LibVault

Physical Database Design

Version 1

4/27/2025

1. Introduction

1.1 Project Overview

LibVault is a relational database system designed to execute library operations efficiently and in a user-friendly manner. It allows for the organization of loanable items, enforces borrowing policies, tracks user memberships, and generates reports in a manner that is useful for both staff and the clientele.

1.2 Scope

LibVault's Library Management System will cover library operations such as Book & Digital Media Management, Membership Management, Borrowing & Returns, and Reservations & Notifications. It will automate tracking of loans, returns, and overdue items, while also generating reports to support data-driven decision-making. The program will include the creation of an ER model, a relational schema, and an SQL-based database with realistic records. However, the project does not include the development of a front-end user interface or integration with external library systems at this stage.

1.3 Glossary

- **Database Management System (DBMS):** Software used to create and manage databases, ensuring structured data storage and retrieval.
- **ER Model (Entity-Relationship Model):** A diagram representation of entities and their relationships in a database.
- **SQL (Structured Query Language):** A programming language used for managing and querying relational databases.
- **Primary Key:** A unique identifier for a record in a database table.
- **ISBN (International Standard Book Number):** A unique identifier assigned to books and other publications.
- **Role-Based Access Control (RBAC):** A security model that restricts access based on user roles.
- **Overdue Tracking:** The process of monitoring items that have not been returned by their due date.
- **Reservations:** A system that allows patrons to place holds on unavailable items.
- **SSL/TLS (Secure Sockets Layer/Transport Layer Security):** Cryptographic protocols that provide secure communication over a network.
- **SSH (Secure Shell):** A network protocol that allows secure access to remote computers.

2. Platform

We decided upon using MariaDB on the EECS cycle servers to host our database as that was the most readily available to all team members and all team members had experience with it beforehand.

3. Database Creation

Located in the code/Database directory

4. Physical Schema

```
CREATE DATABASE LibVault;
USE LibVault;

-- Table: Client
CREATE TABLE Client (
    MemberID CHAR(10) PRIMARY KEY,
    Name VARCHAR(100),
    PhoneNumber VARCHAR(15),
    MembershipType CHAR(15),
    AccountStatus CHAR(10)
);

-- Table: Media
CREATE TABLE Media (
    ISBN CHAR(13) PRIMARY KEY,
    MediaID CHAR(10),
    Title VARCHAR(100),
    Author VARCHAR(100),
    PublicationYear CHAR(4),
    Genre VARCHAR(50),
    AvailabilityStatus CHAR(15),
    Type VARCHAR(50)
);

-- Table: Reservation
CREATE TABLE Reservation (
    ReservationID CHAR(10) PRIMARY KEY,
    ReservationDate DATE,
    ExpirationDate DATE,
    MemberID CHAR(10),
    FOREIGN KEY (MemberID) REFERENCES Client(MemberID)
```

```
);

-- Table: Report
CREATE TABLE Report (
    ReportID CHAR(10) PRIMARY KEY,
    OverdueFee FLOAT(5,2),
    MemberID CHAR(10),
    FOREIGN KEY (MemberID) REFERENCES Client(MemberID)
);

-- Table: Reserves
CREATE TABLE Reserves (
    ReservationID CHAR(10),
    ISBN CHAR(13),
    PRIMARY KEY (ReservationID, ISBN),
    FOREIGN KEY (ReservationID) REFERENCES
Reservation(ReservationID),
    FOREIGN KEY (ISBN) REFERENCES Media(ISBN)
);

-- Table: Analyzes
CREATE TABLE Analyzes (
    ReportID CHAR(10),
    ReservationID CHAR(10),
    PRIMARY KEY (ReportID, ReservationID),
    FOREIGN KEY (ReportID) REFERENCES Report(ReportID),
    FOREIGN KEY (ReservationID) REFERENCES Reservation(ReservationID)
);

-- Table: Purchases
CREATE TABLE Purchases (
    PurchaseID CHAR(10) PRIMARY KEY,
    MemberID CHAR(10),
    ISBN CHAR(13),
    FOREIGN KEY (MemberID) REFERENCES Client(MemberID),
    FOREIGN KEY (ISBN) REFERENCES Media(ISBN)
);
```

