Library Management System

Database Project Report

Submitted to:

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Database Systems

CMPT 354 D100

Submitted by:

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Project Overview

This project involves the development of a comprehensive library management system database that covers core library operations and extended functionalities. The database is designed to manage diverse library items, borrowing and returns, events, personnel, and other features. Key functionalities and scope are outlined below:

- **Diverse Library Items**: The system manages various item types, including books, e-books, magazines, journals, and media (e.g., CDs/DVDs). Each type has specific attributes such as authors, page count (for books), and runtime (for media), but shares common properties such as title, publication date, and status (available, borrowed, etc.).
- **Borrowing and Returns**: The system tracks borrowing and returns, with each transaction recording the item, member, borrow date, due date, and return date. It includes overdue fine calculation based on the due date, ensuring the library's lending process is smooth and well-tracked.
- **Event Hosting**: The library hosts various events (e.g., book clubs, workshops). The system tracks event details (title, description, time, and venue), allowing members to register and track their attendance.
- **Personnel Tracking**: The database manages library members, staff, and volunteers. Staff members have administrative roles, while volunteers assist with tasks. Each individual’s role and activities are recorded in the system.
- **Acquisitions and Help Requests**: Members can request new items for the library collection. Additionally, members can submit help requests, which are tracked and assigned to staff for resolution.

ER Diagram Design

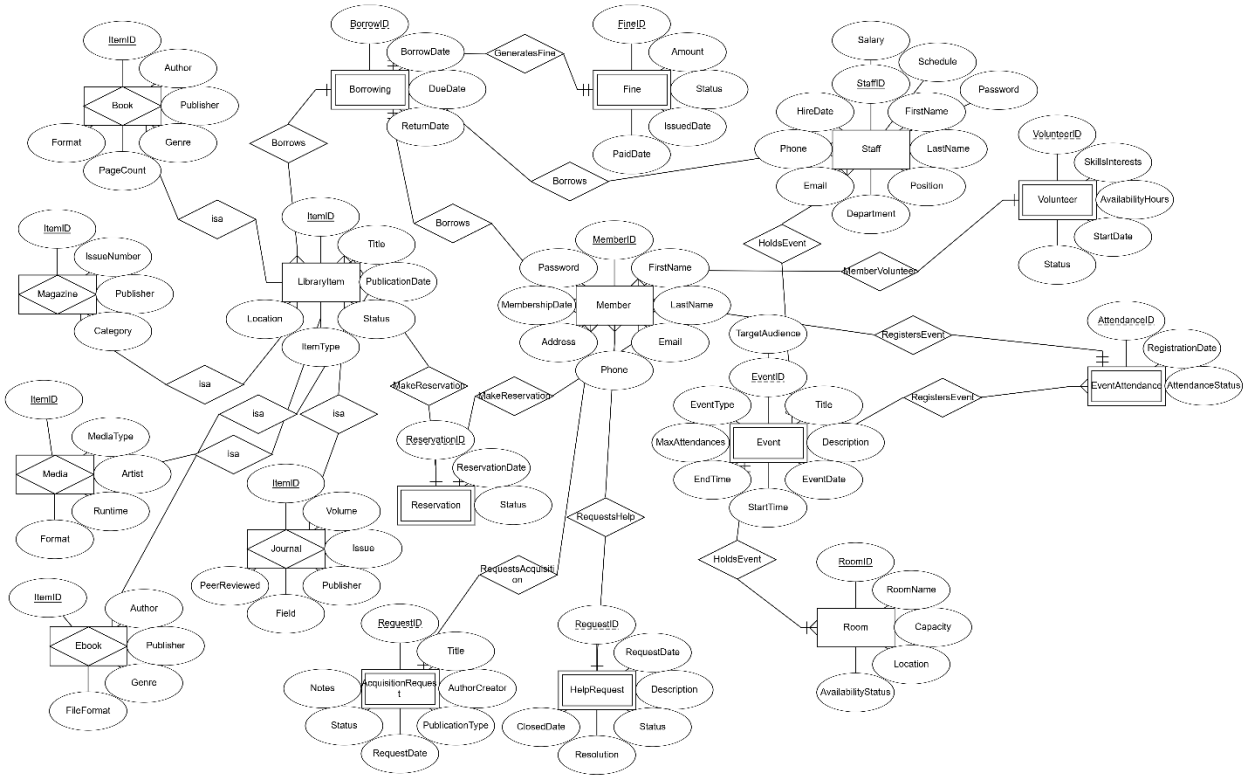
The ER diagram models the library domain by defining key **entities**, **relationships**, and **constraints**, ensuring the structure aligns with real-world interactions in the system. It uses strong

entities for main concepts, weak entities for dependent data, and associative entities for many-to-many relationships.

