Need for a database:

In the realm of modern computing, databases play a pivotal role in managing and organizing large volumes of data efficiently. The primary need for a database arises from the necessity to store, retrieve, and manipulate data systematically. Databases ensure data integrity and security, allowing organizations to maintain consistent and accurate data over time. By centralizing data storage, databases eliminate redundancy and minimize the risk of data inconsistencies, which can occur in file-based systems. Moreover, databases support complex querying capabilities, enabling users to extract meaningful insights and generate reports critical for decision-making processes. In an increasingly data-driven world, the reliability and performance offered by databases are essential for businesses, academic institutions, and governments to function effectively.

Furthermore, databases facilitate concurrent access by multiple users, which is crucial for collaborative environments. Advanced features such as transaction management and concurrency control ensure that simultaneous operations do not lead to data corruption or loss. Databases also provide mechanisms for data backup and recovery, safeguarding against accidental deletions, system failures, or disasters. This robustness is particularly vital for mission-critical applications where data availability and integrity are non-negotiable. As data volumes grow exponentially, the scalability of databases allows organizations to expand their storage capabilities without compromising performance, thereby supporting long-term growth and adaptability.

Difference Between SQL and NoSQL Databases

SQL (Structured Query Language) Databases: SQL databases are relational database management systems (RDBMS) that use structured query language (SQL) for defining and manipulating data. These databases are built on a table-based schema, where data is organized into rows and columns. SQL databases excel in handling structured data and support ACID (Atomicity, Consistency, Isolation, Durability) transactions, which ensure reliable processing of transactions even in the event of errors, power failures, or other issues. Examples of SQL databases include MySQL, PostgreSQL, Oracle, and Microsoft SQL Server. These databases are ideal for applications requiring complex queries, relationships between data, and transactional consistency, such as financial systems, inventory management, and customer relationship management (CRM) systems.

NoSQL (Not Only SQL) Databases: NoSQL databases encompass a variety of database technologies designed to handle unstructured, semi-structured, and structured data. Unlike SQL databases, NoSQL databases do not rely on a fixed schema and are designed for distributed data stores. They can be categorized into four main types: document stores (e.g., MongoDB, CouchDB), key-value stores (e.g., Redis, DynamoDB), column-family stores (e.g., Cassandra, HBase), and graph databases (e.g., Neo4j). NoSQL databases are highly scalable and can handle massive volumes of data with low latency, making them suitable for big data applications, real-time web applications, and Internet of Things (IoT) devices. They often

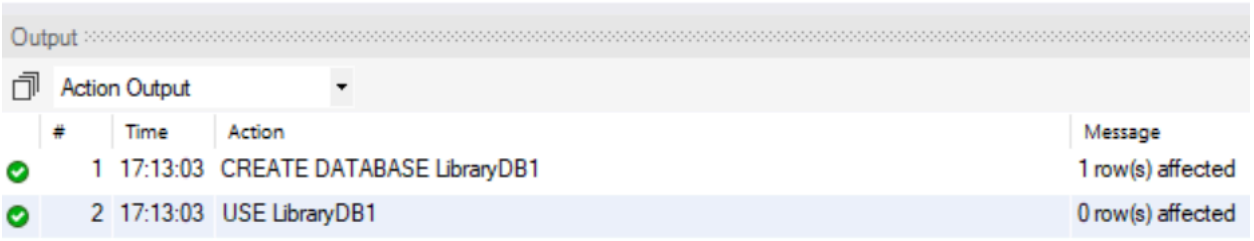
provide eventual consistency rather than strict ACID compliance, prioritizing availability and partition tolerance as per the CAP theorem.

In summary, the choice between SQL and NoSQL databases depends on the specific needs of the application. SQL databases are preferred for structured data and complex transactional operations, while NoSQL databases are favored for their scalability, flexibility, and ability to handle diverse data types in distributed environments.

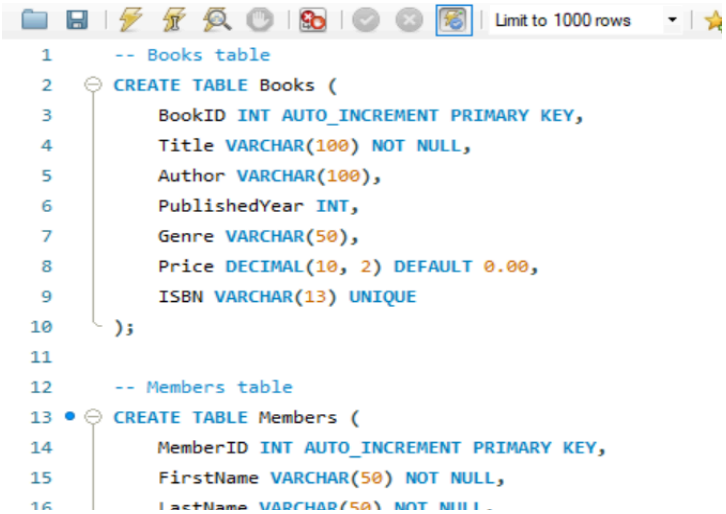
Sample Basic Queries and execution:

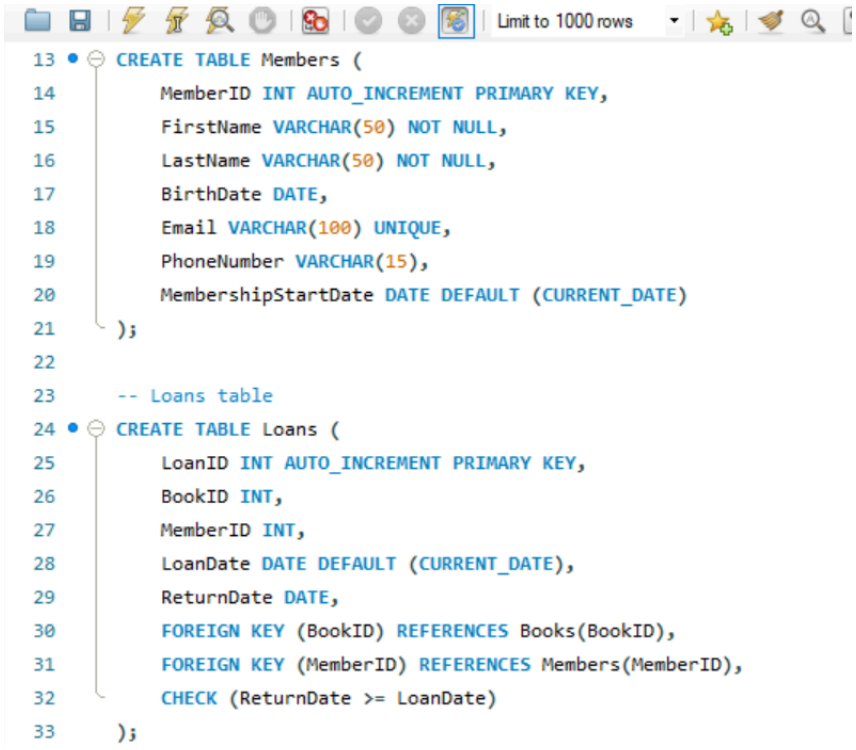
Create Database: This step creates a new database where all tables and data will reside.

```
1  CREATE DATABASE LibraryDB1;
2  USE LibraryDB1;
3
```

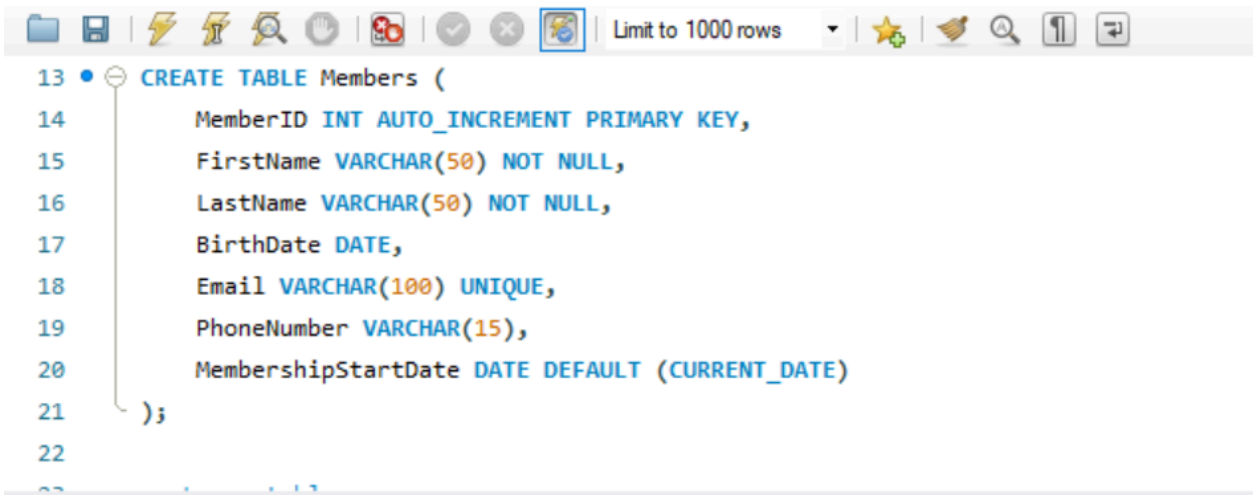


Create Tables with Constraints
Explanation: This step creates tables with various constraints to ensure data integrity. Constraints include PRIMARY KEY, UNIQUE, NOT NULL, FOREIGN KEY, and CHECK.





```
13  CREATE TABLE Members (
14      MemberID INT AUTO_INCREMENT PRIMARY KEY,
15      FirstName VARCHAR(50) NOT NULL,
16      LastName VARCHAR(50) NOT NULL,
17      BirthDate DATE,
18      Email VARCHAR(100) UNIQUE,
19      PhoneNumber VARCHAR(15),
20      MembershipStartDate DATE DEFAULT (CURRENT_DATE)
21  );
22
23  -- Loans table
24  CREATE TABLE Loans (
25      LoanID INT AUTO_INCREMENT PRIMARY KEY,
26      BookID INT,
27      MemberID INT,
28      LoanDate DATE DEFAULT (CURRENT_DATE),
29      ReturnDate DATE,
30      FOREIGN KEY (BookID) REFERENCES Books(BookID),
31      FOREIGN KEY (MemberID) REFERENCES Members(MemberID),
32      CHECK (ReturnDate >= LoanDate)
33  );
```



```
13  CREATE TABLE Members (
14      MemberID INT AUTO_INCREMENT PRIMARY KEY,
15      FirstName VARCHAR(50) NOT NULL,
16      LastName VARCHAR(50) NOT NULL,
17      BirthDate DATE,
18      Email VARCHAR(100) UNIQUE,
19      PhoneNumber VARCHAR(15),
20      MembershipStartDate DATE DEFAULT (CURRENT_DATE)
21  );
22
```

