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Duration: August to September 2024

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Library Management System

Introduction:

The Library Management System (LMS) is a sophisticated database-driven application designed to facilitate the efficient management of a library's book inventory, member records, and borrow/return transactions. This project aims to provide a practical learning experience in SQL commands, database design principles, and data manipulation techniques. The LMS will help librarians streamline their operations, improve user experience, and maintain accurate records.

Objectives:

- **Database Design:** To design a relational database that effectively captures the relationships between books, members, and transactions.
- **Data Manipulation:** To implement SQL queries for inserting, updating, deleting, and retrieving data.
- **User Management:** To manage library members and their borrowing privileges.
- **Reporting:** To generate reports and statistics that provide insights into library usage and inventory status.
- **Future Enhancements:** To outline potential improvements and features for the LMS.

Database Design:

The database consists of five primary tables:

- Books
- Members
- Transactions
- BookCategories
- MembershipTypes

SQL Queries:

1) Create a Database or Schema:

```
CREATE DATABASE Library_Management_System;
```

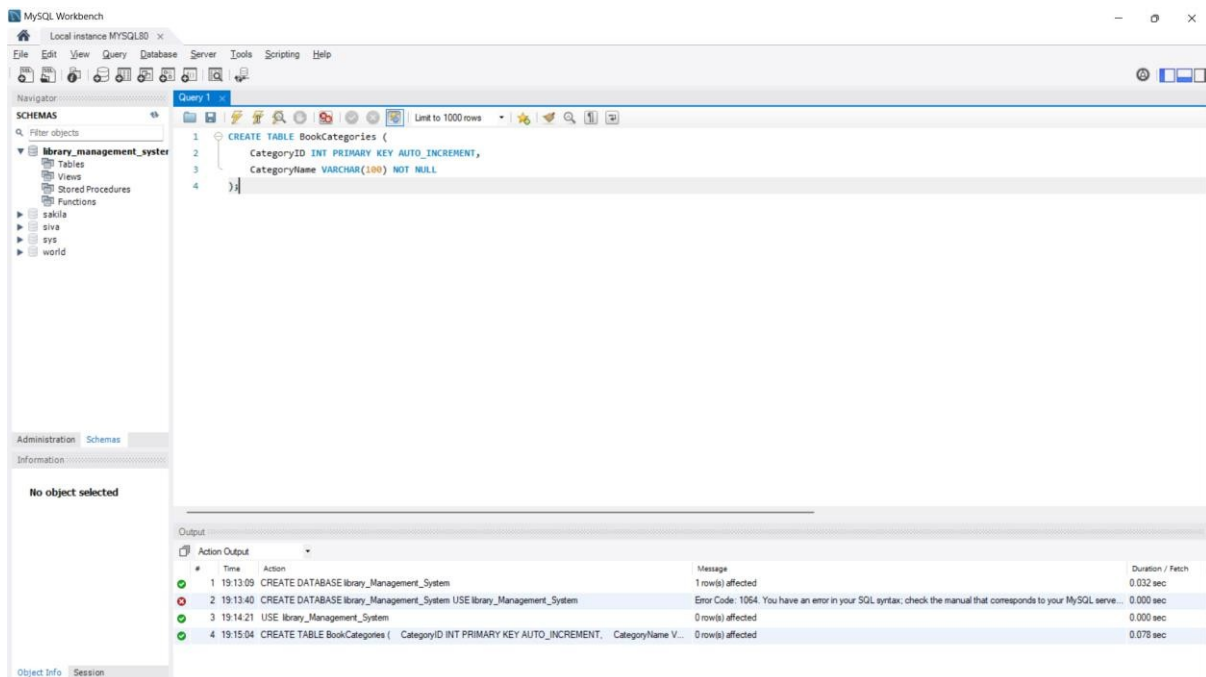
2) Use Database for Data Collection:

```
USE Library_Management_System;
```

3) Create Table:

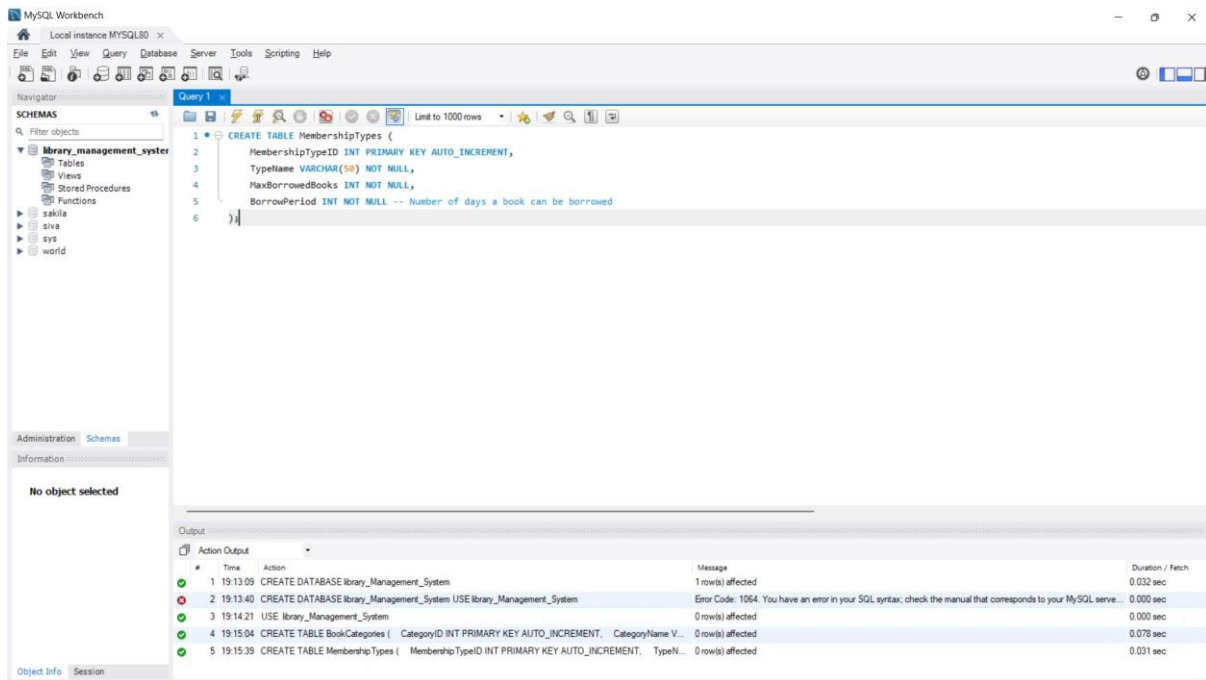
1. Create the BookCategories Table

```
CREATE TABLE BookCategories (  
    CategoryID INT PRIMARY KEY AUTO_INCREMENT,  
    CategoryName VARCHAR(100) NOT NULL  
);
```



