Introduction to Transactions in SQL

Lesson 1: What is a Transaction?

Explanation:

A transaction is a group of SQL operations executed as a single unit. It ensures data consistency and integrity.

A transaction should be either fully completed or fully failed.

Lesson 2: Properties of Transactions (ACID)

Explanation:

1. Atomicity: All operations succeed or none do.

2. Consistency: Database remains valid before and after.

3. Isolation: Transactions do not interfere with each other.

4. Durability: Once committed, changes are permanent.

Lesson 3: Basic Transaction Commands

Commands:

- START TRANSACTION or BEGIN: Starts a transaction.

- COMMIT: Saves changes made.

- ROLLBACK: Undoes changes if an error occurs.

Example 1: Successful Transaction

```
START TRANSACTION;

UPDATE accounts SET balance = balance - 500 WHERE account_id = 1;
UPDATE accounts SET balance = balance + 500 WHERE account_id = 2;

COMMIT;
```

This transaction transfers $500 if both updates succeed.

Example 2: Transaction with Rollback

```
START TRANSACTION;

UPDATE accounts SET balance = balance - 500 WHERE account_id = 1;
UPDATE accounts SET balance = balance + 500 WHERE account_id = 999;  -- Invalid ID

ROLLBACK;
```

The transaction is canceled because the second update fails.

Lesson 4: Using Transactions in Application Code (Python)

```
import sqlite3

conn = sqlite3.connect("bank.db")
cursor = conn.cursor()

try:
    conn.execute("BEGIN")
    cursor.execute("UPDATE accounts SET balance = balance - 500 WHERE account_id = 1")
    cursor.execute("UPDATE accounts SET balance = balance + 500 WHERE account_id = 2")
    conn.commit()
except:
    conn.rollback()
    print("Transaction failed.")
```

Lesson 5: Nested Transactions (Savepoints)

```
START TRANSACTION;


UPDATE accounts SET balance = balance - 100 WHERE account_id = 1;
SAVEPOINT sp1;
UPDATE accounts SET balance = balance + 100 WHERE account_id = 2;
ROLLBACK TO sp1;


COMMIT;
```

Only the second update is rolled back, not the entire transaction.

Practice Exercises

1. Transfer money between two accounts using a transaction.

2. Use ROLLBACK when a withdrawal would cause a negative balance.

3. Use SAVEPOINT to rollback a partial part of a transaction.