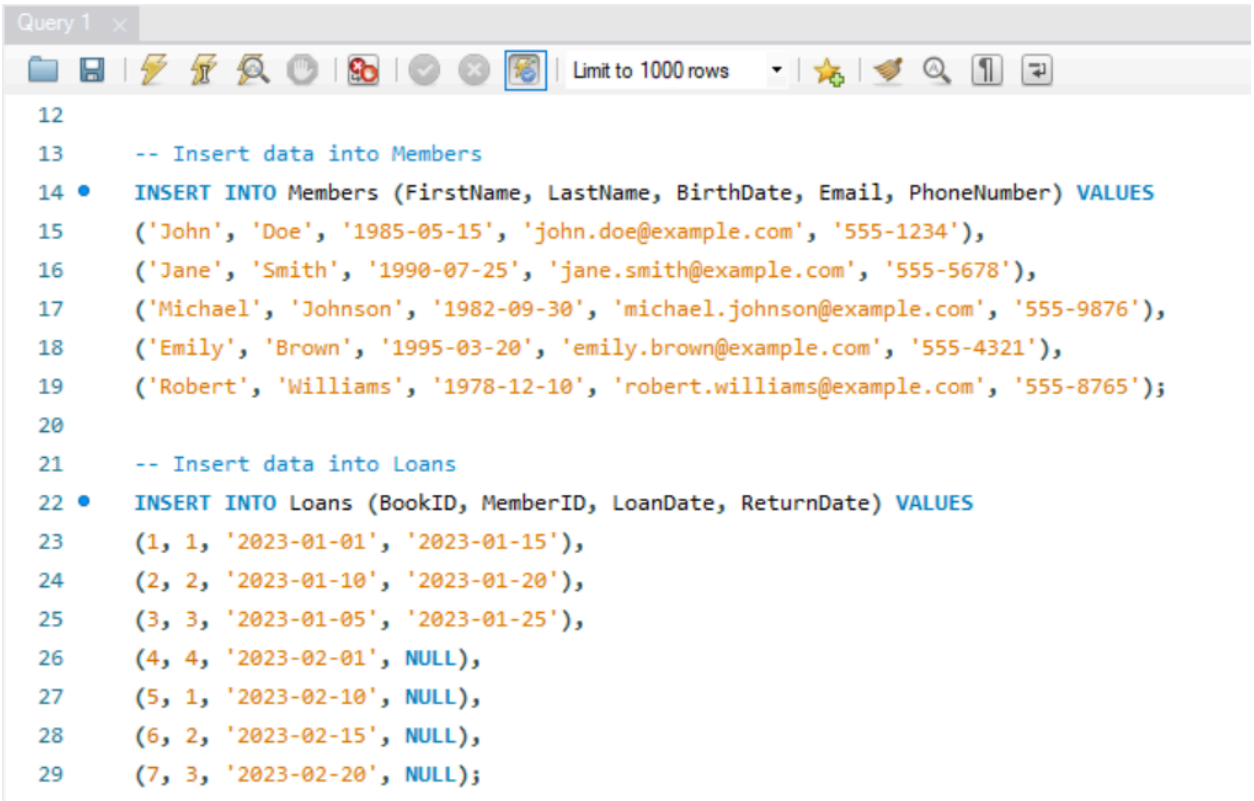
Output

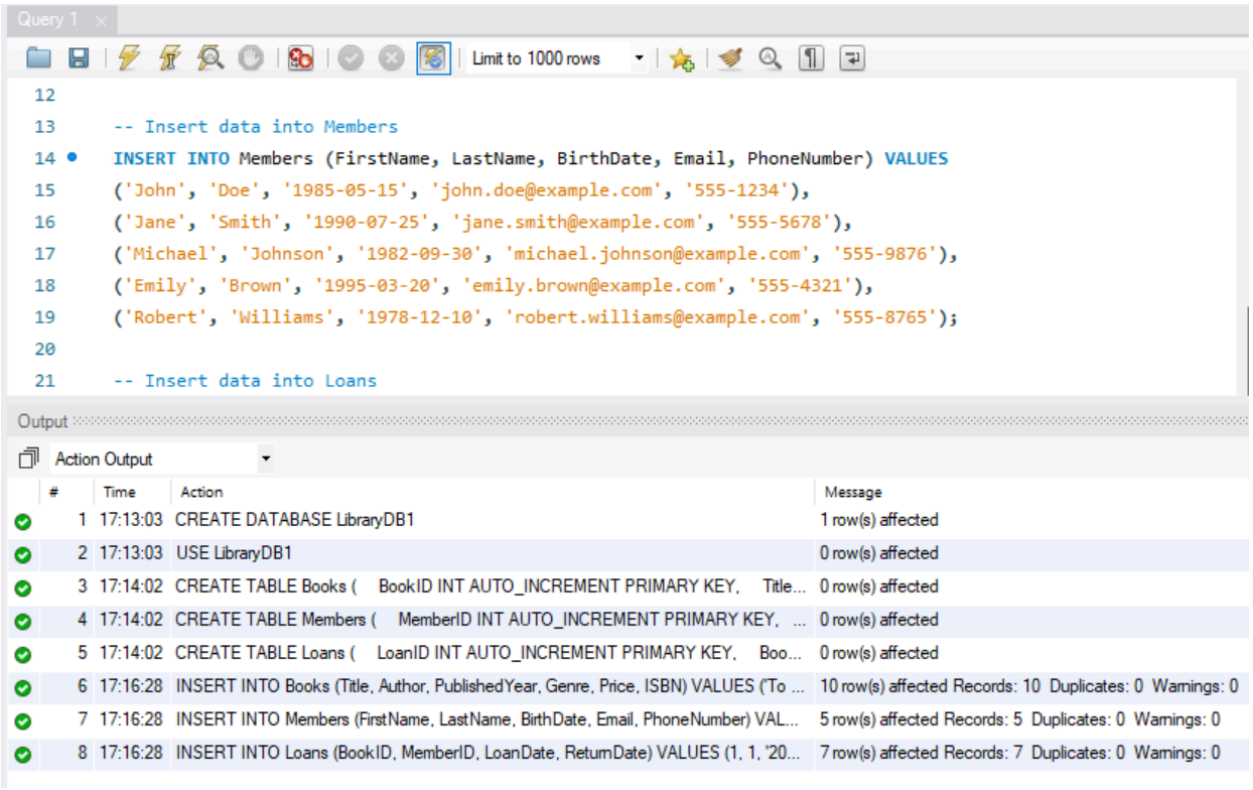
Action Output

#	Time	Action	Message
1	17:13:03	CREATE DATABASE LibraryDB1	1 row(s) affected
2	17:13:03	USE LibraryDB1	0 row(s) affected
3	17:14:02	CREATE TABLE Books (BookID INT AUTO_INCREMENT PRIMARY KEY, Title...	0 row(s) affected
4	17:14:02	CREATE TABLE Members (MemberID INT AUTO_INCREMENT PRIMARY KEY, ...	0 row(s) affected
5	17:14:02	CREATE TABLE Loans (LoanID INT AUTO_INCREMENT PRIMARY KEY, Boo...	0 row(s) affected

Insert Data

Explanation: This step adds records to the tables.





```
12
13      -- Insert data into Members
14      INSERT INTO Members (FirstName, LastName, BirthDate, Email, PhoneNumber) VALUES
15      ('John', 'Doe', '1985-05-15', 'john.doe@example.com', '555-1234'),
16      ('Jane', 'Smith', '1990-07-25', 'jane.smith@example.com', '555-5678'),
17      ('Michael', 'Johnson', '1982-09-30', 'michael.johnson@example.com', '555-9876'),
18      ('Emily', 'Brown', '1995-03-20', 'emily.brown@example.com', '555-4321'),
19      ('Robert', 'Williams', '1978-12-10', 'robert.williams@example.com', '555-8765');
20
21      -- Insert data into Loans
```

Output

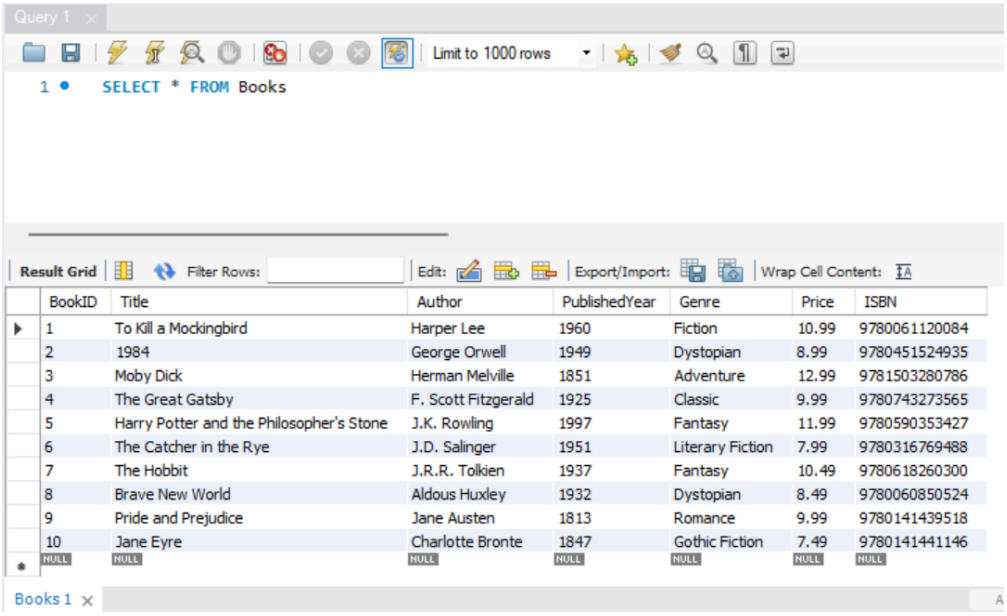
Action Output

#	Time	Action	Message
1	17:13:03	CREATE DATABASE LibraryDB1	1 row(s) affected
2	17:13:03	USE LibraryDB1	0 row(s) affected
3	17:14:02	CREATE TABLE Books (BookID INT AUTO_INCREMENT PRIMARY KEY, Title...	0 row(s) affected
4	17:14:02	CREATE TABLE Members (MemberID INT AUTO_INCREMENT PRIMARY KEY, ...	0 row(s) affected
5	17:14:02	CREATE TABLE Loans (LoanID INT AUTO_INCREMENT PRIMARY KEY, Boo...	0 row(s) affected
6	17:16:28	INSERT INTO Books (Title, Author, PublishedYear, Genre, Price, ISBN) VALUES ('To ...	10 row(s) affected Records: 10 Duplicates: 0 Warnings: 0
7	17:16:28	INSERT INTO Members (FirstName, LastName, BirthDate, Email, PhoneNumber) VAL...	5 row(s) affected Records: 5 Duplicates: 0 Warnings: 0
8	17:16:28	INSERT INTO Loans (BookID, MemberID, LoanDate, ReturnDate) VALUES (1, 1, '20...	7 row(s) affected Records: 7 Duplicates: 0 Warnings: 0

Basic SQL Queries

Explanation: These are simple queries to retrieve, insert, update, and delete data from the tables.

SELECT * FROM Books: This query selects all columns (*) from the Books table.



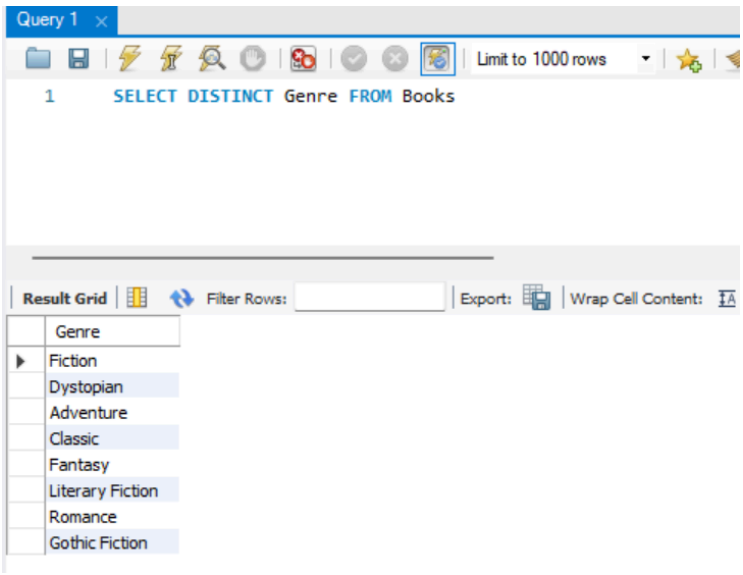
```
1   SELECT * FROM Books
```

Result Grid

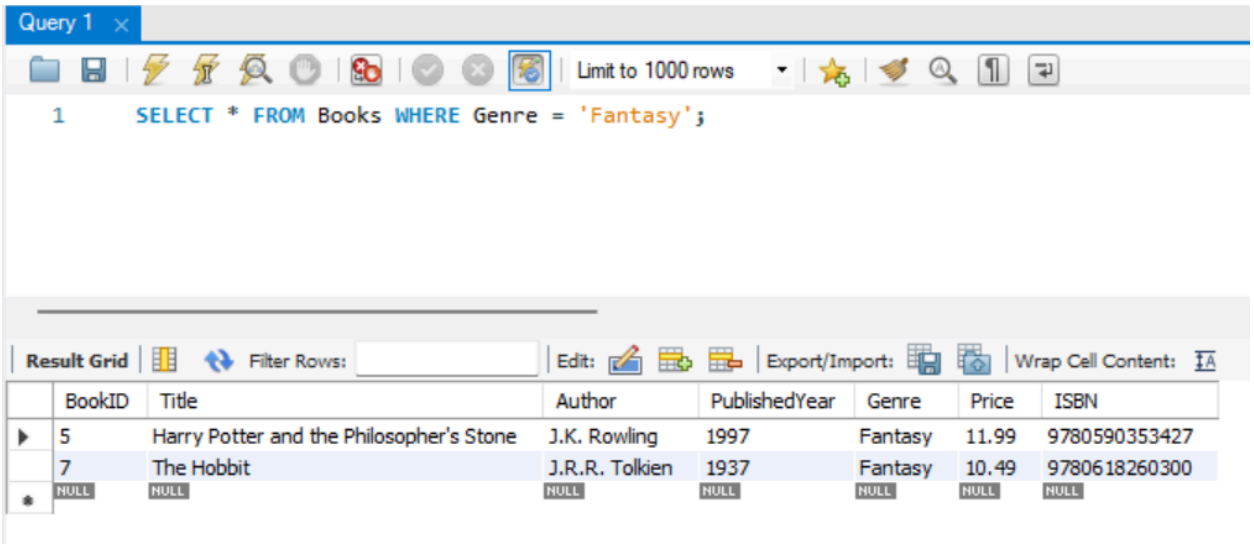
BookID	Title	Author	PublishedYear	Genre	Price	ISBN
1	To Kill a Mockingbird	Harper Lee	1960	Fiction	10.99	9780061120084
2	1984	George Orwell	1949	Dystopian	8.99	9780451524935
3	Moby Dick	Herman Melville	1851	Adventure	12.99	9781503280786
4	The Great Gatsby	F. Scott Fitzgerald	1925	Classic	9.99	9780743273565
5	Harry Potter and the Philosopher's Stone	J.K. Rowling	1997	Fantasy	11.99	9780590353427
6	The Catcher in the Rye	J.D. Salinger	1951	Literary Fiction	7.99	9780316769488
7	The Hobbit	J.R.R. Tolkien	1937	Fantasy	10.49	9780618260300
8	Brave New World	Aldous Huxley	1932	Dystopian	8.49	9780060850524
9	Pride and Prejudice	Jane Austen	1813	Romance	9.99	9780141439518
10	Jane Eyre	Charlotte Bronte	1847	Gothic Fiction	7.49	9780141441146
NULL	NULL	NULL	NULL	NULL	NULL	NULL

Books 1

SELECT DISTINCT: This query selects unique values from the Genre column in the Books table.



WHERE: Filters rows where the Genre column equals 'Fantasy''.



AND & OR:Filters rows where the Genre is 'Fantasy' and the Price is less than 12.

```
SELECT * FROM Books WHERE Genre = 'Fantasy' AND Price < 12;
```

BookID	Title	Author	PublishedYear	Genre	Price	ISBN
5	Harry Potter and the Philosopher's Stone	J.K. Rowling	1997	Fantasy	11.99	9780590353427
7	The Hobbit	J.R.R. Tolkien	1937	Fantasy	10.49	9780618260300

Filters rows where the Genre is 'Classic' or Genre is 'Literary Fiction'

```
SELECT * FROM Books WHERE Genre = 'Classic' OR Genre = 'Literary Fiction';
```

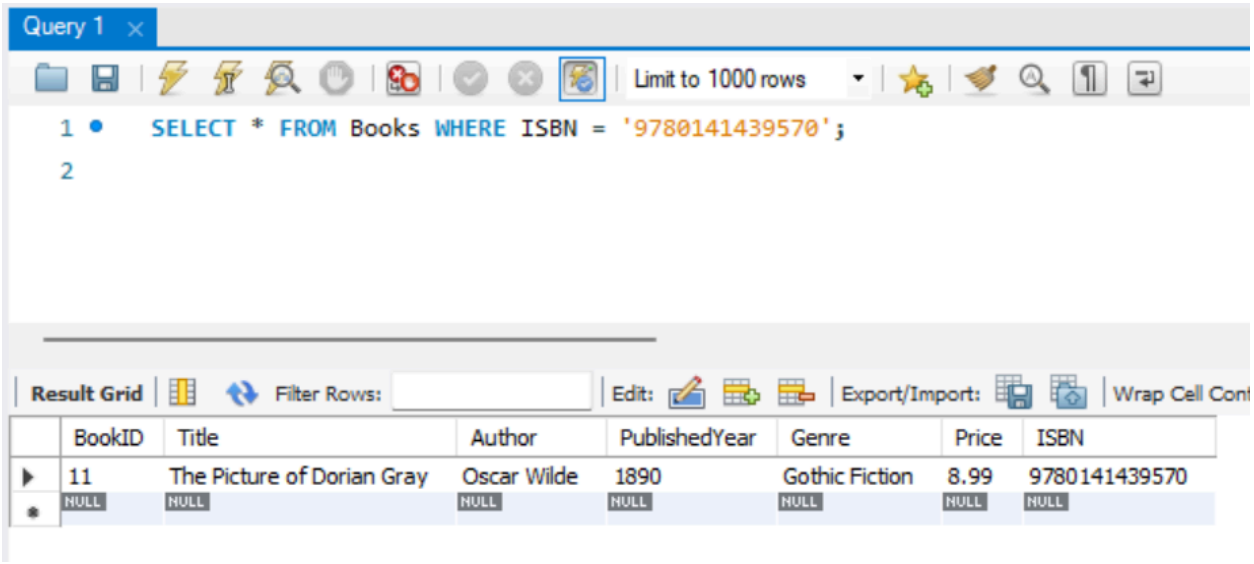
BookID	Title	Author	PublishedYear	Genre	Price	ISBN
4	The Great Gatsby	F. Scott Fitzgerald	1925	Classic	9.99	9780743273565
6	The Catcher in the Rye	J.D. Salinger	1951	Literary Fiction	7.99	9780316769488

ORDER BY : Orders the result set by the PublishedYear column in descending order (DESC).

