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RESEARCH LABS

INNOVATION. AUTOMATION. ANALYTICS

PROJECT ON

Library Management Analysis Using MySQL

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About me

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Business Objective

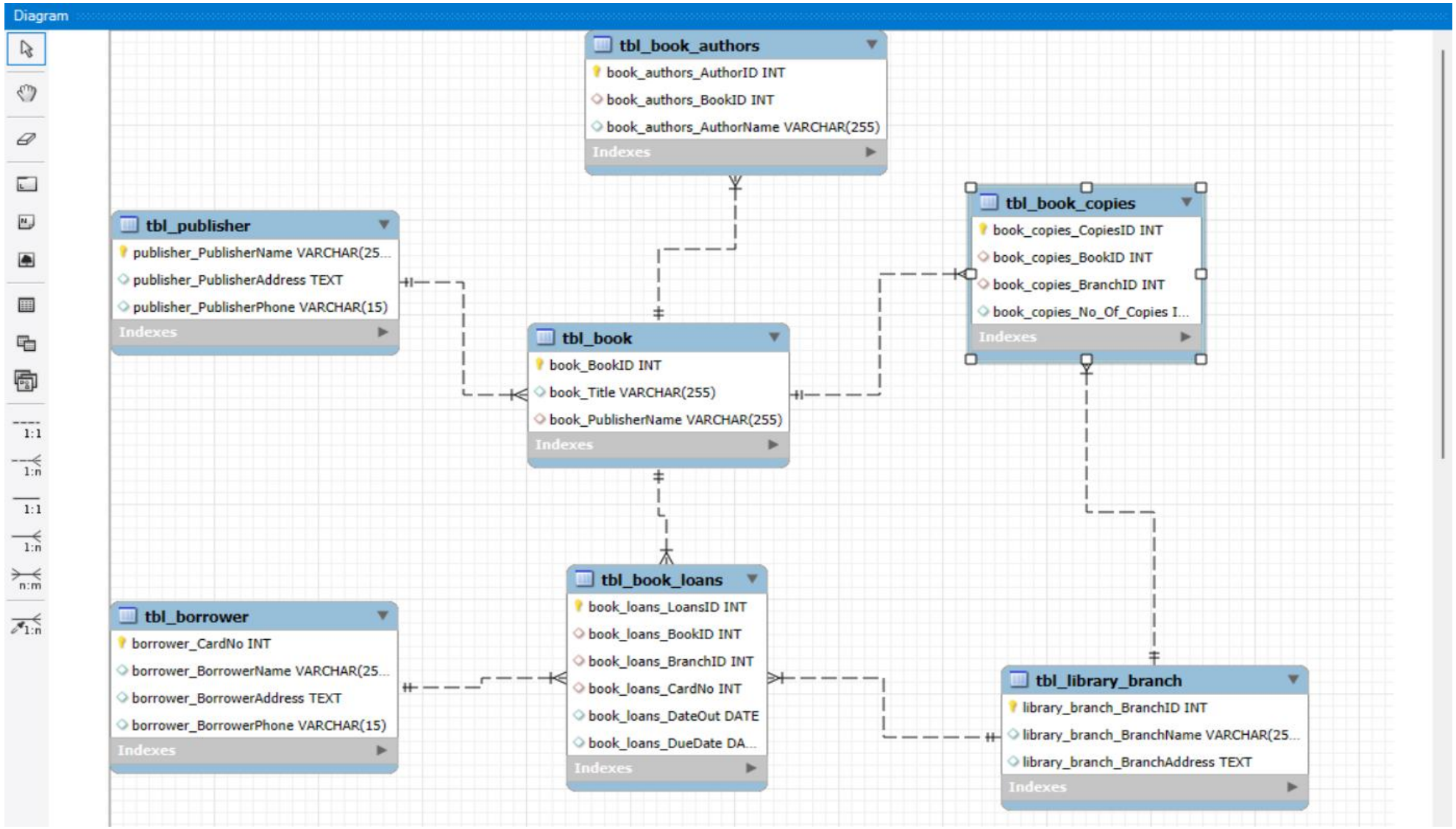
- This project focuses on analyzing a **Library Management System using SQL** to gain meaningful insights from structured library data.
- A Library Management System is an essential tool used to manage and organize library resources such as books, borrowers, authors, publishers, copies ,library branches and loan transactions.
- The analysis involves working with multiple interconnected tables, including **Books, Book Authors, Borrowers, Library Branches, Book Copies, Book Publisher and Book Loans**.
- Through SQL queries, we aim to answer key business questions such as identifying the most borrowed books, monitoring overdue loans, analyzing borrower activity, and managing stock across branches.

