



INNOVATION. AUTOMATION. ANALYTICS

PROJECT ON

Library Database Analysis

About me

Background:

I am L.Thrisha Sai, a B.Tech student specialized in Computer Science and Business Systems.

I want to learn Data Science because it allows me to combine my interest in technology with problem-solving in real-world business contexts. In today's data-driven world, most of the companies rely on insights from data to guide their strategy and operations. I want to gain the skills to collect, analyze, and interpret data to help solve real business challenges, improve decision-making, and create impactful solutions.

work experience:

I am a fresher with a strong interest in data science and database management. Although I do not have prior work experience, I have completed an internship at **Intel-Unnati Labs**, where I gained valuable exposure to research and project development. During this internship, I proposed a research project titled "Innovative Monitoring System for Tele-ICU Patients",

LinkedIn and GitHub profile URLs:

GitHub URL - <https://github.com/Thrishasai>

LinkedIn URL - <https://www.linkedin.com/in/thrisha-sai-28146a272/>



Agenda

Objective:

This project's primary objective is to use SQL to design and analyze a library management database. With appropriate relationships between entities like publishers, books, authors, borrowers, and library branches, the project seeks to build a structured database. We can run SQL queries through this database to find answers to practical business queries like branch-level loan statistics, borrower activity, and book availability. The ultimate objective is to demonstrate how SQL can effectively assist in managing, organizing, and deriving valuable insights from library data.

ER Diagram and schema explanation:

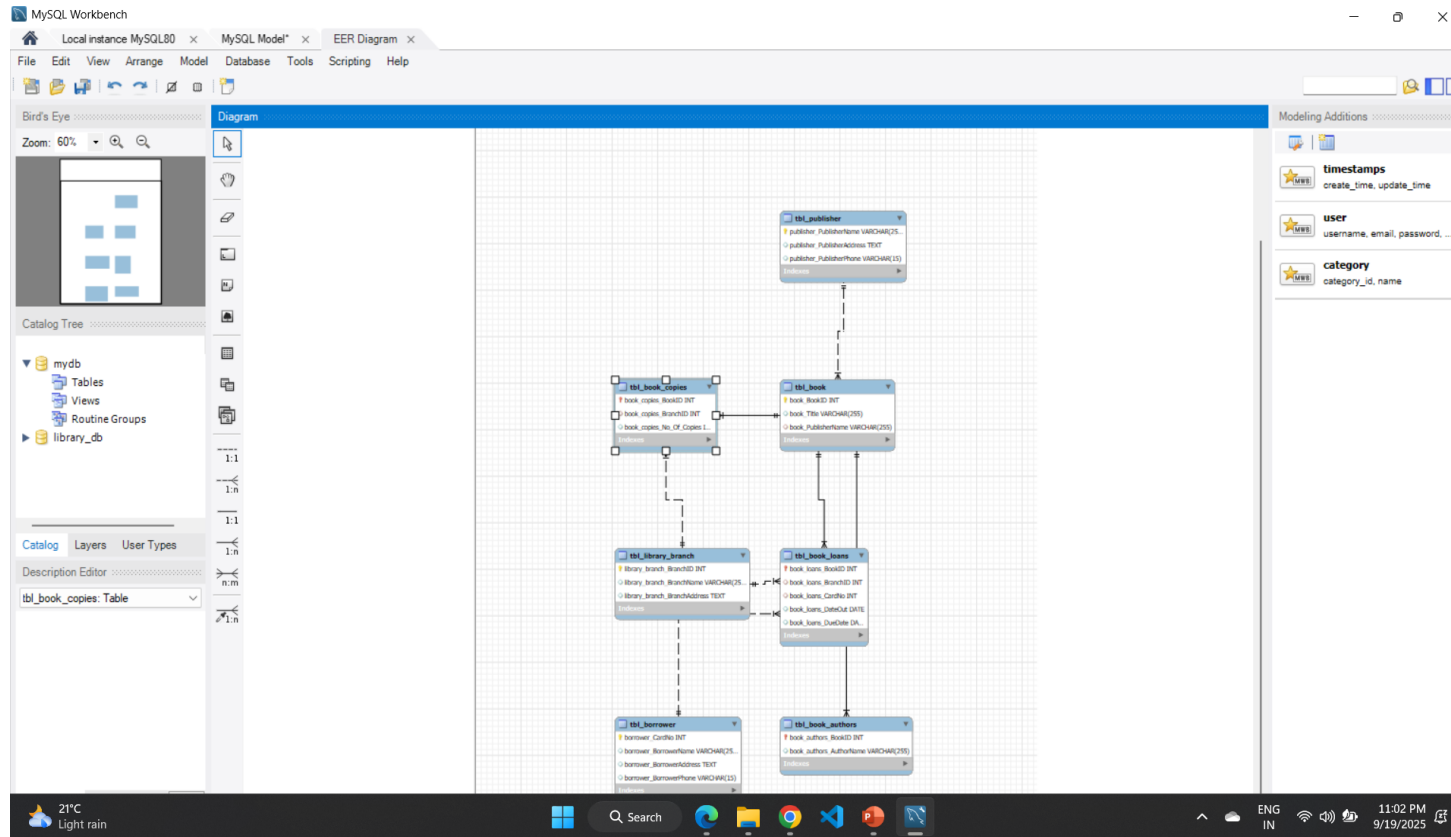


Fig.1:ER Diagram of library database with 7-tables inside the database

The Entity Relationship (ER) diagram of the library database shows how different entities in the system are connected.

