Library Database Management System Logical Relational Model

1. Introduction

Project Overview

The Library Database Management System (LDBMS) is developed to increase the productivity and organization of library management. The system will manage book and digital media management, membership management, borrowing processes, and reporting. By implementing a structured and automated process, the LDBMS will improve user experience, reduce administrative tasks, and ensure accurate record-keeping, providing a more accessible and easier-to-use library system.

Scope

The LDBMS will cover:

- Management of library inventory, including books, digital media, and magazines.
- Tracking of client memberships, borrowing limits, and fees.
- Implementation of borrowing, returning, and reservation functionalities.
- Generation of various reports related to borrowing trends, overdue items, and revenue collection.

Glossary

- **LDBMS**: Library Management System
- **ISBN**: International Standard Book Number
- **UUID**: Universally unique identifier
- **Client**: A registered library member
- **Items**: Books, digital media, and magazines available for borrowing
- **Books and digital media** have the same attributes/ similar attributes
- **Digital media** can be music CDs, audio books, movies, video games, and shows

2. Relational Schema Mapping

2.1 Identified Relations

Relation	Attributes

Users	Username (Primary Key), Role, Password, Deleted
Client	ClientId (Primary Key), Username (Foreign Key), Name, Phone Number, Membership Type, use, Late Fee Rate, Account Status
Library Admin	AdminId (Primary Key), Username (Foreign Key), Name, Phone Number, Account Status
Item	Item Id (Primary Key), Title, Rarity, Availability Status, Max Borrow Days, Renewal Allowed
Item Genre	Item Id (Foreign Key), Genre Id (Foreign Key)
Genre	Gene Id, Name
Book	Item Id(Foreign Key), ISBN, Author, Publication Year
Digital Media	Item Id (Foreign Key), Type, Creator, Genre
Magazine	ID (Primary Key), Issue Number, Publication Date, Latest
Borrowing	Transaction Id (Primary Key), Client ID (Foreign Key), Item ID (Foreign Key), Borrow Date, Due Date, Return Date
Reservation	Reservation Id (Primary Key), Client Id (Foreign Key), Item Id (Foreign Key), Reservation Date
Fees	Fee Id (Primary Key), Transaction Id (Foreign Key), Amount, Due Date, Payment Status

2.2 Relations, Attributes, and Primary Keys

USERS (UserId, Email, Role, Password, Deleted)
   Primary Key: UserId

CLIENT (ClientId, Username, Name, PhoneNumber, MembershipType, BorrowLimit, LateFeeRate, AccountStatus)
   Primary Key: ClientId
   Foreign Key: Username references USERS(Username) on update CASCADE on delete CASCADE

LIBRARY_ADMIN (AdminId, Username, Name, PhoneNumber, AccountStatus)

Primary Key: AdminId
Foreign Key: Username references USERS(Username)

ITEM (ItemId, Title, Rarity, AvailabilityStatus, MaxBorrowDays, RenewalAllowed)
Primary Key: ItemId

GENRE (GenreId, Name)
Primary Key: GenreId

ITEM_GENRE (ItemId, GenreId)
Primary Key: (ItemId, GenreId)
Foreign Key: ItemId references ITEM(ItemId) on update CASCADE on delete CASCADE

Foreign Key: GenreId references GENRE(GenreId) on update CASCADE on delete CASCADE

BOOK (ItemId, ISBN, Author, PublicationYear)
Primary Key: ItemId
Foreign Key: ItemId references ITEM(ItemId) on update CASCADE on delete CASCADE

DIGITAL_MEDIA (ItemId, Type, Creator)
Primary Key: ItemId
Foreign Key: ItemId references ITEM(ItemId) on update CASCADE on delete CASCADE

MAGAZINE (ItemId, IssueNumber, PublicationDate, Latest)
Primary Key: ItemId
Foreign Key: ItemId references ITEM(ItemId) on update CASCADE on delete CASCADE

