



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:

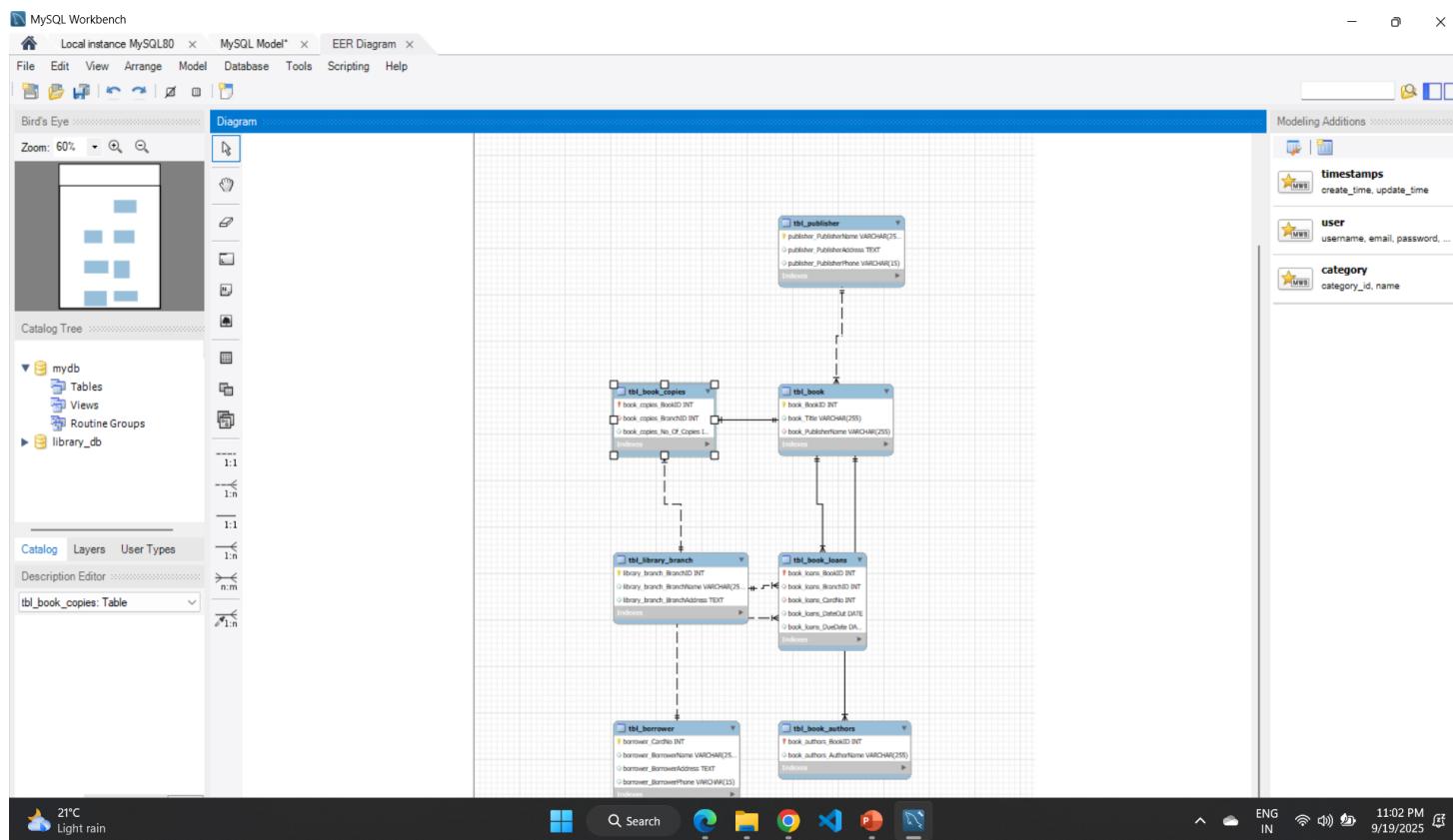


Fig.1:ER Diagram of library database with 7-tables inside the database

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.