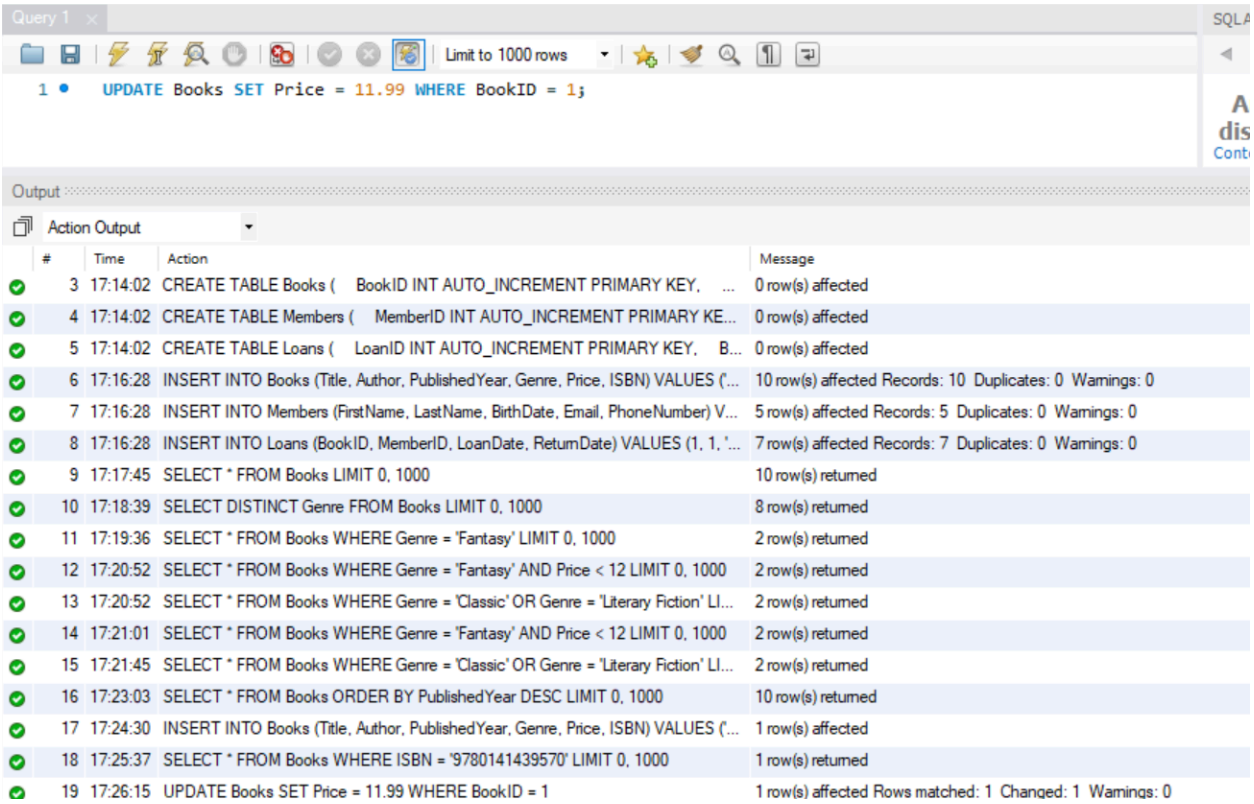
```
SELECT * FROM Books ORDER BY PublishedYear DESC;
```

BookID	Title	Author	PublishedYear	Genre	Price	ISBN
5	Harry Potter and the Philosopher's Stone	J.K. Rowling	1997	Fantasy	11.99	9780590353427
1	To Kill a Mockingbird	Harper Lee	1960	Fiction	10.99	9780061120084
6	The Catcher in the Rye	J.D. Salinger	1951	Literary Fiction	7.99	9780316769488
2	1984	George Orwell	1949	Dystopian	8.99	9780451524935
7	The Hobbit	J.R.R. Tolkien	1937	Fantasy	10.49	9780618260300
8	Brave New World	Aldous Huxley	1932	Dystopian	8.49	9780060850524
4	The Great Gatsby	F. Scott Fitzgerald	1925	Classic	9.99	9780743273565
3	Moby Dick	Herman Melville	1851	Adventure	12.99	9781503280786
10	Jane Eyre	Charlotte Bronte	1847	Gothic Fiction	7.49	9780141441146
9	Pride and Prejudice	Jane Austen	1813	Romance	9.99	9780141439518

INSERT INTO: Inserts a new row into the Books table with specified values for columns (Title, Author, PublishedYear, Genre, Price, ISBN).



UPDATE : Updates the Price column to 11.99 for the row where BookID is 1 in the Books table.



Query 1

Limit to 1000 rows

```
1    SELECT * FROM Books
```

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Content:

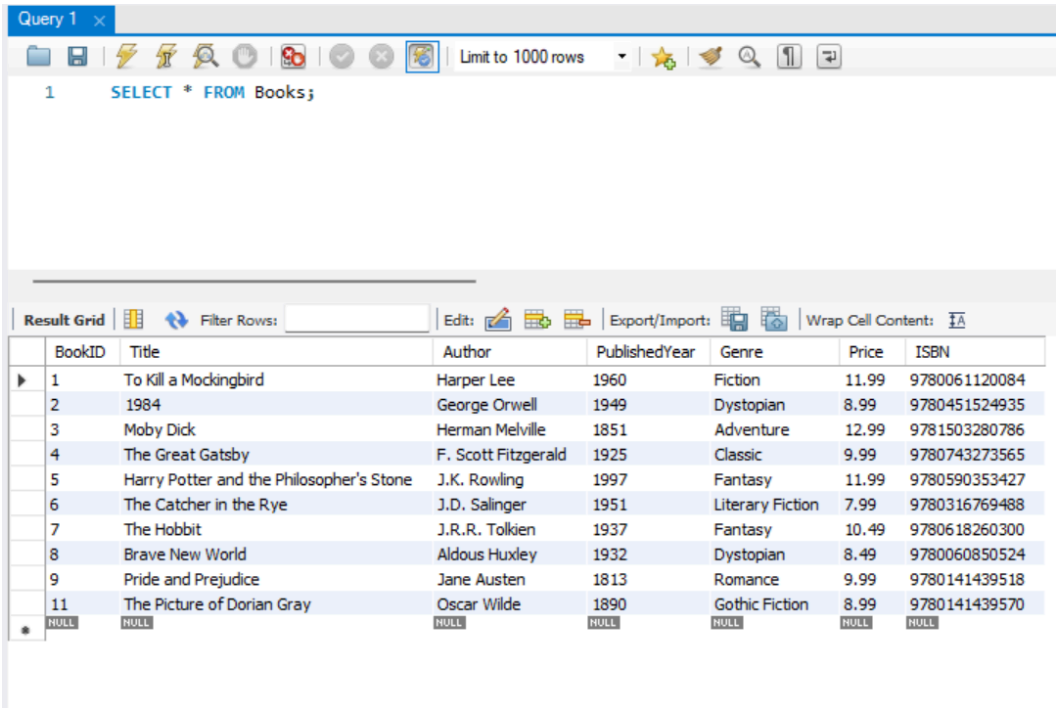
BookID	Title	Author	PublishedYear	Genre	Price	ISBN
1	To Kill a Mockingbird	Harper Lee	1960	Fiction	11.99	9780061120084
2	1984	George Orwell	1949	Dystopian	8.99	9780451524935
3	Moby Dick	Herman Melville	1851	Adventure	12.99	9781503280786
4	The Great Gatsby	F. Scott Fitzgerald	1925	Classic	9.99	9780743273565
5	Harry Potter and the Philosopher's Stone	J.K. Rowling	1997	Fantasy	11.99	9780590353427
6	The Catcher in the Rye	J.D. Salinger	1951	Literary Fiction	7.99	9780316769488
7	The Hobbit	J.R.R. Tolkien	1937	Fantasy	10.49	9780618260300
8	Brave New World	Aldous Huxley	1932	Dystopian	8.49	9780060850524
9	Pride and Prejudice	Jane Austen	1813	Romance	9.99	9780141439518
10	Jane Eyre	Charlotte Bronte	1847	Gothic Fiction	7.49	9780141441146
11	The Picture of Dorian Gray	Oscar Wilde	1890	Gothic Fiction	8.99	9780141439570
NULL	NULL	NULL	NULL	NULL	NULL	NULL

DELETE : Deletes the row from the Books table where BookID is 10.

Query 1

Limit to 1000 row

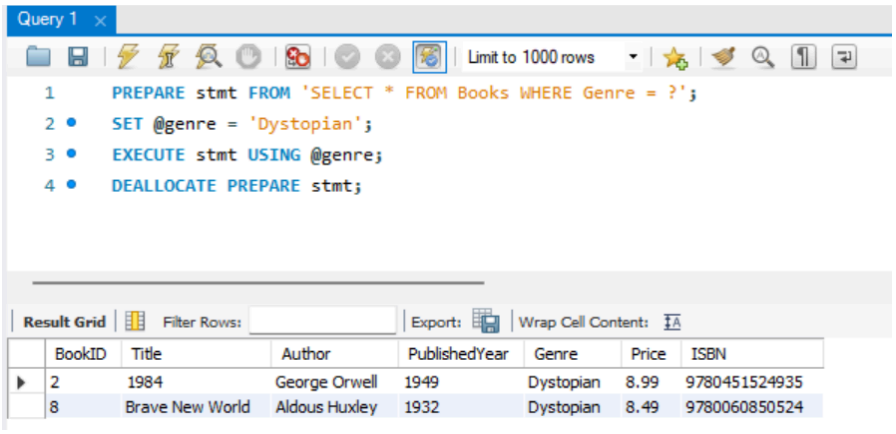
```
1    DELETE FROM Books WHERE BookID = 10;
```



BookID	Title	Author	PublishedYear	Genre	Price	ISBN
1	To Kill a Mockingbird	Harper Lee	1960	Fiction	11.99	9780061120084
2	1984	George Orwell	1949	Dystopian	8.99	9780451524935
3	Moby Dick	Herman Melville	1851	Adventure	12.99	9781503280786
4	The Great Gatsby	F. Scott Fitzgerald	1925	Classic	9.99	9780743273565
5	Harry Potter and the Philosopher's Stone	J.K. Rowling	1997	Fantasy	11.99	9780590353427
6	The Catcher in the Rye	J.D. Salinger	1951	Literary Fiction	7.99	9780316769488
7	The Hobbit	J.R.R. Tolkien	1937	Fantasy	10.49	9780618260300
8	Brave New World	Aldous Huxley	1932	Dystopian	8.49	9780060850524
9	Pride and Prejudice	Jane Austen	1813	Romance	9.99	9780141439518
11	The Picture of Dorian Gray	Oscar Wilde	1890	Gothic Fiction	8.99	9780141439570
NULL	NULL	NULL	NULL	NULL	NULL	NULL

SQL Injection Prevention with Prepared Statements

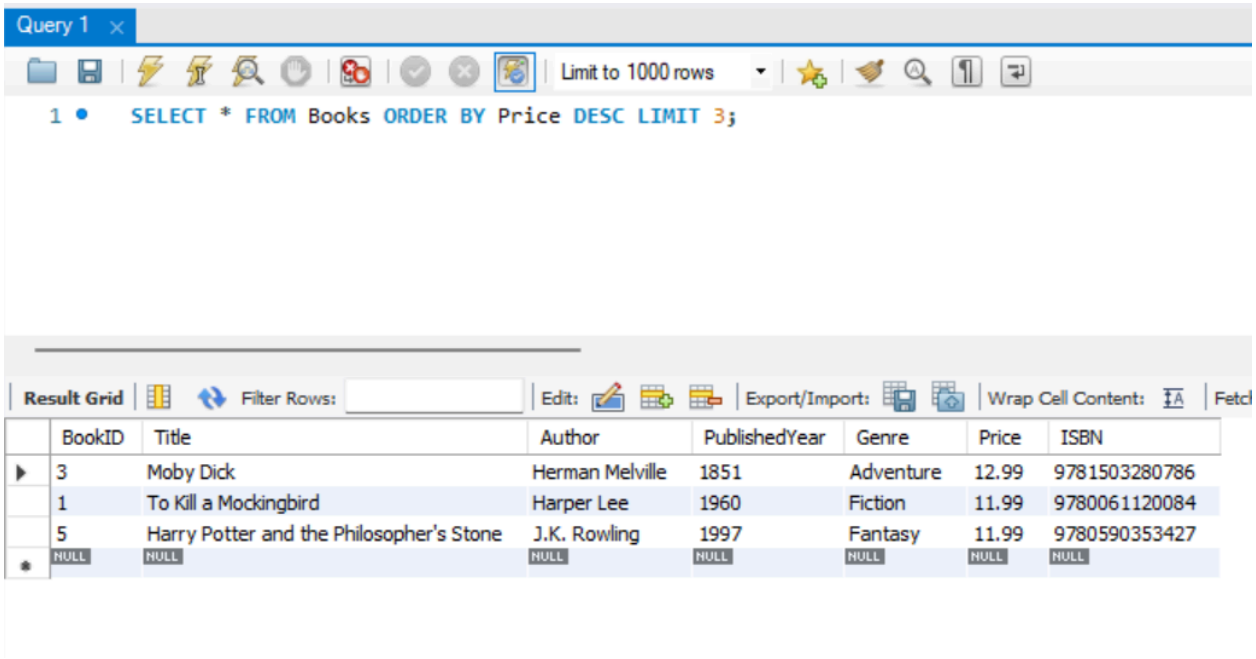
Explanation: Demonstrates how to prevent SQL injection attacks by using prepared statements, which separate the query structure from the data. Safely executes a query to select books by genre without exposing the database to SQL injection risks.



