PHYSICAL DATABASE DESIGN

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Table of Contents

Introduction

Please note that the content of this document may be changed throughout the project's development.

Project Overview

The purpose of this database is to manage, track, and generate various reports of the operations and inventory of a small library.

Scope

From our original project plan:

> "This project encompasses the end-to-end creation of a relational database system tailored for a small library. Specifically, it includes analyzing library requirements, designing data models, implementing the schema in a DBMS, and setting up the rules for borrowing and membership management. The database will track a variety of loanable items, enforce borrowing restrictions, and provide meaningful reports to support library operations."

Glossary

- DBMS: Database Management System
- SQL: Structured Query Language
- PK: Primary Key
- FK: Foreign Key
- IDE: Integrated Development Environment
- ER: Entity-Relationship

Platform Decision

We chose to utilize MariaDB as our database platform. We made this decision because we

Physical Schema

All of our schema files can be found in our GitHub repository in the “sql” folder, but they can be found here as well.

```
MariaDB [447s25_r980m174]> show tables;
+--------------------------+
| Tables_in_447s25_r980m174 |
+--------------------------+
| account_status           |
| author                   |
| fee                      |
| fee_status               |
| genre                    |
| media_item               |
| media_type               |
| membership_type          |
| transaction              |
| user                     |
+--------------------------+
10 rows in set (0.000 sec)
```

account_status

```
CREATE TABLE account_status (
    account_status_id INT NOT NULL AUTO_INCREMENT PRIMARY KEY,
    status_name VARCHAR(50) NOT NULL UNIQUE,
    status_description VARCHAR(255) NOT NULL
);
```

```
MariaDB [447s25_r980m174]> describe account_status;
+------------------+-------------+------+-----+---------+----------------+
| Field            | Type        | Null | Key | Default | Extra          |
+------------------+-------------+------+-----+---------+----------------+
| account_status_id | int(11)     | NO   | PRI | NULL    | auto_increment |
| status_name      | varchar(50) | NO   | UNI | NULL    |                |
+------------------+-------------+------+-----+---------+----------------+
2 rows in set (0.001 sec)
```

author

```
CREATE TABLE author(
    author_id INT NOT NULL PRIMARY KEY AUTO_INCREMENT,
    first_name NVARCHAR(100) NOT NULL,
```

```
    last_name NVARCHAR(100) NOT NULL
);
```

```
MariaDB [447s25_r980m174]> describe author;
+------------+--------------+------+-----+---------+----------------+
| Field      | Type         | Null | Key | Default | Extra          |
+------------+--------------+------+-----+---------+----------------+
| author_id  | int(11)      | NO   | PRI | NULL    | auto_increment |
| first_name | varchar(100) | NO   |     | NULL    |                |
| last_name  | varchar(100) | NO   |     | NULL    |                |
+------------+--------------+------+-----+---------+----------------+
3 rows in set (0.001 sec)
```

fee_status

```
CREATE TABLE fee_status (
    fee_status_id INT NOT NULL AUTO_INCREMENT PRIMARY KEY,
    name NVARCHAR(50) NOT NULL,
    description NVARCHAR(300)
);
```

```
MariaDB [447s25_r980m174]> describe fee_status;
+---------------+--------------+------+-----+---------+----------------+
| Field         | Type         | Null | Key | Default | Extra          |
+---------------+--------------+------+-----+---------+----------------+
| fee_status_id | int(11)      | NO   | PRI | NULL    | auto_increment |
| name          | varchar(50)  | NO   |     | NULL    |                |
| description   | varchar(300) | YES  |     | NULL    |                |
+---------------+--------------+------+-----+---------+----------------+
3 rows in set (0.001 sec)
```

fee

```
CREATE TABLE fee (
    fee_id INT NOT NULL AUTO_INCREMENT PRIMARY KEY,
    user_id INT NOT NULL,
    date_issued DATETIME NOT NULL,
    amount DECIMAL(10, 2) NOT NULL,
    fee_status_id INT NOT NULL,
    CONSTRAINT `fk_user_id` FOREIGN KEY (user_id) REFERENCES user(user_id),
    CONSTRAINT `fk_fee_status_id` FOREIGN KEY (fee_status_id) REFERENCES
fee_status(fee_status_id)
);
```

```
MariaDB [447s25_r980m174]> describe fee;
+---------------+---------------+------+-----+---------+----------------+
| Field         | Type          | Null | Key | Default | Extra          |
+---------------+---------------+------+-----+---------+----------------+
| fee_id        | int(11)       | NO   | PRI | NULL    | auto_increment |
| user_id       | int(11)       | NO   | MUL | NULL    |                |
| date_issued   | datetime      | NO   |     | NULL    |                |
| amount        | decimal(10,2) | NO   |     | NULL    |                |
| fee_status_id | int(11)       | NO   | MUL | NULL    |                |
+---------------+---------------+------+-----+---------+----------------+
5 rows in set (0.001 sec)
```