- **Member and Staff**
  - **Member** and **Staff** are modelled as **strong entities**, each with unique primary keys (MemberID, StaffID) and personal attributes.
  - While conceptually subtypes of a general *Person* entity, are kept distinct.
  - A **1:N relationship** exists between Staff and both **Event** (a staff member may organize many events) and **HelpRequest** (a staff member may handle multiple tickets), reflecting staff responsibilities.
- **LibraryItem and Item Subtypes**
  - LibraryItem is a **generalized entity** representing any item in the library. It stores shared attributes (e.g., title, publication date).
  - Subtypes include **Book**, **Ebook**, **Magazine**, **Journal**, and **Media**, implemented using an **ISA hierarchy**.
  - Each subtype uses the same ItemID as both **primary key** and **foreign key**, forming a **1:1 identifying relationship** (e.g., every Book must link to one LibraryItem).
  - Subtypes are **weak entities** with **total participation**, meaning they cannot exist independently from a LibraryItem.
- **Borrowing and Fine**
  - The **Borrowing** entity captures when a Member borrows a LibraryItem, forming **two 1:N relationships** (Member → Borrowing, LibraryItem → Borrowing).
  - Attributes include BorrowDate, DueDate, and ReturnDate, and optionally, the Staff who processed the transaction.
  - A **Fine** may result from a Borrowing; it is modelled as a **weak entity** with a **1:1 relationship** to Borrowing and **total participation** since a fine cannot exist without borrowing.
- **Event and EventAttendance**
  - **Event** represents library-hosted events and has a **1:N relationship** with Room (each event takes place in one room).

    - A **0/1:1 optional relationship** exists between Event and Staff (not all events have an assigned organizer).
    - **EventAttendance** is an **associative entity** between Member and Event (M:N), with attributes like Status (Registered, Attended, Cancelled).
    - Participation is **total** on both ends, as each attendance record must involve one member and one event.
- **Volunteer**
    - **Volunteer** is a separate entity linked via a **1:1 relationship** to Member, capturing members who choose to volunteer.
    - It includes additional attributes like Skills, StartDate, and Status, without cluttering the Member entity.
    - Participation is **total** from Volunteer to Member (a volunteer must be a registered member), and each member can have **at most one** volunteer record.
- **Requests (AcquisitionRequest & HelpRequest)**
    - **AcquisitionRequest**: Members can request new library items. Each request links to a Member (1:N) and may later be processed by a Staff (optional 0/1:1).
    - **HelpRequest**: Members seek assistance through HelpRequests, which are optionally assigned to Staff.
    - Both entities are modeled as **strong entities** with their own primary keys but logically depend on the presence of a Member.
    - Participation: **Total** from Member, **partial** from Staff (some requests may be unassigned).
- **Reservation**
    - **Reservation** tracks members placing holds on library items. It forms a **many-to-many relationship** between Member and LibraryItem.
    - Constraints ensure a Member can have **only one active reservation per item**, using a **composite uniqueness constraint** on (MemberID, ItemID).
    - Participation is **partial** on both ends (not all items are reserved, and not all members make reservations).
    - Includes attributes like ReservationDate and Status (Pending, Fulfilled, Cancelled).
- **Relationship Constraints**

- All relationships are modeled with **appropriate cardinalities and participation**:
- **Member–Borrowing** is 1:N
- **Member–Volunteer** is 1:1
- **Member–Event–EventAttendance** is M:N resolved via an associative entity
- **Book–LibraryItem** is 1:1 identifying
- **Weak entities** (Book, Fine, EventAttendance) ensure referential integrity by depending on parent entities.
- Constraints reflect real-world logic, e.g., *a fine cannot exist without a borrowing*, or *a volunteer must be a member*.



Normalization and Anomaly Analysis

The database schema was normalized to Boyce–Codd Normal Form (BCNF) to ensure data integrity, eliminate redundancy, and prevent anomalies:

- **Functional Dependencies**: Each table uses a single-attribute primary key, with functional dependencies ensuring all non-key attributes are dependent on the primary key.
- **Normalization**: Tables were analyzed for partial and transitive dependencies. We avoided composite keys by using surrogate keys (e.g., Borrowing, EventAttendance). The design avoids transitive dependencies by storing distinct concepts in separate tables (e.g., LibraryItem and its subtypes).
- **BCNF Justification**: Every table has a unique surrogate primary key, and there are no partial dependencies or improper functional dependencies. Each table's primary key determines all other attributes, satisfying the BCNF condition.
- **Anomalies**: The design eliminates insertion, update, and deletion anomalies by ensuring that each entity’s data is stored only once. For example, borrowing information is stored in the Borrowing table, and the library item’s status is updated without redundancy.

Schema Design

The relational schema was developed in SQLite with the following key tables and constraints:

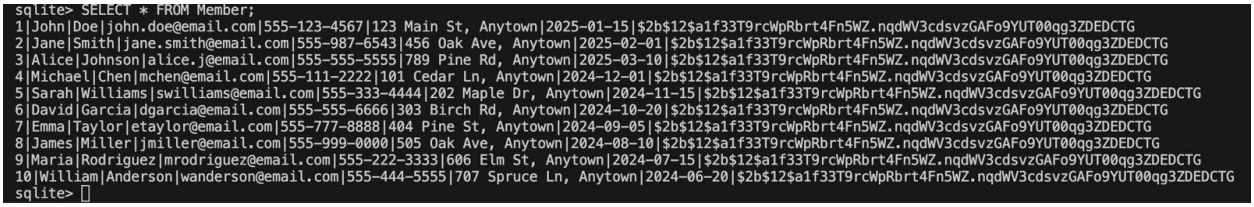
- **Member**: Stores member information (e.g., name, contact info, membership date). Email is unique, and passwords are hashed for security.
- **Staff**: Similar to the Member table but includes position, department, and other staff-specific details.
- **LibraryItem**: The central table storing common attributes for all library materials. Item type is constrained, and status is tracked (e.g., available, borrowed).
- **Item Subtypes (Book, Ebook, etc.)**: Specialized tables store attributes specific to each item type (e.g., Author for books, Artist for media).
- **Borrowing**: Links members with borrowed items, tracking borrowing dates, due dates, return dates, and fines. Ensures referential integrity with foreign keys.

- **Fine**: Tracks fines associated with late returns. It has a 1:1 relationship with Borrowing to ensure consistency.
- **Event and EventAttendance**: Events are stored in the Event table, while EventAttendance tracks member registrations, with status (e.g., Registered, Attended).
- **Volunteer**: Tracks members who volunteer, including skills and availability.

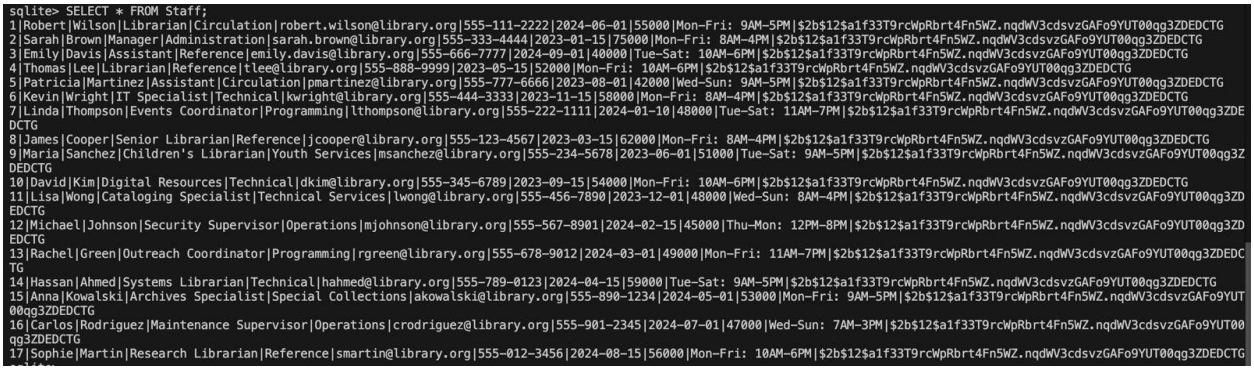
Data Population

To test and demonstrate the system, sample data was inserted, covering various scenarios:

- **Members and Staff**: A list of diverse members and staff, including unique contact details and hashed passwords.



```
sqlite> SELECT * FROM Member;
1|John|Doe|john.doe@email.com|555-123-4567|123 Main St, Anytown|2025-01-15|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
2|Jane|Smith|jane.smith@email.com|555-987-6543|456 Oak Ave, Anytown|2025-02-01|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
3|Alice|Johnson|alice.j@email.com|555-555-5555|789 Pine Rd, Anytown|2025-03-10|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
4|Michael|Chen|mchen@email.com|555-111-2222|101 Cedar Ln, Anytown|2024-12-01|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
5|Sarah|Williams|swilliams@email.com|555-333-4444|202 Maple Dr, Anytown|2024-11-15|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
6|David|Garcia|dgarcia@email.com|555-555-6666|303 Birch Rd, Anytown|2024-10-20|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
7|Emma|Taylor|etaylor@email.com|555-777-8888|404 Pine St, Anytown|2024-09-05|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
8|James|Miller|jmiller@email.com|555-999-0000|505 Oak Ave, Anytown|2024-08-10|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
9|Maria|Rodriguez|mrodriguez@email.com|555-222-3333|606 Elm St, Anytown|2024-07-15|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
10|William|Anderson|wanderson@email.com|555-444-5555|707 Spruce Ln, Anytown|2024-06-20|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
sqlite>
```



```
sqlite> SELECT * FROM Staff;
1|Robert|Wilson|Librarian|Circulation|robert.wilson@library.org|555-111-2222|2024-06-01|55000|Mon-Fri: 9AM-5PM|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
2|Sarah|Brown|Manager|Administration|sarah.brown@library.org|555-333-4444|2023-01-15|75000|Mon-Fri: 8AM-4PM|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
3|Emily|Davis|Assistant|Reference|emily.davis@library.org|555-666-7777|2024-09-01|40000|Tue-Sat: 10AM-6PM|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
4|Thomas|Lee|Librarian|Reference|tlee@library.org|555-888-9999|2023-05-15|52000|Mon-Fri: 10AM-6PM|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
5|Patricia|Martinez|Assistant|Circulation|pmartinez@library.org|555-777-6666|2023-08-01|42000|Wed-Sun: 9AM-5PM|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
6|Kevin|Wright|IT Specialist|Technical|kwright@library.org|555-444-3333|2023-11-15|58000|Mon-Fri: 8AM-4PM|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
7|Linda|Thompson|Events Coordinator|Programming|lthompson@library.org|555-222-1111|2024-01-10|48000|Tue-Sat: 11AM-7PM|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDE
DCTG
8|James|Cooper|Senior Librarian|Reference|jcooper@library.org|555-123-4567|2023-03-15|62000|Mon-Fri: 8AM-4PM|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
9|Maria|Sanchez|Children's Librarian|Youth Services|msanchez@library.org|555-234-5678|2023-06-01|51000|Tue-Sat: 9AM-5PM|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3Z
DEDCTG
10|David|Kim|Digital Resources|Technical|dkim@library.org|555-345-6789|2023-09-15|54000|Mon-Fri: 10AM-6PM|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
11|Lisa|Wong|Cataloging Specialist|Technical Services|lwong@library.org|555-456-7890|2023-12-01|48000|Wed-Sun: 8AM-4PM|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZD
EDCTG
12|Michael|Johnson|Security Supervisor|Operations|mjohnson@library.org|555-567-8901|2024-02-15|45000|Thu-Mon: 12PM-8PM|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZD
EDCTG
13|Rachel|Green|Outreach Coordinator|Programming|rgreen@library.org|555-678-9012|2024-03-01|49000|Mon-Fri: 11AM-7PM|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDC
TG
14|Hassan|Ahmed|Systems Librarian|Technical|hahmed@library.org|555-789-0123|2024-04-15|59000|Tue-Sat: 9AM-5PM|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
15|Anna|Kowalski|Archives Specialist|Special Collections|akowalski@library.org|555-890-1234|2024-05-01|53000|Mon-Fri: 9AM-5PM|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT
00qg3ZDEDCTG
16|Carlos|Rodriguez|Maintenance Supervisor|Operations|crodriguez@library.org|555-901-2345|2024-07-01|47000|Wed-Sun: 7AM-3PM|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00
qg3ZDEDCTG
17|Sophie|Martin|Research Librarian|Reference|smartin@library.org|555-012-3456|2024-08-15|56000|Mon-Fri: 10AM-6PM|$2b$12$a1f33T9rcWpRbrt4Fn5WZ.nqdWV3cdsvzGAFo9YUT00qg3ZDEDCTG
```