BookID	Title	Author	PublishedYear	Genre	Price	ISBN
2	1984	George Orwell	1949	Dystopian	8.99	9780451524935
8	Brave New World	Aldous Huxley	1932	Dystopian	8.49	9780060850524

SELECT TOP :

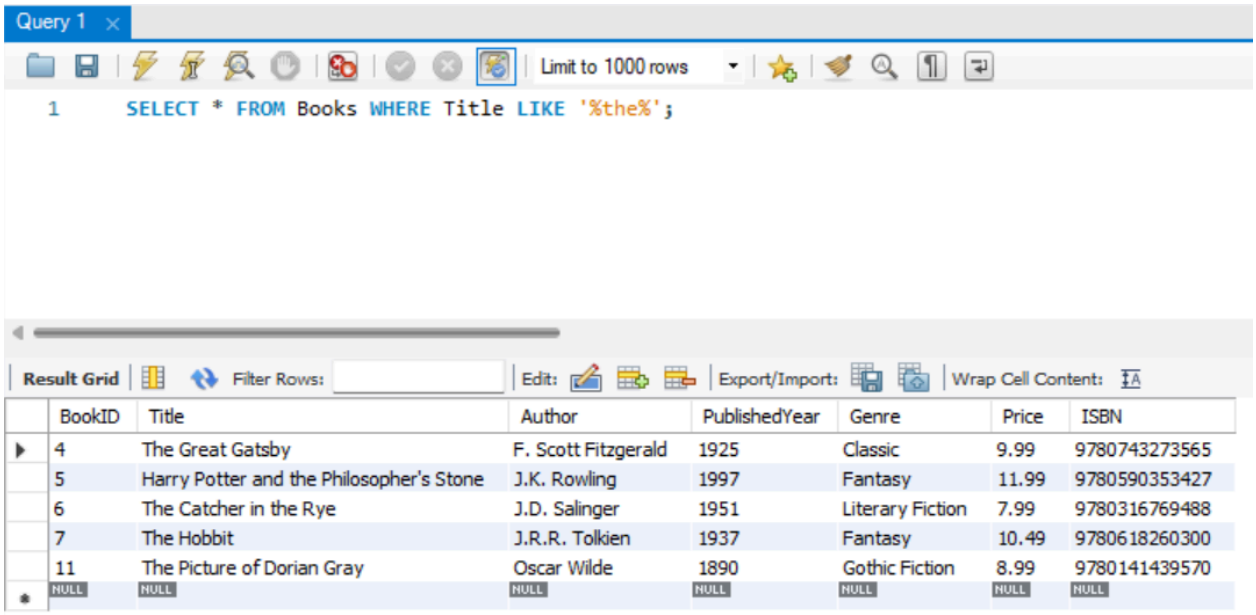
Explanation: Retrieves a specified number of top records from the table. Selects the top 3 most expensive books.



BookID	Title	Author	PublishedYear	Genre	Price	ISBN
3	Moby Dick	Herman Melville	1851	Adventure	12.99	9781503280786
1	To Kill a Mockingbird	Harper Lee	1960	Fiction	11.99	9780061120084
5	Harry Potter and the Philosopher's Stone	J.K. Rowling	1997	Fantasy	11.99	9780590353427
NULL	NULL	NULL	NULL	NULL	NULL	NULL

LIKE and Wildcards

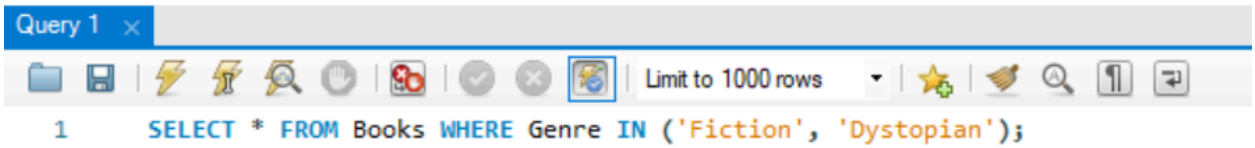
Explanation: Searches for records that match a pattern.

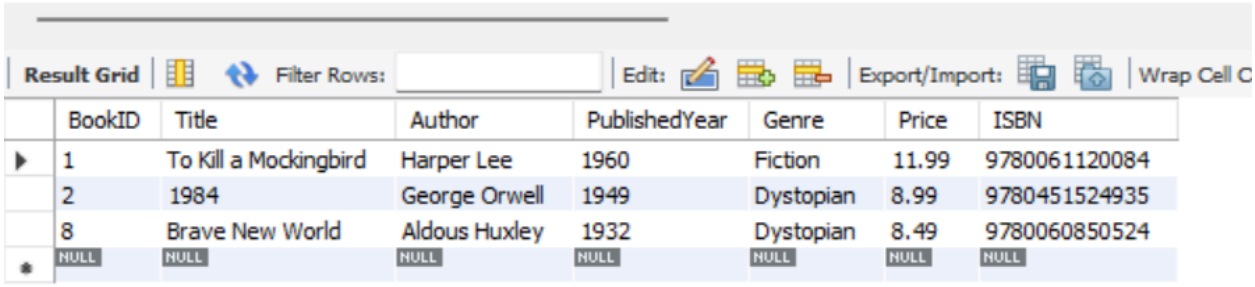


BookID	Title	Author	PublishedYear	Genre	Price	ISBN
4	The Great Gatsby	F. Scott Fitzgerald	1925	Classic	9.99	9780743273565
5	Harry Potter and the Philosopher's Stone	J.K. Rowling	1997	Fantasy	11.99	9780590353427
6	The Catcher in the Rye	J.D. Salinger	1951	Literary Fiction	7.99	9780316769488
7	The Hobbit	J.R.R. Tolkien	1937	Fantasy	10.49	9780618260300
11	The Picture of Dorian Gray	Oscar Wilde	1890	Gothic Fiction	8.99	9780141439570
NULL	NULL	NULL	NULL	NULL	NULL	NULL

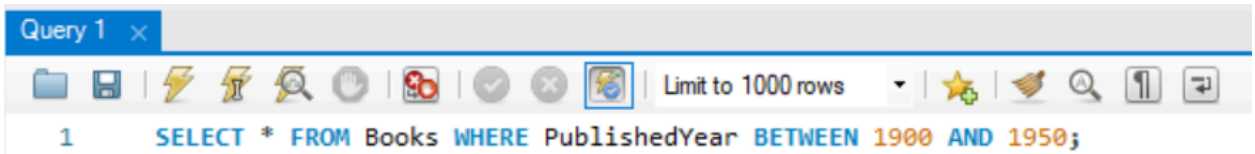
IN and BETWEEN

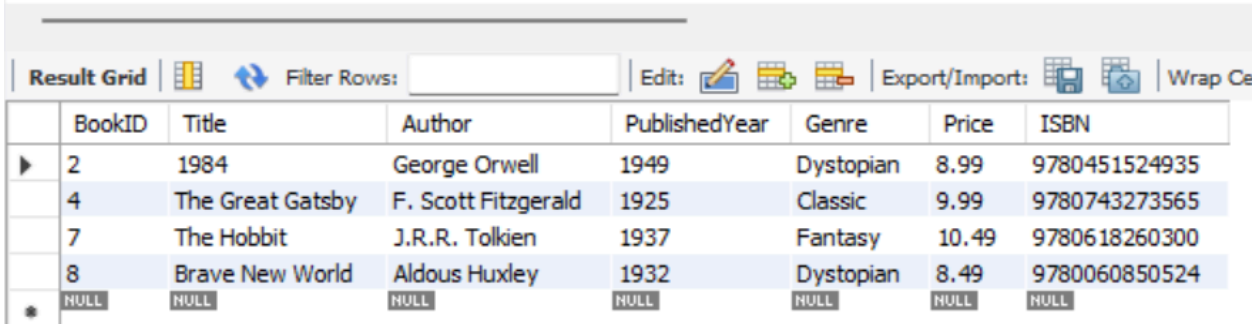
Explanation: The IN operator checks if a value matches any value in a list, and BETWEEN checks if a value is within a range. The below example demonstrates to find books in specific genres or within a certain publication year range.





BookID	Title	Author	PublishedYear	Genre	Price	ISBN
1	To Kill a Mockingbird	Harper Lee	1960	Fiction	11.99	9780061120084
2	1984	George Orwell	1949	Dystopian	8.99	9780451524935
8	Brave New World	Aldous Huxley	1932	Dystopian	8.49	9780060850524
NULL	NULL	NULL	NULL	NULL	NULL	NULL

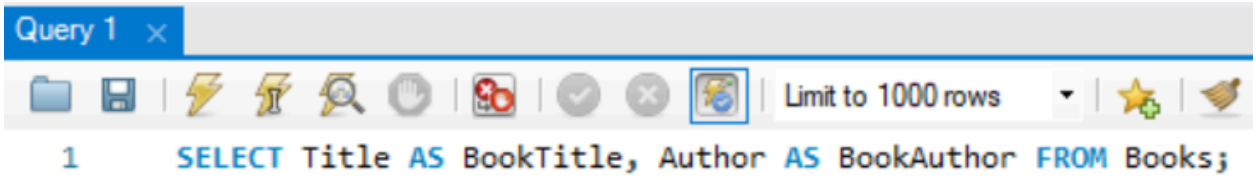




BookID	Title	Author	PublishedYear	Genre	Price	ISBN
2	1984	George Orwell	1949	Dystopian	8.99	9780451524935
4	The Great Gatsby	F. Scott Fitzgerald	1925	Classic	9.99	9780743273565
7	The Hobbit	J.R.R. Tolkien	1937	Fantasy	10.49	9780618260300
8	Brave New World	Aldous Huxley	1932	Dystopian	8.49	9780060850524
NULL	NULL	NULL	NULL	NULL	NULL	NULL

Aliases

Explanation: Assigns temporary names to columns or tables for readability.



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

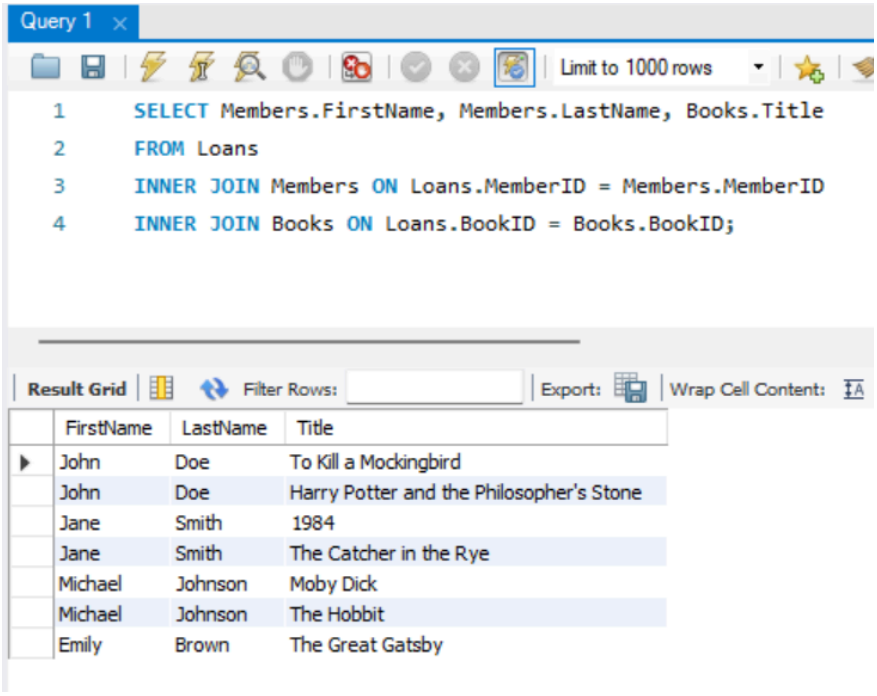
BookTitle	BookAuthor
To Kill a Mockingbird	Harper Lee
1984	George Orwell
Moby Dick	Herman Melville
The Great Gatsby	F. Scott Fitzgerald
Harry Potter and the Philosopher's Stone	J.K. Rowling
The Catcher in the Rye	J.D. Salinger
The Hobbit	J.R.R. Tolkien
Brave New World	Aldous Huxley
Pride and Prejudice	Jane Austen
The Picture of Dorian Gray	Oscar Wilde

Joins

Explanation: Combines records from two or more tables based on related columns.

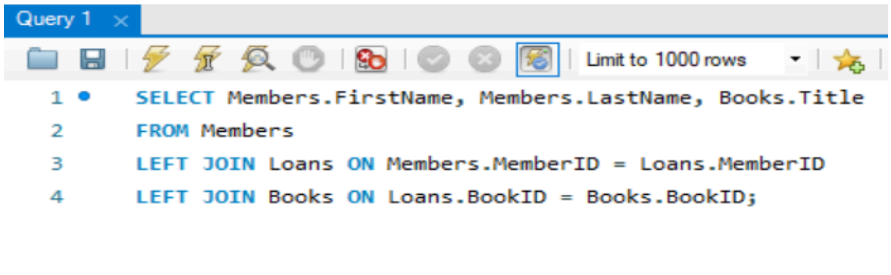
Inner Join:

- This query retrieves the first name and last name of members along with the titles of the books they have borrowed, by matching records from the `Loans`, `Members`, and `Books` tables.



FirstName	LastName	Title
John	Doe	To Kill a Mockingbird
John	Doe	Harry Potter and the Philosopher's Stone
Jane	Smith	1984
Jane	Smith	The Catcher in the Rye
Michael	Johnson	Moby Dick
Michael	Johnson	The Hobbit
Emily	Brown	The Great Gatsby

Left Join: This query retrieves all members' first and last names along with the titles of books they have borrowed (if any), showing NULL for books if no loans exist.



FirstName	LastName	Title
John	Doe	To Kill a Mockingbird
John	Doe	Harry Potter and the Philosopher's Stone
Jane	Smith	1984
Jane	Smith	The Catcher in the Rye
Michael	Johnson	Moby Dick
Michael	Johnson	The Hobbit
Emily	Brown	The Great Gatsby
Robert	Williams	NULL

Right Join: This query retrieves the first name and last name of members along with the titles of the books they have borrowed, including all loans even if there are no corresponding book or member records.

Query 1

Limit to 1000 rows

```
1  SELECT Members.FirstName, Members.LastName, Books.Title
2  FROM Books
3  RIGHT JOIN Loans ON Books.BookID = Loans.BookID
4  RIGHT JOIN Members ON Loans.MemberID = Members.MemberID;
```

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

FirstName	LastName	Title
John	Doe	To Kill a Mockingbird
John	Doe	Harry Potter and the Philosopher's Stone
Jane	Smith	1984
Jane	Smith	The Catcher in the Rye
Michael	Johnson	Moby Dick
Michael	Johnson	The Hobbit
Emily	Brown	The Great Gatsby
Robert	Williams	NULL

Full Join: This query retrieves all members and the books they have borrowed, including members without loans and books not currently on loan, by combining results from left and right joins using UNION.

