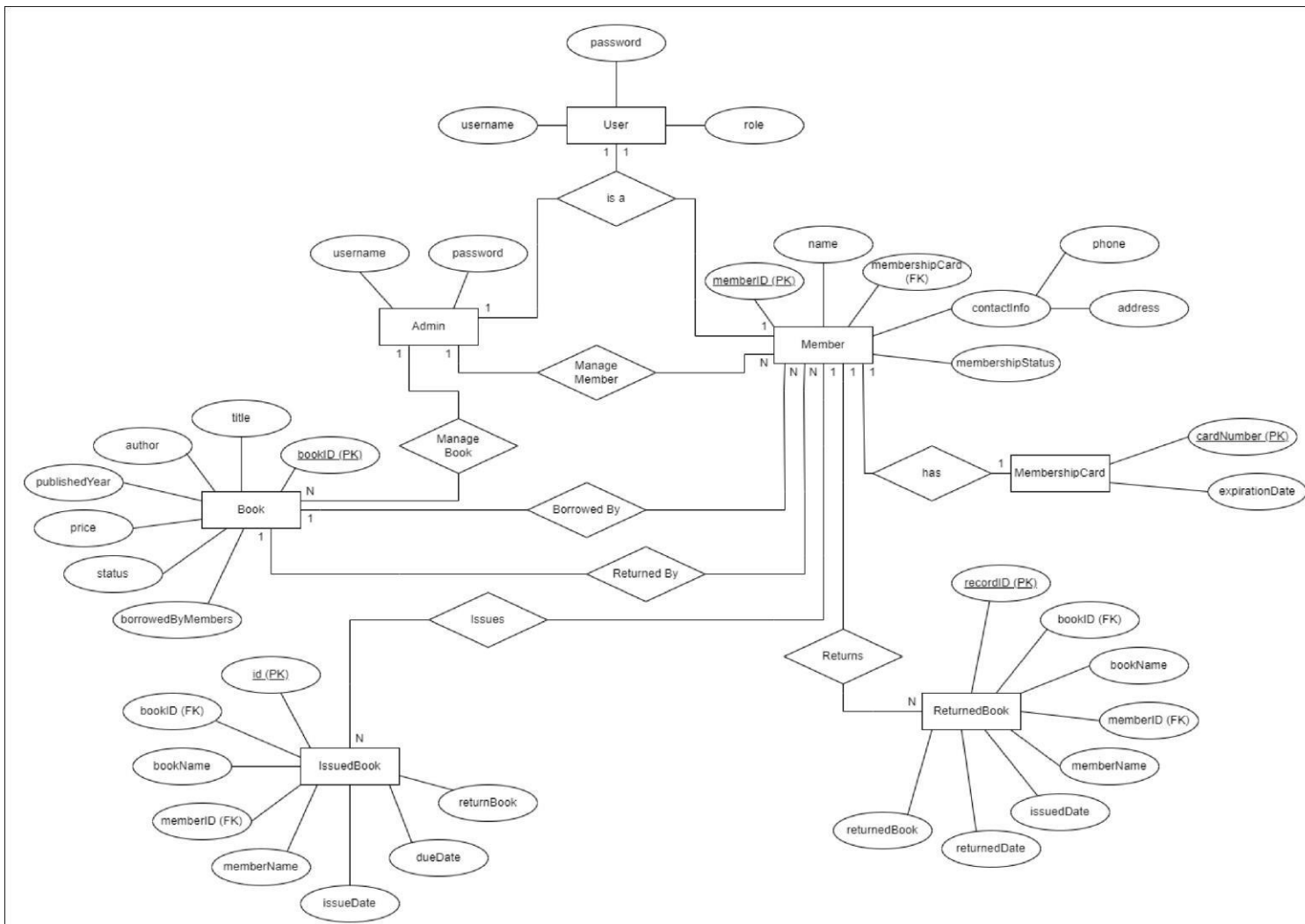
☐ **Search Features:** Add the ability to search books and members by various criteria (e.g., title, name, ☐ category)..

☐ **Reports:** Generate reports such as overdue books, transaction histories, and active members.