- **Library Items**: A catalog of items, including books, e-books, journals, and media, with detailed attributes (e.g., authors, publishers).

```
sqlite> SELECT * FROM LibraryItem;
1|The Great Gatsby|1925-04-10|Borrowed|Book|Fiction
2|Python Programming|2023-01-15|Borrowed|Ebook|Digital Collection
3|National Geographic|2025-03-01|Borrowed|Magazine|Periodicals
4|Journal of Science|2025-02-01|Borrowed|Journal|Academic
5|The Beatles Anthology|2000-10-05|Available|Media|Media Section
6|1984|1949-06-08|Available|Book|Fiction
7|To Kill a Mockingbird|1960-07-11|Borrowed|Book|Fiction
8|Data Science Basics|2024-01-15|Borrowed|Ebook|Digital Collection
9|Web Development Guide|2024-02-01|Available|Ebook|Digital Collection
10|Time Magazine|2025-03-15|Available|Magazine|Periodicals
11|Scientific American|2025-03-01|Available|Magazine|Periodicals
12|Nature|2025-02-15|Available|Journal|Academic
13|Pink Floyd Collection|1994-10-10|Available|Media|Media Section
14|Star Wars Trilogy|2011-09-16|Borrowed|Media|Media Section
15|The Lord of the Rings|1954-07-29|Borrowed|Book|Fiction
16|The Hobbit|1937-09-21|Available|Book|Fantasy
17|Pride and Prejudice|1813-01-28|Available|Book|Classic
18|The Catcher in the Rye|1951-07-16|Available|Book|Fiction
19|One Hundred Years of Solitude|1967-05-30|Available|Book|Literary Fiction
20|The Alchemist|1988-01-01|Available|Book|Fiction
21|Brave New World|1932-01-01|Available|Book|Science Fiction
22|Machine Learning Fundamentals|2024-01-20|Available|Ebook|Digital Collection
23|JavaScript Complete Guide|2024-02-15|Borrowed|Ebook|Digital Collection
24|Digital Marketing 2024|2024-03-01|Available|Ebook|Digital Collection
25|Artificial Intelligence Basics|2024-01-10|Available|Ebook|Digital Collection
26|Cloud Computing Essentials|2024-02-20|Available|Ebook|Digital Collection
27|Cybersecurity Handbook|2024-03-05|Available|Ebook|Digital Collection
28|Big Data Analytics|2024-01-25|Borrowed|Ebook|Digital Collection
29|Forbes|2025-03-10|Available|Magazine|Periodicals
30|Wired|2025-03-05|Available|Magazine|Periodicals
31|The Economist|2025-03-15|Available|Magazine|Periodicals
32|Popular Science|2025-03-01|Borrowed|Magazine|Periodicals
33|New Yorker|2025-03-20|Available|Magazine|Periodicals
34|Sports Illustrated|2025-03-08|Available|Magazine|Periodicals
35|Rolling Stone|2025-03-12|Available|Magazine|Periodicals
36|Journal of Computer Science|2025-01-01|Borrowed|Journal|Academic
37|Journal of Medicine|2025-02-01|Available|Journal|Academic
38|Journal of Engineering|2025-03-01|Available|Journal|Academic
39|Journal of History|2025-04-01|Available|Journal|Academic
40|The Matrix|1999-03-31|Available|Media|Media Section
41|Inception|2010-07-16|Available|Media|Media Section
42|Interstellar|2014-11-07|Available|Media|Media Section
43|The Dark Knight Trilogy|2008-07-18|Available|Media|Media Section
44|Avatar|2009-12-18|Available|Media|Media Section
45|Titanic|1997-12-19|Available|Media|Media Section
46|Cell|2025-02-10|Available|Journal|Academic
47|The Lancet|2025-02-05|Available|Journal|Academic
48|IEEE Spectrum|2025-02-15|Available|Journal|Academic
49|JAMA|2025-02-01|Available|Journal|Academic
50|Chemical Reviews|2025-02-20|Available|Journal|Academic
51|Psychological Review|2025-02-08|Available|Journal|Academic
52|Environmental Science|2025-02-12|Available|Journal|Academic
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52|Environmental Science|2025-02-12|Available|Journal|Academic
53|Economic Journal|2025-02-25|Available|Journal|Academic
54|The Art of Computer Programming|1968-01-01|Available|Book|Technical
55|Introduction to Algorithms|2009-07-31|Available|Book|Technical
56|Artificial Intelligence: A Modern Approach|2010-12-15|Available|Book|Technical
57|The Pragmatic Programmer|1999-10-20|Available|Book|Technical
58|Clean Code: A Handbook of Agile Software Craftsmanship|2008-08-01|Available|Book|Technical
59|Queen Greatest Hits|1981-10-26|Available|Media|Media Section
60|The Godfather Collection|1972-03-14|Available|Media|Media Section
61|Michael Jackson: Thriller|1982-11-30|Available|Media|Media Section
62|Lord of the Rings Trilogy|2001-12-19|Available|Media|Media Section
63|Led Zeppelin IV|1971-11-08|Available|Media|Media Section
64|Matrix Trilogy|1999-03-31|Available|Media|Media Section
65|David Bowie Collection|1969-11-14|Available|Media|Media Section
66|The New York Times|2025-03-01|Available|Magazine|Periodicals
67|The Wall Street Journal|2025-03-02|Available|Magazine|Periodicals
68|Scientific American|2025-03-03|Available|Magazine|Periodicals
69|Nature Reviews|2025-03-04|Available|Magazine|Periodicals
70|The Atlantic Monthly|2025-03-05|Available|Magazine|Periodicals
71|The New Yorker|2025-03-06|Available|Magazine|Periodicals
72|Time Magazine|2025-03-07|Available|Magazine|Periodicals
73|National Geographic Kids|2025-03-08|Available|Magazine|Periodicals
74|Smithsonian Magazine|2025-03-09|Available|Magazine|Periodicals
75|Popular Mechanics|2025-03-10|Available|Magazine|Periodicals
76|Esquire Magazine|2025-03-11|Available|Magazine|Periodicals
```