2. Create the MembershipTypes Table:

```
CREATE TABLE MembershipTypes (  
    MembershipTypeID INT PRIMARY KEY AUTO_INCREMENT,  
    TypeName VARCHAR(50) NOT NULL,  
    MaxBorrowedBooks INT NOT NULL,  
    BorrowPeriod INT NOT NULL -- Number of days a book can be borrowed );
```



3. Create the Books Table:

CREATE TABLE Books (

BookID INT PRIMARY KEY AUTO_INCREMENT,

Title VARCHAR(255) NOT NULL,

Author VARCHAR(255) NOT NULL,

Publisher VARCHAR(255) NOT NULL,

PublicationYear YEAR NOT NULL,

ISBN VARCHAR(13) NOT NULL UNIQUE,

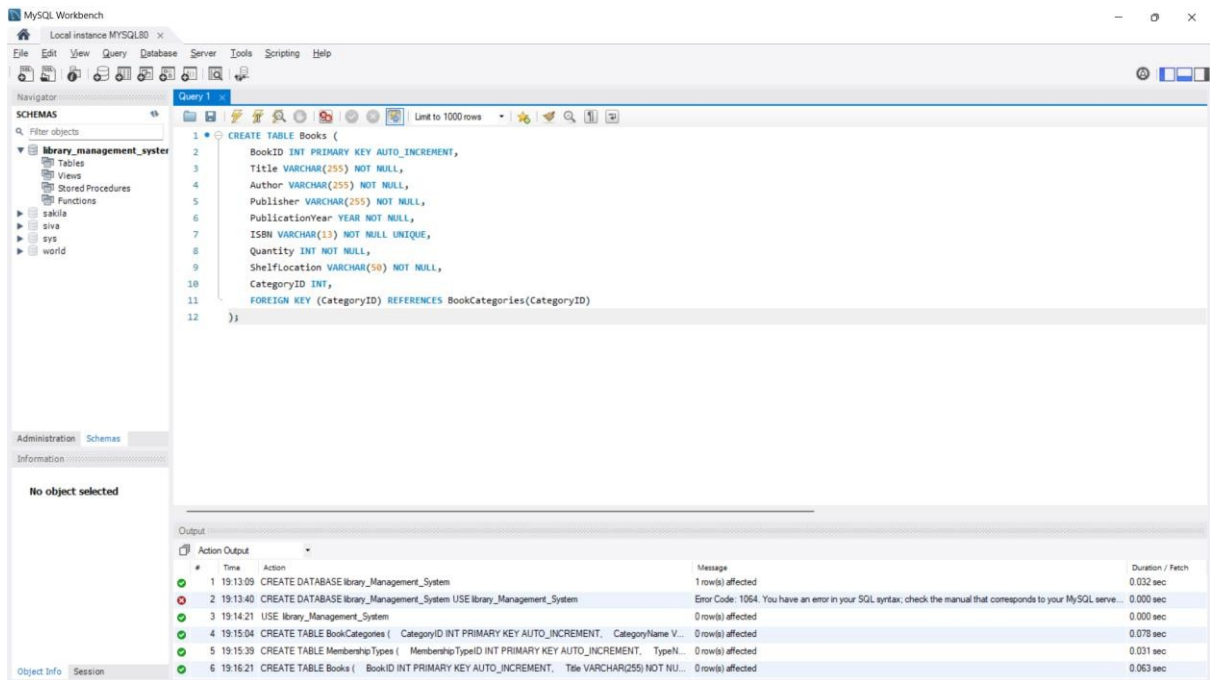
Quantity INT NOT NULL,

ShelfLocation VARCHAR(50) NOT NULL,

CategoryID INT,

FOREIGN KEY (CategoryID) REFERENCES BookCategories(CategoryID)

);