Query 1

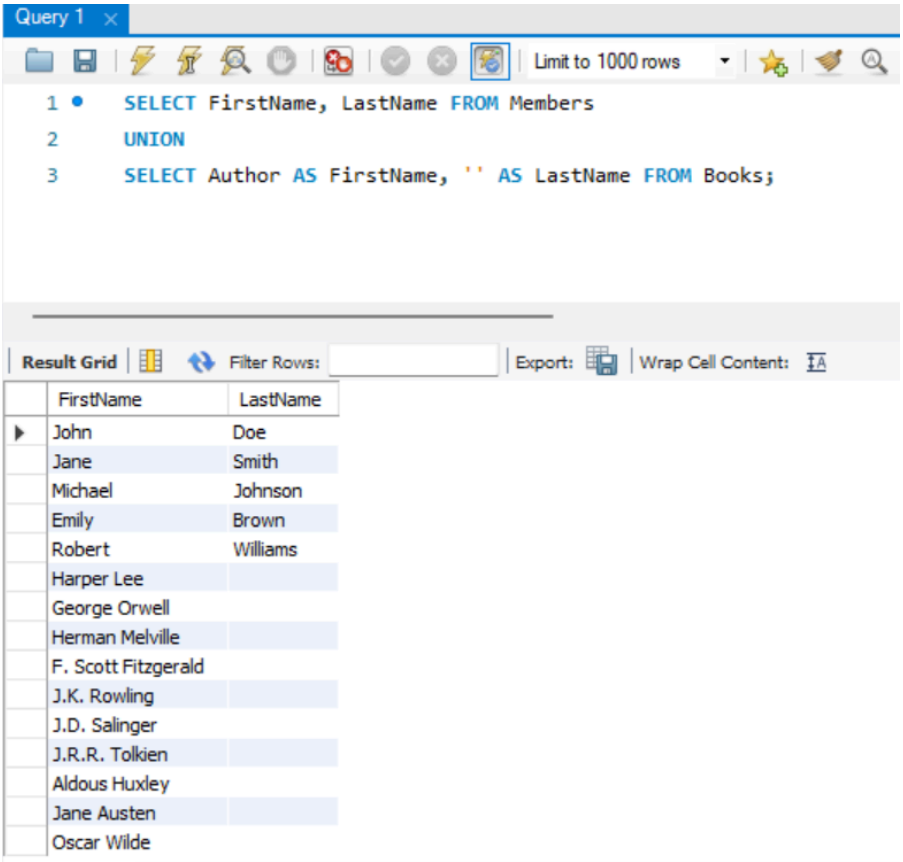
Limit to 1000 rows

```
1  SELECT Members.FirstName, Members.LastName, Books.Title
2  FROM Members
3  LEFT JOIN Loans ON Members.MemberID = Loans.MemberID
4  LEFT JOIN Books ON Loans.BookID = Books.BookID
5  UNION
6  SELECT Members.FirstName, Members.LastName, Books.Title
7  FROM Books
8  RIGHT JOIN Loans ON Books.BookID = Loans.BookID
9  RIGHT JOIN Members ON Loans.MemberID = Members.MemberID;
```

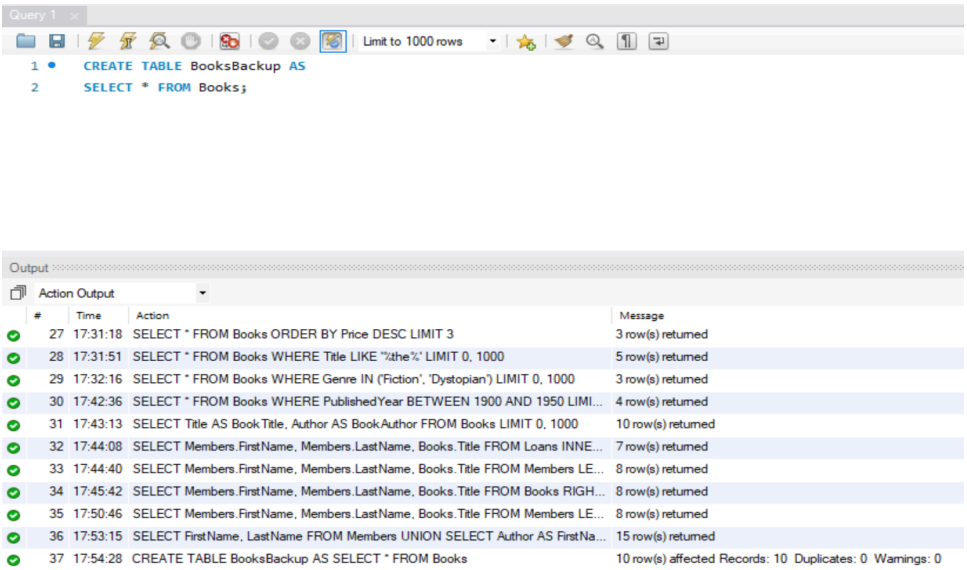
Result Grid | Filter Rows: | Export: | Wrap Cell Content:

FirstName	LastName	Title
John	Doe	To Kill a Mockingbird
John	Doe	Harry Potter and the Philosopher's Stone
Jane	Smith	1984
Jane	Smith	The Catcher in the Rye
Michael	Johnson	Moby Dick
Michael	Johnson	The Hobbit
Emily	Brown	The Great Gatsby
Robert	Williams	NULL

Union: This query combines a list of members' first and last names with a list of book authors (using the author's name as the first name and leaving the last name empty), removing any duplicates.

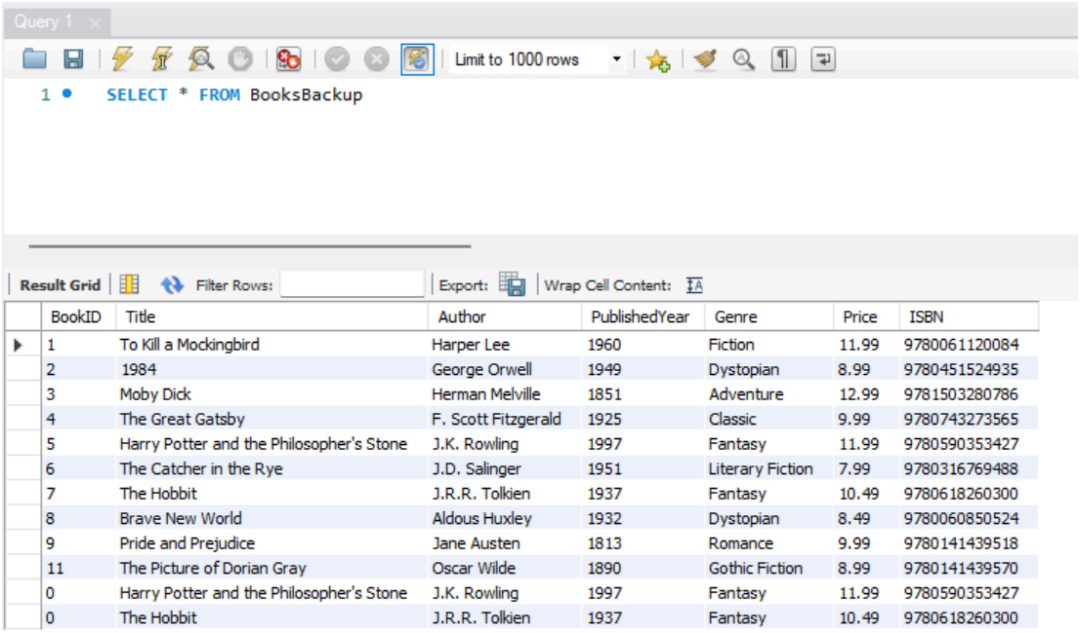


Select Into: This command creates a new table named BooksBackup and populates it with all the data from the existing Books table.



Insert Into : This SQL statement copies books categorized under 'Fantasy' from the Books table into the BooksBackup table, including all columns (Title, Author, PublishedYear, Genre, Price, ISBN).

INSERT INTO BooksBackup (Title, Author, PublishedYear, Genre, Price, ISBN) SELECT Title, Author, PublishedYear, Genre, Price, ISBN FROM Books WHERE Genre = 'Fantasy';

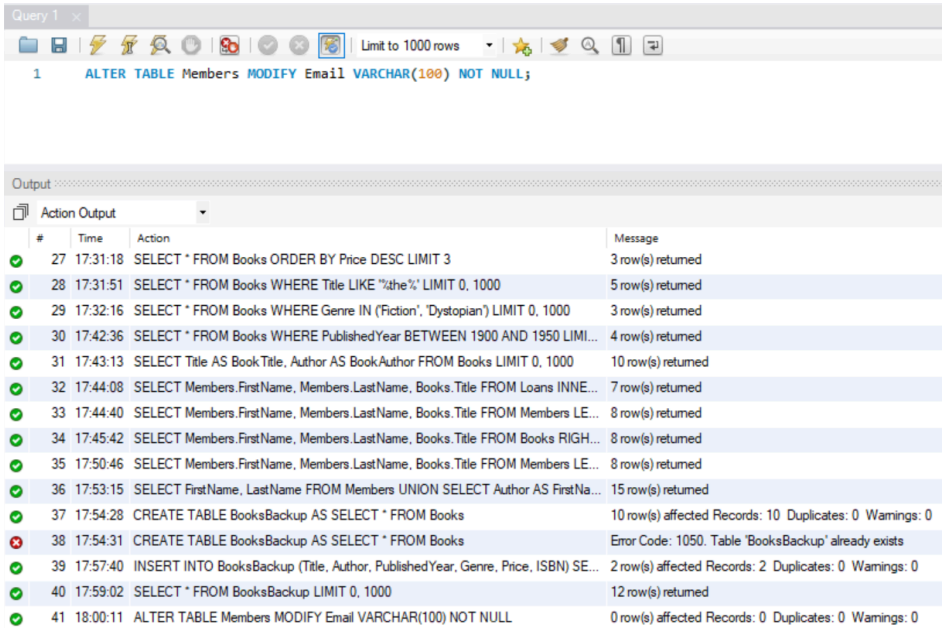


```
SELECT * FROM BooksBackup
```

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

BookID	Title	Author	PublishedYear	Genre	Price	ISBN
1	To Kill a Mockingbird	Harper Lee	1960	Fiction	11.99	9780061120084
2	1984	George Orwell	1949	Dystopian	8.99	9780451524935
3	Moby Dick	Herman Melville	1851	Adventure	12.99	9781503280786
4	The Great Gatsby	F. Scott Fitzgerald	1925	Classic	9.99	9780743273565
5	Harry Potter and the Philosopher's Stone	J.K. Rowling	1997	Fantasy	11.99	9780590353427
6	The Catcher in the Rye	J.D. Salinger	1951	Literary Fiction	7.99	9780316769488
7	The Hobbit	J.R.R. Tolkien	1937	Fantasy	10.49	9780618260300
8	Brave New World	Aldous Huxley	1932	Dystopian	8.49	9780060850524
9	Pride and Prejudice	Jane Austen	1813	Romance	9.99	9780141439518
11	The Picture of Dorian Gray	Oscar Wilde	1890	Gothic Fiction	8.99	9780141439570
0	Harry Potter and the Philosopher's Stone	J.K. Rowling	1997	Fantasy	11.99	9780590353427
0	The Hobbit	J.R.R. Tolkien	1937	Fantasy	10.49	9780618260300

Not Null : This SQL statement modifies the Members table by changing the data type of the Email column to VARCHAR(100) and sets it to be NOT NULL, ensuring all members must have an email address defined.

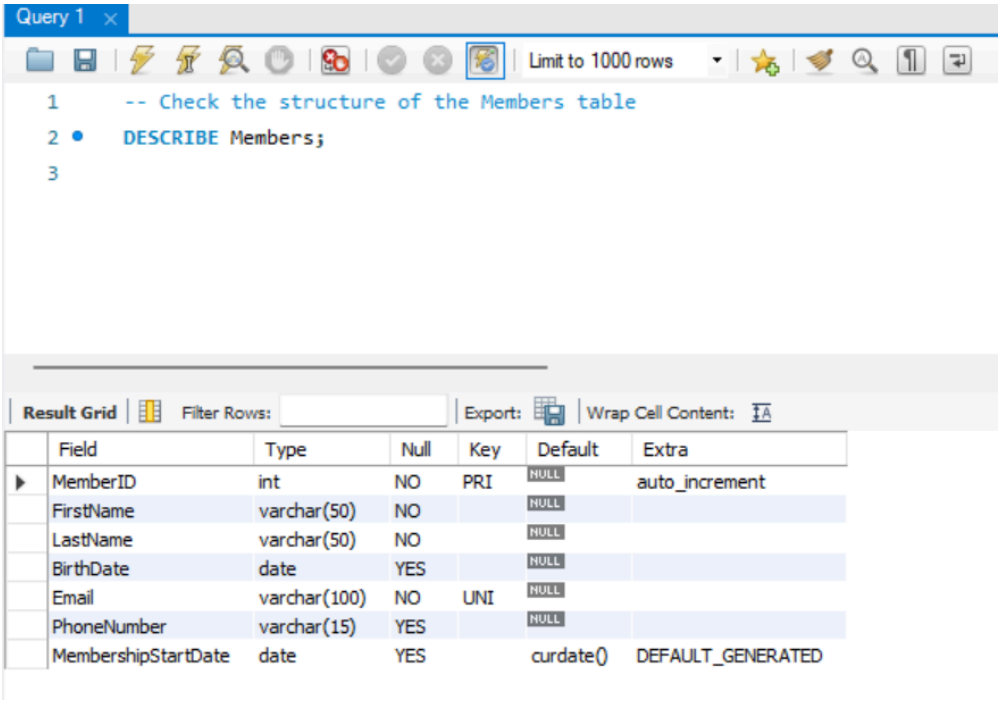


```
ALTER TABLE Members MODIFY Email VARCHAR(100) NOT NULL;
```

Output

Action Output

#	Time	Action	Message
27	17:31:18	SELECT * FROM Books ORDER BY Price DESC LIMIT 3	3 row(s) returned
28	17:31:51	SELECT * FROM Books WHERE Title LIKE '%the%' LIMIT 0, 1000	5 row(s) returned
29	17:32:16	SELECT * FROM Books WHERE Genre IN ('Fiction', 'Dystopian') LIMIT 0, 1000	3 row(s) returned
30	17:42:36	SELECT * FROM Books WHERE PublishedYear BETWEEN 1900 AND 1950 LIMI...	4 row(s) returned
31	17:43:13	SELECT Title AS BookTitle, Author AS BookAuthor FROM Books LIMIT 0, 1000	10 row(s) returned
32	17:44:08	SELECT Members.FirstName, Members.LastName, Books.Title FROM Loans INNE...	7 row(s) returned
33	17:44:40	SELECT Members.FirstName, Members.LastName, Books.Title FROM Members LE...	8 row(s) returned
34	17:45:42	SELECT Members.FirstName, Members.LastName, Books.Title FROM Books RIGH...	8 row(s) returned
35	17:50:46	SELECT Members.FirstName, Members.LastName, Books.Title FROM Members LE...	8 row(s) returned
36	17:53:15	SELECT FirstName, LastName FROM Members UNION SELECT Author AS FirstNa...	15 row(s) returned
37	17:54:28	CREATE TABLE BooksBackup AS SELECT * FROM Books	10 row(s) affected Records: 10 Duplicates: 0 Warnings: 0
38	17:54:31	CREATE TABLE BooksBackup AS SELECT * FROM Books	Error Code: 1050. Table 'BooksBackup' already exists
39	17:57:40	INSERT INTO BooksBackup (Title, Author, PublishedYear, Genre, Price, ISBN) SE...	2 row(s) affected Records: 2 Duplicates: 0 Warnings: 0
40	17:59:02	SELECT * FROM BooksBackup LIMIT 0, 1000	12 row(s) returned
41	18:00:11	ALTER TABLE Members MODIFY Email VARCHAR(100) NOT NULL	0 row(s) affected Records: 0 Duplicates: 0 Warnings: 0



Field	Type	Null	Key	Default	Extra
MemberID	int	NO	PRI	NULL	auto_increment
FirstName	varchar(50)	NO		NULL	
LastName	varchar(50)	NO		NULL	
BirthDate	date	YES		NULL	
Email	varchar(100)	NO	UNI	NULL	
PhoneNumber	varchar(15)	YES		NULL	
MembershipStartDate	date	YES		curdate()	DEFAULT_GENERATED

Unique : This SQL command adds a unique constraint (UC_Email) on the Email column in the Members table, ensuring that each email address must be unique among all rows in the table.