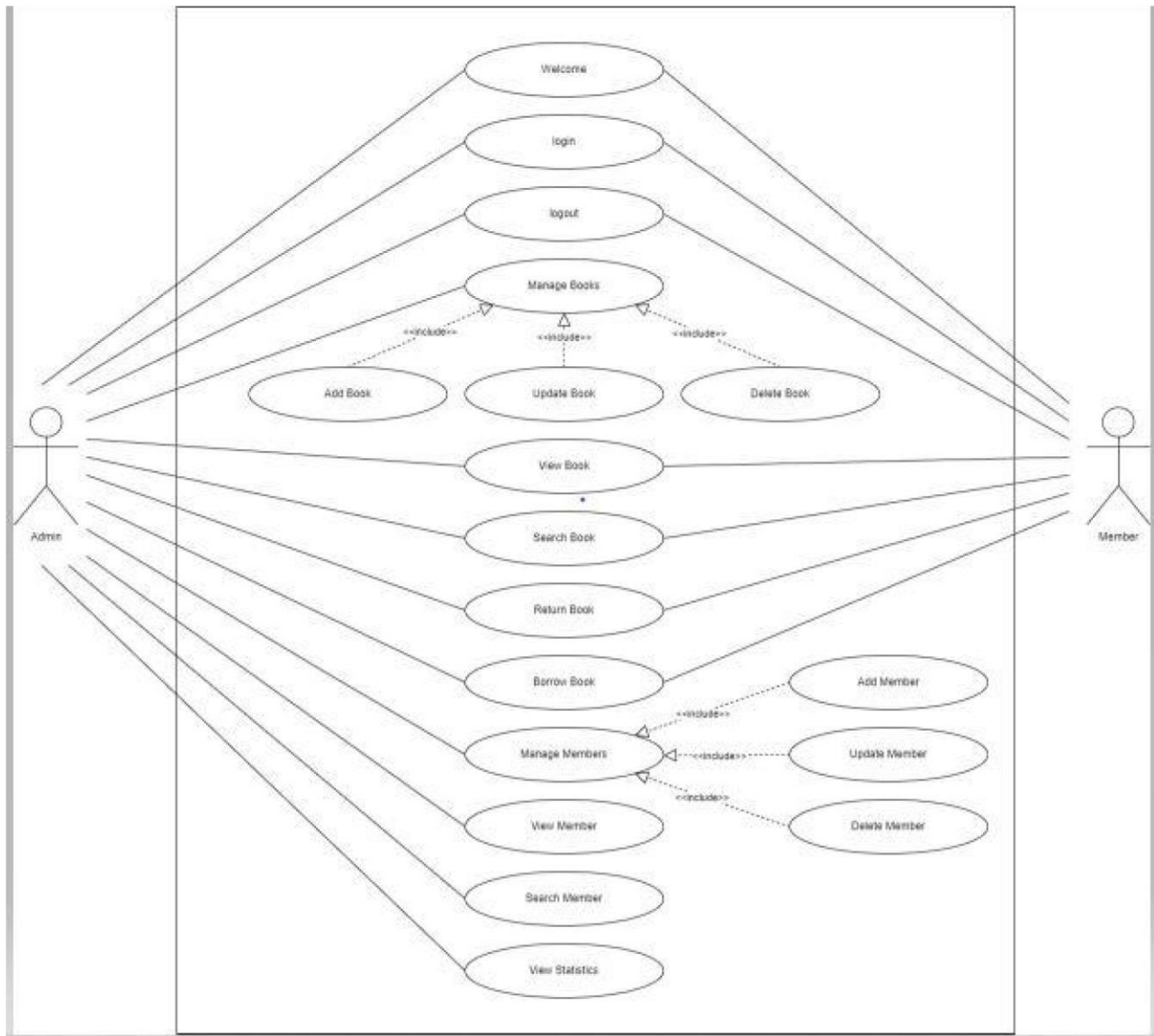
Advanced UI: Transition from Java Swing to JavaFX for enhanced styling and responsiveness.