The main entities are **Publisher, Book, Authors, Library Branch, Borrower, Book Copies, and Book Loans.**

- **Publisher** is linked to **Book** through the publisher name, indicating which publisher released a particular book.
- **Book** is further connected to **Book Authors**, establishing the relationship between books and their respective authors.
- **Library Branch** stores information about different branches of the library, and it is linked to both **Book Copies** and **Book Loans.**
- **Book Copies** represents the number of copies of each book available at different branches.
- **Borrower** contains details of library members, which is connected to **Book Loans**, showing which borrower has borrowed which book.
- **Book Loans** serves as the central table that records the issue of books from branches to borrowers, along with loan dates and due dates.

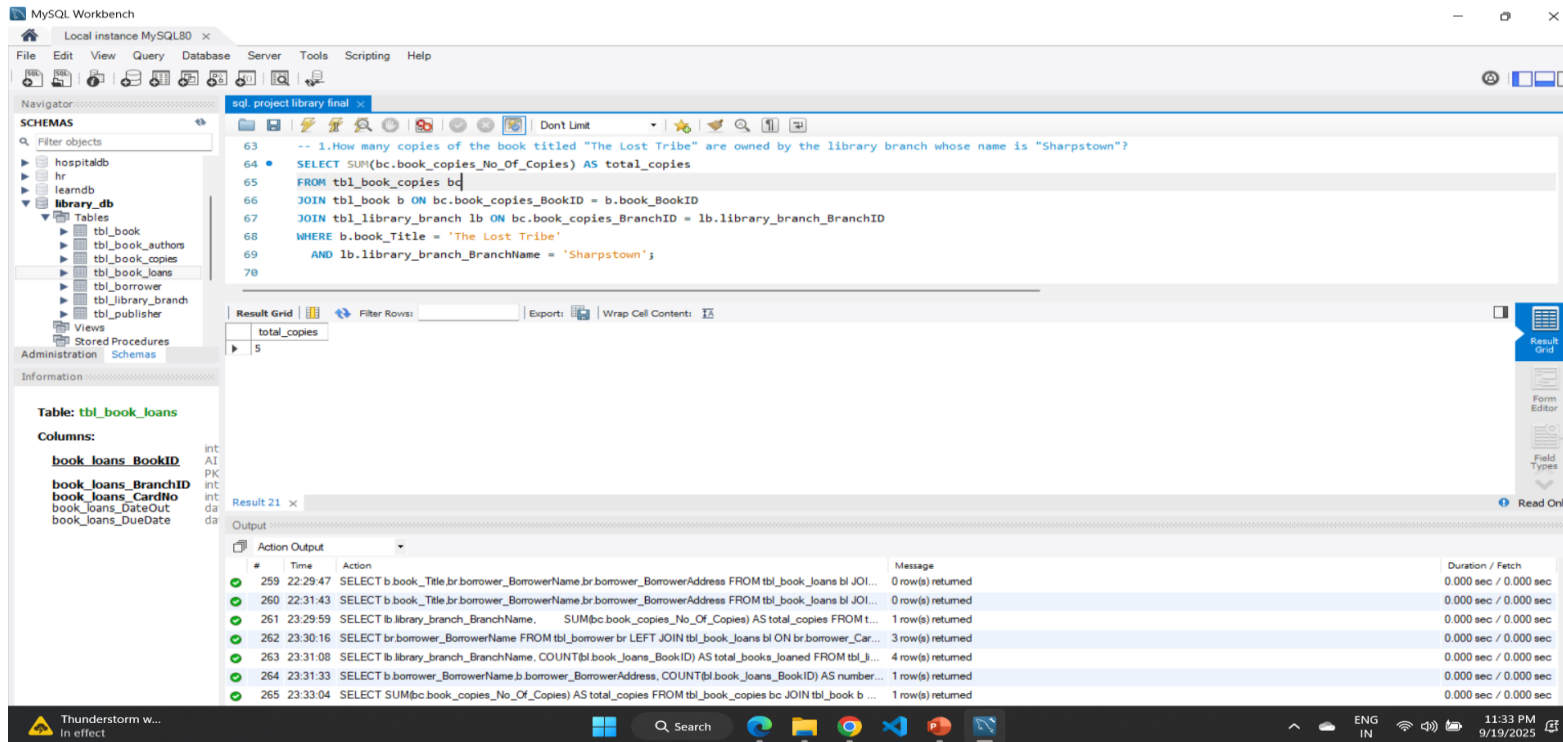
Key analysis questions (use cases):

- Copies of “*The Lost Tribe*” in Sharpstown branch.
- Copies of “*The Lost Tribe*” across branches.
- Borrowers with no books checked out.
- Books loaned from Sharpstown (Due Date: 2/3/18).
- Total books loaned per branch.
- Borrowers with >5 books checked out.
- Copies of books by Stephen King in Central branch.

SQL query results with screenshots or summaries:

1. How many copies of “The Lost Tribe” are in Sharpstown branch?

Result: 5 copies - Returns the total number of copies of the book "The Lost Tribe" in the "Sharpstown" library branch.



The screenshot displays the MySQL Workbench interface. The left sidebar shows the 'Schemas' tree with 'library_db' selected. The main editor window contains the following SQL query:

```
-- 1.How many copies of the book titled "The Lost Tribe" are owned by the library branch whose name is "Sharpstown"?
SELECT SUM(bc.book_copies_No_Of_Copies) AS total_copies
FROM tbl_book_copies bc
JOIN tbl_book b ON bc.book_copies_BookID = b.book_BookID
JOIN tbl_library_branch lb ON bc.book_copies_BranchID = lb.library_branch_BranchID
WHERE b.book_Title = 'The Lost Tribe'
AND lb.library_branch_BranchName = 'Sharpstown';
```

The 'Result Grid' shows a single row with the value 5 for the column 'total_copies'.