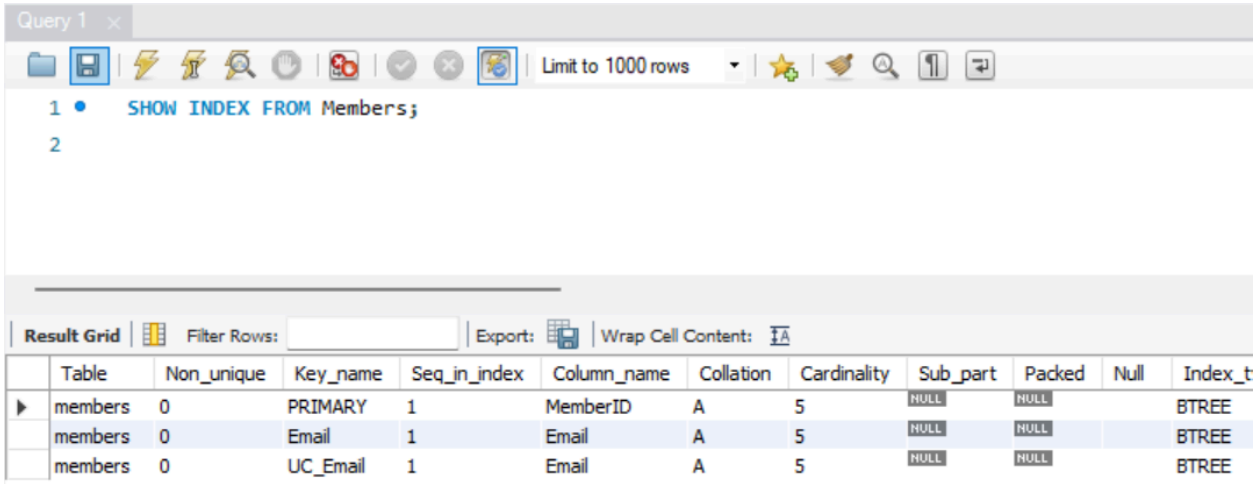
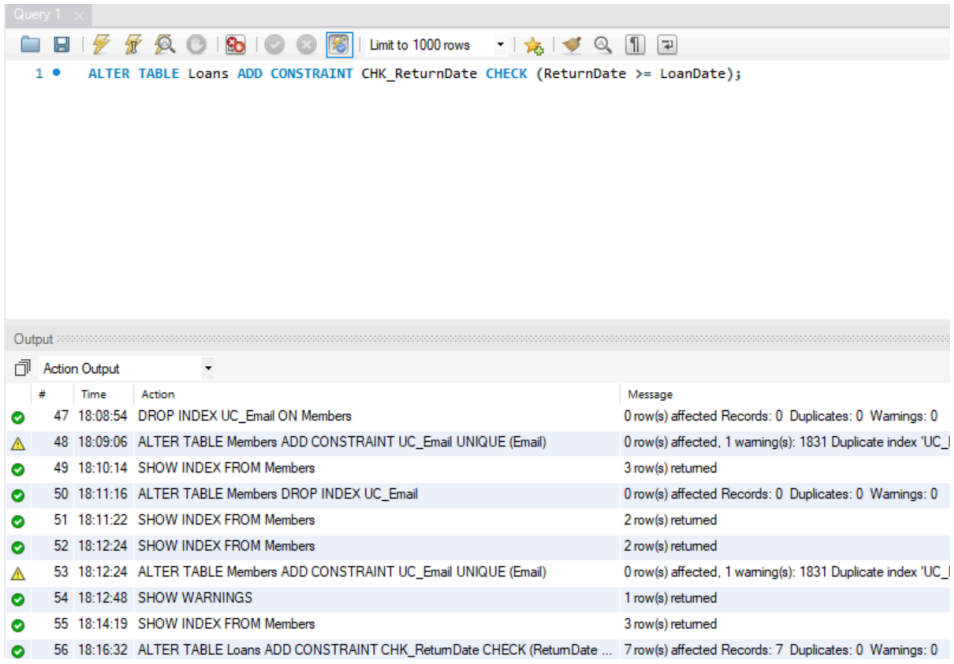
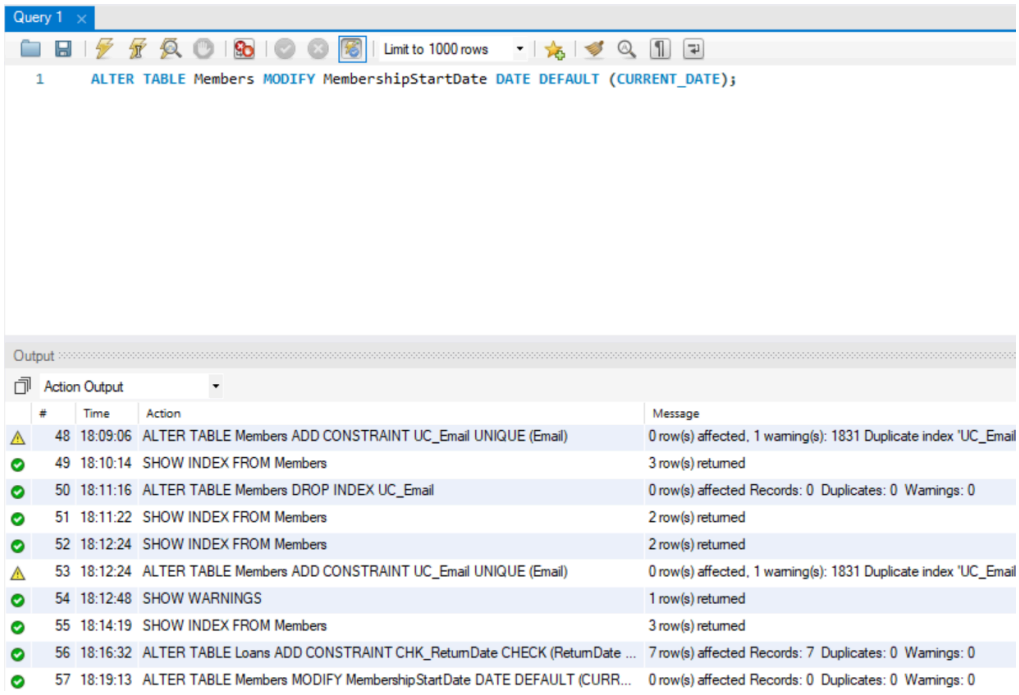


Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_t
members	0	PRIMARY	1	MemberID	A	5	NULL	NULL		BTREE
members	0	Email	1	Email	A	5	NULL	NULL		BTREE
members	0	UC_Email	1	Email	A	5	NULL	NULL		BTREE

Check : This SQL statement adds a constraint to the Loans table ensuring that the ReturnDate must be greater than or equal to the LoanDate for all records.



Default : This SQL statement modifies the Members table schema to set a default value of the current date (CURRENT_DATE) for the MembershipStartDate column.



Create Index: This SQL statement creates an index named idx_title on the Title column of the Books table, which improves the efficiency of searching and retrieving rows based on the Title column.

CREATE INDEX idx_title ON Books (Title);

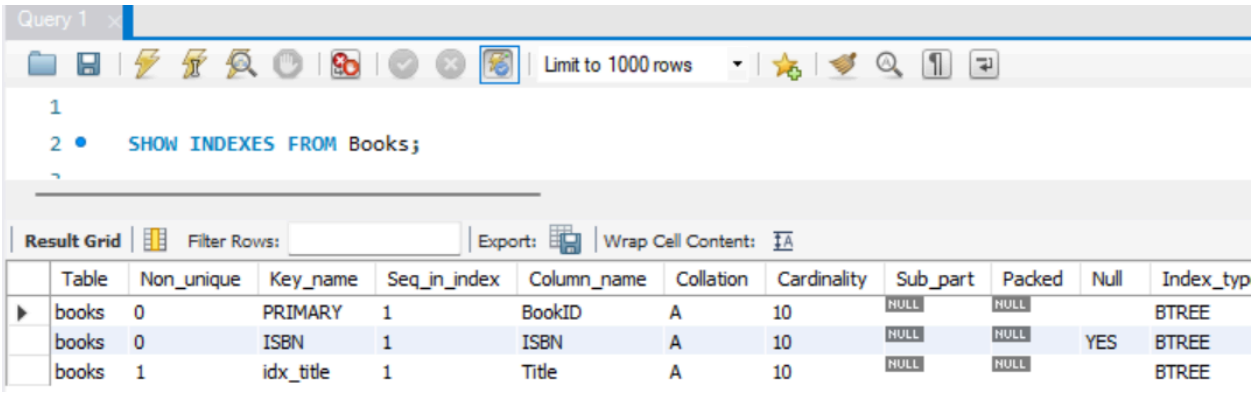
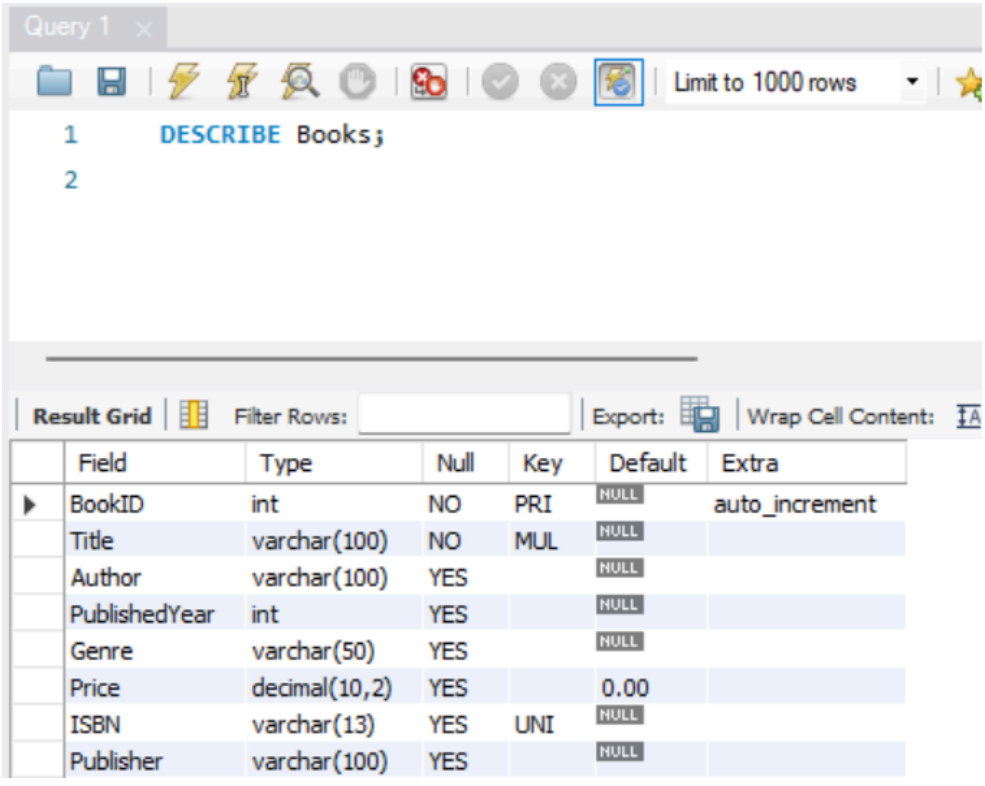


Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_typ
books	0	PRIMARY	1	BookID	A	10	NULL	NULL		BTREE
books	0	ISBN	1	ISBN	A	10	NULL	NULL	YES	BTREE
books	1	idx_title	1	Title	A	10	NULL	NULL		BTREE

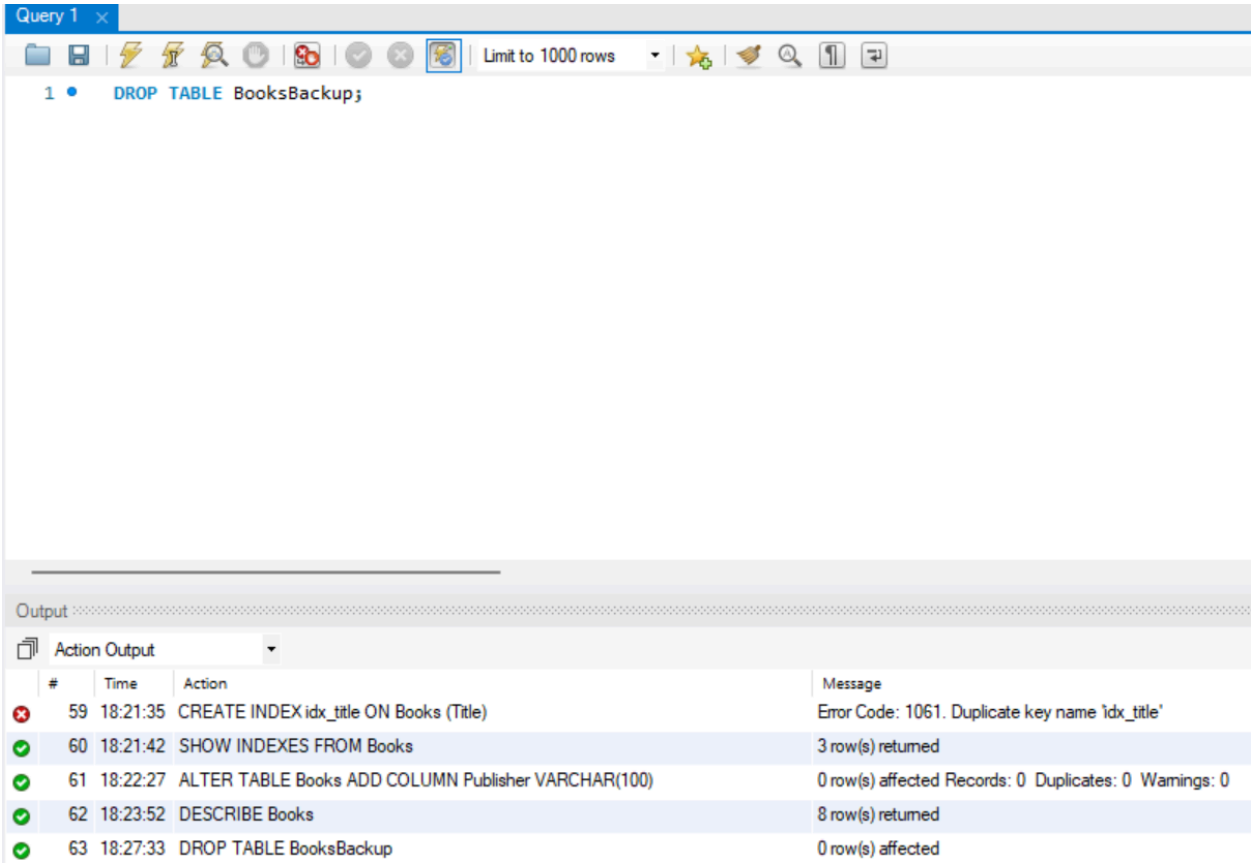
Alter: This SQL command adds a new column named Publisher to the Books table with a data type of VARCHAR(100).