9. Diagrams

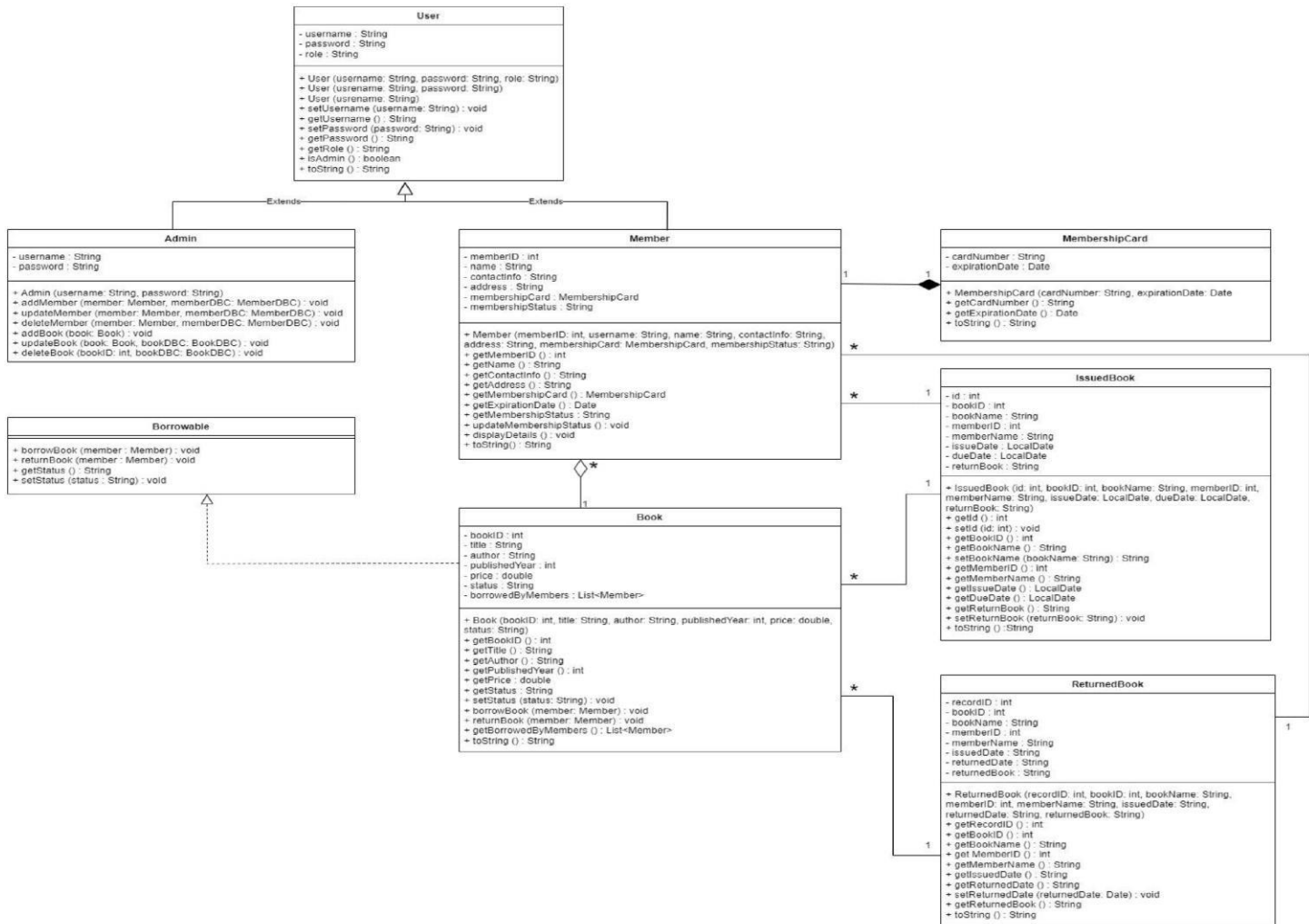
9.1. ER Diagram



9.2. Use Case Diagram



❖ Class Diagram



10. Conclusion

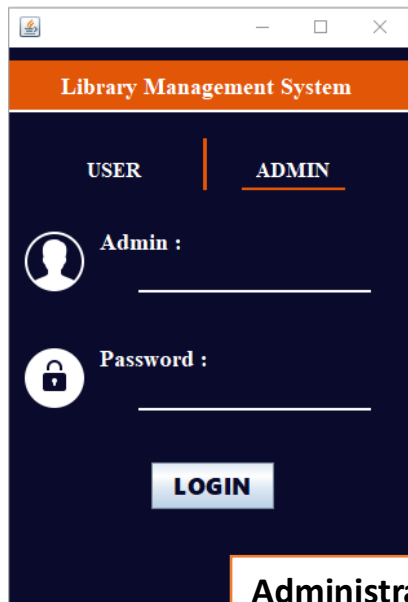
The **Library Management System (LMS)** developed in this project is a feature-rich application that effectively applies object-oriented programming principles. Its modular architecture, with a clear separation of concerns between the Controller, Model, and View components, ensures both maintainability and scalability.