4. Create the Members Table

CREATE TABLE Members (

MemberID INT PRIMARY KEY AUTO_INCREMENT,

FirstName VARCHAR(50) NOT NULL,

LastName VARCHAR(50) NOT NULL,

Email VARCHAR(100) NOT NULL UNIQUE,

PhoneNumber VARCHAR(15),

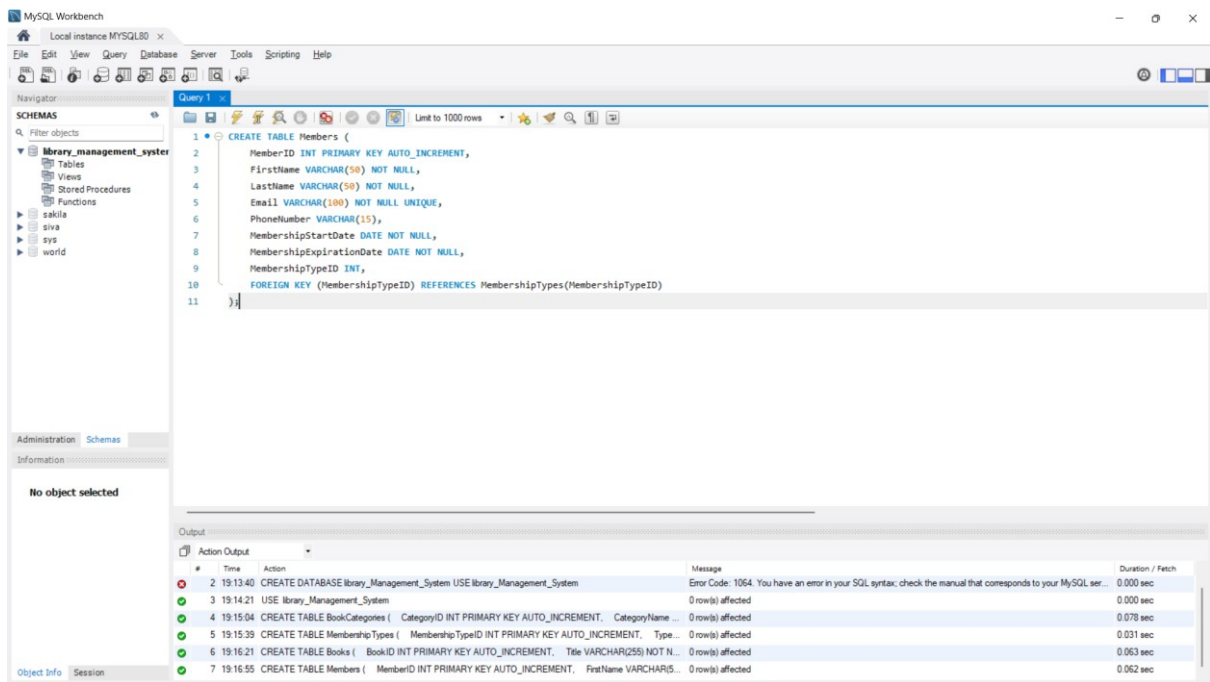
MembershipStartDate DATE NOT NULL,

MembershipExpirationDate DATE NOT NULL,

MembershipTypeID INT,

FOREIGN KEY (MembershipTypeID) REFERENCES
MembershipTypes(MembershipTypeID)

);



5. Create the Transactions Table

CREATE TABLE Transactions (

TransactionID INT PRIMARY KEY AUTO_INCREMENT,

BookID INT,

MemberID INT,

BorrowDate DATE NOT NULL,

DueDate DATE NOT NULL,

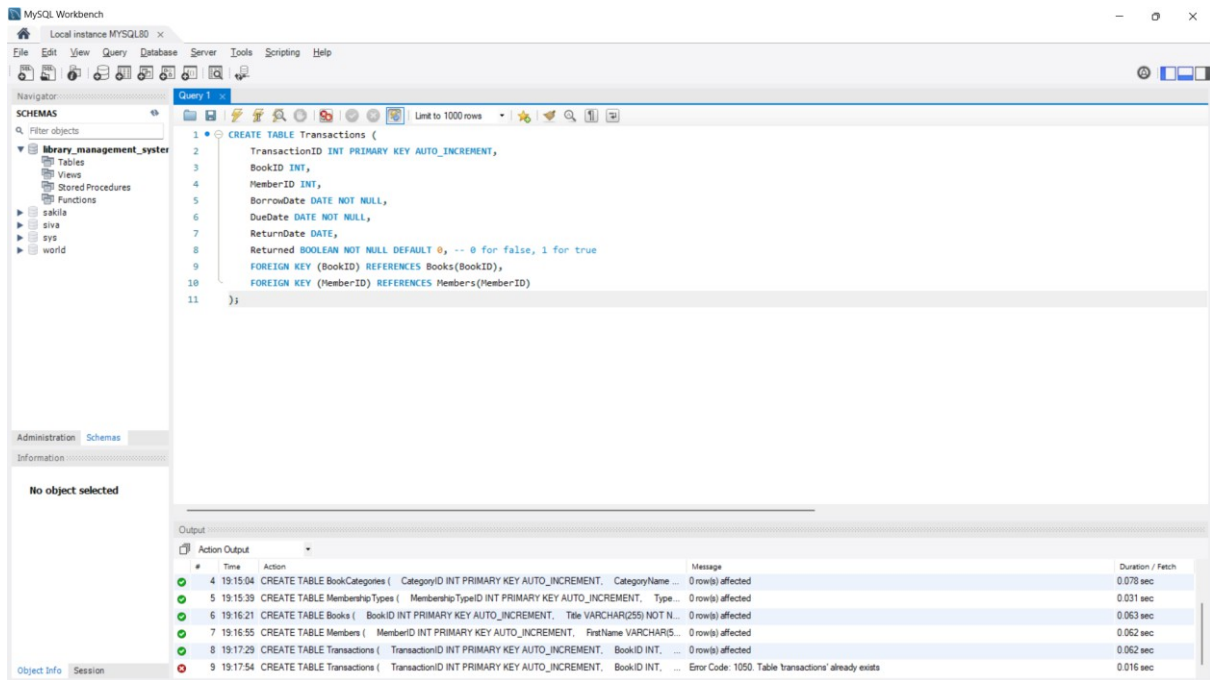
ReturnDate DATE,

Returned BOOLEAN NOT NULL DEFAULT 0, -- 0 for false, 1 for true

FOREIGN KEY (BookID) REFERENCES Books(BookID),

FOREIGN KEY (MemberID) REFERENCES Members(MemberID)