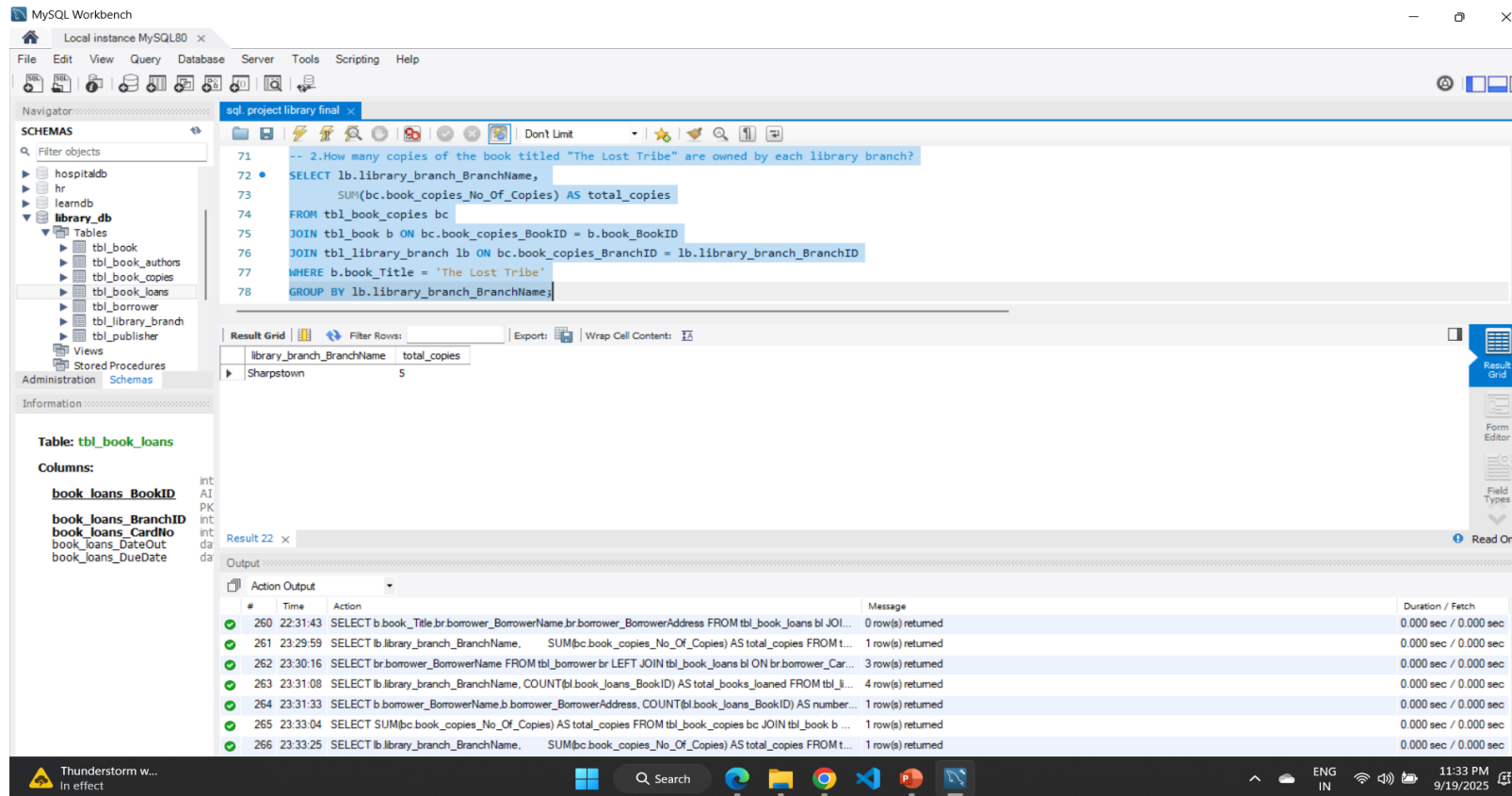
The 'Table: tbl_book_loans' is also visible in the left sidebar, with columns: book_loans_BookID, book_loans_BranchID, book_loans_CardNo, book_loans_DateOut, and book_loans_DueDate.

The 'Output' tab at the bottom shows the execution log with the following entries:

#	Time	Action	Message	Duration / Fetch
259	22:29:47	SELECT b book_Title,br borrower_BorrowerName,br borrower_BorrowerAddress FROM tbl_book_loans bl JOIN...	0 row(s) returned	0.000 sec / 0.000 sec
260	22:31:43	SELECT b book_Title,br borrower_BorrowerName,br borrower_BorrowerAddress FROM tbl_book_loans bl JOIN...	0 row(s) returned	0.000 sec / 0.000 sec
261	23:29:59	SELECT lb.library_branch_BranchName, SUM(bc.book_copies_No_Of_Copies) AS total_copies FROM t...	1 row(s) returned	0.000 sec / 0.000 sec
262	23:30:16	SELECT br.borrower_BorrowerName FROM tbl_borrower br LEFT JOIN tbl_book_loans bl ON br.borrower_Car...	3 row(s) returned	0.000 sec / 0.000 sec
263	23:31:08	SELECT lb.library_branch_BranchName, COUNT(tbl_book_loans_BookID) AS total_books_loaned FROM tbl_l...	4 row(s) returned	0.000 sec / 0.000 sec
264	23:31:33	SELECT b.borrower_BorrowerName, COUNT(tbl_book_loans_BookID) AS number...	1 row(s) returned	0.000 sec / 0.000 sec
265	23:33:04	SELECT SUM(bc.book_copies_No_Of_Copies) AS total_copies FROM tbl_book_copies bc JOIN tbl_book b ...	1 row(s) returned	0.000 sec / 0.000 sec

2. How many copies of “The Lost Tribe” are owned by each branch?

Result: Distribution shown per branch (Sharpstown = 5 others vary depending on data). -Shows **how many copies** of "The Lost Tribe" each **library branch** owns.