Key components include the **Management class** for coordinating system operations, the **Database class** for handling database logic, and the **Constructor and Variable Declaration class** for managing data objects. The **Graphical User Interface (GUI)** provides an intuitive and user-friendly experience.

By leveraging OOP concepts such as **encapsulation**, **inheritance**, and **composition** the LMS achieves high modularity and flexibility, making it adaptable for future development. This report offers a comprehensive overview of the system's architecture, providing valuable insights for understanding and maintaining the LMS.

11. GUI of the System

❖ Login



Library Management System

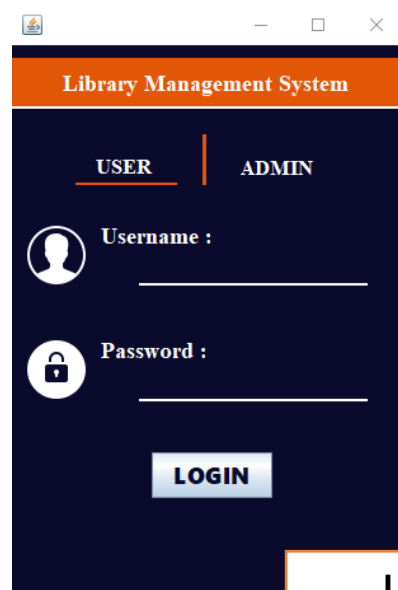
USER | ADMIN

Admin :

Password :

LOGIN

Administration Login



Library Management System

USER | ADMIN

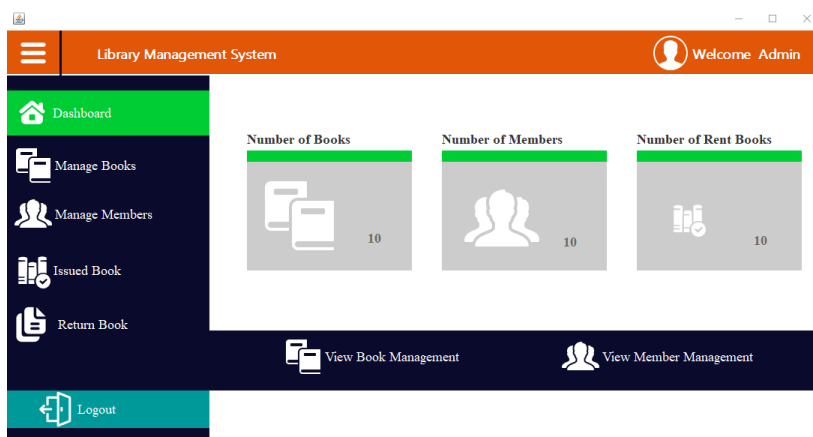
Username :

Password :

LOGIN

User Login

❖ Dashboard



Library Management System

Welcome Admin

- Dashboard
- Manage Books
- Manage Members
- Issued Book
- Return Book
- Logout

Number of Books: 10

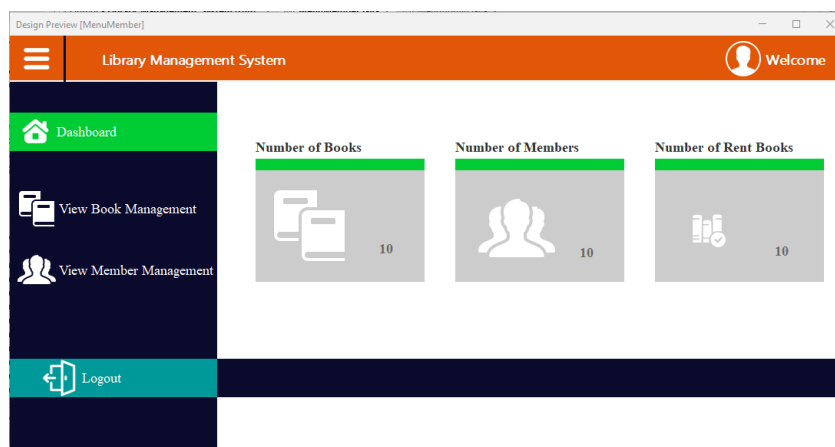
Number of Members: 10

Number of Rent Books: 10

View Book Management

View Member Management

Admin Dashboard



Design Preview [MenuMember]