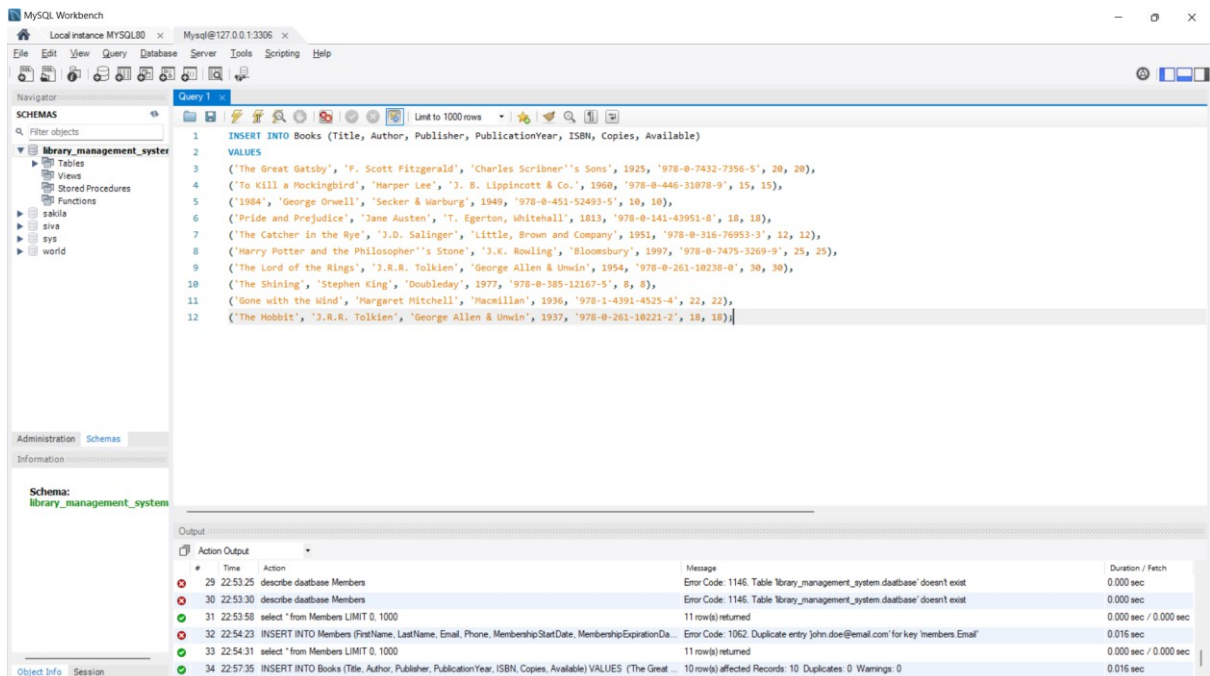
);



SQL Queries:

1. Inserting Data

Insert a New Book



SELECT * FROM books;

The screenshot shows the MySQL Workbench interface. The 'Query' tab is active, displaying the query `select * from books;`. The 'Result Grid' shows 11 rows of data from the 'books' table. The columns are: BookID, Title, Author, Publisher, PublicationYear, ISBN, Copies, and Available. The data includes books like '1984', 'The Great Gatsby', 'To Kill a Mockingbird', etc.

BookID	Title	Author	Publisher	PublicationYear	ISBN	Copies	Available
1	1984	George Orwell	Secker & Warburg	1949	978-0-45152493-5	5	5
2	The Great Gatsby	F. Scott Fitzgerald	Charles Scribner's Sons	1925	978-0-7432-7356-5	20	20
3	To Kill a Mockingbird	Harper Lee	J. B. Lippincott & Co.	1960	978-0-446-31078-9	15	15
4	1984	George Orwell	Secker & Warburg	1949	978-0-451-52493-5	10	10
5	Pride and Prejudice	Jane Austen	T. Egerton, Whitehall	1813	978-0-141-43951-8	18	18
6	The Catcher in the Rye	J.D. Salinger	Little, Brown and Company	1951	978-0-316-76953-3	12	12
7	Harry Potter and the Philosopher's Stone	J.K. Rowling	Bloomsbury	1997	978-0-7475-3269-9	25	25
8	The Lord of the Rings	J.R.R. Tolkien	George Allen & Unwin	1954	978-0-261-10238-0	30	30
9	The Shining	Stephen King	Doubleday	1977	978-0-385-12167-5	8	8
10	Gone with the Wind	Margaret Mitchell	Macmillan	1936	978-1-4391-4525-4	22	22
11	The Hobbit	J.R.R. Tolkien	George Allen & Unwin	1937	978-0-261-10221-2	18	18

3) Insert a New Member

The screenshot shows the MySQL Workbench interface. The 'Query' tab is active, displaying a query to insert new members into the 'Members' table. The query is as follows:

```
1 INSERT INTO Members (FirstName, LastName, Email, Phone, MembershipStartDate, MembershipExpirationDate)
2 VALUES
3 ('John', 'Doe', 'john.doe@email.com', '555-1234', '2024-01-01', '2025-01-01'),
4 ('Jane', 'Smith', 'jane.smith@email.com', '555-5678', '2024-01-01', '2025-01-01'),
5 ('Emily', 'Johnson', 'emily.johnson@email.com', '555-8765', '2024-01-01', '2025-01-01'),
6 ('Michael', 'Brown', 'michael.brown@email.com', '555-4321', '2024-01-01', '2025-01-01'),
7 ('Sarah', 'Davis', 'sarah.davis@email.com', '555-3456', '2024-01-01', '2025-01-01'),
8 ('David', 'Wilson', 'david.wilson@email.com', '555-7890', '2024-01-01', '2025-01-01'),
9 ('Laura', 'Martinez', 'laura.martinez@email.com', '555-6543', '2024-01-01', '2025-01-01'),
10 ('James', 'Garcia', 'james.garcia@email.com', '555-9876', '2024-01-01', '2025-01-01'),
11 ('Karen', 'Rodriguez', 'karen.rodriguez@email.com', '555-3210', '2024-01-01', '2025-01-01'),
12 ('Robert', 'Lee', 'robert.lee@email.com', '555-2109', '2024-01-01', '2025-01-01');
13
```

The 'Output' tab shows the execution results, indicating that 10 rows were affected.