The screenshot shows the MySQL Workbench interface. The left sidebar displays the 'SCHEMAS' tree with 'library_db' selected, showing tables like 'tbl_book', 'tbl_book_authors', 'tbl_book_copies', 'tbl_book_loans', 'tbl_borrower', 'tbl_library_branch', and 'tbl_publisher'. The main editor window contains a SQL query:

```
-- 2.How many copies of the book titled "The Lost Tribe" are owned by each library branch?
SELECT lb.library_branch_BranchName,
       SUM(bc.book_copies_No_Of_Copies) AS total_copies
FROM   tbl_book_copies bc
JOIN   tbl_book b ON bc.book_copies_BookID = b.book_BookID
JOIN   tbl_library_branch lb ON bc.book_copies_BranchID = lb.library_branch_BranchID
WHERE  b.book_Title = 'The Lost Tribe'
GROUP BY lb.library_branch_BranchName;
```

The 'Result Grid' shows the following data:

library_branch_BranchName	total_copies
Sharpstown	5

The bottom panel shows the 'Output' tab with a log of SQL actions and their execution times. The last action is a SELECT query that returned 1 row(s).

3. Borrowers with no books checked out

Result: List of borrower names who currently have no active loans. Jane Smith, Angela Thompson, Haley Jackson.

Lists names of **borrowers who have not checked out any books.**

The screenshot shows the MySQL Workbench interface. The left sidebar displays the 'SCHEMAS' tree with 'library_db' selected, showing tables like 'tbl_book', 'tbl_book_authors', 'tbl_book_copies', 'tbl_book_loans', 'tbl_borrower', 'tbl_library_branch', and 'tbl_publisher'. The main editor window contains a SQL query:

```
-- 3.Retrieve the names of all borrowers who do not have any books checked out.
80
81 • SELECT br.borrower_BorrowerName
82 FROM tbl_borrower br
83 LEFT JOIN tbl_book_loans bl ON br.borrower_CardNo = bl.book_loans_CardNo
84 WHERE bl.book_loans_CardNo IS NULL;
85
-- 4.For each book that is loaned out from the "Sharpstown" branch and whose DueDate is 2/3/18, retrieve the book title, the borrower's name, and the borrower's address.
86
87 • SELECT b.book_Title,br.borrower_BorrowerName,br.borrower_BorrowerAddress
```

The 'Result Grid' shows the output of the first query:

borrower_BorrowerName
Jane Smith
Angela Thompson
Haley Jackson

The 'Output' pane at the bottom shows the execution log with the following entries:

#	Time	Action	Message	Duration / Fetch
262	23:30:16	SELECT br.borrower_BorrowerName FROM tbl_borrower br LEFT JOIN tbl_book_loans bl ON br.borrower_Car...	3 row(s) returned	0.000 sec / 0.000 sec
263	23:31:08	SELECT lb.library_branch_BranchName, COUNT(bl.book_loans_BookID) AS total_books_loaned FROM tbl_l...	4 row(s) returned	0.000 sec / 0.000 sec
264	23:31:33	SELECT b.borrower_BorrowerName,b.borrower_BorrowerAddress, COUNT(bl.book_loans_BookID) AS number...	1 row(s) returned	0.000 sec / 0.000 sec
265	23:33:04	SELECT SUM(bc.book_copies_No_Of_Copies) AS total_copies FROM tbl_book_copies bc JOIN tbl_book b ...	1 row(s) returned	0.000 sec / 0.000 sec
266	23:33:25	SELECT lb.library_branch_BranchName, SUM(bc.book_copies_No_Of_Copies) AS total_copies FROM t...	1 row(s) returned	0.000 sec / 0.000 sec
267	23:33:38	3.Retrieve the names of all borrowers who do not have any books checked out. SELECT br.borrower_Borrowe...	Error Code: 1064. You have an error in your SQL syntax; check the manual that corresponds to your MySQL se...	0.000 sec
268	23:33:44	SELECT br.borrower_BorrowerName FROM tbl_borrower br LEFT JOIN tbl_book_loans bl ON br.borrower_Car...	3 row(s) returned	0.000 sec / 0.000 sec

4. Books loaned from Sharpstown with Due Date = 2/3/18

Result: Returns book title, borrower's name, and address for matching records. There are no matching results meant there are no books loaned from Sharpstown with due date 2/3/18. Retrieves **book titles, borrower names, and addresses** for books loaned from **Sharpstown branch**, with a **due date of Feb 3, 2018**.

The screenshot displays the MySQL Workbench interface. The left sidebar shows the 'SCHEMAS' panel with a tree view of the 'library_db' database, including tables like 'tbl_book', 'tbl_book_copies', 'tbl_book_loans', 'tbl_borrower', 'tbl_library_branch', and 'tbl_publisher'. The main editor window shows a SQL query with line numbers 86 to 93. The query is a SELECT statement that joins 'tbl_book_loans', 'tbl_book', 'tbl_library_branch', and 'tbl_borrower' to retrieve book titles, borrower names, and addresses for books loaned from the 'Sharpstown' branch with a due date of '2018-02-03'. The 'Result Grid' at the bottom shows the execution results, including a table with columns 'book_title', 'borrower_BorrowerName', and 'borrower_BorrowerAddress'. The 'Output' panel at the bottom right shows the execution log with timestamps and messages, indicating that the query was executed successfully and returned 0 rows.

```
86 -- 4. For each book that is loaned out from the "Sharpstown" branch and whose DueDate is 2/3/18, retrieve the book title, the borrower's name, and the borrower's address.
87 SELECT b.book_Title, br.borrower_BorrowerName, br.borrower_BorrowerAddress
88 FROM tbl_book_loans bl JOIN tbl_book b ON bl.book_loans_BookID = b.book_BookID
89 JOIN tbl_library_branch lb ON bl.book_loans_BranchID = lb.library_branch_BranchID
90 JOIN tbl_borrower br ON bl.book_loans_CardNo = br.borrower_CardNo
91 WHERE lb.library_branch_BranchName = 'Sharpstown'
92 AND bl.book_loans_DueDate = '2018-02-03';
93 -- 5. For each library branch, retrieve the branch name and the total number of books loaned out from that branch.
```

book_title	borrower_BorrowerName	borrower_BorrowerAddress
------------	-----------------------	--------------------------