- **Borrowing and Returns**: Simulated borrowing records, including overdue items and fine calculations.

```
sqlite> SELECT * FROM Borrowing;
1|1|1|2025-03-15|2025-03-29||
2|2|3|2025-03-20|2025-04-03||
3|3|7|2025-03-01|2025-03-15||
4|4|14|2025-03-05|2025-03-19||
5|1|2|2025-02-15|2025-03-01|2025-03-05|
6|2|4|2025-02-20|2025-03-06|2025-03-02|
7|5|8|2025-03-10|2025-03-24||
8|6|15|2025-03-12|2025-03-26||
9|7|23|2025-03-08|2025-03-22||
10|8|28|2025-03-01|2025-03-15|2025-03-14|
11|9|32|2025-02-28|2025-03-14|2025-03-13|
12|10|36|2025-03-05|2025-03-19||
sqlite>
sqlite>
```

```
sqlite> SELECT * FROM Fine;
1|3|2.5|Unpaid|2025-03-05|
2|4|1|Paid|2025-03-02|
3|5|3.5|Unpaid|2025-03-10|
4|6|5|Unpaid|2025-03-08|
5|7|2|Paid|2025-03-07|
6|8|4.5|Unpaid|2025-03-06|
7|9|1.5|Paid|2025-03-04|
8|10|3|Unpaid|2025-03-03|
9|11|2.5|Paid|2025-03-01|
10|12|6|Unpaid|2025-02-28|
sqlite> SELECT * FROM Borrowing;
1|1|1|2025-03-15|2025-03-29||
2|2|3|2025-03-20|2025-04-03||
3|3|7|2025-03-01|2025-03-15||
4|4|14|2025-03-05|2025-03-19||
5|1|2|2025-02-15|2025-03-01|2025-03-05|
6|2|4|2025-02-20|2025-03-06|2025-03-02|
7|5|8|2025-03-10|2025-03-24||
8|6|15|2025-03-12|2025-03-26||
9|7|23|2025-03-08|2025-03-22||
10|8|28|2025-03-01|2025-03-15|2025-03-14|
11|9|32|2025-02-28|2025-03-14|2025-03-13|
12|10|36|2025-03-05|2025-03-19||
```

```
sqlite> SELECT * FROM Fine WHERE Amount > 0;
1|3|2.5|Unpaid|2025-03-05|
2|4|1|Paid|2025-03-02|
3|5|3.5|Unpaid|2025-03-10|
4|6|5|Unpaid|2025-03-08|
5|7|2|Paid|2025-03-07|
6|8|4.5|Unpaid|2025-03-06|
7|9|1.5|Paid|2025-03-04|
8|10|3|Unpaid|2025-03-03|
9|11|2.5|Paid|2025-03-01|
10|12|6|Unpaid|2025-02-28|
sqlite>
```