genre

```
CREATE TABLE genre(
    genre_id INT NOT NULL PRIMARY KEY AUTO_INCREMENT,
    `name` NVARCHAR(50) NOT NULL CHECK (LENGTH(name) >= 1)
);
```

```
MariaDB [447s25_r980m174]> describe genre;
+----------+-------------+------+-----+---------+----------------+
| Field    | Type        | Null | Key | Default | Extra          |
+----------+-------------+------+-----+---------+----------------+
| genre_id | int(11)     | NO   | PRI | NULL    | auto_increment |
| name     | varchar(50) | NO   |     | NULL    |                |
+----------+-------------+------+-----+---------+----------------+
2 rows in set (0.001 sec)
```

media_item

```
CREATE TABLE media_item (
    media_id INT NOT NULL AUTO_INCREMENT PRIMARY KEY,
    author_id INT,
    genre_id INT,
    media_type_id INT,
    title VARCHAR(255) NOT NULL CHECK (CHAR_LENGTH(title) >= 1),
    publication_year INT NOT NULL CHECK (publication_year BETWEEN 0 AND 2025),
    availability TINYINT NOT NULL CHECK (availability IN (0, 1)),
    isbn VARCHAR(13) NOT NULL CHECK (CHAR_LENGTH(isbn) = 13 AND isbn REGEXP
'^(978|979)[0-9]+$'),

    CONSTRAINT `fk_author_id` FOREIGN KEY (author_id) REFERENCES
author(author_id),
    CONSTRAINT `fk_genre_id` FOREIGN KEY (genre_id) REFERENCES genre(genre_id),
    CONSTRAINT `fk_media_type_id` FOREIGN KEY (media_type_id) REFERENCES
media_type(media_type_id),
    CONSTRAINT unique_isbn UNIQUE (isbn)
```

```
);
```

```
MariaDB [447s25_r980m174]> describe media_item;
+------------------+--------------+------+-----+---------+----------------+
| Field            | Type         | Null | Key | Default | Extra          |
+------------------+--------------+------+-----+---------+----------------+
| media_id         | int(11)      | NO   | PRI | NULL    | auto_increment |
| author_id        | int(11)      | YES  | MUL | NULL    |                |
| genre_id         | int(11)      | YES  | MUL | NULL    |                |
| media_type_id    | int(11)      | YES  | MUL | NULL    |                |
| title            | varchar(255) | NO   |     | NULL    |                |
| publication_year | int(11)      | NO   |     | NULL    |                |
| availability     | tinyint(4)   | NO   |     | NULL    |                |
| isbn             | varchar(13)  | NO   | UNI | NULL    |                |
+------------------+--------------+------+-----+---------+----------------+
8 rows in set (0.001 sec)
```

media_type

```
CREATE TABLE media_type (
    media_type_id INT NOT NULL PRIMARY KEY AUTO_INCREMENT,
    media_type_name VARCHAR(50) NOT NULL CHECK (CHAR_LENGTH(media_type_name) >=
1)
);
```

```
MariaDB [447s25_r980m174]> describe media_type;
+-----------------+-------------+------+-----+---------+----------------+
| Field           | Type        | Null | Key | Default | Extra          |
+-----------------+-------------+------+-----+---------+----------------+
| media_type_id   | int(11)     | NO   | PRI | NULL    | auto_increment |
| media_type_name | varchar(50) | NO   |     | NULL    |                |
+-----------------+-------------+------+-----+---------+----------------+
2 rows in set (0.001 sec)
```

membership_type

```
CREATE TABLE membership_type(
    membership_type_id INT NOT NULL PRIMARY KEY AUTO_INCREMENT,
    membership_type_name NVARCHAR(50) NOT NULL CHECK
(LENGTH(membership_type_name) >= 1),
    membership_description NVARCHAR(300) NOT NULL CHECK
(LENGTH(membership_description) >= 1),
    borrowing_limit INT NOT NULL CHECK (0 <= borrowing_limit <= 50)
);
```

```
MariaDB [447s25_r980m174]> describe membership_type;
+-------------------------+--------------+------+-----+---------+----------------+
| Field                   | Type         | Null | Key | Default | Extra          |
+-------------------------+--------------+------+-----+---------+----------------+
| membership_type_id      | int(11)      | NO   | PRI | NULL    | auto_increment |
| membership_type_name    | varchar(50)  | NO   |     | NULL    |                |
| membership_description  | varchar(300) | NO   |     | NULL    |                |
| borrowing_limit         | int(11)      | NO   |     | NULL    |                |
+-------------------------+--------------+------+-----+---------+----------------+
4 rows in set (0.001 sec)
```