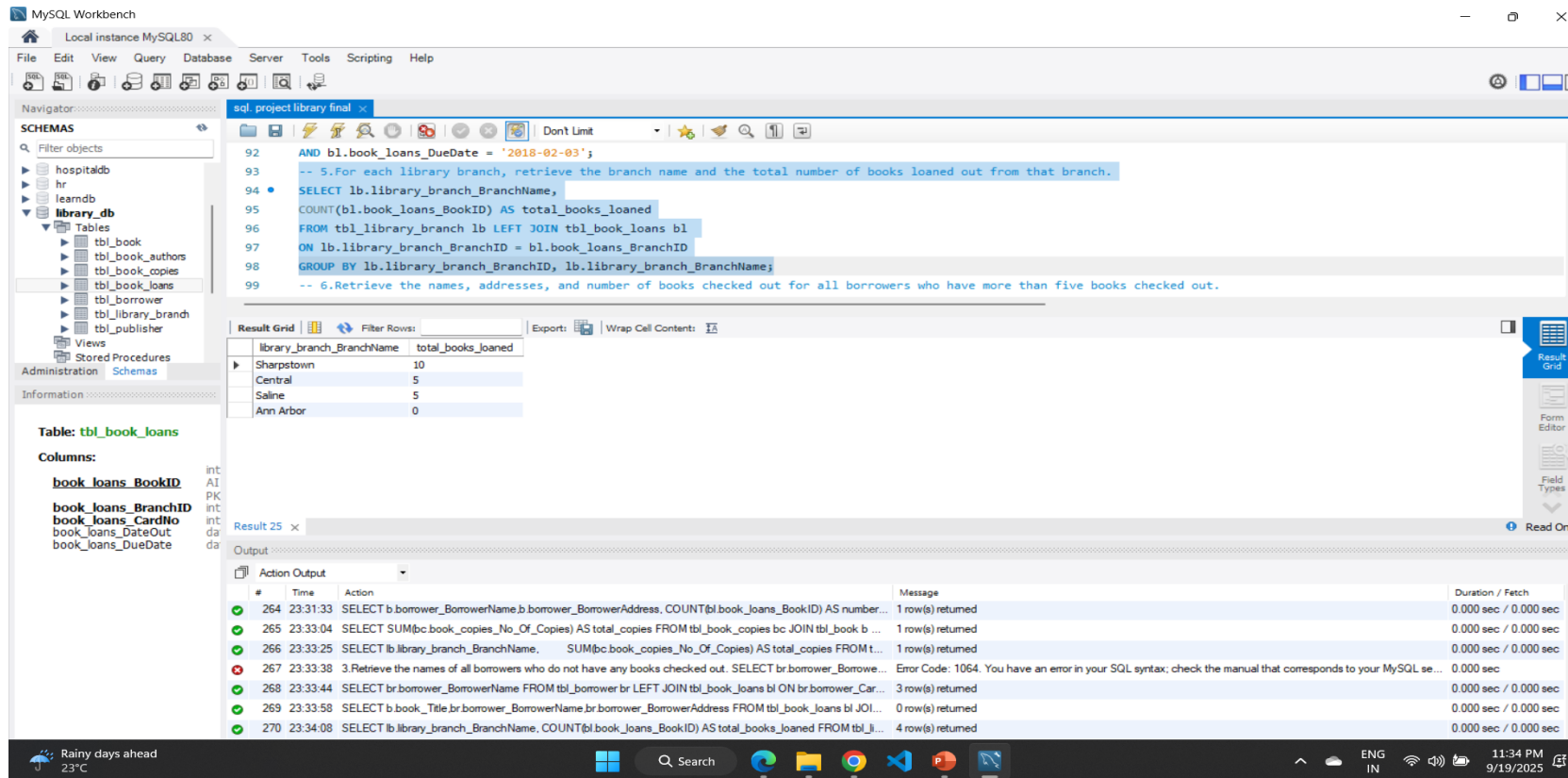
Result 24 x

Output

#	Time	Action	Message	Duration / Fetch
263	23:31:08	SELECT lb.library_branch_BranchName, COUNT(bl.book_loans_BookID) AS total_books_loaned FROM tbl_li...	4 row(s) returned	0.000 sec / 0.000 sec
264	23:31:33	SELECT b.borrower_BorrowerName, b.borrower_BorrowerAddress, COUNT(bl.book_loans_BookID) AS number...	1 row(s) returned	0.000 sec / 0.000 sec
265	23:33:04	SELECT SUM(bc.book_copies_No_Of_Copies) AS total_copies FROM tbl_book_copies bc JOIN tbl_book b ...	1 row(s) returned	0.000 sec / 0.000 sec
266	23:33:25	SELECT lb.library_branch_BranchName, SUM(bc.book_copies_No_Of_Copies) AS total_copies FROM t...	1 row(s) returned	0.000 sec / 0.000 sec
267	23:33:38	3. Retrieve the names of all borrowers who do not have any books checked out. SELECT br.borrower_Borrowe...	Error Code: 1064. You have an error in your SQL syntax; check the manual that corresponds to your MySQL se...	0.000 sec
268	23:33:44	SELECT br.borrower_BorrowerName FROM tbl_borrower br LEFT JOIN tbl_book_loans bl ON br.borrower_Car...	3 row(s) returned	0.000 sec / 0.000 sec
269	23:33:58	SELECT b.book_Title, br.borrower_BorrowerName, br.borrower_BorrowerAddress FROM tbl_book_loans bl JOI...	0 row(s) returned	0.000 sec / 0.000 sec

5. Total number of books loaned per branch

Result: Each branch with count of total issued books. 'Sharpstown'- '10', 'Central'- '5', 'Saline'- '5'(rest of the branches have 0 number of books loaned),Shows the **total number of books loaned from each library branch**. Includes branches even if they have **zero loans** (LEFT JOIN).



