IT5008: Tutorial 6 — Stored Procedures and Triggers

Pratik Karmakar

School of Computing,
National University of Singapore

AY25/26 S1

Scenario

Students at the **National University of Ngendipura (NUN)** buy, lend, and borrow books.
NUNStA commissions *Apasaja Private Limited* to implement an online book exchange system that records:

- Students: name, faculty, department, **email**, join year.
- Books: title, authors, publisher, edition, **ISBN10**, **ISBN13**.
- Loans: `borrowed` date, `returned` date (`NULL` if active).

Auditing preserves records of graduated students and copies with loans.
This tutorial uses the schema/data from "Creating and Populating Tables."

Questions

1. Stored Functions and Procedures
   (a) Implement `borrow_book` (function/procedure) to check availability of a copy, insert a loan, and return/raise a message.
   - Scenario: Adeline Wong (`awong007@msn.com`) tries to borrow 3 copies of "Applied Calculus" (`ISBN13=978-0470170526`).
2. Triggers
   (a) Create a trigger that enforces: a student may have at most 3 active loans (local strategy).
   (b) Create a trigger that ensures globally no student exceeds 3 active loans (global strategy).

1(a). Function borrow_book

```
CREATE OR REPLACE FUNCTION borrow_book (
  borrower_email VARCHAR(256),
  isbn13 CHAR(14),
  borrow_date DATE
) RETURNS TEXT AS $$
DECLARE
  available_copy RECORD;
BEGIN
  SELECT * INTO available_copy
  FROM copy c
  WHERE c.book = isbn13
    AND NOT EXISTS (
      SELECT 1 FROM loan l
      WHERE l.book=c.book
        AND l.copy=c.copy
        AND l.owner=c.owner
        AND l.returned IS NULL)
  LIMIT 1;
  IF NOT FOUND THEN
    RETURN 'No available copies of '||isbn13;
  ELSE
    INSERT INTO loan (borrower, owner, book,
      copy, borrowed)
    VALUES (borrower_email, available_copy.owner,
            available_copy.book,
      available_copy.copy, borrow_date);
    RETURN 'Book '||isbn13||' borrowed by
      '||borrower_email;
  END IF;
END;
$$ LANGUAGE plpgsql;
```

1(a). Procedure borrow_book

```
CREATE OR REPLACE PROCEDURE borrow_book (
  borrower_email VARCHAR(256),
  isbn13 CHAR(14),
  borrow_date DATE
) AS $$
DECLARE
  available_copy RECORD;
BEGIN
  SELECT * INTO available_copy
  FROM copy c
  WHERE c.book = isbn13
    AND NOT EXISTS (
      SELECT 1 FROM loan l
      WHERE l.book=c.book
        AND l.copy=c.copy
        AND l.owner=c.owner
        AND l.returned IS NULL)
  LIMIT 1;
  IF NOT FOUND THEN
    RAISE NOTICE 'No copies of %', isbn13;
  ELSE
    INSERT INTO loan (borrower, owner, book,
      copy, borrowed)
    VALUES (borrower_email, available_copy.owner,
            available_copy.book,
      available_copy.copy, borrow_date);
    RAISE NOTICE 'Book % borrowed by %', isbn13,
      borrower_email;
  END IF;
END;
$$ LANGUAGE plpgsql;
```

2(a). Local Loan Limit Trigger

Max 3 active loans per student.

```
1  CREATE OR REPLACE FUNCTION check_local_loan_limit()
2  RETURNS TRIGGER AS $$
3  DECLARE active_loan_count INT;
4  BEGIN
5    SELECT COUNT(*) INTO active_loan_count
6    FROM loan l
7    WHERE l.borrower = NEW.borrower
8      AND l.returned ISNULL;
9
10   IF active_loan_count >= 3 THEN
11     RETURN NULL; -- prevent insert
12   ELSE
13     RETURN NEW;
14   END IF;
15 END;
16 $$ LANGUAGE plpgsql;
17
18 CREATE TRIGGER enforce_local_loan_limit_insert
19 BEFORE INSERT ON loan
20 FOR EACH ROW EXECUTE FUNCTION check_local_loan_limit();
```

2(b). Global Loan Limit Trigger

Ensure no student exceeds 3 active loans.

```
1  CREATE OR REPLACE FUNCTION check_global_loan_limit()
2  RETURNS TRIGGER AS $$
3  DECLARE violating_student RECORD;
4  BEGIN
5    SELECT l.borrower INTO violating_student
6    FROM loan l
7    WHERE l.returned ISNULL
8    GROUP BY l.borrower
9    HAVING COUNT(*) > 3;
10
11   IF violating_student IS NOT NULL THEN
12     RAISE EXCEPTION '% exceeds loan limit', violating_student;
13   ELSE
14     RETURN NEW;
15   END IF;
16 END;
17 $$ LANGUAGE plpgsql;
18
19 CREATE TRIGGER enforce_global_loan_limit
20 AFTER INSERT OR UPDATE ON loan
21 FOR EACH ROW EXECUTE FUNCTION check_global_loan_limit();
```

Guidelines & Remarks

- Functions return a value; procedures raise notices or exceptions.
- Local vs Global strategies: local checks per row; global checks across all rows.
- Use **BEFORE** triggers with `RETURN NULL` to cancel insertions.
- Use **AFTER** triggers with `RAISE EXCEPTION` for global consistency.
- Dropping schema (`DROP SCHEMA ... CASCADE`) ensures removal of triggers/functions.

Questions?
Drop a mail at: pratik.karmakar@u.nus.edu