Library Management System

Welcome

- Dashboard
- View Book Management
- View Member Management
- Logout

Number of Books: 10

Number of Members: 10

Number of Rent Books: 10

User Dashboard

❖ Add Books

Book Management

Welcome Admin

Add Books

Book_ID	Book_Name	Book_Author	Published Year	Genre	isActive
B001	The Great Gatsby	F. Scott Fitzgerald	1925	Fiction	<input checked="" type="checkbox"/>
B002	To Kill a Mockin...	Harper Lee	1960	Fiction	<input checked="" type="checkbox"/>
B003	Physics	Perera	2024	Other Genres	<input checked="" type="checkbox"/>
B005	Nature	Namjoon	2021	Classics	<input checked="" type="checkbox"/>
B007	Black and White	Liam	2021	Adventurous	<input checked="" type="checkbox"/>
B008	D2	augustD	2024	Non-Fiction	<input checked="" type="checkbox"/>
B009	Diary of a wimp...	Chris Martin	2019	Fiction	<input checked="" type="checkbox"/>
B010	JAVA	Charlie Puth	2025	Other Genres	<input type="checkbox"/>
B011	Genetics	Perera	2022	Other Genres	<input type="checkbox"/>
B012	Operating System	Green	1988	Other Genres	<input checked="" type="checkbox"/>
B013	De	abc	2024	Children's Literat...	<input checked="" type="checkbox"/>

Published Year:

Genre :

❖ Add Members

Member Management


Welcome Admin


Add Member


Member ID	Member Name	Contact No	E - Mail	MembershipCar...	Expiery Date	active
M001	Ali	1234567890	alikhannnnnn@...	MC071	2024-11-04	<input checked="" type="checkbox"/>
M002	Bob	0987654321	bob@example....	MC071	2024-11-04	<input checked="" type="checkbox"/>
M003	Johnson	1122334455	alicej@example...	MC003	2024-08-21	<input type="checkbox"/>
M004	Brown	5566778899	bobb@example...	MC004	2027-02-19	<input checked="" type="checkbox"/>
M005	Charlie Puth	6677889900	charlied@exam...	MC005	2026-11-30	<input checked="" type="checkbox"/>
M007	Harry	087654332	harry@gmail.c...	MC007	2024-11-24	<input checked="" type="checkbox"/>
M008	Black	078976421	black@gmail.c...	MC034	2024-11-24	<input checked="" type="checkbox"/>
M009	Zee	0789654	zee1234@gmail...	MC071	2024-11-04	<input type="checkbox"/>
M010	Wednesday	thing@gmail.com	0101100001	MC110	2021-02-15	<input checked="" type="checkbox"/>

Expiery Date :

❖ Issued Books


Books Management


Welcome Admin


Issued Books

Student :

Ali

Book :

The Great Gatsby

Quantity :

Get Date :

Return Date :

ADD


UPDATE


DELETE


Search

id	name	book	quantity	get date	return date
8	Brown	To Kill a Mocking...	5	2024-11-01	2024-11-08
9	Johnson	Black and White	1	2029-11-12	2028-11-06
10	Charlie Puth	Diary of a wimpy ...	3	2025-04-01	2025-01-07
11	Ali	Physics	1	2024-07-21	2025-11-14
12	Black	Nature	8	2024-02-22	2024-03-14
13	Harry	D2	4	2022-11-22	2025-05-21

❖ Return Books


Books Management


Welcome Admin


Return Books

Student :

Ali

Book :

The Great Gatsby

Quantity :

Return Date :