The screenshot displays the MySQL Workbench interface. The left sidebar shows the 'SCHEMAS' panel with a tree view of the 'library_db' database, including tables like 'tbl_book', 'tbl_book_authors', 'tbl_book_copies', 'tbl_book_loans', 'tbl_borrower', 'tbl_library_branch', and 'tbl_publisher'. The main editor window shows a SQL query titled 'sql. project library final'. The query is as follows:

```
92 AND b1.book_loans_DueDate = '2018-02-03';
93 -- 5.For each library branch, retrieve the branch name and the total number of books loaned out from that branch.
94 SELECT lb.library_branch_BranchName,
95 COUNT(b1.book_loans_BookID) AS total_books_loaned
96 FROM tbl_library_branch lb LEFT JOIN tbl_book_loans b1
97 ON lb.library_branch_BranchID = b1.book_loans_BranchID
98 GROUP BY lb.library_branch_BranchID, lb.library_branch_BranchName;
99 -- 6.Retrieve the names, addresses, and number of books checked out for all borrowers who have more than five books checked out.
```

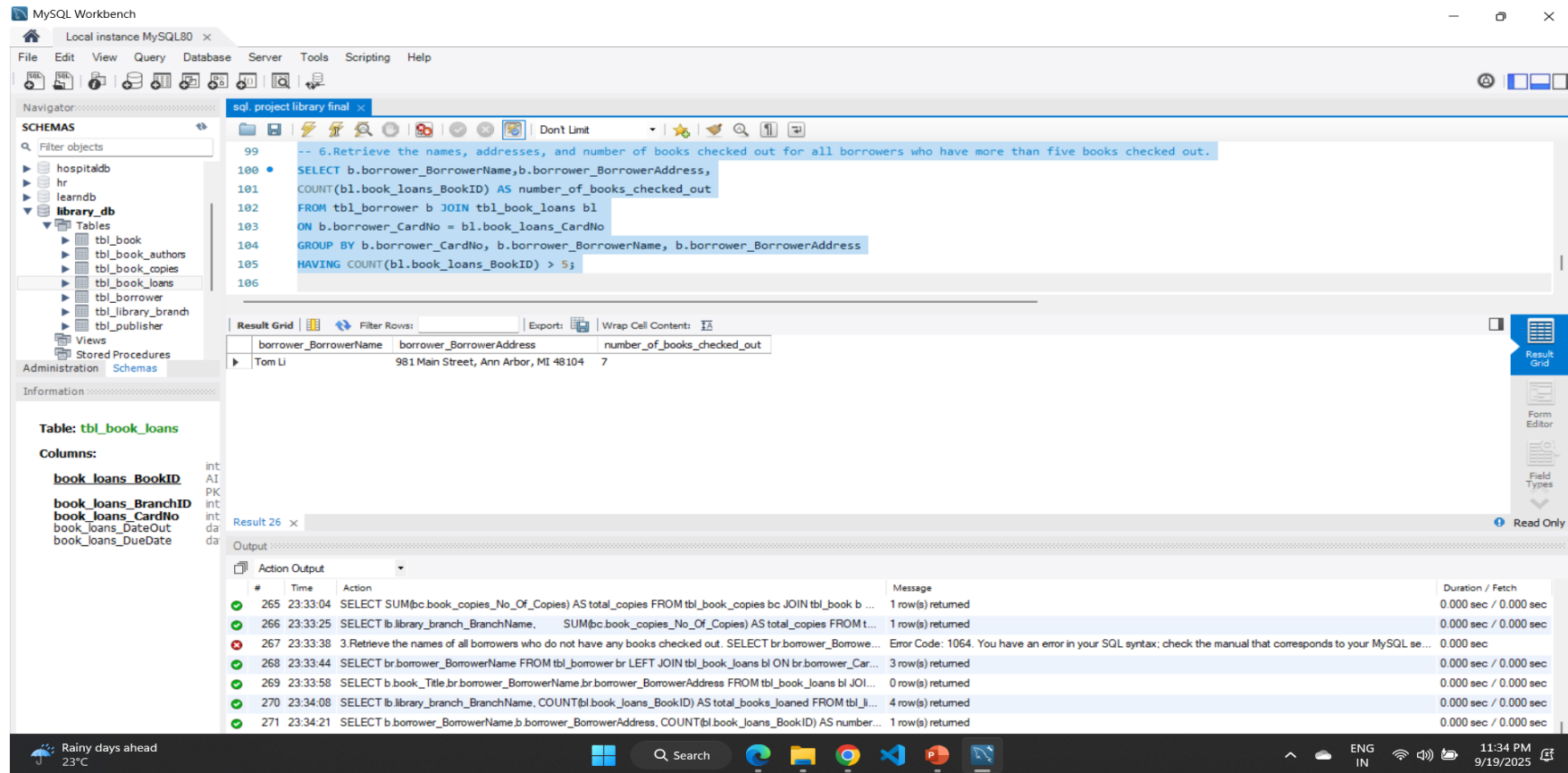
Below the query editor, the 'Result Grid' shows the output of the query:

library_branch_BranchName	total_books_loaned
Sharpstown	10
Central	5
Saline	5
Ann Arbor	0

The bottom panel shows the 'Output' tab with a log of SQL actions and their execution times. The log includes messages such as 'SELECT b.borrower_BorrowerName, b.borrower_BorrowerAddress, COUNT(b1.book_loans_BookID) AS number...' and 'SELECT SUM(bc.book_copies_No_Of_Copies) AS total_copies FROM tbl_book_copies bc JOIN tbl_book b ...'.