- **Events and Attendance**: Various library events were added, with member registrations and attendance status.

```
sqlite> SELECT * FROM Event;
1|Book Club: Classics|Discussing classic literature|2025-04-15|18:00|19:30|15|BookClub|Adults|1|1
2|Python Workshop|Intro to Python programming|2025-04-20|14:00|16:00|10|Workshop|Teens/Adults|2|2
3|Summer Reading Kickoff|Launch of summer reading program|2025-06-01|10:00|12:00|50|Other|All Ages|3|4
4|Art Exhibition|Local artists showcase|2025-04-25|13:00|17:00|30|ArtShow|Adults|4|1
5|Movie Night|Classic film screening|2025-05-10|19:00|21:30|20|Screening|Adults|2|3
6|Story Time|Interactive children's stories|2025-04-10|10:30|11:30|15|Other|Children|1|4
7|Science Fair|Student science project showcase|2025-05-15|13:00|16:00|40|Other|All Ages|5|6
8|Poetry Reading|Local poets share their work|2025-05-20|19:00|20:30|25|Other|Adults|6|2
9|Tech Talk|Latest in technology trends|2025-05-25|18:00|19:30|30|Workshop|Adults|7|3
10|Game Night|Board games and puzzles|2025-06-05|17:00|20:00|20|Other|Teens|8|5
11|Author Meet|Q&A with local author|2025-06-10|14:00|15:30|35|Other|All Ages|9|1
sqlite>
```

```
sqlite> SELECT * FROM EventAttendance;
1|1|1|2025-03-20|Registered
2|1|2|2025-03-21|Registered
3|3|3|2025-04-01|Registered
4|3|4|2025-04-02|Registered
5|4|5|2025-04-05|Registered
6|4|6|2025-04-06|Registered
7|5|1|2025-04-15|Registered
8|5|2|2025-04-16|Registered
9|6|7|2025-03-25|Registered
10|6|8|2025-03-26|Registered
```

- **Volunteers**: Sample volunteer records with skills and availability.

```
sqlite> SELECT * FROM Volunteer;
1|3|Reading to children, event setup|Wed/Fri: 3PM-6PM|2025-03-01|Active
2|4|Computer assistance, cataloging|Mon/Thu: 2PM-5PM|2025-02-15|Active
3|5|Children's programs, shelving|Tue/Sat: 10AM-2PM|2025-01-20|Active
4|6|Event setup, technical support|Wed/Fri: 4PM-8PM|2025-02-01|Active
5|7|Book club leader, circulation desk|Mon/Wed: 9AM-1PM|2025-03-15|Active
6|8|Language tutoring, reference desk|Tue/Thu: 1PM-4PM|2025-02-10|Active
7|9|Digital literacy, teen programs|Mon/Wed: 3PM-7PM|2025-02-20|Active
8|10|Senior programs, book sorting|Fri/Sat: 10AM-2PM|2025-03-05|Active
9|1|ESL assistance, cataloging|Thu/Sat: 2PM-6PM|2025-03-10|Active
10|2|Children's storyteller, shelving|Wed/Sun: 11AM-3PM|2025-03-20|Active
sqlite>
```

- **Requests (Acquisition and Help)**: Examples of acquisition and help requests, including their statuses.

```
sqlite> SELECT * FROM HelpRequest;
1|2|2025-03-26|Need help finding research materials|Open|||
2|3|2025-03-25|Need assistance with online catalog|Open|||
3|4|2025-03-24|Having trouble accessing e-books|InProgress|||
4|5|2025-03-23|Request for research guidance|Open|||
5|6|2025-03-22|Printing service help needed|Resolved|||
6|7|2025-03-21|Need help with database search|Open|||
7|8|2025-03-20|Computer login issues|InProgress|||
8|9|2025-03-19|Help with citation formatting|Open|||
9|10|2025-03-18|Audiobook downloading help|Resolved|||
10|1|2025-03-17|Wifi connection problems|Open|||
11|2|2025-03-16|Study room reservation help|InProgress|||
sqlite>
```