ALTER TABLE Books ADD COLUMN Publisher VARCHAR(100);



Field	Type	Null	Key	Default	Extra
BookID	int	NO	PRI	NULL	auto_increment
Title	varchar(100)	NO	MUL	NULL	
Author	varchar(100)	YES		NULL	
PublishedYear	int	YES		NULL	
Genre	varchar(50)	YES		NULL	
Price	decimal(10,2)	YES		0.00	
ISBN	varchar(13)	YES	UNI	NULL	
Publisher	varchar(100)	YES		NULL	

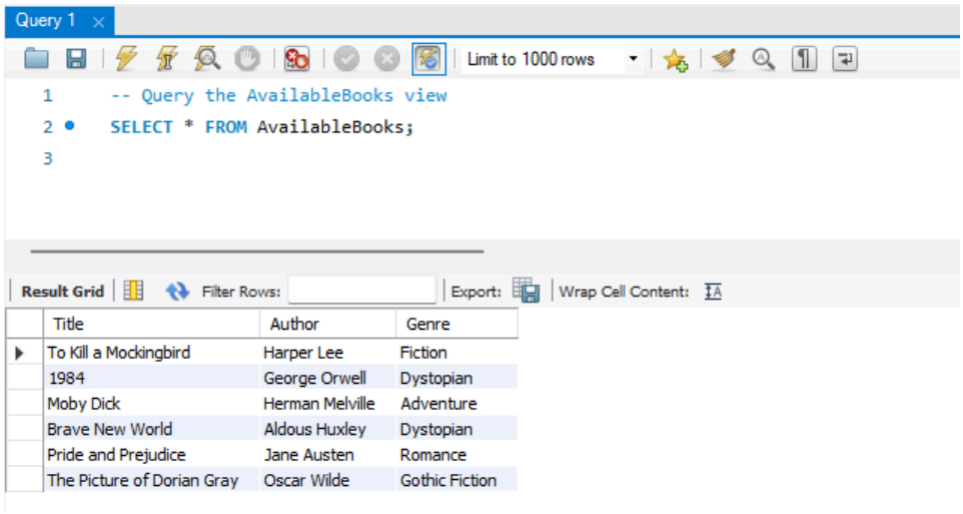
DROP: This command deletes (drops) the table named `BooksBackup` from the database.



Auto Increment : The AUTO_INCREMENT keyword in the LoanID INT AUTO_INCREMENT PRIMARY KEY statement ensures that the LoanID column will automatically generate a unique sequential number for each new row inserted into the Loans table, simplifying the management of primary key values.
Example: CREATE TABLE Loans (LoanID INT AUTO_INCREMENT PRIMARY KEY, BookID INT, MemberID INT, LoanDate DATE DEFAULT CURRENT_DATE, ReturnDate DATE, FOREIGN KEY (BookID) REFERENCES Books(BookID), FOREIGN KEY (MemberID) REFERENCES Members(MemberID), CHECK (ReturnDate >= LoanDate));

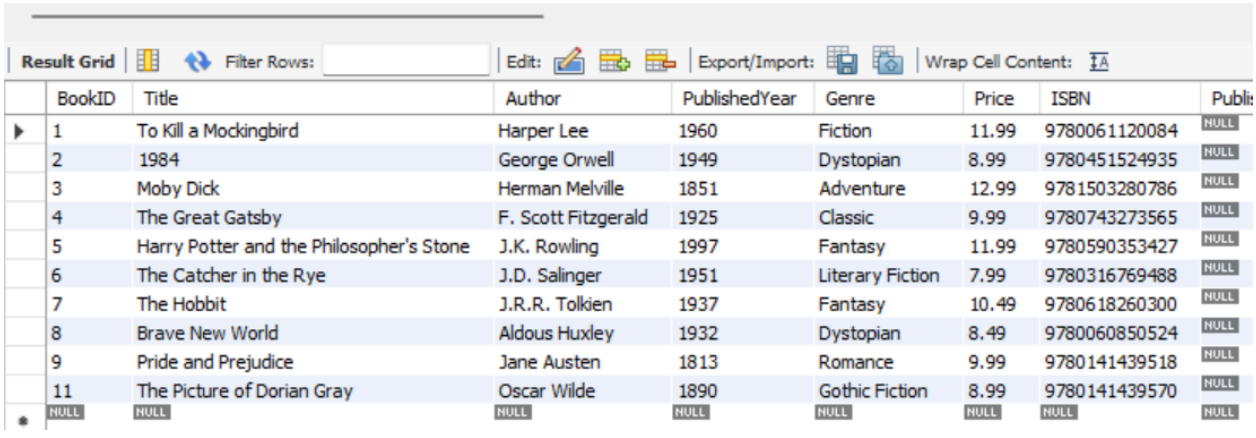
Views: This view AvailableBooks lists titles, authors, and genres from the Books table excluding those currently on loan (where ReturnDate is NULL in the Loans table).

CREATE VIEW AvailableBooks AS SELECT Title, Author, Genre FROM Books WHERE BookID NOT IN (SELECT BookID FROM Loans WHERE ReturnDate IS NULL);



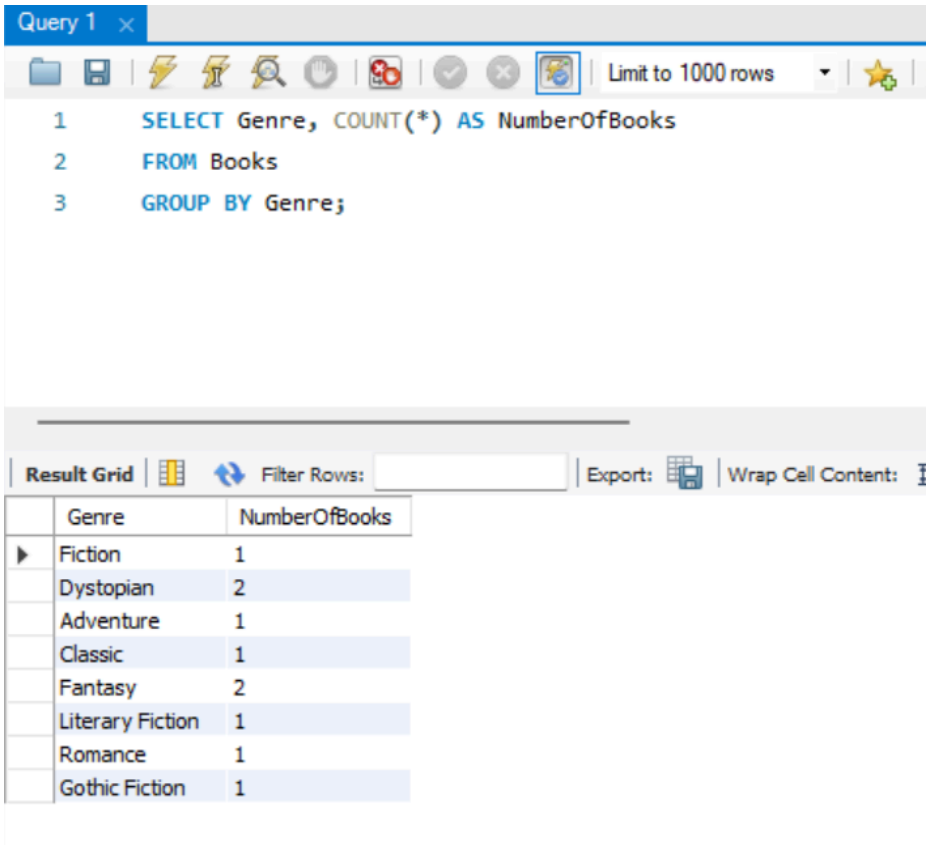
Title	Author	Genre
To Kill a Mockingbird	Harper Lee	Fiction
1984	George Orwell	Dystopian
Moby Dick	Herman Melville	Adventure
Brave New World	Aldous Huxley	Dystopian
Pride and Prejudice	Jane Austen	Romance
The Picture of Dorian Gray	Oscar Wilde	Gothic Fiction

Null Values : This query selects all records from the Books table where the Publisher column has a NULL value.



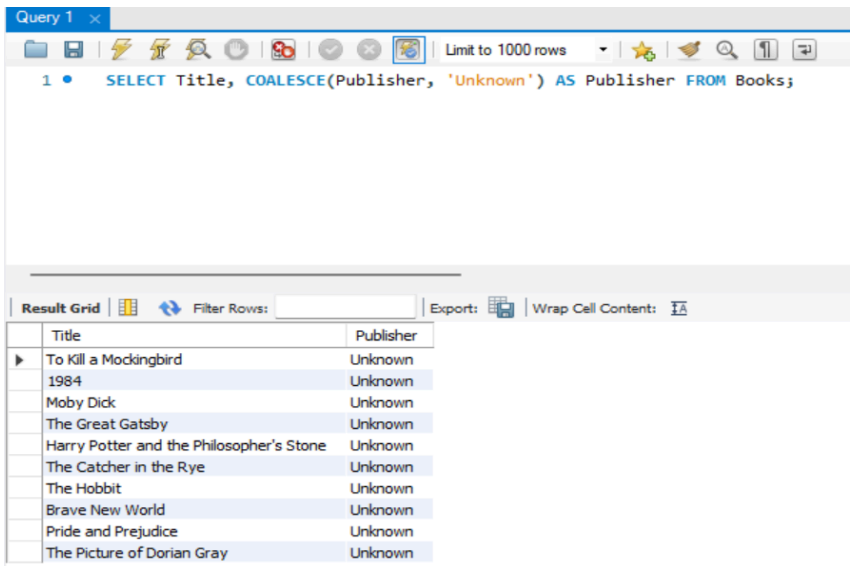
BookID	Title	Author	PublishedYear	Genre	Price	ISBN	Publi
1	To Kill a Mockingbird	Harper Lee	1960	Fiction	11.99	9780061120084	NULL
2	1984	George Orwell	1949	Dystopian	8.99	9780451524935	NULL
3	Moby Dick	Herman Melville	1851	Adventure	12.99	9781503280786	NULL
4	The Great Gatsby	F. Scott Fitzgerald	1925	Classic	9.99	9780743273565	NULL
5	Harry Potter and the Philosopher's Stone	J.K. Rowling	1997	Fantasy	11.99	9780590353427	NULL
6	The Catcher in the Rye	J.D. Salinger	1951	Literary Fiction	7.99	9780316769488	NULL
7	The Hobbit	J.R.R. Tolkien	1937	Fantasy	10.49	9780618260300	NULL
8	Brave New World	Aldous Huxley	1932	Dystopian	8.49	9780060850524	NULL
9	Pride and Prejudice	Jane Austen	1813	Romance	9.99	9780141439518	NULL
11	The Picture of Dorian Gray	Oscar Wilde	1890	Gothic Fiction	8.99	9780141439570	NULL
NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Group By : This query counts the number of books in each genre from the `Books` table and displays the genre along with the count of books in that genre.



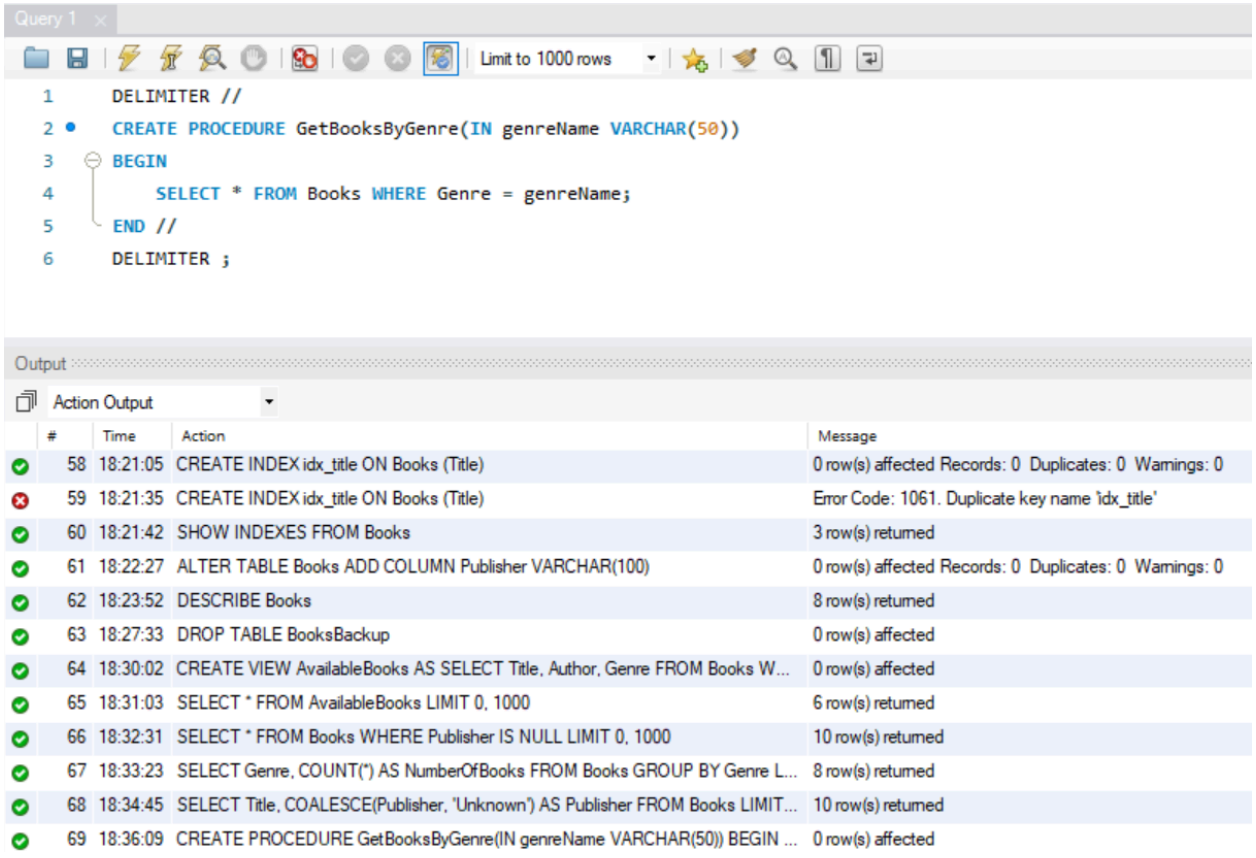
Genre	NumberOfBooks
Fiction	1
Dystopian	2
Adventure	1
Classic	1
Fantasy	2
Literary Fiction	1
Romance	1
Gothic Fiction	1

Null Functions : This query selects the Title of books from the Books table, replacing NULL values in the Publisher column with 'Unknown' using the COALESCE function, and aliases the result column as Publisher.