transaction

```
CREATE TABLE `transaction` (
    transaction_id INT AUTO_INCREMENT PRIMARY KEY,
    user_id INT NOT NULL,
    media_id INT NOT NULL,
    checkout_date DATE NOT NULL,
    due_date DATE NOT NULL,
    return_date DATE,

    FOREIGN KEY (user_id) REFERENCES user(user_id),
    FOREIGN KEY (media_id) REFERENCES media_item(media_id)
);
```

```
MariaDB [447s25_r980m174]> describe transaction;
+----------------+---------+------+-----+---------+----------------+
| Field          | Type    | Null | Key | Default | Extra          |
+----------------+---------+------+-----+---------+----------------+
| transaction_id | int(11) | NO   | PRI | NULL    | auto_increment |
| user_id        | int(11) | NO   | MUL | NULL    |                |
| media_id       | int(11) | NO   | MUL | NULL    |                |
| checkout_date  | date    | NO   |     | NULL    |                |
| due_date       | date    | NO   |     | NULL    |                |
| return_date    | date    | YES  |     | NULL    |                |
+----------------+---------+------+-----+---------+----------------+
6 rows in set (0.001 sec)
```

user

```
CREATE TABLE user(
    user_id INT NOT NULL PRIMARY KEY AUTO_INCREMENT,
    membership_type_id INT NOT NULL,
    account_status_id INT NOT NULL,
    first_name NVARCHAR(100) NOT NULL CHECK (LENGTH(first_name) >= 1),
```

```
    last_name NVARCHAR(100) NOT NULL CHECK (LENGTH(first_name) >= 1),
    email NVARCHAR(320) NOT NULL CHECK (email LIKE '%@__%.%'),
    phone NVARCHAR(10) NOT NULL CHECK (LENGTH(phone) = 10 and phone REGEXP '^[0-
9]+$'),
    is_staff BIT NOT NULL,

    CONSTRAINT `fk_membership_type_id` FOREIGN KEY (membership_type_id)
REFERENCES membership_type(membership_type_id), -- Need to wait until this table
is in
    CONSTRAINT `fk_account_status_id` FOREIGN KEY (account_status_id) REFERENCES
account_status(account_status_id) -- Need to wait until this table is in
);
```

```
MariaDB [447s25_r980m174]> describe user;
+-------------------+-------------+------+-----+---------+----------------+
| Field             | Type        | Null | Key | Default | Extra          |
+-------------------+-------------+------+-----+---------+----------------+
| user_id           | int(11)     | NO   | PRI | NULL    | auto_increment |
| membership_type_id | int(11)     | NO   | MUL | NULL    |                |
| account_status_id | int(11)     | NO   | MUL | NULL    |                |
| first_name        | varchar(100) | NO   |     | NULL    |                |
| last_name         | varchar(100) | NO   |     | NULL    |                |
| email             | varchar(320) | NO   |     | NULL    |                |
| phone             | varchar(10) | NO   |     | NULL    |                |
| is_staff          | bit(1)      | NO   |     | NULL    |                |
+-------------------+-------------+------+-----+---------+----------------+
8 rows in set (0.001 sec)
```

Database Contents

account_status

```
MariaDB [447s25_r980m174]> select * from account_status;
+-------------------+-------------+
| account_status_id | status_name |
+-------------------+-------------+
|                 3 | Banned      |
|                 1 | New         |
|                 2 | Regular     |
+-------------------+-------------+
3 rows in set (0.000 sec)
```

author

```
MariaDB [447s25_r980m174]> select * from author;
+-----------+-------------+-------------+
| author_id | first_name  | last_name   |
+-----------+-------------+-------------+
|         1 | George      | Orwell      |
|         2 | Stephen     | King        |
|         3 | Charles     | Dickens     |
|         4 | Edgar Allen | Poe         |
|         5 | Isaac       | Asimov      |
|         6 | William     | Shakespeare |
|         7 | Margaret    | Atwood      |
|         8 | George R.R. | Martin      |
|         9 | J.K.        | Rowling     |
|        10 | Stan        | Lee         |
|        11 | R.L.        | Stine       |
|        12 | James       | Patterson   |
|        13 | John        | Irving      |
+-----------+-------------+-------------+
13 rows in set (0.000 sec)
```

