Nulls, Updates, and Stored Procedures

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CS411: Database Systems

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Leaning Objectives

After this lecture, you should be able to:

- Understand the effect of Nulls in SQL
- Write commands to update database instance and schema
- Define and execute Stored Procedures in MySQL

Outline

- Nulls in SQL
- Database Updates
- Stored Procedures

Null Values

- Tuples in SQL relations can have NULL as a value for one or more components.
- Meaning depends on context. Two common cases:
  - *Missing value* : e.g., we know Royal cafe has some address, but we don't know what it is.
  - *Inapplicable* : e.g., the value of attribute *spouse* for an unmarried person.

Comparing NULL's to Values

- The logic of conditions in SQL is really 3-valued logic: TRUE, FALSE, UNKNOWN.
- *Comparison:* When any value is compared with NULL, the truth value is UNKNOWN.
- *Outcome:* But a query only produces a tuple in the answer if its truth value for the WHERE clause is TRUE (not FALSE or UNKNOWN).

Null Values

- If x=Null then what is the the value of 4*(3-x)/7 ?

  NULL

- If x=Null, then what is the truth value of x="Joe"?

  UNKNOWN

Three-Valued Logic

- To understand how AND, OR, and NOT work in 3-valued logic, think of TRUE = 1, FALSE = 0, and UNKNOWN = ½.
- AND = MIN; OR = MAX, NOT(x) = 1-x.
- Example:

TRUE AND (FALSE OR NOT(UNKNOWN))

= MIN(1, MAX(0, (1 - ½))) =

MIN(1, MAX(0, ½)) = MIN(1, ½) = ½

= UNKNOWN.

Another Example

- C1 AND C2 = min(C1, C2)
- C1 OR C2 = max(C1, C2)
- NOT C1 = 1 – C1

```
SELECT *
FROM Person
WHERE  (age < 25) AND
       (height > 6 OR weight > 190)
```

E.g.
age=20
height=NULL
weight=200

Rule in SQL: include only tuples that yield TRUE

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Database Modifications

- A modification command does not return a result the way a query does, but it changes the database in some way.
- There are two kinds of database modifications:

1. *Instance Modifications*
   - *Insert* a tuple or tuples.
   - *Delete* a tuple or tuples.
   - *Update* the value(s) of an existing tuple or tuples.
2. Schema Modifications
   - Add/Drop/Modify column
   - Drop Table/View

Insertion

- To insert a single tuple:

  INSERT INTO <relation>

  VALUES (<list of values>);

- Example: add to Likes (customer, drink) the fact that Sally likes Latte.

```
INSERT INTO Likes
VALUES('Sally', 'Latte');
```

Specifying Attributes in Insert

```
INSERT INTO Likes
VALUES('Sally', 'Latte');
```

- BUT: this assumes that we remember the order of attributes of Likes
- Instead: we can be explicit: to insert Sally into Likes (customer, drink):

```
INSERT INTO Likes(drink, customer)
VALUES('Latte', 'Sally');
```

- Can also add multiple tuples separated by commas

Specifying Attributes in INSERT

Overall, two reasons to specify attributes in the INSERT statement:

1. We may have forgotten the standard order of attributes for the relation.
2. We don't have values for all attributes, and we want the system to fill in missing components with NULL or a default value.

   simply omit the ones you don't want to insert

Inserting Many Tuples

We may insert the entire result of a query into a relation, using the form:

INSERT INTO <relation>

(<subquery>);

E.g.,
```
INSERT INTO Drinks(name)
 SELECT drink FROM Sells;
```

Deletion

- To delete tuples satisfying a condition from some relation:

```
DELETE FROM <relation>
WHERE <condition>;
```

Example: Deletion

- Delete from Likes (customer, drink) the fact that Sally likes Latte:

```
DELETE FROM Likes
WHERE customer = ‘Sally’ AND
  drink = ‘Latte’;
```

Example: Delete all Tuples

- Make the relation Likes empty:

```
DELETE FROM Likes;
```

- Note no WHERE clause needed.
- Table is not deleted: use the DROP TABLE statement instead

Example: Delete Many Tuples

- Delete from Drinks(name, manf) all drinks manufactured by Starbucks

```
DELETE FROM Drinks
WHERE name = ‘Starbucks’;
```

Another Example: Delete Many Tuples

- Delete from Drinks (name, manf) all drinks for which there is another drink by the same manufacturer.

```
DELETE FROM Drinks
WHERE name  IN (
 SELECT b1.name
   FROM Drinks b1, Drinks b2
 WHERE b1.manf = b2.manf AND
  b1.name <> b2.name);
```

Drinks with the same manufacturer and different names

Updates

- To change certain attributes in certain tuples of a relation:

```
UPDATE <relation>
SET <list of attribute assignments>
WHERE <condition on tuples>;
```

Example: Update

- Change Fred’s phone number to 555-1212:

```
UPDATE Customer
SET phone = ‘555-1212’
WHERE name = ‘Fred’;
```

- Add area code ‘217’ to Fred’s phone number:

```
UPDATE Customer
SET phone = ‘(217)’ || phone
WHERE name = ‘Fred’;
```

What about Multiple Users?

- What happens if multiple users update + delete at the same time?
- This requires management of concurrent operations
- We'll talk about **concurrency control** later in the semester

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Stored Procedures in MySQL

- A Stored Procedure is a set of SQL statements (with an assigned name) stored in the DBMS and can be called by multiple programs.
- Stored Procedure Syntax:

```
CREATE PRCEDURE sp_name
    (proc_parameter,…)
BEGIN
    -- execution code
END;
```

proc_parameter:

`[ IN | OUT | INOUT ]` ***param_name param_type***

- IN parameters for passing values into the procedure,
- OUT parameters for passing value back from procedure to the calling program
- INOUT: is a combination of IN and OUT parameters.

Example

Write a Stored Procedure that returns the FirstName, LastName, and Average GPA for each student

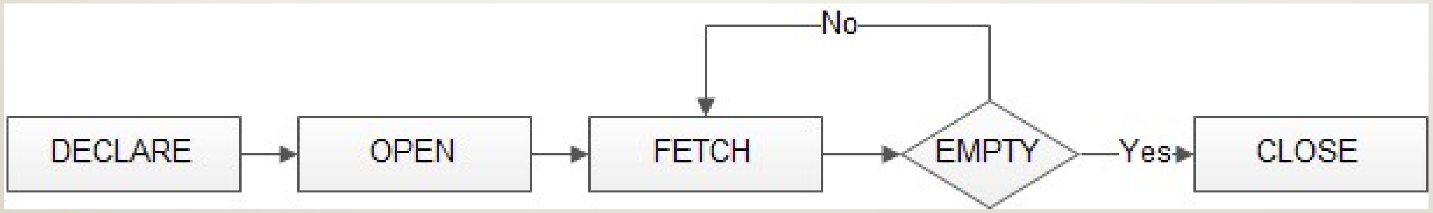
```
DELIMITER //
CREATE PROCEDURE GetAverageScore ()
BEGIN
     SELECT s.FirstName, s.LastName, AVG(Score) AS avgScore
     FROM Enrollments e JOIN Students s
                             ON (e.NetId = s.NetId)
     GROUP BY s.NetId;
END //
DELIMITER ;
```

Calling the procedure:

```
CALL GetAverageScore();
```

Stored Procedures in MySQL

- In stored procedures, you can:
  - declare variables
  - use conditional IF-THEN-ELSE or loops such as WHILE and REPEAT statements
  - use cursors: A cursor is used to iterate through a set of rows returned by a query so that we can process each individual row.
- how does MySQL cursor work?



Source: http://www.mysqltutorial.org/mysql-cursor/

Using Variables in MySQL SP

Define a stored procedure that takes a department name and returns the total number of students in that department.

```
DELIMITER //
CREATE PROCEDURE GetTotalStds (IN dept VARCHAR(30))
BEGIN
        DECLARE totalStds INT DEFAULT 0
        SELECT COUNT(*)
        INTO totalStds
        FROM Students
        WHERE Department= dept;

        SELECT totalStds;
END //
DELIMITER ;
```

Calling the procedure: CALL GetTotalStds('CS');

Passing values IN and OUT of SPs

Define a stored procedure that takes a department and returns the total number of students in that department.

```
DELIMITER //
CREATE PROCEDURE GetTotalStds (
        IN dept VARCHAR(30),
        OUT total INT)
BEGIN
        SELECT COUNT(*)
        INTO total
        FROM Students
        WHERE Department= dept;
END //
DELIMITER ;
```

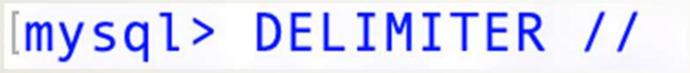
Calling the procedure: CALL GetTotalStds(‘CS',@total);