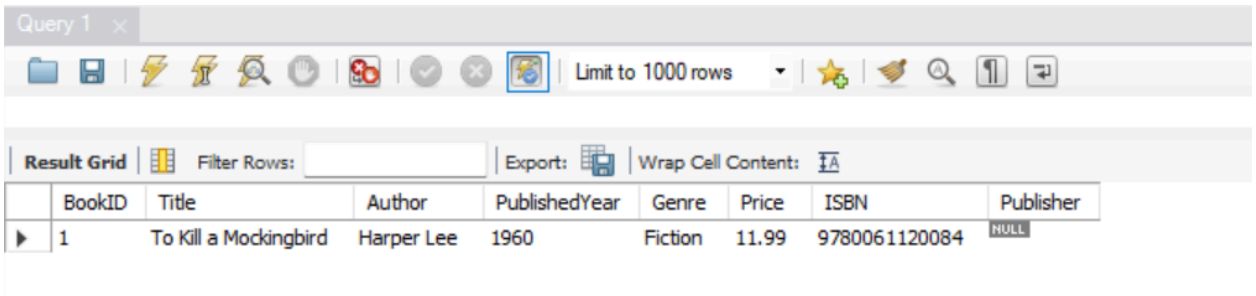


Title	Publisher
To Kill a Mockingbird	Unknown
1984	Unknown
Moby Dick	Unknown
The Great Gatsby	Unknown
Harry Potter and the Philosopher's Stone	Unknown
The Catcher in the Rye	Unknown
The Hobbit	Unknown
Brave New World	Unknown
Pride and Prejudice	Unknown
The Picture of Dorian Gray	Unknown

Stored Procedure : This SQL script defines a stored procedure named `GetBooksByGenre` that accepts a genre name as input and retrieves all columns from the `Books` table where the genre matches the input parameter.



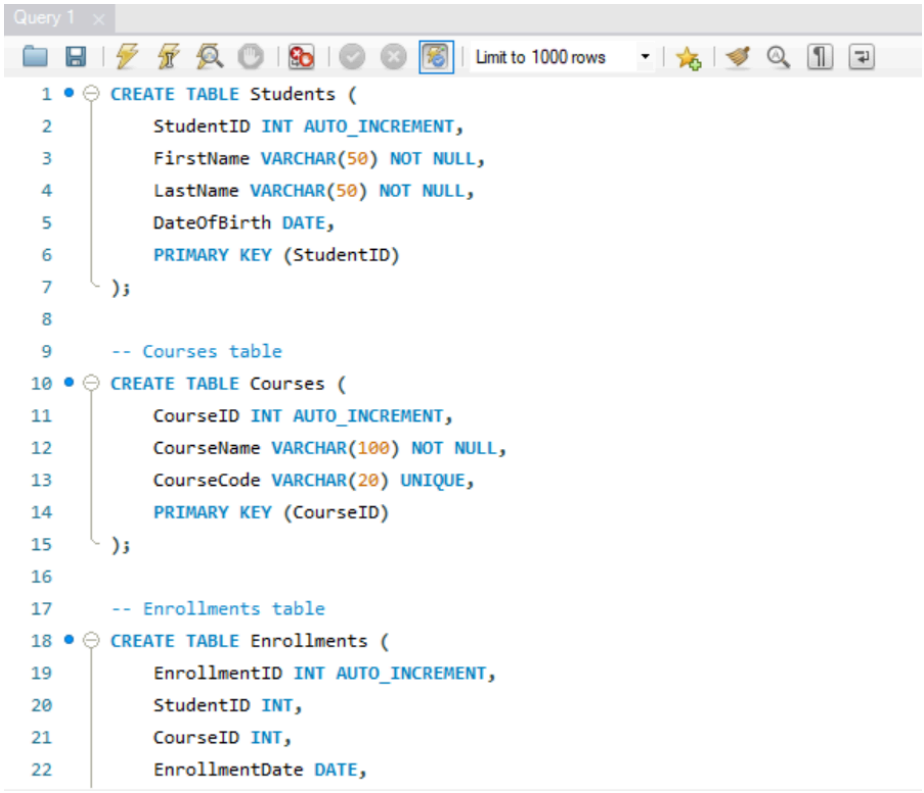
CALL GetBooksByGenre('Fiction');

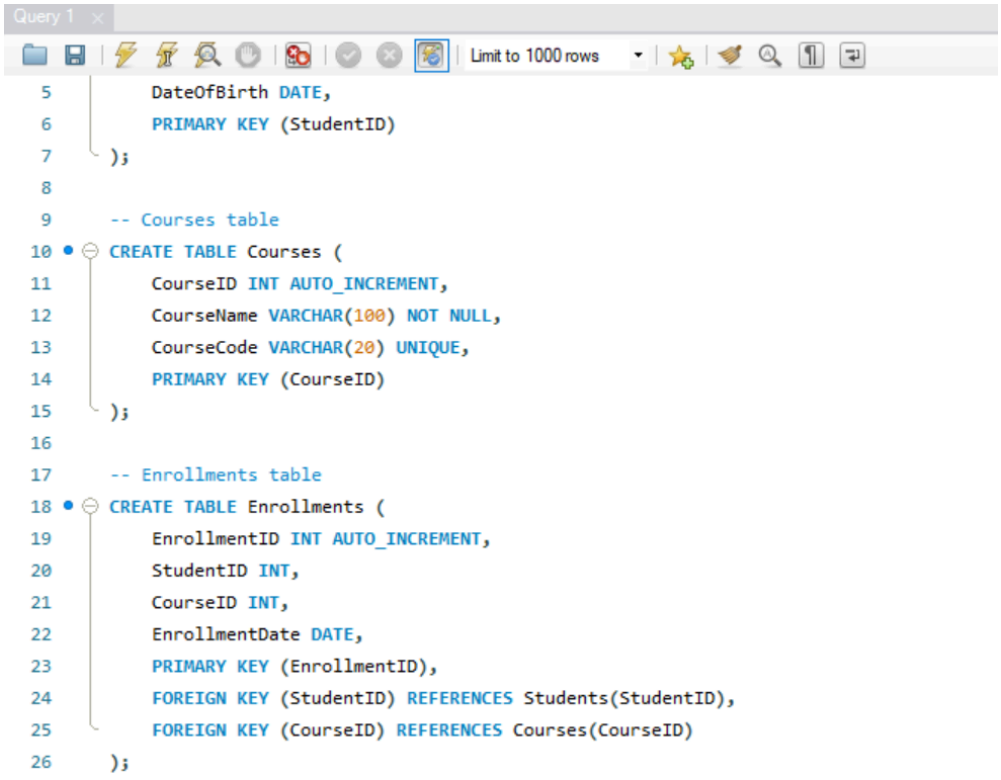


Primary Key & Foreign Key:

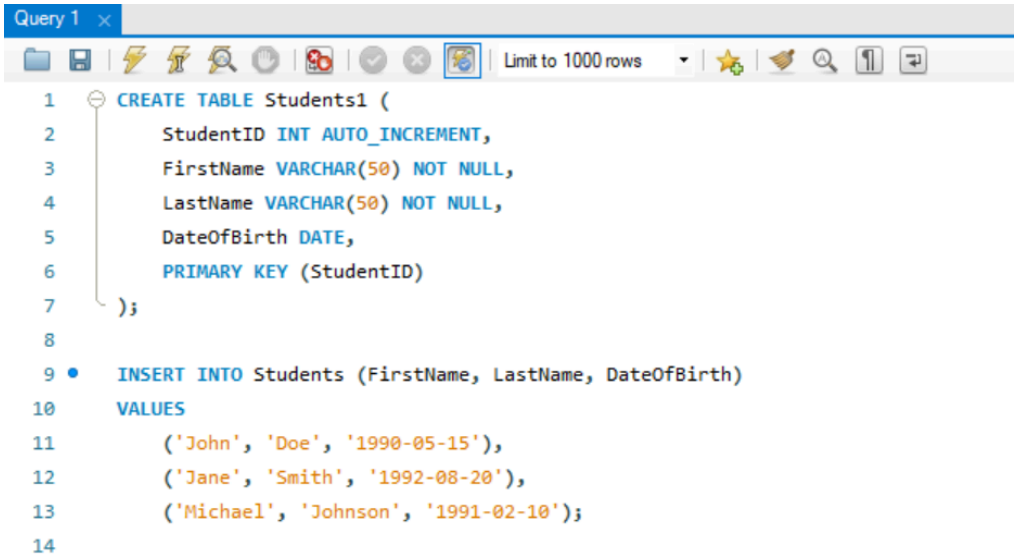
Primary Key: Uniquely identifies each row in a table. Ensures data integrity, prevents duplicates, and allows for efficient indexing.

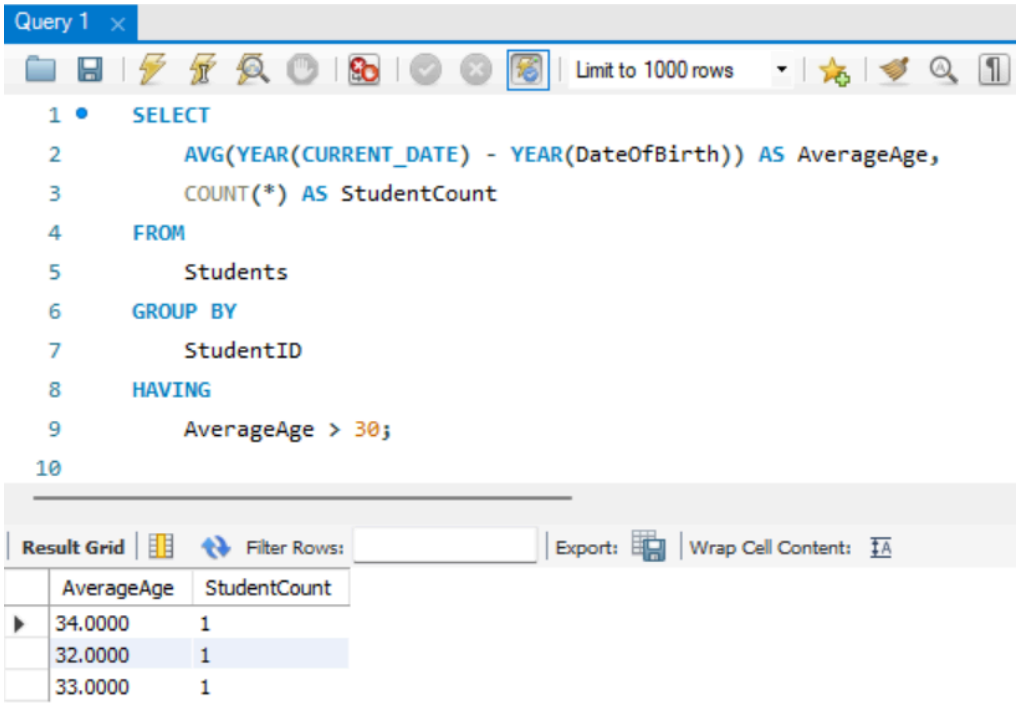
Foreign Key: Establishes relationships between tables based on the primary key of another table. Ensures referential integrity, maintains data consistency, and supports relational database structure.





Having Function : The HAVING clause in SQL filters grouped data based on aggregate conditions specified after GROUP BY. It's used to select specific groups that meet certain criteria, akin to how WHERE filters individual rows.





Callable Statement

Theory:

- Definition: A CallableStatement in SQL is a feature used in programming languages like Java to execute stored procedures or functions that are stored in a database.
- Usage: It allows applications to call database procedures with input parameters and retrieve output parameters or results.
- Preparedness: Unlike regular SQL statements, CallableStatement is precompiled, which means it can be executed multiple times with different parameters efficiently.
- Benefits: It enhances security by preventing SQL injection and improves performance by reducing compilation overhead.
- Examples: In Java, you prepare a CallableStatement to execute a stored procedure with parameters and retrieve results as needed.

Prepared Statement

Theory:

- Definition: A PreparedStatement in SQL is a feature used to execute SQL queries multiple times with varying parameters.
- Functionality: It precompiles SQL queries and allows parameterized execution, enhancing performance and security.
- Parameterization: SQL parameters are placeholders in the query that are filled dynamically during execution, preventing SQL injection attacks.
- Efficiency: Prepared statements are compiled once by the database server and cached, enabling quick execution with different parameter values.
- Example: In a web application, a PreparedStatement is used to insert user data into a database securely, ensuring data integrity and protection.

Concept of Normalization in SQL

Theory:

- Definition: Normalization in SQL is the process of organizing data in a database to reduce redundancy and dependency by dividing large tables into smaller tables and defining relationships between them.
- Objective: To eliminate data anomalies (like insertion, update, and deletion anomalies) and improve data integrity.
- Levels of Normalization:
    - First Normal Form (1NF): Ensures atomicity of data (no repeating groups).
    - Second Normal Form (2NF): Ensures all non-key attributes are fully functional dependent on the primary key.
    - Third Normal Form (3NF): Ensures no transitive dependency among non-key attributes.
    - Higher Normal Forms (BCNF, 4NF, 5NF): Address more complex data dependencies and ensure further reduction in redundancy.
- Benefits:
    - Reduces storage space by avoiding duplicate data.
    - Improves data consistency and accuracy.
    - Simplifies maintenance and enhances query performance.
- Example:
    - In a library database, separate tables for Books, Authors, and Genres are created. Each table contains specific attributes related to books, authors, and genres respectively, linked through primary and foreign keys.