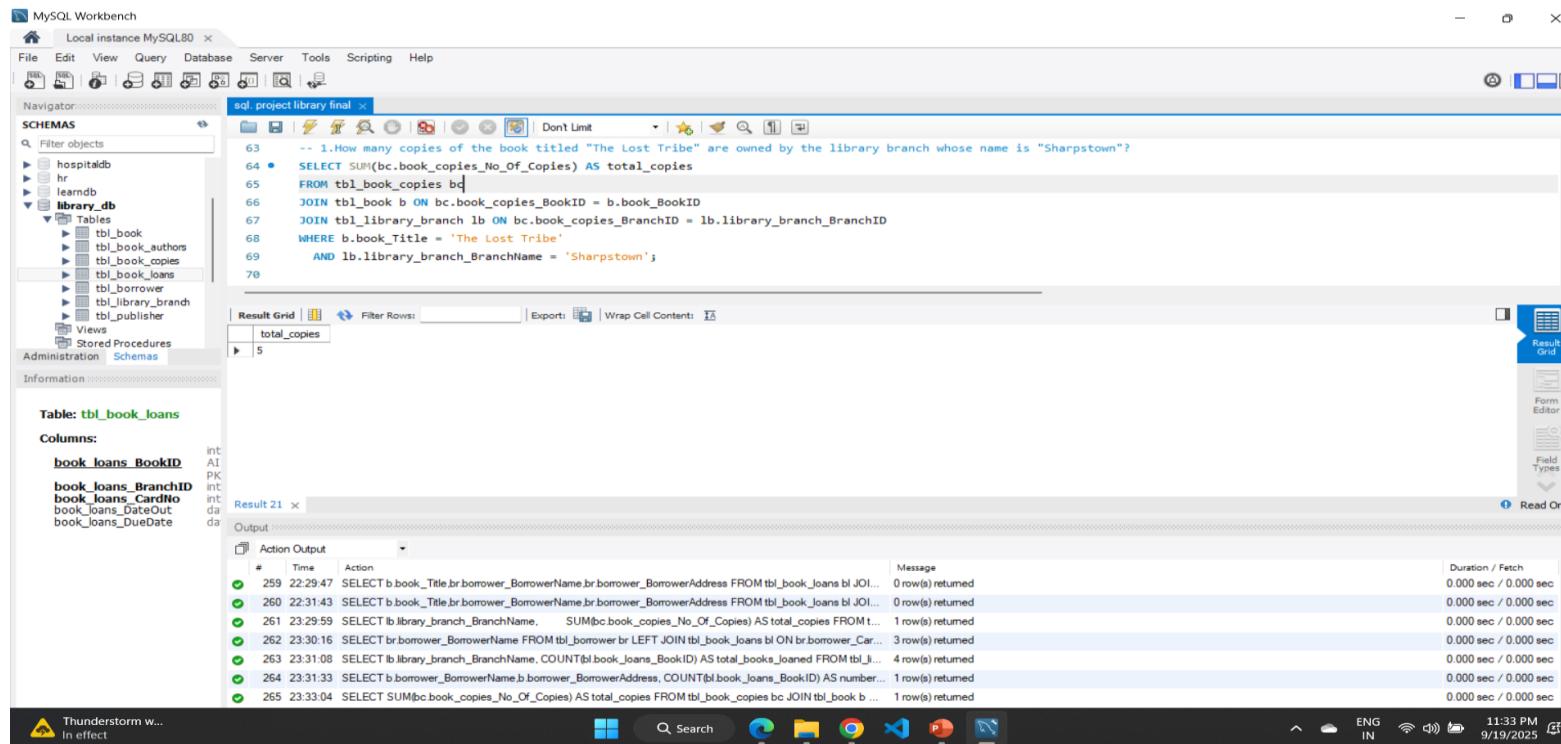
Key analysis questions (use cases):

- 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 shows the MySQL Workbench interface with the following details:

- Navigator:** Shows the database schema with the **library_db** database selected, containing tables like **tbl_book**, **tbl_book_copies**, and **tbl_library_branch**.
- Query Editor:** The query is displayed:

```
-- 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';
```
- Result Grid:** The result of the query is shown in a table:

total_copies
5
- Action Output:** A log of the executed SQL statements and their performance metrics:

#	Time	Action	Message	Duration / Fetch
259	22:29:47	SELECT b.book_Title,b.borrower_BorrowerName,b.borrower_BorrowerAddress FROM tbl_book_loans bl JOIN b ON bl.book_ID=b.book_ID WHERE bl.BranchID=1 AND b.book_Title='The Lost Tribe'	0 row(s) returned	0.000 sec / 0.000 sec
260	22:31:43	SELECT b.book_Title,b.borrower_BorrowerName,b.borrower_BorrowerAddress FROM tbl_book_loans bl JOIN b ON bl.book_ID=b.book_ID WHERE bl.BranchID=1 AND b.book_Title='The Lost Tribe'	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 tbl_book_copies bc JOIN lb.library_branch lb ON bc.BranchID=lb.library_branch_BranchID WHERE bc.BookID=(SELECT book_ID FROM b WHERE book_Title='The Lost Tribe') AND lb.BranchName='Sharpstown'	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_ID=bl.BranchID WHERE bl.BranchID=1	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_book_loans bl JOIN lb.library_branch lb ON bl.BranchID=lb.library_branch_BranchID WHERE bl.BranchID=1	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_of_loans FROM b JOIN tbl_book_loans bl ON b.book_ID=bl.book_ID WHERE b.book_Title='The Lost Tribe' AND bl.BranchID=1	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 ON bc.BookID=b.book_ID WHERE b.book_Title='The Lost Tribe' AND bc.BranchID=1	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 with the following details:

- Schemas:** library_db
- Tables:** tbl_book_loans
- Query Editor:** Contains the following SQL code:

```
-- 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;
```
- Result Grid:** Shows the output of the query:

library_branch_BranchName	total_copies
Sharpstown	5
- Action Output:** Displays the execution log with the following entries:

#	Time	Action	Message	Duration / Fetch
260	22:31:43	SELECT b.book_Title,br.borrower_BorrowerName,br.borrower_BorrowerAddress FROM tbl_book_loans bl JOINtbl_book b ON bl.book_loans_BookID = b.book_BookID WHERE b.book_Title = 'The Lost Tribe'	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 FROMtbl_book_copies bc JOINtbl_book b ON bc.book_copies_BookID = b.book_BookID WHERE b.book_Title = 'The Lost Tribe' GROUP BY lb.library_branch_BranchName	1 row(s) returned	0.000 sec / 0.000 sec
262	23:30:16	SELECT br.borrower_BorrowerName FROMtbl_book_loans bl LEFT JOINtbl_book b ON bl.book_loans_BookID = b.book_BookID WHERE b.book_Title = 'The Lost Tribe'	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 FROMtbl_book_loans bl JOINtbl_book b ON bl.book_loans_BookID = b.book_BookID WHERE b.book_Title = 'The Lost Tribe' GROUP BY lb.library_branch_BranchName	4 row(s) returned	0.000 sec / 0.000 sec
264	23:31:33	SELECT b.borrower_BorrowerName,br.borrower_BorrowerAddress, COUNT(bl.book_loans_BookID) AS total_books_loaned FROMtbl_book_loans bl JOINtbl_book b ON bl.book_loans_BookID = b.book_BookID WHERE b.book_Title = 'The Lost Tribe' GROUP BY b.borrower_BorrowerName,br.borrower_BorrowerAddress	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 FROMtbl_book_copies bc JOINtbl_book b ON bc.book_copies_BookID = b.book_BookID WHERE b.book_Title = 'The Lost Tribe'	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 FROMtbl_book_copies bc JOINtbl_book b ON bc.book_copies_BookID = b.book_BookID WHERE b.book_Title = 'The Lost Tribe' GROUP BY lb.library_branch_BranchName	1 row(s) returned	0.000 sec / 0.000 sec

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 with the following details:

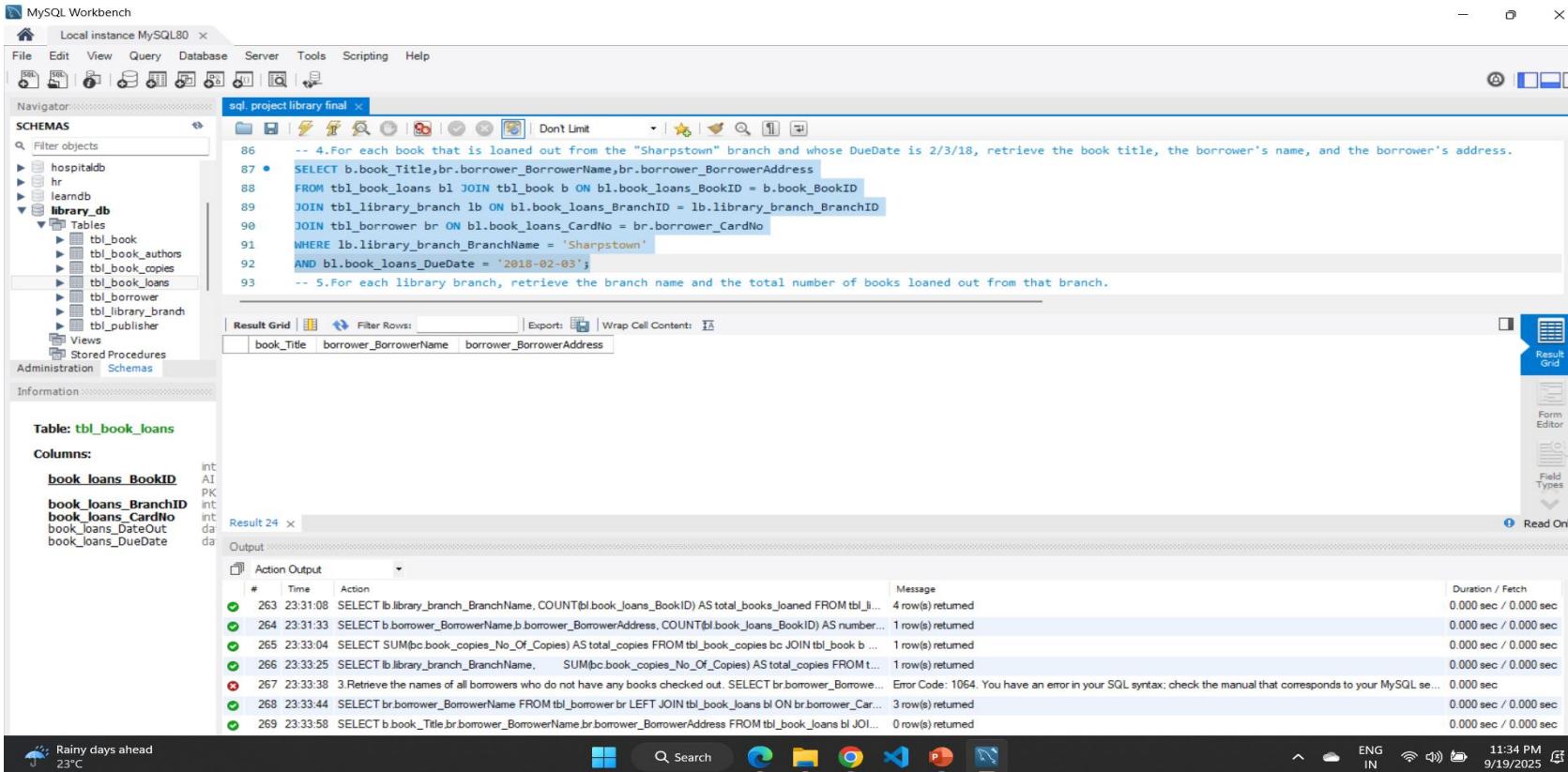
- File Bar:** File, Edit, View, Query, Database, Server, Tools, Scripting, Help.
- Navigator:** Schemas (hospitaldb, hr, learndb, library_db), Tables (tbl_book, tbl_book_authors, tbl_book_copies, tbl_book_loans, tbl_borrower, tbl_library_branch, tbl_publisher).
- Query Editor:** sql.project.library.final.x (Local instance MySQL80). The query is:

```
-- 3.Retrieve the names of all borrowers who do not have any books checked out.  
SELECT br.borrower_BorrowerName  
FROM tbl_borrower br  
LEFT JOIN tbl_book_loans bl ON br.borrower_CardNo = bl.book_loans_CardNo  
WHERE bl.book_loans_CardNo IS NULL;  
  
-- 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.  
SELECT b.book_Title,br.borrower_BorrowerName,br.borrower_BorrowerAddress
```
- Result Grid:** Shows the results of the first query:

borrower_BorrowerName
Jane Smith
Angela Thompson
Haley Jackson
- Action Output:** Shows the execution log with 268 entries, all successful (green checkmarks). The last few entries are:
 - 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
 - 263 23:31:08 SELECT bl.library_branch.BranchName, COUNT(bl.book_loans_BookID) AS total_books_loaned FROM bl.li... 4 row(s) returned
 - 264 23:31:33 SELECT b.borrower_BorrowerName,b.borrower_BorrowerAddress,COUNT(bl.book_loans_BookID) AS number... 1 row(s) returned
 - 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
 - 266 23:33:25 SELECT bl.library_branch.BranchName, SUM(bc.book_copies_No_Of_Copies) AS total_copies FROM bl.li... 1 row(s) returned
 - 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