fee_status

```
MariaDB [447s25_r980m174]> select * from fee_status;
+---------------+---------+------------------------------+
| fee_status_id | name    | description                  |
+---------------+---------+------------------------------+
|             1 | Issued  | The fee is issued to the user  |
|             2 | Overdue | The fee is overdue its payment |
|             3 | Paid    | The fee has been paid          |
+---------------+---------+------------------------------+
3 rows in set (0.000 sec)
```

fee

```
MariaDB [447s25_r980m174]> select * from fee;
+--------+---------+---------------------+--------+---------------+
| fee_id | user_id | date_issued         | amount | fee_status_id |
+--------+---------+---------------------+--------+---------------+
|      1 |       1 | 2025-02-01 00:00:00 |   5.00 |             1 |
|      2 |       2 | 2025-02-15 00:00:00 |  10.00 |             2 |
|      3 |       3 | 2025-03-05 00:00:00 |  10.00 |             1 |
|      4 |       4 | 2025-03-20 00:00:00 |  10.00 |             2 |
|      5 |       5 | 2025-03-30 00:00:00 |   5.00 |             1 |
+--------+---------+---------------------+--------+---------------+
5 rows in set (0.000 sec)
```

genre

```
MariaDB [447s25_r980m174]> select * from genre;
+----------+-------------+
| genre_id | name        |
+----------+-------------+
|        1 | Sci-Fi      |
|        2 | Romance     |
|        3 | Fantasy     |
|        4 | Thriller    |
|        5 | Mystery     |
|        6 | Young Adult |
|        7 | Self-Help   |
|        8 | Poetry      |
+----------+-------------+
8 rows in set (0.000 sec)
```

media_item

```
MariaDB [447s25_r980m174]> select * from media_item;
+----------+-----------+----------+---------------+---------------------------------------+------------------+--------------+---------------+
| media_id | author_id | genre_id | media_type_id | title                                 | publication_year | availability | isbn          |
+----------+-----------+----------+---------------+---------------------------------------+------------------+--------------+---------------+
|        1 |         1 |        1 |             1 | Nineteen Eighty-Four                  |             1949 |            1 | 9780151660346 |
|        2 |         1 |        1 |             1 | Animal Farm                           |             1945 |            1 | 9780151002177 |
|        3 |         2 |        4 |             1 | Fairy Tale                            |             2022 |            1 | 9781668002179 |
|        4 |         2 |        4 |             1 | Revival                               |             2014 |            1 | 9781476770383 |
|        5 |         3 |        6 |             1 | David Copperfield                     |             1850 |            1 | 9780393958287 |
|        6 |         3 |        6 |             1 | Bleak House                           |             1853 |            1 | 9780679405689 |
|        7 |         4 |        8 |             1 | The Raven                             |             1845 |            1 | 9781648337062 |
|        8 |         4 |        4 |             1 | The Tell-Tale Heart                   |             1843 |            1 | 9781648337079 |
|        9 |         5 |        1 |             1 | I, Robot                              |             1950 |            1 | 9780553294385 |
|       10 |         5 |        1 |             1 | The Last Question                     |             1956 |            1 | 9781884214493 |
|       11 |         6 |        2 |             1 | The Temptest                          |             1610 |            1 | 9780143128632 |
|       12 |         6 |        2 |             1 | Hamlet                                |             1603 |            1 | 9780143128625 |
|       13 |         7 |        6 |             1 | The Handmaid's Tale                   |             1985 |            0 | 9780385490818 |
|       14 |         7 |        1 |             1 | Oryx and Crake                        |             2003 |            1 | 9780307398482 |
|       15 |         8 |        3 |             1 | A Game of Thrones                     |             1996 |            0 | 9780007428540 |
|       16 |         9 |        3 |             1 | Harry Potter and the Chamber of Secrets |             1998 |            0 | 9780439064866 |
|       17 |         9 |        3 |             1 | Fantastic Beasts and Where to Find Them |             2001 |            1 | 9781338216790 |
+----------+-----------+----------+---------------+---------------------------------------+------------------+--------------+---------------+
17 rows in set (0.000 sec)
```

media_type

```
MariaDB [447s25_r980m174]> select * from media_type;
+---------------+-----------------+
| media_type_id | media_type_name |
+---------------+-----------------+
|             1 | Book            |
|             2 | Ebook           |
|             3 | Audiobook       |
|             4 | Magazine        |
|             5 | Newspaper       |
|             6 | Journal         |
|             7 | Comic           |
|             8 | Graphic Novel   |
+---------------+-----------------+
8 rows in set (0.000 sec)
```