Approach to Business Objective

To design and understand a relational database structure for a Library Management System using multiple interconnected tables. We Focus on:

- **To retrieve meaningful information** from the database
- **To analyze book borrowing patterns** such as frequently issued books and active borrowers.
- **To identify overdue books and pending returns** by analyzing loan and due date information.
- **To monitor book availability across library branches** and manage inventory effectively.
- **To support decision-making for library administration** by providing data-driven insights.

EER-Diagram



Tables Overview

Tables	No Of Columns	No Of Rows
Publisher	3	16
Book	3	20
Book Copies	4	80
Book_Authors	3	20
Library_Branch	3	4
Borrower	4	8
Book_Loans	6	296

Number Of Copies Of “Lost Tribe” In “Sharpstown” branch.

```
SELECT tbl_book.book_Title as Title,tbl_library_branch.library_branch_BranchName as Branch_Name,
(tbl_book_copies.book_copies_No_Of_Copies) as Copies
FROM tbl_book_copies
JOIN tbl_book ON tbl_book_copies.book_copies_BookID = tbl_book.book_BookID
JOIN tbl_library_branch ON tbl_book_copies.book_copies_BranchID = tbl_library_branch.library_branch_BranchID
WHERE tbl_book.book_Title = 'The Lost Tribe'
AND tbl_library_branch.library_branch_BranchName = 'Sharpstown';
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

Title	Branch_Name	Copies
The Lost Tribe	Sharpstown	5

INSIGHTS :-

- **There are 5 copies of book Titled “The Lost Tribe” in Library Branch “Sharpstown”.**

The Copies of “The Lost Tribe” owned by each branch.

```sql
SELECT tbl_library_branch.library_branch_BranchName as Library_Branch,
SUM(tbl_book_copies.book_copies_No_Of_Copies) AS TotalCopies
FROM tbl_book_copies
JOIN tbl_book ON tbl_book_copies.book_copies_BookID = tbl_book.book_BookID
JOIN tbl_library_branch ON tbl_book_copies.book_copies_BranchID = tbl_library_branch.library_branch_BranchID
WHERE tbl_book.book_Title = 'The Lost Tribe'
GROUP BY tbl_library_branch.library_branch_BranchName;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

Library_Branch	TotalCopies
Sharpstown	5
Central	5
Saline	5
Ann Arbor	5

INSIGHTS :-

- **The 4 branches of libraries contains 5 copies of book “The Lost Tribe” in each branch.**
- **Same as all others remaining three books has same number of copies in each branch.**

Borrower who do not have any book check out.

```
SELECT tbl_borrower.borrower_BorrowerName as Borrower_Name,borrower_CardNo as Card_No,borrower_BorrowerPhone as Phone_Number,borrower_BorrowerAddress as Borrower_Address
FROM tbl_borrower
LEFT JOIN tbl_book_loans ON tbl_borrower.borrower_CardNo = tbl_book_loans.book_loans_CardNo
WHERE tbl_book_loans.book_loans_CardNo IS NULL;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

Borrower_Name	Card_No	Phone_Number	Borrower_Address
Jane Smith	101	212-931-4124	1321 4th Street, New York, NY 10014

INSIGHTS :-

- **Out of eight borrowers wee have only one borrower, who do not have checked out any book from library.**

Borrower's Information from Library Branch with respect to Due-Date.

```
SELECT b.book_Title,library_branch_branchName as Branch_Name, 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_borrower br ON bl.book_loans_CardNo = br.borrower_CardNo
JOIN tbl_library_branch lb ON bl.book_loans_BranchID = lb.library_branch_BranchID
WHERE lb.library_branch_BranchName = 'Sharpstown'
AND bl.book_loans_DueDate = '2018-02-03';
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

book_Title	borrower_BorrowerName	borrower_BorrowerAddress	Branch_Name
The Hobbit	Tom Li	981 Main Street, Ann Arbor, MI 48104	Sharpstown
Eragon	Tom Li	981 Main Street, Ann Arbor, MI 48104	Sharpstown
A Wise Mans Fear	Tom Li	981 Main Street, Ann Arbor, MI 48104	Sharpstown
Harry Potter and the Philosophers Stone	Tom Li	981 Main Street, Ann Arbor, MI 48104	Sharpstown
Hard Boiled Wonderland and The End of the World	Tom Li	981 Main Street, Ann Arbor, MI 48104	Sharpstown
The Hitchhikers Guide to the Galaxy	Tom Li	981 Main Street, Ann Arbor, MI 48104	Sharpstown
The Hobbit	Tom Li	981 Main Street, Ann Arbor, MI 48104	Sharpstown

Result 9

INSIGHTS :-

- **Tom Li has loaned out 34 books from the branch "Sharpstown" before Due Date.**
- **As per the analysis Tom Li has the highest number of book loaned out (83).**
- **Out of 83 books he used to read 34 books from the library branch "sharpstown"**

Number of Books loaned with respect to Library Branch Name

```
SELECT tbl_library_branch.library_branch_BranchName AS BranchName,
COUNT(tbl_book_loans.book_loans_LoansID) AS TotalBooksLoaned
FROM tbl_library_branch
LEFT JOIN tbl_book_loans ON tbl_library_branch.library_branch_BranchID = tbl_book_loans.book_loans_BranchID
GROUP BY tbl_library_branch.library_branch_BranchID, tbl_library_branch.library_branch_BranchName;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

BranchName	TotalBooksLoaned
Sharpstown	60
Central	66
Saline	60
Ann Arbor	110

INSIGHTS :-

- **Library name “Ann Arbor” has highest number of books loaned .**
- **“Sharpstown” and “Saline” has lowest number of books loaned.**

Information of Borrower who checked out more than 5 Books.