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 shows the MySQL Workbench interface. The top menu bar includes File, Edit, View, Query, Database, Server, Tools, Scripting, and Help. The left sidebar displays the Navigator with Schemas (hospitaldb, hr, learnedb, library_db) and Tables (tbl_book, tbl_book_authors, tbl_book_copies, tbl_book_loans, tbl_borrower, tbl_library_branch, tbl_publisher). The main area contains a query editor window titled "sql_project_library_final" with the following SQL code:

```
-- 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.  
SELECT b.book_Title,br.borrower_BorrowerName,br.borrower_BorrowerAddress  
FROM tbl_book_loans bl JOIN tbl_book b ON bl.book_loans_BookID = b.book_BookID  
JOIN tbl_library_branch lb ON bl.book_loans_BranchID = lb.library_branch_BranchID  
JOIN tbl_borrower br ON bl.book_loans_CardNo = br.borrower_CardNo  
WHERE lb.library_branch_BranchName = 'Sharpstown'  
AND bl.book_loans_DueDate = '2018-02-03';  
  
-- 5. For each library branch, retrieve the branch name and the total number of books loaned out from that branch.
```

Below the query editor is a "Result Grid" table with columns: book_Title, borrower_BorrowerName, and borrower_BorrowerAddress. The "Output" pane at the bottom shows the execution history with 269 actions, all of which completed successfully with 0.000 sec / 0.000 sec duration.

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).

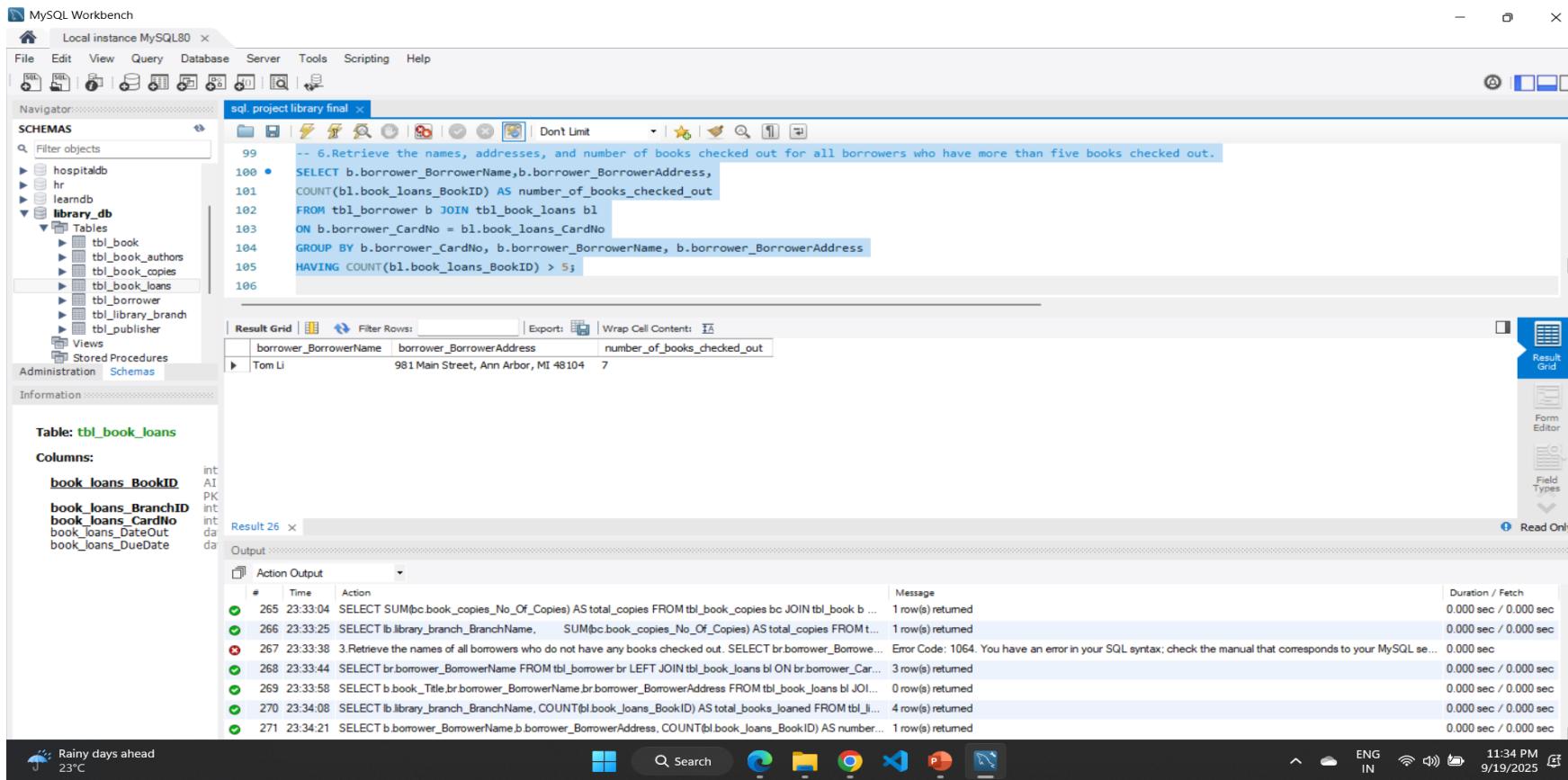
The screenshot shows the MySQL Workbench interface with a query editor window titled "sql_project_library_final". The code is a LEFT JOIN query to calculate the total number of books loaned per branch. The results are displayed in a grid:

library_branch_BranchName	total_books_loaned
Sharpstown	10
Central	5
Saline	5
Ann Arbor	0

The "Output" pane at the bottom shows the execution log with several rows of logs, mostly green checkmarks indicating successful queries. One row shows an error message: "Error Code: 1064. You have an error in your SQL syntax; check the manual that corresponds to your MySQL se...".

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 shows the MySQL Workbench interface with the following details:

- Navigator:** Shows the database schema with the **library_db** database selected, containing tables like **tbl_book**, **tbl_book_authors**, **tbl_book_copies**, **tbl_book_loans**, **tbl_borrower**, **tbl_library_branch**, and **tbl_publisher**.
- Query Editor:** Displays the SQL query:

```
-- 6.Retrieve the names, addresses, and number of books checked out for all borrowers who have more than five books checked out.
SELECT b.borrower_BorrowerName, b.borrower_BorrowerAddress,
       COUNT(bl.book_loans_BookID) AS number_of_books_checked_out
  FROM tbl_borrower b JOIN tbl_book_loans bl
    ON b.borrower_CardNo = bl.book_loans_CardNo
 GROUP BY b.borrower_CardNo, b.borrower_BorrowerName, b.borrower_BorrowerAddress
 HAVING COUNT(bl.book_loans_BookID) > 5;
```
- Result Grid:** Shows the query results in a table:

borrower_BorrowerName	borrower_BorrowerAddress	number_of_books_checked_out
Tom Li	981 Main Street, Ann Arbor, MI 48104	7
- Output:** Shows the execution history of the session, including the last 271 actions.

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 shows the MySQL Workbench interface with the following details:

- Schemas:** library_db
- Tables:** tbl_book, tbl_book_authors, tbl_book_copies, tbl_book_loans, tbl_borrower, tbl_library_branch, tbl_publisher
- Query Editor:** Contains the following SQL code:

```
-- 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".
SELECT b.book_Title, bc.book_copies_No_Of_Copies
FROM tbl_book_authors ba
JOIN tbl_book b ON ba.book_AuthorID = b.book_ID
JOIN tbl_book_copies bc ON b.book_ID = bc.book_copies_BookID
JOIN tbl_library_branch lb ON bc.book_copies_BranchID = lb.library_branch_BranchID
WHERE ba.book_authors_AuthorName = 'Stephen King'
AND lb.library_branch_BranchName = 'Central';
```
- Result Grid:** Shows the results of the query.
- Table Information:** Shows the structure of the **tbl_book_loans** table.
- Action Output:** Shows the execution log with the following entries:

#	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_Borrower...	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_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
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