ADD

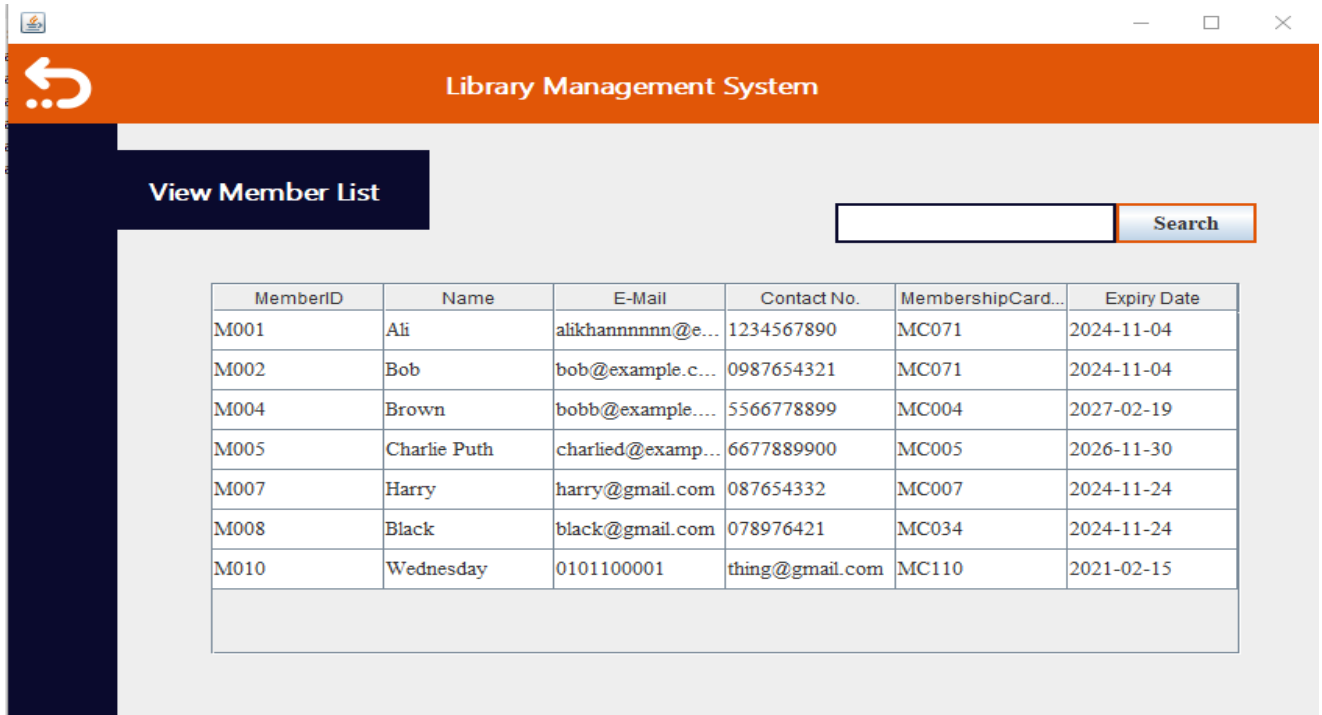
UPDATE

DELETE

Search

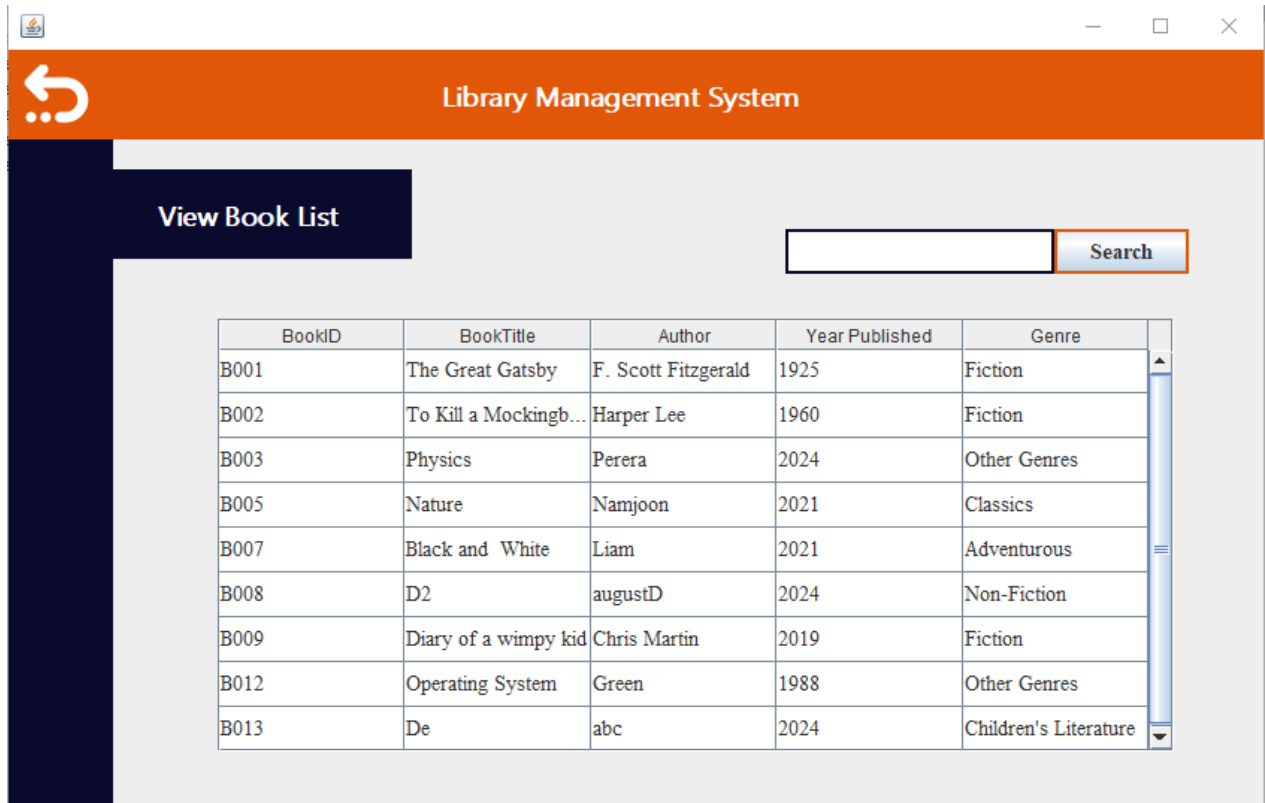
ID	Student	Book	Quantity	Return Date
1	Zee	To Kill a Mockingbird	8	2025-09-10
2	Harry	Black and White	5	2024-09-23
3	Johnson	Nature	3	2024-11-03
4	Ali	The Great Gatsby	7	2029-08-12
5	Charlie Puth	D2	6	2024-11-07
6	Harry	To Kill a Mockingbird	3	2020-05-18
7	Brown	Nature	3	2024-11-01

❖ View Member Management



MemberID	Name	E-Mail	Contact No.	MembershipCard...	Expiry Date
M001	Ali	alikhannnnnn@e...	1234567890	MC071	2024-11-04
M002	Bob	bob@example.c...	0987654321	MC071	2024-11-04
M004	Brown	bobb@example....	5566778899	MC004	2027-02-19
M005	Charlie Puth	charlied@examp...	6677889900	MC005	2026-11-30
M007	Harry	harry@gmail.com	087654332	MC007	2024-11-24
M008	Black	black@gmail.com	078976421	MC034	2024-11-24
M010	Wednesday	0101100001	thing@gmail.com	MC110	2021-02-15

❖ View Book Management



BookID	BookTitle	Author	Year Published	Genre
B001	The Great Gatsby	F. Scott Fitzgerald	1925	Fiction
B002	To Kill a Mockingb...	Harper Lee	1960	Fiction
B003	Physics	Perera	2024	Other Genres
B005	Nature	Namjoon	2021	Classics
B007	Black and White	Liam	2021	Adventurous
B008	D2	augustD	2024	Non-Fiction
B009	Diary of a wimpy kid	Chris Martin	2019	Fiction
B012	Operating System	Green	1988	Other Genres
B013	De	abc	2024	Children's Literature

12. References

- Java: The Complete Reference" by Herbert Schildt
- Oracle Java Documentation
- ▪ [Oracle Java Docs](#)
- W3 School
- Kadhem Tech youtube channel