#	Time	Action	Message	Duration / Fetch
19	22:42:08	drop database library_management_system	3 row(s) affected	0.047 sec
20	22:44:41	create database library_management_system	1 row(s) affected	0.016 sec
21	22:44:51	use library_management_system	0 row(s) affected	0.000 sec
22	22:48:39	CREATE TABLE Books (BookID INT PRIMARY KEY AUTO_INCREMENT, Title VARCHAR(255) NOT NULL)	0 row(s) affected	0.078 sec
23	22:49:15	CREATE TABLE Members (MemberID INT PRIMARY KEY AUTO_INCREMENT, FirstName VARCHAR(50), LastName VARCHAR(50), Email VARCHAR(100), Phone VARCHAR(20), MembershipStartDate DATE, MembershipExpirationDate DATE)	0 row(s) affected	0.062 sec
24	22:49:33	CREATE TABLE Transactions (TransactionID INT PRIMARY KEY AUTO_INCREMENT, BookID INT, MemberID INT, TransactionDate DATE, TransactionStatus VARCHAR(20))	0 row(s) affected	0.063 sec

SELECT * FROM Members;

The screenshot shows the MySQL Workbench interface. The 'Query' tab is active, displaying the query `select * from Members;`. The 'Result Grid' shows the data for the 'Members' table, which has 11 rows. The columns are MemberID, FirstName, LastName, Email, Phone, MembershipStartDate, and MembershipExpirationDate.

MemberID	FirstName	LastName	Email	Phone	MembershipStartDate	MembershipExpirationDate
1	Alice	Smith	alice.smith@email.com	555-6789	2023-01-01	2024-01-01
2	John	Doe	john.doe@email.com	555-1234	2024-01-01	2025-01-01
3	Jane	Smith	jane.smith@email.com	555-5678	2024-01-01	2025-01-01
4	Emily	Johnson	emily.johnson@email.com	555-8765	2024-01-01	2025-01-01
5	Michael	Brown	michael.brown@email.com	555-4321	2024-01-01	2025-01-01
6	Sarah	Davis	sarah.davis@email.com	555-3456	2024-01-01	2025-01-01
7	David	Wilson	david.wilson@email.com	555-7890	2024-01-01	2025-01-01
8	Laure	Martinez	laure.martinez@email.com	555-4567	2024-01-01	2025-01-01
9	James	Garcia	james.garcia@email.com	555-0987	2024-01-01	2025-01-01
10	Karen	Rodriguez	karen.rodriguez@email.com	555-3210	2024-01-01	2025-01-01
11	Robert	Lee	robert.lee@email.com	555-2109	2024-01-01	2025-01-01

The 'Output' tab shows the execution of the query. It displays the action output, including the time taken to execute the query (22:53:15) and the message 'Error Code: 1146. Table 'library_management_system' doesn't exist'.

4) Update Data

Update Book Information:

The screenshot shows the MySQL Workbench interface. The 'Query' tab is active, displaying the query `UPDATE Books SET Available = Available - 1 WHERE BookID = 1 AND Available > 0;`. The 'Result Grid' shows the data for the 'Books' table, which has 11 rows. The columns are BookID, Title, Author, Publisher, PublicationYear, ISBN, Copies, and Available.

BookID	Title	Author	Publisher	PublicationYear	ISBN	Copies	Available
1	1984	George Orwell	Secker & Warburg	1949	978-0-451-52493-5	5	3
2	The Great Gatsby	F. Scott Fitzgerald	Charles Scribner's Sons	1925	978-0-7432-7266-5	20	20
3	To Kill a Mockingbird	Harper Lee	J. B. Lippincott & Co.	1960	978-0-446-31078-9	15	15
4	1984	George Orwell	Secker & Warburg	1949	978-0-451-52493-5	10	10
5	Pride and Prejudice	Jane Austen	T. Egerton, Whitehall	1813	978-0-141-43951-8	18	18
6	The Catcher in the Rye	J.D. Salinger	Little, Brown and Company	1951	978-0-316-76953-3	12	12
7	Harry Potter and the Philosopher's Stone	J.K. Rowling	Bloomsbury	1997	978-0-7475-3269-9	25	25
8	The Lord of the Rings	J.R.R. Tolkien	George Allen & Unwin	1954	978-0-261-10238-0	30	30
9	The Shining	Stephen King	Doubleday	1977	978-0-385-12167-5	8	8
10	Gone with the Wind	Margaret Mitchell	Macmillan	1936	978-1-4391-4525-4	22	22
11	The Hobbit	J.R.R. Tolkien	George Allen & Unwin	1937	978-0-261-10221-2	18	18

The 'Output' tab shows the execution of the query. It displays the action output, including the time taken to execute the query (23:01:59) and the message 'Error Code: 1062. Duplicate entry 'john.doe@email.com' for key 'Members Email''. It also shows the number of rows affected (1 row(s) affected) and the number of rows returned (11 row(s) returned).

Update Member Information :

The screenshot shows the MySQL Workbench interface. The 'Query' tab is active, displaying the following SQL query:

```
1 • UPDATE Members
2 • SET Phone = '555-0000'
3 • WHERE MemberID = 1;
4 • select * from Members;
```

The 'Result Grid' shows the results of the query, displaying 11 rows of member data. The 'Output' tab shows the execution log, indicating that the update was successful for 1 row.