BORROWING (TransactionId, ClientId, ItemId, BorrowDate, DueDate, ReturnDate)
Primary Key: TransactionId
Foreign Key: ClientId references CLIENT(ClientId) on update CASCADE on delete CASCADE

Foreign Key: ItemId references ITEM(ItemId) on update CASCADE on delete CASCADE

RESERVATION (ReservationId, ClientId, ItemId, ReservationDate, Status)
Primary Key: ReservationId
Foreign Key: ClientId references CLIENT(ClientId) on update CASCADE on delete CASCADE

Foreign Key: ItemId references ITEM(ItemId) on update CASCADE on delete CASCADE

FEES (FeeId, TransactionId, Amount, DueDate, PaymentStatus)
Primary Key: FeeId
Foreign Key: TransactionId references BORROWING(TransactionId) on update CASCADE on delete CASCADE

ADMIN_MANAGES_ITEM (AdminId, ItemId)
Primary Key: (AdminId, ItemId)
Foreign Key: AdminId references LIBRARY_ADMIN(AdminId) on update CASCADE on delete CASCADE

Foreign Key: ItemId references ITEM(ItemId) on update CASCADE on delete CASCADE

ADMIN_MANAGES_CLIENT (AdminId, ClientId)
Primary Key: (AdminId, ClientId)
Foreign Key: AdminId references LIBRARY_ADMIN(AdminId) on update CASCADE on delete CASCADE
Foreign Key: ClientId references CLIENT(ClientId) on update CASCADE on delete CASCADE

2.3 Functional Dependencies

USERS:
Username → Role, Password, Deleted

CLIENT:
ClientId → Username, Name, PhoneNumber, MembershipType, BorrowLimit, LateFeeRate, AccountStatus

MembershipType → BorrowLimit, LateFeeRate

LIBRARY_ADMIN:
AdminId → Username, Name, PhoneNumber, AccountStatus

ITEM:

ItemId → Title, Rarity, AvailabilityStatus, MaxBorrowDays, RenewalAllowed

Rarity → MaxBorrowDays

GENRE:
GenreId → Name

BOOK:
ItemId → ISBN, Author, PublicationYear

ISBN → ItemId

DIGITAL_MEDIA:
ItemId → Type, Creator

MAGAZINE:
ItemId → IssueNumber, PublicationDate, Latest

BORROWING:
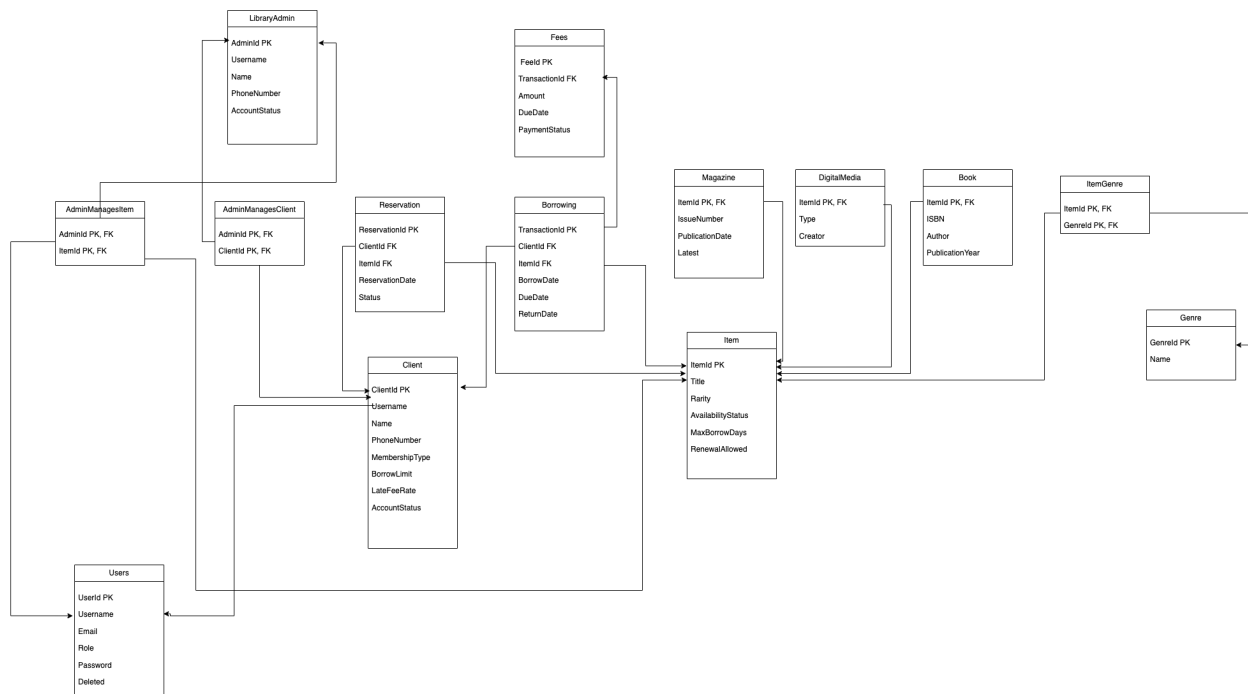TransactionId → ClientId, ItemId, BorrowDate, DueDate, ReturnDate

