Experiment:11

Name-Parijat Pal

UID-23BCC70037

Part A: Prevent Duplicate Enrollments Using Locking Description:

Simulate concurrent users attempting to enroll students in courses. Implement a mechanism that prevents two users from enrolling the same student into the same course simultaneously by using transactions and unique constraints.

Input Format:

- Table StudentEnrollments with columns:
 - o enrollment id (INT, Primary Key)
 - o student name (VARCHAR(100))
 - o course id (VARCHAR(10))
 - o enrollment date (DATE)

Output Format:

Only one user should be able to insert the record successfully for a given (student_name, course id) pair.

Constraints:

- Each student can enroll in a course only once.
- The pair (student_name, course_id) must be unique.
- Use transactions to handle concurrent access.

Sample Input:

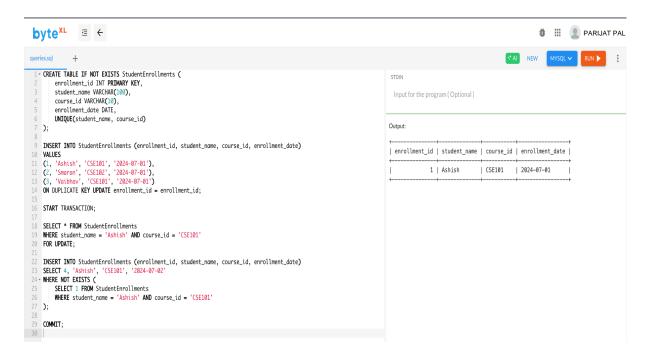
enrollment_id	student_name	course_id	enrollment_date
1	Ashish	CSE101	2024-07-01
2	Smaran	CSE102	2024-07-01
3	Vaibhav	CSE101	2024-07-01

Sample Output:If two users try to enroll 'Ashish' in 'CSE101', only the first will succeed; the second will get a constraint violation.

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Query:
```

```
CREATE TABLE IF NOT EXISTS StudentEnrollments (
  enrollment id INT PRIMARY KEY,
  student_name VARCHAR(100),
  course_id VARCHAR(10),
  enrollment date DATE,
  UNIQUE(student_name, course_id)
);
INSERT INTO StudentEnrollments (enrollment_id, student_name, course_id,
enrollment date)
VALUES
(1, 'Ashish', 'CSE101', '2024-07-01'),
(2, 'Smaran', 'CSE102', '2024-07-01'),
(3, 'Vaibhav', 'CSE101', '2024-07-01')
ON DUPLICATE KEY UPDATE enrollment_id = enrollment_id;
START TRANSACTION;
SELECT * FROM StudentEnrollments
WHERE student name = 'Ashish' AND course id = 'CSE101'
FOR UPDATE;
INSERT INTO StudentEnrollments (enrollment_id, student_name, course_id,
enrollment date)
SELECT 4, 'Ashish', 'CSE101', '2024-07-02'
WHERE NOT EXISTS (
  SELECT 1 FROM StudentEnrollments
  WHERE student_name = 'Ashish' AND course_id = 'CSE101'
);
COMMIT;
```

Output:



Part B: Use SELECT FOR UPDATE to Lock Student Record Description:

Use row-level locking via **SELECT FOR UPDATE** to prevent conflicts. Simulate a situation where a student is being verified before enrollment and locked until confirmation, preventing other users from updating it simultaneously.

Input Format:

• Same table: StudentEnrollments

Output Format:

The selected row will be locked until the transaction is committed or rolled back. Other users trying to access that row will be blocked.

Constraints:

- Use start transaction and select for update.
- Locking should block conflicting transactions on the same record.

Sample Input:

Simulation Steps (Using Row-Level Locking with SELECT FOR UPDATE)

User A:

- 1. Start a transaction.
- 2. Use a SELECT FOR UPDATE query to lock the specific row where:
 - O Student name is 'Ashish'
 - Course ID is 'CSE101'
- 3. Keep the transaction open (do not commit or rollback yet).

This locks the row so that no one else can update it until User A finishes.

User B (while User A's transaction is still open):

1. Try to update the same row (student name = 'Ashish' and course id = 'CSE101').

This update will be blocked (it will wait) because the row is locked by User A.

Sample Output:

User B will be blocked until User A finishes the transaction.

```
Query:
CREATE TABLE IF NOT EXISTS StudentEnrollments (
  enrollment id INT PRIMARY KEY,
  student_name VARCHAR(100),
  course id VARCHAR(10),
  enrollment_date DATE,
  UNIQUE(student_name, course_id)
);
INSERT INTO StudentEnrollments (enrollment id, student name, course id,
enrollment_date)
VALUES
(1, 'Ashish', 'CSE101', '2024-07-01'),
(2, 'Smaran', 'CSE102', '2024-07-01'),
(3, 'Vaibhav', 'CSE101', '2024-07-01')
ON DUPLICATE KEY UPDATE enrollment_id = enrollment_id;
START TRANSACTION;
SELECT*
FROM StudentEnrollments
WHERE student_name = 'Ashish' AND course_id = 'CSE101'
FOR UPDATE;
UPDATE StudentEnrollments
SET enrollment_date = '2024-08-01'
WHERE student_name = 'Ashish' AND course_id = 'CSE101';
COMMIT;
```

Output:



Part C: Demonstrate Locking Preserving Consistency in Concurrent Transactions Description:

Demonstrate how locking preserves data consistency when multiple users attempt concurrent updates. Show how update conflicts are avoided when row-level locks are used appropriately in transactions.

Input Format:

Same StudentEnrollments table as above.

Output Format:

Conflicting operations are serialized due to locking, and data remains consistent without corruption or duplication.

Constraints:

- Each user must use transactions with locking.
- Show that without locking, both users could overwrite each other's changes.

Sample Input:

enrollment_id	student_name	course_id	enrollment_date
1	Ashish	CSE101	2024-07-01

Sample Output:

After both users run their updates one after the other, only the last committed update is reflected — no race condition or inconsistent data.

Output:

