EECS 447 Project

Conceptual Modeling
EECS 447

Version 1.3

Revision History

Date	Version	Description	Authors
02/07/25	1.0	Document creation, role assignment, and initial division of document sections.	Fatima Avila, Siddh Bharucha, Bhavik Goplani, Vy Luu, Suhaan Syed, Alexis Vielma
02/07/25	1.2	Brainstorming, ER Diagram creation	Fatima Avila, Siddh Bharucha, Bhavik Goplani, Vy Luu, Suhaan Syed, Alexis Vielma
03/16/25	1.1	Document finalization and revision of modeling and written sections.	Fatima Avila, Siddh Bharucha, Bhavik Goplani, Vy Luu, Suhaan Syed, Alexis Vielma

Database Requirements Specifications

1.   Introduction

The database will function as a Library Management System (LMS) designed to manage and organize physical content, including books, magazines, and digital media. Its primary purpose is to maintain book inventory by tracking borrowing and returns as well as store member information. The scope of this project focuses on content organization, search functionality and user interactions, but will not cover the reservation of conference/study rooms, display information about library events, or modification to membership accounts. By structuring the data efficiently, the system will enable an enhanced user experience for all members from borrowers to library staff.

Glossary:
- LMS (Library Management System): A software system designed to manage library resources, including books, digital media, memberships, and borrowing transactions.
- ISBN (International Standard Book Number): A unique numeric identifier assigned to books for classification and tracking.
- ISSN (International Standard Serial Number): A unique identifier for periodicals, such as magazines and journals.
- MariaDB: The specific DBMS selected for this project, compatible with MySQL, used to store and manage library records.
- Primary Key (PK): A unique identifier assigned to each record in a database table to ensure data integrity.
- Foreign Key (FK): A database field that links one table to another, maintaining relationships between entities.
- Authentication & Authorization: Security measures that control system access, ensuring that only authorized users can modify records or access sensitive data.
- Backup & Recovery: A strategy for storing copies of data to protect against data loss due to system failures or security breaches.

2.   ER Model Components

2.1.   Entities and Attributes

- **Member**
  - **Member_ID** *(PK, Integer)*
  - Name *(String)*
  - Contact_Info *(String)*
  - Membership_Type_ID *(FK, Integer)*
  - Account_Status *(Enum: Active, Suspended, Overdue)*
- **Membership_Type**
  - **Membership_Type_ID** *(PK, Integer)*
  - Type_Name *(String)*
  - Max_Borrow_Limit *(Integer)*
  - Fine_Rate *(Decimal)*
- **Library_Item** *(Superclass entity for Books, Magazines, Digital Media)*
  - **Item_ID** *(PK, Integer)*
  - Title *(String)*
  - Item_Type *(Enum: Book, Magazine, Digital Media)*
  - Availability_Status *(Enum: Available, On Loan, Reserved)*
- **Book** *(Subclass of Library_Item)*
  - **Book_ID** *(PK/FK Item_ID, Integer)*
  - ISBN *(String, Unique)*
  - Author *(String)*
  - Genre *(String)*
  - Publication_Year *(Integer)*
- **Digital_Media** *(Specialization of Library Item)*
  Media_ID *(PK, Integer)*
  - Creator *(String)*
  - Format *(Enum: eBook, Audiobook, Video, Other)*
- **Magazine** *(Specialization of Library Item)*
  - **Magazine_ID** *(PK, Integer)*
  - Issue_Number *(Integer)*
  - Publication_Date *(Date)*
- **Membership_Type**

- ○ **Type_ID** *(PK, Integer)*
- ○ Type_Name *(String: Regular, Student, Senior Citizen, etc.)*
- ○ Max_Borrow_Limit *(Integer)*
- ○ Fine_Rate *(Decimal)*

Membership Type	Max_Borrow_Limit	Fine_Rate ($/day)
Regular Member	5	$0.25
Student Member	15	$0.10
Senior Citizen Member	10	$0.15

- ● **Borrowing_Transaction**
  - ○ **Borrow_ID** *(PK, Integer)*
  - ○ Member_ID *(FK, Integer)*
  - ○ Item_ID *(FK, Integer)*
  - ○ Borrow_Date *(Date)*
  - ○ Due_Date *(Date)*
  - ○ Return_Date *(Date, nullable)*
  - ○ Fine_Incurred *(Decimal)*
- ● **Reservation**
  - ○ **Reservation_ID** *(PK, Integer)*
  - ○ Member_ID *(FK, Integer)*
  - ○ Item_ID *(FK, Integer)*
  - ○ Reservation_Date *(Date)*
  - ○ Expiry_Date *(Date)*
- ● **Payment**
  - ○ **Payment_ID** *(PK, Integer)*
  - ○ Member_ID *(FK, Integer)*
  - ○ Amount_Paid *(Decimal)*
  - ○ Payment_Date *(Date)*
- ● **Staff**
  - ○ **Staff_ID** *(PK, Integer)*
  - ○ Name *(String)*
  - ○ Role *(Enum: Librarian, Administrator, etc.)*
  - ○ Contact_Info *(String)*
- ● **Notification**

- ○ **Notification_ID** *(PK, Integer)*
- ○ Member_ID *(FK, Integer)*
- ○ Notification_Date *(DateTime)*
- ○ Notification_Type *(Enum: Reservation, Due Date Alert, Overdue Alert)*