MemberID	Firstname	Lastname	Email	Phone	MembershipStartDate	MembershipExpirationDate
1	Alice	Smith	alice.smith@email.com	555-0000	2023-01-01	2024-01-01
2	John	Doe	john.doe@email.com	555-1234	2024-01-01	2025-01-01
3	Jane	Smith	jane.smith@email.com	555-5678	2024-01-01	2025-01-01
4	Emily	Johnson	emily.johnson@email.com	555-8765	2024-01-01	2025-01-01
5	Michael	Brown	michael.brown@email.com	555-4321	2024-01-01	2025-01-01
6	Sarah	Davis	sarah.davis@email.com	555-3456	2024-01-01	2025-01-01
7	David	Wilson	david.wilson@email.com	555-7890	2024-01-01	2025-01-01
8	Laura	Martinez	laura.martinez@email.com	555-6543	2024-01-01	2025-01-01
9	James	Garcia	james.garcia@email.com	555-0987	2024-01-01	2025-01-01
10	Karen	Rodriguez	karen.rodriguez@email.com	555-3210	2024-01-01	2025-01-01
11	Robert	Lee	robert.lee@email.com	555-2109	2024-01-01	2025-01-01

5) Delete Data

Delete a Book :

The screenshot shows the MySQL Workbench interface. The 'Query' tab is active, displaying the following SQL query:

```
1 • DELETE FROM Books
2 • WHERE BookID = 1;
3 • select * from Members;
```

The 'Result Grid' shows the results of the query, displaying 11 rows of member data. The 'Output' tab shows the execution log, indicating that the delete operation was successful for 1 row.

MemberID	Firstname	Lastname	Email	Phone	MembershipStartDate	MembershipExpirationDate
1	Alice	Smith	alice.smith@email.com	555-0000	2023-01-01	2024-01-01
2	John	Doe	john.doe@email.com	555-1234	2024-01-01	2025-01-01
3	Jane	Smith	jane.smith@email.com	555-5678	2024-01-01	2025-01-01
4	Emily	Johnson	emily.johnson@email.com	555-8765	2024-01-01	2025-01-01
5	Michael	Brown	michael.brown@email.com	555-4321	2024-01-01	2025-01-01
6	Sarah	Davis	sarah.davis@email.com	555-3456	2024-01-01	2025-01-01
7	David	Wilson	david.wilson@email.com	555-7890	2024-01-01	2025-01-01
8	Laura	Martinez	laura.martinez@email.com	555-6543	2024-01-01	2025-01-01
9	James	Garcia	james.garcia@email.com	555-0987	2024-01-01	2025-01-01
10	Karen	Rodriguez	karen.rodriguez@email.com	555-3210	2024-01-01	2025-01-01
11	Robert	Lee	robert.lee@email.com	555-2109	2024-01-01	2025-01-01

Delete a Member :

The screenshot shows the MySQL Workbench interface. The 'Query' tab is active, displaying the following SQL query:

```
1 * DELETE FROM Members;
2 * WHERE MemberID = 1;
3 * select * from Members;
```

The 'Result Grid' shows the output of the query, which is a table with 7 columns: MemberID, FirstName, LastName, Email, Phone, MembershipStartDate, and MembershipExpirationDate. The table contains 12 rows of data.

The 'Output' tab shows the execution results of the query. The output is a table with 4 columns: #, Time, Action, and Message. The output shows the execution of the DELETE statement and the subsequent SELECT statement.

#	Time	Action	Message
53	23:10:24	DELETE FROM Books WHERE BookID = 1	0 row(s) affected
54	23:10:24	select * from Members LIMIT 0, 1000	11 row(s) returned
55	23:11:26	DELETE FROM Members WHERE MemberID = 1	1 row(s) affected
56	23:11:26	select * from Members LIMIT 0, 1000	10 row(s) returned
57	23:11:38	DELETE FROM Members WHERE MemberID = 1	0 row(s) affected
58	23:11:38	select * from Members LIMIT 0, 1000	10 row(s) returned

5) Retrieve Data

Get All Books :

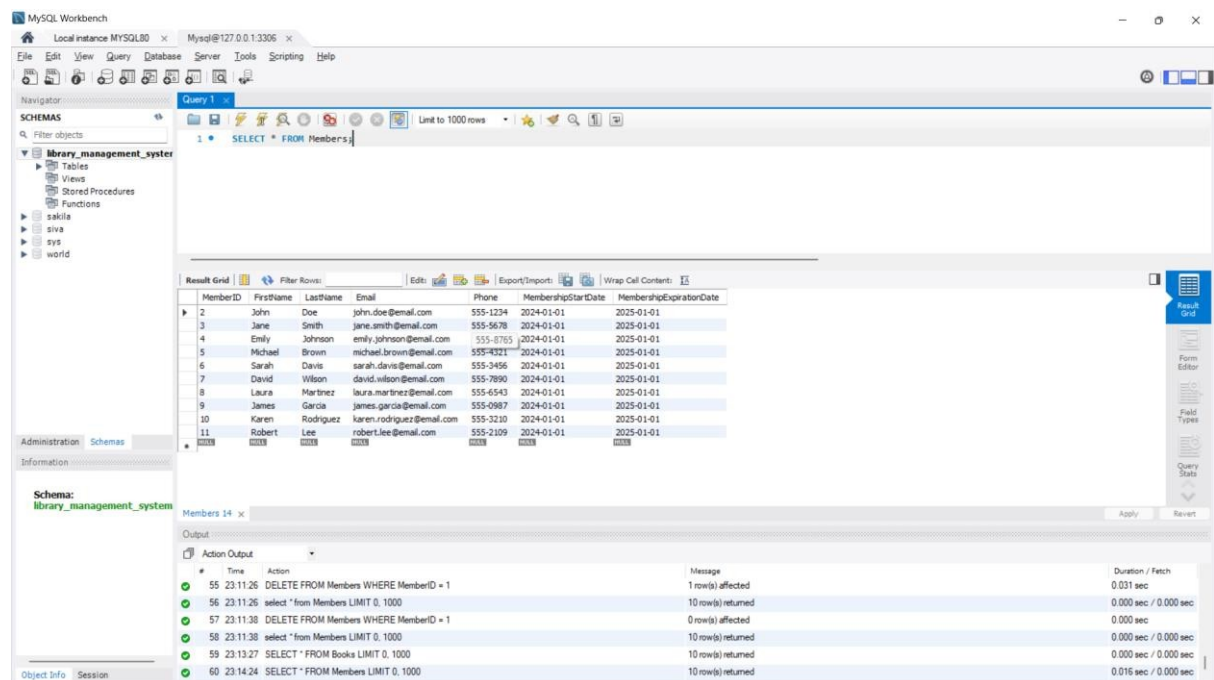
The screenshot shows the MySQL Workbench interface. The 'Query' tab is active, displaying the following SQL query:

```
1 * SELECT * FROM Books;
```