RESERVATION:
ReservationId → ClientId, ItemId, ReservationDate, Status

FEES:
FeeId → TransactionId, Amount, DueDate, PaymentStatus

3. Relational Schema Diagram

4. Data Dictionary

Attribute	Data Type	Constraints	Description
UserId	UUID	Not null	Unique identifier for finding user in database
Email	VARCHAR(50)	Not null	Unique identifier for user login
Role	VARCHAR(20)	Not null	User's role in the system
Password	VARCHAR(255)	Not null	Hashed password
Deleted	BOOLEAN	Not null	Flag indicating if account is deleted
ClientId	UUID	Not null	Unique identifier for client
Name	VARCHAR(100)	Not null	Full name of client/admin
PhoneNumber	VARCHAR(15)	Can be null	Contact number
MembershipType	VARCHAR(20)	Not null	Type of membership
BorrowLimit	INT	Not null	Maximum items allowed to borrow
LateFeeRate	DECIMAL(5,2)	Not null	Daily fee rate for late returns

AccountStatus	VARCHAR(20)	Not null	Current status of account
AdminId	UUID	Not null	Unique identifier for admin
ItemId	UUID	Not null	Unique identifier for item
Title	VARCHAR(255)	Not null	Title of the item
Rarity	VARCHAR(20)	Not null	Rarity classification
AvailabilityStatus	VARCHAR(20)	Not null	Current status of item
MaxBorrowDays	INT	Can be null	Maximum days allowed for borrowing
RenewalAllowed	BOOLEAN	Not null	Whether renewal is allowed
GenreId	UUID	Not null	Unique identifier for genre
ISBN	VARCHAR(20)	Not Null	International Standard Book Number
Author	VARCHAR(100)	Not Null	Author's name
PublicationYear	INT	Not nul	Year of publication
Type	VARCHAR(20)	Not null	Type of digital media
Creator	VARCHAR(100)	Not null	Creator of digital media

IssueNumber	VARCHAR(20)	Not null	Issue number or identifier
PublicationDate	DATE	Not null	Date of publication
Latest	BOOLEAN	Not null	Flag indicating if it's the latest issue
TransactionId	UUID	Not null	Unique identifier for transaction
BorrowDate	DATE	Can be null	Date of borrowing
DueDate	DATE	Not null	Date item is due
ReturnDate	DATE	Not null	Date item was returned
ReservationId	UUID	Not null	Unique identifier for reservation
ReservationDate	DATE	Can be null	Date of reservation
Status	VARCHAR(20)	Not null	Status of reservation
FeeId	UUID	Not null	Unique identifier for fee
Amount	DECIMAL(10,2)	Not null	Fee amount
PaymentStatus	VARCHAR(20)	Not null	Status of payment