Application Development

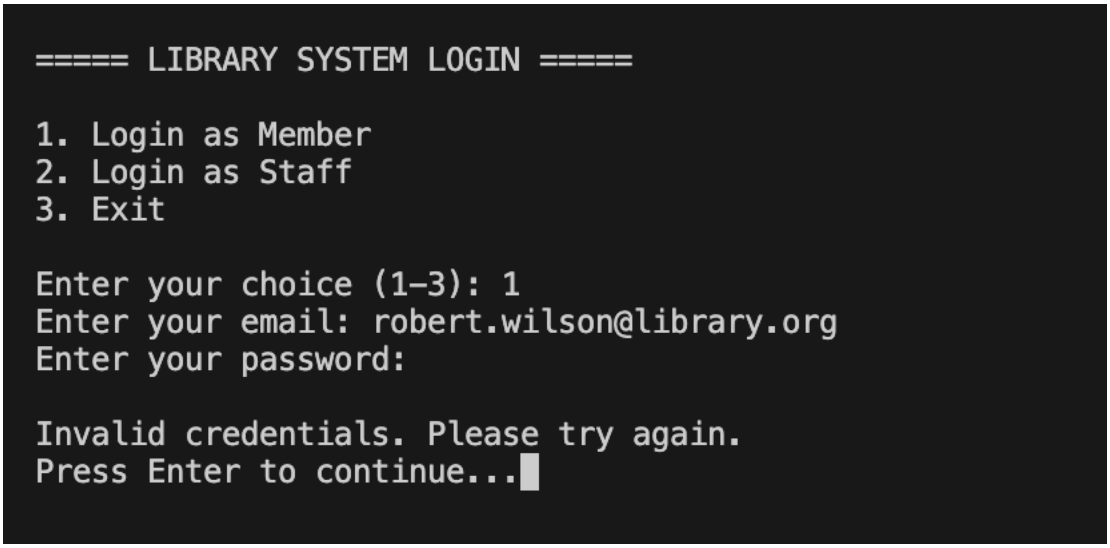
A Python application was developed to interact with the SQLite database, providing an interface for both library staff and members. Key features of the application include:

- **Item Search**: Allows users to search for library items by title, author, or type.
- **Borrowing and Returning Items**: Members can borrow and return items, with automatic status updates and fine calculations.
- **Event Registration**: Members can register for events, track their attendance, and manage cancellations.
- **Volunteering**: Members can sign up as volunteers, and staff can manage volunteer information.
- **Help Requests**: Members can submit help requests, and staff can manage and resolve them.

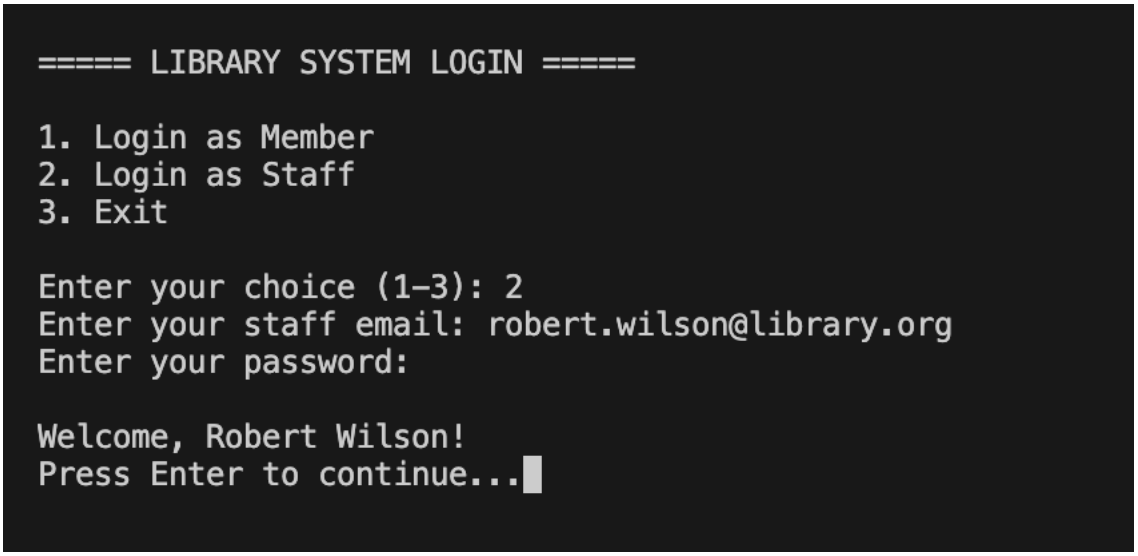
Code Run Through

The provided screenshots show a typical user interaction scenario with the Library Management System application:

Login Attempt as Member: The first image demonstrates a login attempt by a library user (member). The system rejects the login due to invalid credentials and prompts the user to try again.