The 'Result Grid' shows the output of the query, which is a table with 7 columns: BookID, Title, Author, Publisher, PublicationYear, ISBN, and Copies. The table contains 13 rows of data.

BookID	Title	Author	Publisher	PublicationYear	ISBN	Copies
2	The Great Gatsby	F. Scott Fitzgerald	Charles Scribner's Sons	1925	978-0-7432-7336-5	20
3	To Kill a Mockingbird	Harper Lee	J. B. Lippincott & Co.	1960	978-0-446-31078-9	15
4	1984	George Orwell	Secker & Warburg	1949	978-0-451-52493-5	10
5	Pride and Prejudice	Jane Austen	T. Egerton, Whitehall	1813	978-0-141-43951-8	18
6	The Catcher in the Rye	J.D. Salinger	Little, Brown and Company	1951	978-0-316-76953-3	12
7	Harry Potter and the Philosopher's Stone	J.K. Rowling	Bloomsbury	1997	978-0-7475-3269-9	25
8	The Lord of the Rings	J.R.R. Tolkien	George Allen & Unwin	1954	978-0-261-10238-0	30
9	The Shining	Stephen King	Doubleday	1977	978-0-385-12167-5	8
10	Gone with the Wind	Margaret Mitchell	Macmillan	1936	978-1-4391-4525-4	22
11	The Hobbit	J.R.R. Tolkien	George Allen & Unwin	1937	978-0-261-10221-2	18

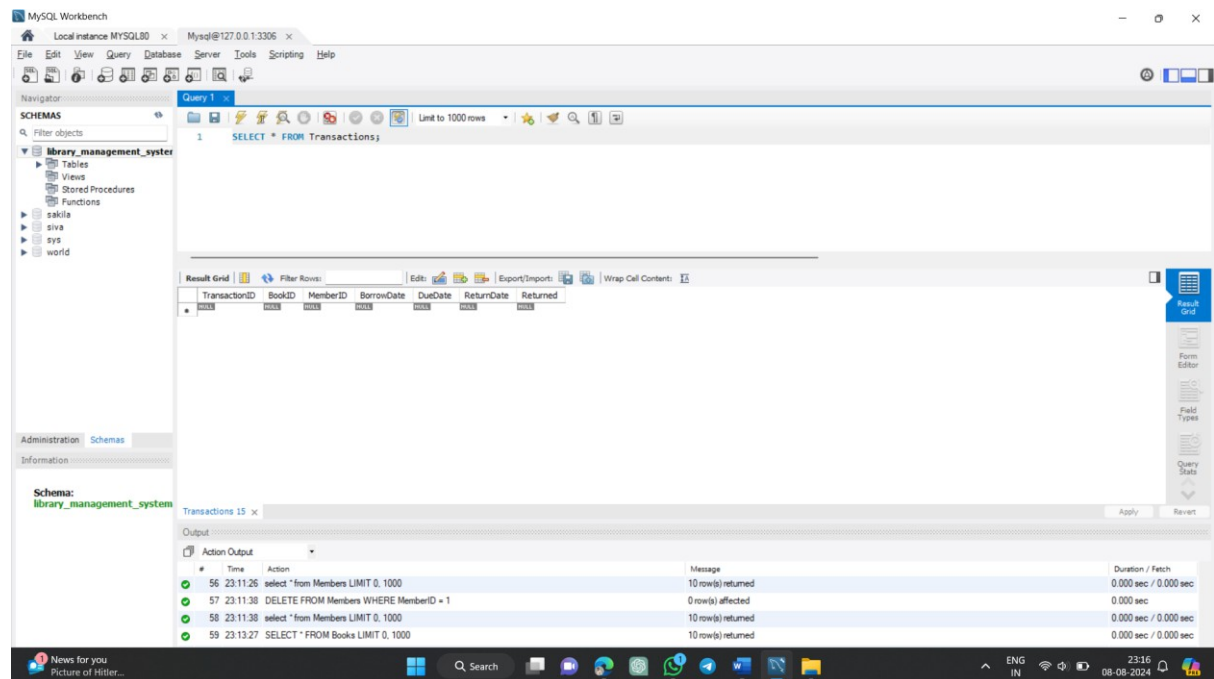
Get All Members



MySQL Workbench interface showing the 'Members' table in the 'library_management_system' schema. The table contains 11 rows of member data.