Getting the result: SELECT @total;

SP Example using Cursor

- Suppose we want to compute the average GPA for students per department and save the result in a new table DeptAvgGPA(deptName, AverageScore)

- **STEP 1: Change the delimiter from ; to //**

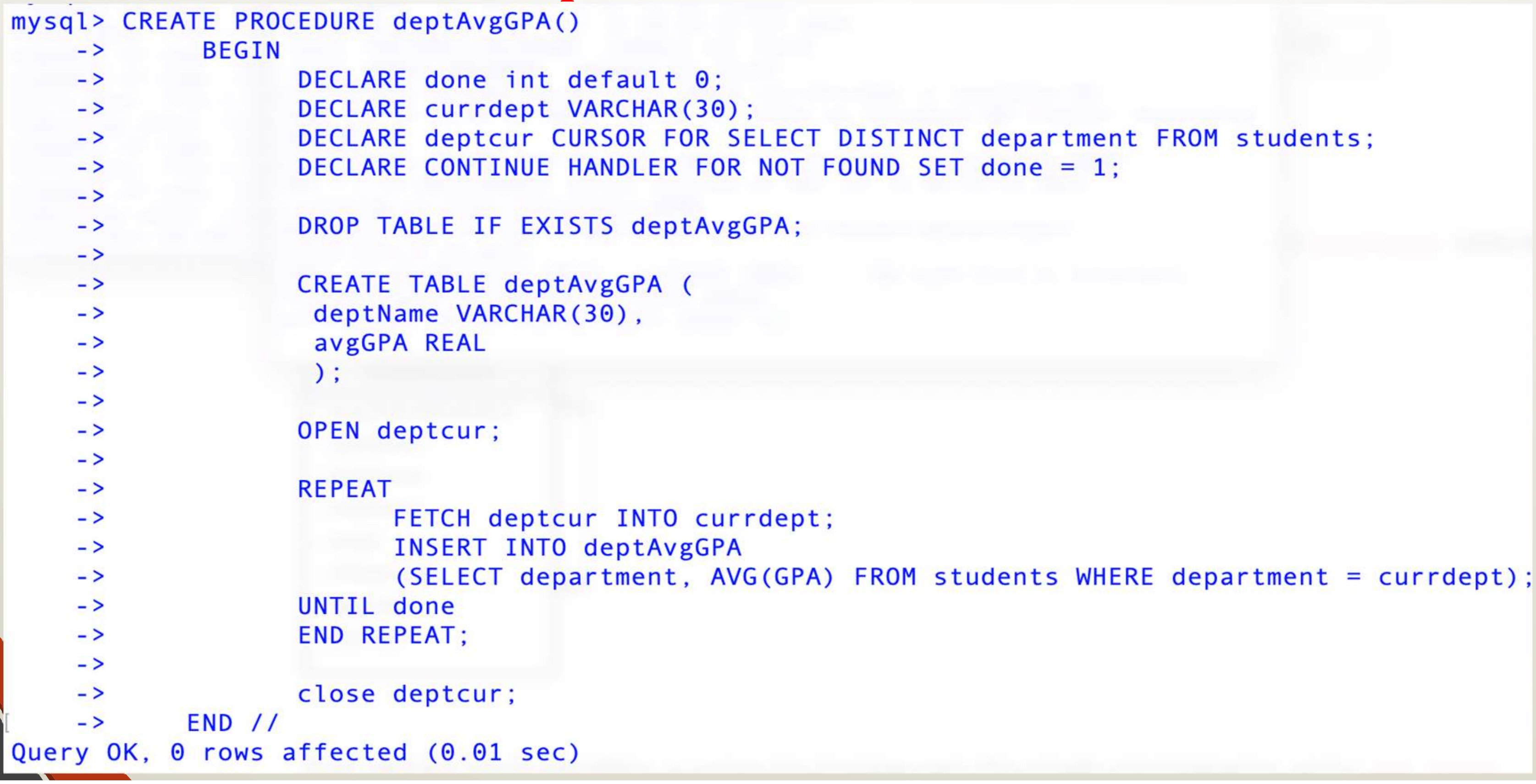


```
mysql> DELIMITER //
```

SP Example using Cursor

- Suppose we want to compute the average students' GPA per department and save the result in a new table DeptAvgGPA(deptName, AverageScore)

