TechTitans

Library Management System
Database Requirements Specifications
EECS 447

Version 1.0

Revision History

Date	Version	Description	Authors
02/27/25	1.0	Document creation, role assignment, and initial division of document sections.	Fatima Avila, Siddh Bharucha, Bhavik Goplani, Vy Luu, Suhaan Syed, Alexis Vielma
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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. Stakeholders

1. **Library Staff (Administrators & Librarians)**
    - Oversee library operations, manage users, and maintain inventory.
    - Process book check-outs, returns, and overdue fine collection.
    - Generate reports on borrowing trends and member activity.
2. **Library Members (Users)**
    - Borrow, return, and reserve books or digital media.
    - View borrowing history, due dates, and outstanding fines.
    - Receive notifications about due dates, availability, and membership status.
3. **Library Management (Decision Makers)**
    - Monitor system efficiency and financial reports.
    - Adjust policies such as borrowing limits, late fee rates, and membership fees.
4. **IT & Database Administrators**
    - Maintain the system's security, database integrity, and performance.
    - Ensure data backup and disaster recovery mechanisms are in place.
5. **Developers (Project Team - Tech Titans)**
    - Design and implement the database structure.
    - Develop and optimize queries, stored procedures, and triggers.
    - Ensure the web-based user interface aligns with system needs.
6. **Additional Stakeholders:**
    - For the purpose of this assignment, our stakeholders will be professor and TA's

3. Requirements

3.1. Functional Requirements

These are essential database functions that must be implemented.

User & Membership Management

- Store user information: Unique ID, name, contact info, membership type
- Support multiple membership types: Regular, student, senior citizen, etc.
- Enforce borrowing limits and fees based on membership type (regular, student, senior citizen)

- Maintain **account status** (active, suspended, overdue fees):

Book & Digital Media Management

- Store book attributes: title, author, ISBN, publication year, genre, status (available/on-loan)
- Include magazines and digital media with attributes like issue number, publication date
- Allow addition, deletion, and modification of items by librarians
- Ensure real-time updates to availability status

Borrowing & Returning Process

- Allow members to borrow books within their membership limits
- Track borrow date, return due date, late fees dynamically
- Support renewals if allowed by membership type
- Maintain borrowing history for analysis and reporting

Reservations & Notifications

- Members can reserve books that are currently on loan
- Notify members when reserved books become available
- Send alerts for due dates, overdue books, reservation status

Fines & Payments

- Automatically calculate late fees based on overdue days
- Allow members to pay fines and update account status
- Generate fee reports for revenue tracking

Reporting & Analytics

- Generate borrowing trends (most borrowed books, popular genres)
- List members with overdue books and their fines
- Provide collection analysis (books with low circulation, old books)
- Identify frequent borrowers and membership activity
- Monthly revenue reports from fines and membership fees

Security & Access Control

- Librarians have admin privileges (modify records, generate reports)
- Members have restricted access (view books, borrow, reserve)
- Implement authentication & authorization for secure access

3.2. Data Entities & Attributes

The database will contain the following key entities:

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)	-	

3.3. Non-Functional Requirements

These define system performance, security, and constraints.

- **Performance Metrics**
    - Response time for queries (e.g., book search) should be <1 second.
    - Borrowing and returning transactions should process within 2 seconds.
    - System should support concurrent users without performance degradation.
- **Security & Compliance**
    - Implement role-based access control (RBAC) for staff and members.
    - Encrypt sensitive data (e.g., user contact details).
    - Ensure compliance with data privacy laws (e.g., GDPR, CCPA).
    - Regular database backups to prevent data loss.
- **Scalability & Future Expansion**
    - Databases should support multiple library branches in the future.
    - Ensure the system can handle 100,000+ books and 10,000+ users.
    - Optimize queries and indexing for efficient searches.
- **Usability & Accessibility**
    - User-friendly web interface for staff and members.
    - System must be mobile-responsive for easy access.
    - Provide multi-language support (optional future enhancement).

4. Hardware and Software Requirements

Software Requirements:

- **Database Management System (DBMS):** MariaDB 10.x
    - Purpose: Selected for its advanced features, compatibility with MySQL, and robust performance, ideal for complex database applications like a streaming service.
    - Deployment: To be installed and managed on EECS department servers.

Hardware Requirements:

- **Server Hardware:**
    - Location: Hosted on EECS department servers.
    - Processor: Recommended Intel Xeon CPU E5-2630 v4 @ 2.20GHz or better.
    - Memory: At least 16 GB RAM, with 32 GB recommended for optimal performance.
    - Storage: Minimum 500 GB SSD, preferably with RAID configuration for data redundancy and enhanced performance.
    - Network: Gigabit Ethernet for reliable high-speed data transfer.

Connectivity and Security:

- Access: Secure VPN access to EECS servers for database management and maintenance.
- Security Configurations:
    - Firewall: Configured to allow traffic through MariaDB-specific ports while securing others.
    - Encryption: SSL/TLS protocols implemented for secure data transmission.

Data Management and Compliance:

- Backup Solutions: Regular scheduled backups both locally on additional EECS server storage and optionally, cloud storage for enhanced data safety.
- Monitoring and Maintenance:
    - Tools: Use of tools like Nagios or Grafana to monitor server and database performance.
    - Compliance: All setups to comply with university's IT security policies and legal requirements concerning data handling.

5. Appendix

- Project Vision & Plan: please refer to project plan and vision document for more background

6. Github Repository

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