MemberID	FirstName	LastName	Email	Phone	MembershipStartDate	MembershipExpirationDate
2	John	Doe	john.doe@email.com	555-1234	2024-01-01	2025-01-01
3	Jane	Smith	jane.smith@email.com	555-5678	2024-01-01	2025-01-01
4	Emily	Johnson	emily.johnson@email.com	555-8765	2024-01-01	2025-01-01
5	Michael	Brown	michael.brown@email.com	555-9012	2024-01-01	2025-01-01
6	Sarah	Davis	sarah.davis@email.com	555-3456	2024-01-01	2025-01-01
7	David	Wilson	david.wilson@email.com	555-7890	2024-01-01	2025-01-01
8	Laura	Martinez	laura.martinez@email.com	555-6543	2024-01-01	2025-01-01
9	James	Garcia	james.garcia@email.com	555-0987	2024-01-01	2025-01-01
10	Karen	Rodriguez	karen.rodriguez@email.com	555-5210	2024-01-01	2025-01-01
11	Robert	Lee	robert.lee@email.com	555-2109	2024-01-01	2025-01-01

Get All Transactions



MySQL Workbench interface showing the 'Transactions' table in the 'library_management_system' schema. The table contains 15 rows of transaction data.

TransactionID	BookID	MemberID	BorrowDate	DueDate	ReturnDate	Returned
55	23.11.26	DELETE FROM Members WHERE MemberID = 1				
56	23.11.26	select * from Members LIMIT 0, 1000				
57	23.11.38	DELETE FROM Members WHERE MemberID = 1				
58	23.11.38	select * from Members LIMIT 0, 1000				
59	23.13.27	SELECT * FROM Books LIMIT 0, 1000				
60	23.14.24	SELECT * FROM Members LIMIT 0, 1000				

Get Overdue Books

The screenshot shows the MySQL Workbench interface. The 'Query' tab is active, displaying a SQL query to find overdue books. The query is as follows:

```
1 SELECT b.Title, t.DueDate
2 FROM Transactions t
3 JOIN Books b ON t.BookID = b.BookID
4 WHERE t.Returned = FALSE AND t.DueDate < CURRENT_DATE;
```

The 'Result Grid' is empty, showing columns 'Title' and 'DueDate'. The 'Output' pane shows the execution log with the following entries:

#	Time	Action	Message	Duration / Fetch
57	23:11:38	DELETE FROM Members WHERE MemberID = 1	0 row(s) affected	0.000 sec
58	23:11:38	select * from Members LIMIT 0, 1000	10 row(s) returned	0.000 sec / 0.000 sec
59	23:13:27	SELECT * FROM Books LIMIT 0, 1000	10 row(s) returned	0.000 sec / 0.000 sec
60	23:14:24	SELECT * FROM Members LIMIT 0, 1000	10 row(s) returned	0.016 sec / 0.000 sec
61	23:15:24	SELECT * FROM Transactions LIMIT 0, 1000	0 row(s) returned	0.015 sec / 0.000 sec
62	23:16:40	SELECT b.Title, t.DueDate FROM Transactions t JOIN Books b ON t.BookID = b.BookID WHERE t.Returned = FALSE AND t.DueDate < CURRENT_DATE	0 row(s) returned	0.016 sec / 0.000 sec

6) Borrow and Return Transactions :

The screenshot shows the MySQL Workbench interface. The 'Query' tab is active, displaying a SQL query to insert borrow and return transactions. The query is as follows:

```
1 INSERT INTO Transactions (BookID, MemberID, BorrowDate, DueDate, Returned)
2 VALUES (2, 2, '2024-01-05', '2024-02-05', FALSE),
3         (3, 3, '2024-01-15', '2024-02-15', FALSE), -- Member 3 borrows Book 3
4         (4, 4, '2024-01-18', '2024-02-18', FALSE), -- Member 4 borrows Book 4
5         (5, 5, '2024-01-20', '2024-02-20', FALSE); -- Member 5 borrows Book 5
```

The 'Result Grid' shows the following data:

TransactionID	BookID	MemberID	BorrowDate	DueDate	ReturnDate	Returned
21	2	2	2024-01-05	2024-02-05	NULL	0
22	2	2	2024-01-05	2024-02-05	NULL	0
23	2	2	2024-01-05	2024-02-05	NULL	0
26	2	2	2024-01-05	2024-02-05	NULL	0
45	2	2	2024-01-05	2024-02-05	NULL	0
46	3	3	2024-01-15	2024-02-15	NULL	0
47	4	4	2024-01-18	2024-02-18	NULL	0
48	5	5	2024-01-20	2024-02-20	NULL	0
NULL	NULL	NULL	NULL	NULL	NULL	NULL

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

#	Time	Action	Message	Duration / Fetch
103	23:34:43	INSERT INTO Transactions (BookID, MemberID, BorrowDate, DueDate, Returned) VALUES (2, 2, '2024-01-05', '2024-02-05', FALSE)	1 row(s) affected	0.015 sec
104	23:34:43	INSERT INTO Transactions (BookID, MemberID, BorrowDate, DueDate, Returned) VALUES (3, 3, '2024-01-15', '2024-02-15', FALSE)	Error Code: 1064. You have an error in your SQL syntax; check the manual that corresponds to your MySQL se...	0.000 sec
105	23:35:09	INSERT INTO Transactions (BookID, MemberID, BorrowDate, DueDate, Returned) VALUES (4, 4, '2024-01-18', '2024-02-18', FALSE)	Error Code: 1452. Cannot add or update a child row: a foreign key constraint fails (library_management_system...	0.016 sec
106	23:35:23	INSERT INTO Transactions (BookID, MemberID, BorrowDate, DueDate, Returned) VALUES (5, 5, '2024-01-20', '2024-02-20', FALSE)	Error Code: 1452. Cannot add or update a child row: a foreign key constraint fails (library_management_system...	0.000 sec
107	23:35:48	INSERT INTO Transactions (BookID, MemberID, BorrowDate, DueDate, Returned) VALUES (2, 2, '2024-01-05', '2024-02-05', FALSE)	4 row(s) affected Records: 4 Duplicates: 0 Warnings: 0	0.016 sec
108	23:35:48	select * from Transactions LIMIT 0, 1000	8 row(s) returned	0.000 sec / 0.000 sec

Library Database Management System has been Successfully Created.