5. Data Population

Done Manually:

```
USE LibVault;

-- Insert Clients
INSERT INTO Client VALUES
('C0001', 'Alice Johnson', '123-456-7890', 'Regular', 'Active'),
('C0002', 'Bob Smith', '234-567-8901', 'Student', 'Active'),
('C0003', 'Clara Zane', '345-678-9012', 'Administrator',
'Suspended');

-- Insert Media
INSERT INTO Media VALUES
('9780134685991', 'M0001', 'Effective Java', 'Joshua Bloch', '2018',
'Non-fiction', 'Available', 'Book'),
('9780262033848', 'M0002', 'Introduction to Algorithms', 'Thomas H.
Cormen', '2009', 'Non-fiction', 'On Hold', 'Book'),
('9780596009205', 'M0003', 'Head First Java', 'Kathy Sierra', '2005',
'Fiction', 'Reserved', 'Book');

-- Insert Reservations
INSERT INTO Reservation VALUES
('R0001', '2025-04-01', '2025-04-15', 'C0001'),
('R0002', '2025-04-02', '2025-04-16', 'C0002');

-- Insert Reports
INSERT INTO Report VALUES
('RP0001', 5.50, 'C0001'),
('RP0002', 0.00, 'C0002');

-- Insert Reserves
INSERT INTO Reserves VALUES
('R0001', '9780134685991'),
('R0002', '9780262033848');

-- Insert Analyzes
INSERT INTO Analyzes VALUES
('RP0001', 'R0001'),
('RP0002', 'R0002');

-- Insert Purchases
INSERT INTO Purchases VALUES
('P0001', 'C0001', '9780596009205'),
('P0002', 'C0002', '9780134685991');
```

5. Table Contents

Located in tablecontents.txt in the code/Database directory, also provided below:

```
-- Output of SELECT * FROM Client;
+-----------+-----------------+--------------+----------------+---------------+
| MemberID  | Name            | PhoneNumber  | MembershipType | AccountStatus |
+-----------+-----------------+--------------+----------------+---------------+
| C0001     | Alice Johnson   | 123-456-7890 | Regular        | Active        |
| C0002     | Bob Smith       | 234-567-8901 | Student        | Active        |
| C0003     | Clara Zane      | 345-678-9012 | Administrator  | Suspended     |
+-----------+-----------------+--------------+----------------+---------------+

-- Output of SELECT * FROM Media;
+------------+-----------+---------------------------+------------------+---------------+-----------------+-------------------+--------+
| ISBN       | MediaID   | Title                     | Author           | PublicationYear | Genre           | AvailabilityStatus| Type   |
+------------+-----------+---------------------------+------------------+---------------+-----------------+-------------------+--------+
| 9780134685991 | M0001  | Effective Java            | Joshua Bloch     | 2018          | Non-fiction     | Available         | Book   |
| 9780262033848 | M0002  | Introduction to Algorithms | Thomas H. Cormen | 2009          | Non-fiction     | On Hold           | Book   |
| 9780596009205 | M0003  | Head First Java           | Kathy Sierra     | 2005          | Fiction         | Reserved          | Book   |
+------------+-----------+---------------------------+------------------+---------------+-----------------+-------------------+--------+

-- Output of SELECT * FROM Reservation;
+---------------+-----------------+-----------------+-----------+
| ReservationID | ReservationDate | ExpirationDate | MemberID |
+---------------+-----------------+-----------------+-----------+
| R0001         | 2025-04-01      | 2025-04-15      | C0001     |
| R0002         | 2025-04-02      | 2025-04-16      | C0002     |
+---------------+-----------------+-----------------+-----------+

-- Output of SELECT * FROM Report;
+-----------+------------+-----------+
| ReportID  | OverdueFee | MemberID  |
+-----------+------------+-----------+
| RP0001    | 5.50       | C0001     |
| RP0002    | 0.00       | C0002     |
+-----------+------------+-----------+

-- Output of SELECT * FROM Reserves;
+---------------+------------+
| ReservationID | ISBN       |
+---------------+------------+
| R0001         | 9780134685991 |
| R0002         | 9780262033848 |
+---------------+------------+

-- Output of SELECT * FROM Analyzes;
+-----------+---------------+
| ReportID  | ReservationID |
+-----------+---------------+
| RP0001    | R0001         |
| RP0002    | R0002         |
+-----------+---------------+

-- Output of SELECT * FROM Purchases;
+------------+-----------+------------+
| PurchaseID | MemberID | ISBN       |
+------------+-----------+------------+
| P0001      | C0001     | 9780596009205 |
| P0002      | C0002     | 9780134685991 |
+------------+-----------+------------+
```