Login as Staff: Next, the staff member, "Robert Wilson," successfully logs into the system using staff credentials. After successful authentication, the user accesses the **Library Staff Menu**, which provides options such as processing item returns, managing help requests, events, acquisition requests, volunteers, fines, and logging out.



```
===== LIBRARY STAFF MENU =====
Logged in as: Robert Wilson (Librarian)

1. Process Item Return
2. Manage Help Requests
3. Manage Events
4. Process Acquisition Requests
5. Manage Volunteers
6. View/Manage Fines
7. Log Out

Enter your choice (1-7): 3
```

Event Management: Selecting "Manage Events," the staff member views a detailed list of upcoming events. After selecting a particular event (e.g., "Game Night"), the system provides detailed event information such as the date, time, location, target audience, organizer, attendance count, and event description. It also clearly states if there are currently no registered attendees.

```
===== MANAGE LIBRARY EVENTS =====

1. View Upcoming Events
2. View Past Events
3. Create New Event
4. Manage Event Attendance
5. Return to Staff Menu

Enter your choice (1-5): 1
/Users/pranayratan/Documents/CMPT 354/group project/library-app.py:45: DeprecationWarning: The default date adapter is deprecated as of Python 3.12; see the
 sqlite3 documentation for suggested replacement recipes
  self.cursor.execute(query, params)

Upcoming Events:
+------+-------------------------+-----------+------------+---------------+-----------------+--------------+-------------------+
|   ID | Title                   | Type      | Date       | Time          | Room            | Attendance   | Organizer         |
+======+=========================+===========+============+===============+=================+==============+===================+
|    6 | Story Time              | Other     | 2025-04-10 | 10:30 - 11:30 | Study Room 1    | 2/15         | Robert Wilson     |
+------+-------------------------+-----------+------------+---------------+-----------------+--------------+-------------------+
|    1 | Book Club: Classics     | BookClub  | 2025-04-15 | 18:00 - 19:30 | Reading Room A  | 2/15         | Robert Wilson     |
+------+-------------------------+-----------+------------+---------------+-----------------+--------------+-------------------+
|    2 | Python Workshop         | Workshop  | 2025-04-20 | 14:00 - 16:00 | Conference Room B | 0/10       | Sarah Brown       |
+------+-------------------------+-----------+------------+---------------+-----------------+--------------+-------------------+
|    4 | Art Exhibition          | ArtShow   | 2025-04-25 | 13:00 - 17:00 | Reading Room A  | 2/30         | Thomas Lee        |
+------+-------------------------+-----------+------------+---------------+-----------------+--------------+-------------------+
|    5 | Movie Night             | Screening | 2025-05-10 | 19:00 - 21:30 | Media Room C    | 2/20         | Sarah Brown       |
+------+-------------------------+-----------+------------+---------------+-----------------+--------------+-------------------+
|    7 | Science Fair            | Other     | 2025-05-15 | 13:00 - 16:00 | Computer Lab    | 0/40         | Patricia Martinez |
+------+-------------------------+-----------+------------+---------------+-----------------+--------------+-------------------+
|    8 | Poetry Reading          | Other     | 2025-05-20 | 19:00 - 20:30 | Conference Room B | 0/25       | Kevin Wright      |
+------+-------------------------+-----------+------------+---------------+-----------------+--------------+-------------------+
|    9 | Tech Talk               | Workshop  | 2025-05-25 | 18:00 - 19:30 | Media Room C    | 0/30         | Linda Thompson    |
+------+-------------------------+-----------+------------+---------------+-----------------+--------------+-------------------+
|    3 | Summer Reading Kickoff  | Other     | 2025-06-01 | 10:00 - 12:00 | Study Room 1    | 2/50         | Emily Davis       |
+------+-------------------------+-----------+------------+---------------+-----------------+--------------+-------------------+
|   10 | Game Night              | Other     | 2025-06-05 | 17:00 - 20:00 | Study Room 2    | 0/20         | James Cooper      |
+------+-------------------------+-----------+------------+---------------+-----------------+--------------+-------------------+
|   11 | Author Meet             | Other     | 2025-06-10 | 14:00 - 15:30 | Reading Room A  | 0/35         | Maria Sanchez     |
+------+-------------------------+-----------+------------+---------------+-----------------+--------------+-------------------+

Enter Event ID to view longer description (or 0 to go back):
```

```
===== EVENT DETAILS: Game Night =====
Date: 2025-06-05
Time: 17:00 - 20:00
Type: Other
Location: Study Room 2
Target Audience: Teens
Organizer: James Cooper
Attendance: 0/20

Description: Board games and puzzles

No registered attendees for this event.

Press Enter to continue...
```

```
===== LIBRARY STAFF MENU =====
Logged in as: Robert Wilson (Librarian)

1. Process Item Return
2. Manage Help Requests
3. Manage Events
4. Process Acquisition Requests
5. Manage Volunteers
6. View/Manage Fines
7. Log Out

Enter your choice (1-7): 7

You have been logged out.
Press Enter to continue...
```

```
===== LIBRARY SYSTEM LOGIN =====

1. Login as Member
2. Login as Staff
3. Exit

Enter your choice (1-3): 3
Thank you for using the Library Management System. Goodbye!
```

Conclusion

The Library Management System successfully integrates core library operations, including catalog management, borrowing, events, and personnel tracking, with a well-structured database schema. The Python application provides an efficient interface for both members and staff, allowing seamless interaction with the database. The system's normalization and the use of functional dependencies ensure data integrity, making it a robust solution for library management.