Shiraz University
Advanced Database Systems

Assignment 4

Transactions and Concurrency Control

Department of Electrical and Computer Engineering
Instructor: Professor Sadreddini

Deadline:

03 bahman 1404, at 11:59 PM (Tehran Time)

Introduction

Transactions are a fundamental concept in database systems, ensuring data consistency and correctness in the presence of concurrent access and system failures. To guarantee reliable execution, database systems rely on the **ACID** properties and use concurrency control mechanisms such as transaction isolation levels.

In this assignment, you will work with SQL transactions to:

- Implement and control transactions using SQL commands.
- Observe common concurrency anomalies.
- Apply different isolation levels.
- Analyze how isolation levels prevent concurrency problems.

All experiments must be performed on a relational DBMS that supports transactions (e.g., PostgreSQL, MySQL/InnoDB, or SQL Server).

Part 1 – Transaction Control

Task 1: Transaction Implementation

Write SQL scripts that demonstrate the use of:

- `BEGIN`
- `COMMIT`
- `ROLLBACK`

Your script must:

(a) Create a sample table (e.g., `accounts` or `products`).

(b) Perform at least one successful transaction that is committed.

(c) Perform at least one transaction that is rolled back.

(d) Clearly show the database state before and after each transaction.

Part 2 – Concurrency Anomalies

Task 2: Reproducing a Concurrency Anomaly

Manually reproduce **one** of the following concurrency anomalies:

- Lost Update
- Non-Repeatable Read
- Dirty Read (if supported by your DBMS)

Requirements:

(a) Use at least two concurrent transactions (Transaction T1 and T2).

(b) Provide the SQL statements executed by each transaction.

(c) Show the final incorrect or inconsistent result.

Clearly explain why the anomaly occurs.

Part 3 – Isolation Levels

Task 3: Applying Isolation Levels

Repeat the experiment from Part 2 using the following isolation levels:

- `READ COMMITTED`
- `REPEATABLE READ`
- (Optional) `SERIALIZABLE`

For each isolation level:

(a) Specify how the isolation level is set in SQL.

(b) Execute the same transaction steps.

(c) Record whether the anomaly still occurs.

Part 4 – Analysis and Report

Task 4: Isolation Level Analysis

In a short report, analyze the results and answer the following questions:

- Which isolation levels prevent the observed anomaly?

- Why lower isolation levels allow the anomaly to occur?

- What trade-offs exist between isolation level and performance?

Your explanations must be clear, concise, and technically accurate.

Submission Instructions

1. Your ZIP file must contain:

   - SQL scripts for all tasks
   - A PDF report containing explanations and analysis

2. Submit a single compressed archive (`.zip only; not .rar`) by email to: `adb.graders@gmail.com`.

3. Use the following exact format:

   - Archive Name: `ADB-HW4-Jack_White-90012768.zip`
   - Email Subject: `Assignment 4:  90012768`

   Replace "Jack White" with your full name and "90012768" with your student number.

4. Late submissions will not be accepted unless explicitly approved by the instructor.