membership_type

```
MariaDB [447s25_r980m174]> select * from membership_type;
+-------------------+---------------------+-----------------------------------------------------------------+----------------+
| membership_type_id | membership_type_name | membership_description                                          | borrowing_limit |
+-------------------+---------------------+-----------------------------------------------------------------+----------------+
|                 1 | Normal              | The most basic memberdhip type                                  |             10 |
|                 2 | Student             | Student membership allows discounts and higher borrowing rate   |             20 |
|                 3 | Researcher          | Researcher membership allows higher borrowing rate              |             50 |
+-------------------+---------------------+-----------------------------------------------------------------+----------------+
3 rows in set (0.000 sec)
```

transaction

```
MariaDB [447s25_r980m174]> select * from transaction;
+----------------+---------+----------+---------------+------------+-------------+
| transaction_id | user_id | media_id | checkout_date | due_date   | return_date |
+----------------+---------+----------+---------------+------------+-------------+
|              1 |       1 |        1 | 2025-01-05    | 2025-01-19 | 2025-02-03  |
|              2 |       2 |        3 | 2025-01-31    | 2025-02-14 | 2025-02-20  |
|              3 |       2 |        4 | 2025-02-18    | 2025-03-04 | 2025-03-10  |
|              4 |       4 |        6 | 2025-03-01    | 2025-03-15 | 2025-03-23  |
|              5 |       4 |        7 | 2025-03-10    | 2025-03-24 | 2025-04-01  |
|             13 |       1 |        1 | 2025-01-05    | 2025-01-19 | 2025-02-03  |
|             14 |       2 |        3 | 2025-01-31    | 2025-02-14 | 2025-02-20  |
|             15 |       2 |        4 | 2025-02-18    | 2025-03-04 | 2025-03-10  |
|             16 |       4 |        6 | 2025-03-01    | 2025-03-15 | 2025-03-23  |
|             17 |       4 |        7 | 2025-03-10    | 2025-03-24 | 2025-04-01  |
|             18 |       7 |       13 | 2025-04-02    | 2025-04-16 | NULL        |
|             19 |       8 |       15 | 2025-04-08    | 2025-04-22 | NULL        |
|             20 |       1 |       17 | 2025-04-10    | 2025-04-24 | NULL        |
|             21 |       2 |       20 | 2025-04-11    | 2025-04-25 | NULL        |
|             22 |       2 |       22 | 2025-04-13    | 2025-04-27 | NULL        |
|             23 |       8 |       24 | 2025-04-15    | 2025-04-29 | NULL        |
|             24 |       8 |       26 | 2025-04-18    | 2025-05-02 | NULL        |
+----------------+---------+----------+---------------+------------+-------------+
17 rows in set (0.000 sec)
```

user

```
MariaDB [447s25_r980m174]> select * from user;
+---------+-------------------+-------------------+------------+-----------+-------------------------+------------+----------+
| user_id | membership_type_id | account_status_id | first_name | last_name | email                   | phone      | is_staff |
+---------+-------------------+-------------------+------------+-----------+-------------------------+------------+----------+
|       1 |                 1 |                 1 | John       | Doe       | john.doe@gmail.com      | 1234567890 |          |
|       2 |                 1 |                 1 | Jane       | Smith     | jane.smith@gmail.com    | 2345678901 |          |
|       3 |                 1 |                 1 | Alice      | Johnson   | alice.johnson@gmail.com | 3456789012 |          |
|       4 |                 1 |                 1 | Bob        | Brown     | bob.brown@gmail.com     | 4567890123 |          |
|       5 |                 1 |                 1 | Charlie    | Davis     | charlie.davis@gmail.com | 5678901234 |          |
|       6 |                 1 |                 1 | Emily      | Wilson    | emily.wilson@gmail.com  | 6789012345 |          |
|       7 |                 1 |                 1 | Frank      | Miller    | frank.miller@gmail.com  | 7890123456 |          |
|       8 |                 1 |                 1 | Grace      | Taylor    | grace.taylor@gmail.com  | 8901234567 |          |
|       9 |                 1 |                 1 | Henry      | Anderson  | henry.anderson@gmail.com | 9012345678 |          |
|      10 |                 1 |                 1 | Ivy        | Thomas    | ivy.thomas@gmail.com    | 0123456789 |          |
+---------+-------------------+-------------------+------------+-----------+-------------------------+------------+----------+
10 rows in set (0.001 sec)
```

Appendices

N/A