```
SELECT tbl_borrower.borrower_BorrowerName AS Borrower_Name,tbl_borrower.borrower_BorrowerAddress AS Borrower_Address,
COUNT(tbl_book_loans.book_loans_LoansID) AS Books_Checked_Out
FROM tbl_borrower
JOIN tbl_book_loans ON tbl_borrower.borrower_CardNo = tbl_book_loans.book_loans_CardNo
GROUP BY tbl_borrower.borrower_CardNo,tbl_borrower.borrower_BorrowerName,tbl_borrower.borrower_BorrowerAddress
HAVING COUNT(tbl_book_loans.book_loans_LoansID) > 5;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

Borrower_Name	Borrower_Address	Books_Checked_Out
Joe Smith	1321 4th Street, New York, NY 10014	42
Tom Li	981 Main Street, Ann Arbor, MI 48104	83
Angela Thompson	2212 Green Avenue, Ann Arbor, MI 48104	60
Harry Emnace	121 Park Drive, Ann Arbor, MI 48104	18
Tom Haverford	23 75th Street, New York, NY 10014	36
Haley Jackson	231 52nd Avenue New York, NY 10014	12
Michael Horford	653 Glen Avenue, Ann Arbor, MI 48104	45

INSIGHTS :-

- **Out of eight borrowers there are Seven borrowers who have more than five books checked out.**
- **Tom li has checked out maximum number of books i.e 83.**
- **Haley Jackson has checked out minimum number of books checked out i.e 12.**

In Library Branch “Central” number of copies of books written by “Stephen King”

```
SELECT book_authors_AuthorName as Author_Name,tbl_book.book_Title AS Title,
COALESCE(tbl_book_copies.book_copies_No_Of_Copies, 0) AS Central_Copies
FROM tbl_book
JOIN tbl_book_authors ON tbl_book.book_BookID = tbl_book_authors.book_authors_BookID
LEFT JOIN tbl_book_copies ON tbl_book.book_BookID = tbl_book_copies.book_copies_BookID
LEFT JOIN tbl_library_branch ON tbl_book_copies.book_copies_BranchID = tbl_library_branch.library_branch_BranchID
WHERE tbl_book_authors.book_authors_AuthorName = 'Stephen King'
AND tbl_library_branch.library_branch_BranchName = 'Central';
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

Author_Name	Title	Central_Copies
Stephen King	It	5
Stephen King	The Green Mile	5

INSIGHTS :- “Central” library branch has 5 copies of “IT” and 5 Copies of “The Green Mile” by Author “Stephen King”.

Business Insights

The SQL-based analysis of the Library Management System provides actionable insights into **user behavior, book demand.**
By implementing data-driven recommendations, the library can **improve resource utilization, enhance user satisfaction, reduce delays, and optimize costs.**
Here are some key business insights:-

- Book Availability Across Branches.
- Identification of Inactive Borrowers.
- Tracking Due-Date Specific Loans.

Conclusion And Recommendation

Conclusion:

- The Library Management Analysis project provides a comprehensive understanding of how data-driven insights can improve the efficiency, accessibility, and overall performance of a library system.
- The analysis highlights important operational patterns, including book availability, frequently issued books, active members, and overdue returns.
- Overall, this project proves that an effective library management system backed by analytical queries enhances decision-making, ensures better utilization of resources.

Recommendation:

- Demand-Based Stock Optimization.
- Automated Due-Date Notifications.
- Branch-Specific Performance Monitoring.

Experience/Challenges working on SQL

Experiences:-

- Learned how SQL is used to solve real-world problems in library management.
- Understood relationships between tables such as books, borrowers, book copies, loans, and branches.
- Learned how primary and foreign keys maintain data integrity.
- Converted raw data into meaningful business insights like book availability, inactive borrowers, and due-date tracking.

Challenges:-

- Initially faced difficulty identifying correct joins between multiple tables.
- Required careful analysis of foreign key relationships.
- Combining multiple tables with correct conditions was challenging.
- Errors like incorrect joins or missing conditions led to inaccurate results.
- Ensuring accurate results when data was evenly distributed across branches required careful grouping and aggregation.

THANK YOU

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