6. Borrowers with more than 5 books checked out

Result: Names, addresses, and number of books checked out (only those exceeding 5). Only one -'Tom Li', '981 Main Street, Ann Arbor, MI 48104', '7'. Lists borrowers who have checked out **more than 5 books**, along with their **name** and **address**.



The screenshot displays the MySQL Workbench interface. The left sidebar shows the 'SCHEMAS' panel with a tree view of databases including 'hospitaldb', 'hr', 'learnadb', and 'library_db'. The 'library_db' database is selected, showing tables like 'tbl_book', 'tbl_book_authors', 'tbl_book_copies', 'tbl_book_loans', 'tbl_borrower', 'tbl_library_branch', and 'tbl_publisher'. The main editor window shows a SQL query in the 'sql project library final' tab. The query is as follows:

```
99  -- 6.Retrieve the names, addresses, and number of books checked out for all borrowers who have more than five books checked out.
100  SELECT b.borrower_BorrowerName,b.borrower_BorrowerAddress,
101  COUNT(b1.book_loans_BookID) AS number_of_books_checked_out
102  FROM tbl_borrower b JOIN tbl_book_loans b1
103  ON b.borrower_CardNo = b1.book_loans_CardNo
104  GROUP BY b.borrower_CardNo, b.borrower_BorrowerName, b.borrower_BorrowerAddress
105  HAVING COUNT(b1.book_loans_BookID) > 5;
106
```

The 'Result Grid' shows the following data:

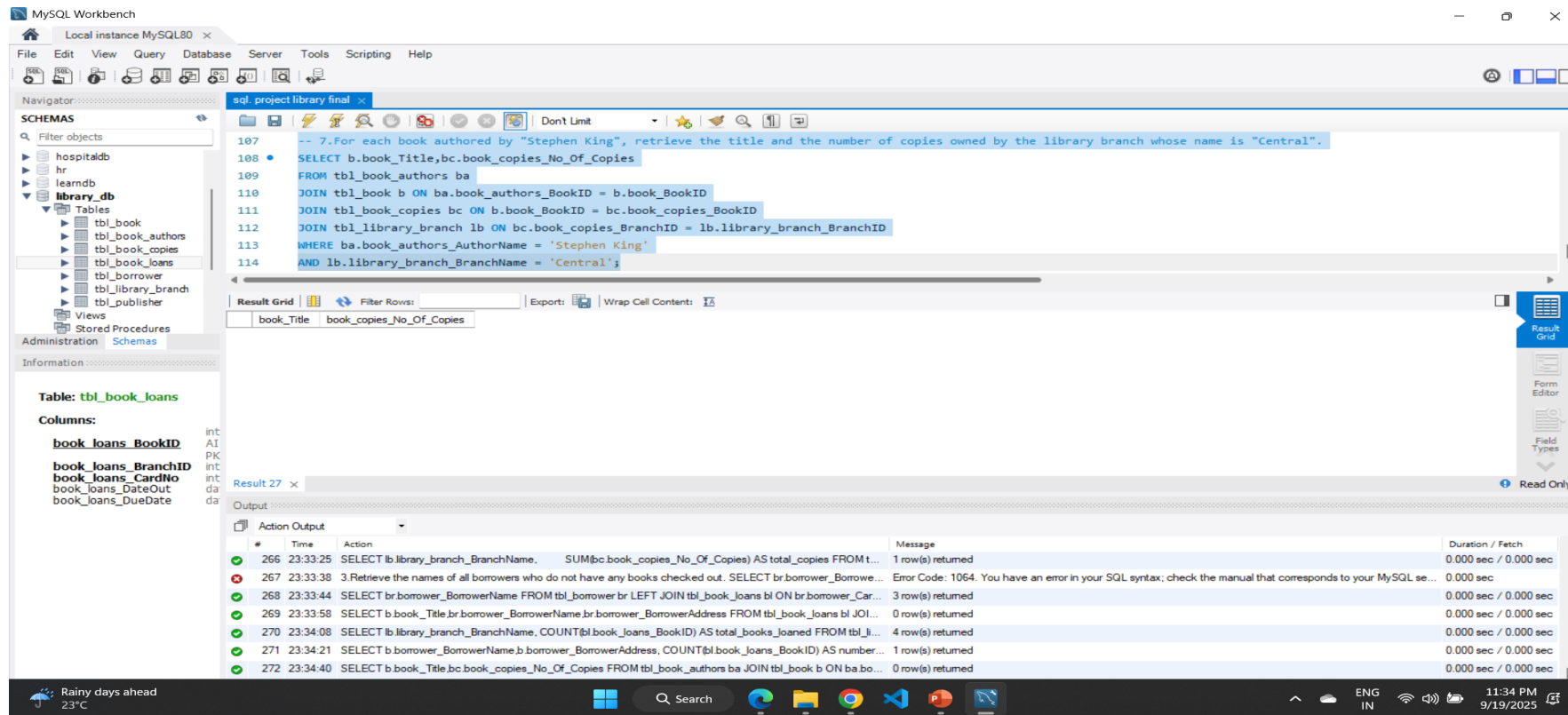
borrower_BorrowerName	borrower_BorrowerAddress	number_of_books_checked_out
Tom Li	981 Main Street, Ann Arbor, MI 48104	7

The bottom panel shows the 'Output' window with a table of query execution results:

#	Time	Action	Message	Duration / Fetch
265	23:33:04	SELECT SUM(bc.book_copies_No_Of_Copies) AS total_copies FROM tbl_book_copies bc JOIN tbl_book b ...	1 row(s) returned	0.000 sec / 0.000 sec
266	23:33:25	SELECT b.library_branch_BranchName, SUM(bc.book_copies_No_Of_Copies) AS total_copies FROM t...	1 row(s) returned	0.000 sec / 0.000 sec
267	23:33:38	3. Retrieve the names of all borrowers who do not have any books checked out. SELECT br.borrower_Borrowe...	Error Code: 1064. You have an error in your SQL syntax; check the manual that corresponds to your MySQL se...	0.000 sec
268	23:33:44	SELECT br.borrower_BorrowerName FROM tbl_borrower br LEFT JOIN tbl_book_loans bl ON br.borrower_Car...	3 row(s) returned	0.000 sec / 0.000 sec
269	23:33:58	SELECT b.book_Title,br.borrower_BorrowerName,br.borrower_BorrowerAddress FROM tbl_book_loans bl JOI...	0 row(s) returned	0.000 sec / 0.000 sec
270	23:34:08	SELECT b.library_branch_BranchName, COUNT(bl.book_loans_BookID) AS total_books_loaned FROM tbl_li...	4 row(s) returned	0.000 sec / 0.000 sec
271	23:34:21	SELECT b.borrower_BorrowerName,b.borrower_BorrowerAddress, COUNT(bl.book_loans_BookID) AS number...	1 row(s) returned	0.000 sec / 0.000 sec

7. Books by Stephen King in Central branch

Result: Titles of Stephen King's books along with total copies available at Central branch. It results 0 as there are no Titles of Stephen King's books along with total copies available at Central branch. Finds all **books written by Stephen King** and shows how many **copies** of each are available in the "**Central**" branch.



The screenshot displays the MySQL Workbench interface. The left sidebar shows the 'SCHEMAS' tree with 'library_db' selected. The main editor window contains a SQL query (lines 107-114) that selects book titles and the number of copies from the 'tbl_book_copies' table, joined with 'tbl_book_authors' and 'tbl_library_branch', filtering for books by Stephen King in the 'Central' branch. The 'Result Grid' at the bottom shows the execution output, including a message indicating an error (Error Code: 1064) due to a syntax issue in the SQL query.

```
107 -- 7.For each book authored by "Stephen King", retrieve the title and the number of copies owned by the library branch whose name is "Central".
108 SELECT b.book_Title,bc.book_copies_No_Of_Copies
109 FROM tbl_book_authors ba
110 JOIN tbl_book b ON ba.book_authors_BookID = b.book_BookID
111 JOIN tbl_book_copies bc ON b.book_BookID = bc.book_copies_BookID
112 JOIN tbl_library_branch lb ON bc.book_copies_BranchID = lb.library_branch_BranchID
113 WHERE ba.book_authors_AuthorName = 'Stephen King'
114 AND lb.library_branch_BranchName = 'Central';
```

Result Grid

#	Time	Action	Message	Duration / Fetch
266	23:33:25	SELECT lb.library_branch_BranchName, SUM(bc.book_copies_No_Of_Copies) AS total_copies FROM t...	1 row(s) returned	0.000 sec / 0.000 sec
267	23:33:38	3.Retrieve the names of all borrowers who do not have any books checked out. SELECT br.borrower_Borrowe...	Error Code: 1064. You have an error in your SQL syntax; check the manual that corresponds to your MySQL se...	0.000 sec
268	23:33:44	SELECT br.borrower_BorrowerName FROM tbl_borrower br LEFT JOIN tbl_book_loans bl ON br.borrower_Car...	3 row(s) returned	0.000 sec / 0.000 sec
269	23:33:58	SELECT b.book_Title,br.borrower_BorrowerName,br.borrower_BorrowerAddress FROM tbl_book_loans bl JOI...	0 row(s) returned	0.000 sec / 0.000 sec
270	23:34:08	SELECT lb.library_branch_BranchName, COUNT(bl.book_loans_BookID) AS total_books_loaned FROM tbl_j...	4 row(s) returned	0.000 sec / 0.000 sec
271	23:34:21	SELECT b.borrower_BorrowerName,b.borrower_BorrowerAddress, COUNT(bl.book_loans_BookID) AS number...	1 row(s) returned	0.000 sec / 0.000 sec
272	23:34:40	SELECT b.book_Title,bc.book_copies_No_Of_Copies FROM tbl_book_authors ba JOIN tbl_book b ON ba.bo...	0 row(s) returned	0.000 sec / 0.000 sec

Final business insights and recommendations

The analysis of the library database provided several important observations.

The Sharpstown branch holds limited but significant copies of popular books such as “*The Lost Tribe*”, making it a key location for that title.

The borrower analysis revealed that some members check out more than five books, which may result in resource imbalances and longer wait times for others.

Interestingly, the Central branch does not currently hold any books authored by Stephen King, despite his general popularity. This highlights an opportunity for the library to expand its collection in response to reader demand.

Based on these findings, it is recommended to optimize book distribution across branches, implement borrower monitoring policies for fair access.

Conclusion

In conclusion, the Library Database successfully demonstrated how SQL can be used to design, query, and analyze a relational database in a real-world context. The library database schema maintained proper relationships between entities while supporting meaningful queries to solve business problems. Through this project, we identified branch-level book distribution patterns, borrower activity levels, and author-specific popularity trends. These findings show the importance of structured data and query-based analysis in making informed decisions for resource management and service improvement in libraries.

Experience/Challenges working on SQL – Data Analysis Project

While working on this SQL project, gained valuable hands-on experience in database design, schema creation, and query formulation. One of the main challenges was ensuring that all foreign key relationships were correctly implemented to maintain data integrity across multiple tables. Writing queries with multiple joins was initially complex, especially when handling conditions like borrowers with no books or ensuring accurate counts per branch. Another challenge was handling cases such as NULL values and ensuring queries worked even for branches or borrowers with no records. Overcoming these challenges helped me improve my SQL skills, understand real-world use cases better, and appreciate the importance of clean schema design for smooth data analysis.

THANK
YOU