2.2. Data Entities & Attributes

Entity	Attributes	Primary Key	Foreign Keys	Relationships
Members	Member ID, Name, Contact Info, Membership Type, Account Status	Member ID (PK)	Membership Type (FK)	Members borrow books, incur fines, and make reservations
Membership Types	Type ID, Type Name, Max Borrow Limit, Fine Rate	Type ID (PK)	-	Defines borrowing rules for members
Library Items	Item ID, Title, Type (Book/Digital/Magazine), Availability Status	Item ID (PK)	-	General table for all items
Books	Book ID (PK), Title, Author, ISBN, Genre, Publication Year, Status (Available/On Loan)	Book ID (PK)	Item ID (FK)	Inherits from Library Items
Digital Media	Media ID (PK), Title, Creator, Format, Availability Status	Media ID (PK)	Item ID (FK)	Inherits from Library Items
Magazines	Magazine ID (PK), Title, Issue Number, Publication Date, Status	Magazine ID (PK)	Item ID (FK)	Inherits from Library Items
Borrowing Transactions	Borrow ID, Member ID, Item ID, Borrow Date, Due Date, Return Date, Fine Incurred	Borrow ID (PK)	Member ID (FK), Item ID (FK)	Tracks check-outs and returns
Reservations	Reservation ID, Member ID, Item ID, Reservation Date, Expiry Date	Reservation ID (PK)	Member ID (FK), Item ID (FK)	Holds reservation details
Payments	Payment ID, Member ID, Amount Paid, Payment Date	Payment ID (PK)	Member ID (FK)	Tracks fines paid by users
Library staff	Staff ID (PK), Name, Role, Contact Info	Staff ID (PK)	-	

2.3. Relationships and multiplicities

Relationship	Entities and Multiplicity	Explanation
Has Type	Member (M) ↔ Membership Type (1)	Each member has exactly one Membership Type; one Membership Type can apply to many members.
Borrow	Member (1) ↔ (0..*) Borrowing_Transaction	Members can borrow many items; each borrowing transaction is tied to exactly one member and one item.
Item_Borrowed	Library_Item (1) ↔ (0...N) Borrowing_Transaction	Each Library Item can be borrowed multiple times (historical records).
Reserved_By	Library_Item (0...1) ↔ (0...N) Reservations	Items may have zero or more reservations; each reservation is for exactly one item and one member.
Reservation_Made_By	Member (1) ↔ (0...N) Reservations	Members can place multiple reservations.
Makes_Payment	Member (1) ↔ (0...N) Payments	Each payment is made by one member; members can make multiple payments.
Sends_Notification	Member (1) ↔ (0...N) Notifications	Members can receive multiple notifications (e.g., overdue alerts, reservation status).
Managed_By	Borrowing_Transaction (0...N) ↔ (1) Staff	Each transaction (borrowing/returning) can be processed by exactly one staff; staff handle multiple transactions.

2.4. Key Constraints & Data Integrity

- Each `Member` has exactly one `Membership_Type`.
- Borrowing is constrained by the `Membership_Type`'s max borrowing limit.
- Library items have their availability status dynamically updated by borrowing transactions.
- Reservations have expiration constraints (expiry date after which reservation is invalid).
- Payments update `Member` account status (active/suspended due to unpaid fines).
- Fine calculations based on overdue days and fine rates defined in the membership type..
- **Reservations:** only allowed for items currently unavailable.
- Notifications are triggered automatically by item status and borrowing events.
- Librarians (staff) have administrative privileges for item and member record management.
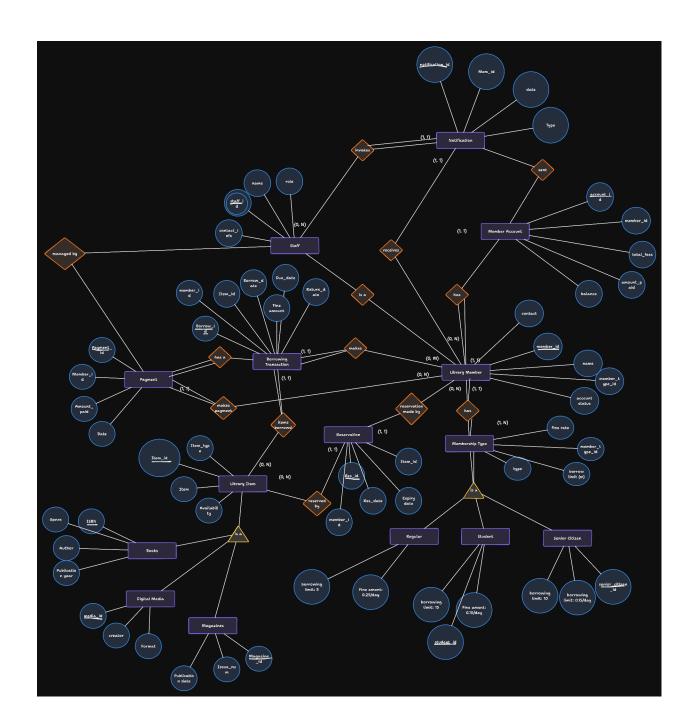
- Access to borrowing history, fine reports, and member activity restricted based on roles (Staff vs. Member).

3. ER Model

Link to a pdf version: [PDF](#)

4. Appendix

- [Project Vision & Plan](): please refer to project plan and vision document for more background
- [Project Requirements & Constraints:]() please refer to project requirements document for more requirements & constraints
- [ER Diagram:]() please refer to ER diagram link for a clearer version of er diagram

5. **Github Repository**

- Link: https://github.com/aelxxs/tech-titans