STEP 2: Define the stored procedure

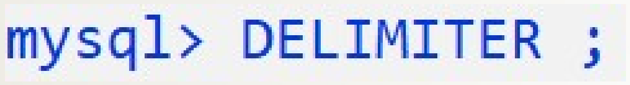


```
mysql> CREATE PROCEDURE deptAvgGPA()
    ->      BEGIN
    ->            DECLARE done int default 0;
    ->            DECLARE currdept VARCHAR(30);
    ->            DECLARE deptcur CURSOR FOR SELECT DISTINCT department FROM students;
    ->            DECLARE CONTINUE HANDLER FOR NOT FOUND SET done = 1;
    ->
    ->            DROP TABLE IF EXISTS deptAvgGPA;
    ->
    ->            CREATE TABLE deptAvgGPA (
    ->             deptName VARCHAR(30),
    ->             avgGPA REAL
    ->             );
    ->
    ->            OPEN deptcur;
    ->
    ->            REPEAT
    ->                  FETCH deptcur INTO currdept;
    ->                  INSERT INTO deptAvgGPA
    ->                  (SELECT department, AVG(GPA) FROM students WHERE department = currdept);
    ->            UNTIL done
    ->            END REPEAT;
    ->
    ->            close deptcur;
    ->     END //
Query OK, 0 rows affected (0.01 sec)
```

SP Example using Cursor

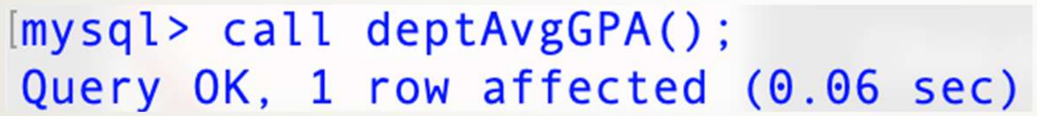
- Suppose we want to compute the average score for students per department and save the result in a new table DeptAvgGPA(<u>deptName</u>, AverageScore)

STEP 3: Changing the delimiter back to semi colon (;)



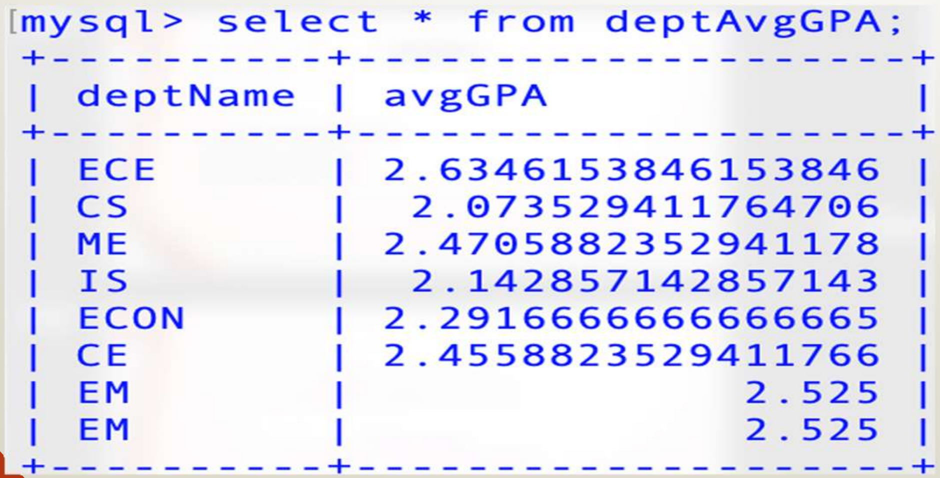
```
mysql> DELIMITER ;
```

STEP 4: calling stored procedure



```
mysql> call deptAvgGPA();
Query OK, 1 row affected (0.06 sec)
```

Viewing the results:



```
mysql> select * from deptAvgGPA;
+-----------+---------------------+
| deptName  | avgGPA              |
+-----------+---------------------+
| ECE       | 2.634615384615384 6 |
| CS        |  2.07352941176470 6 |
| ME        | 2.470588235294117 8 |
| IS        |  2.14285714285714 3 |
| ECON      | 2.291666666666666 5 |
| CE        | 2.455882352941176 6 |
| EM        |               2.525 |
| EM        |               2.525 |
+-----------+---------------------+
```

MySQL Stored Procedures Tutorial

http://www.mysqltutorial.org/mysql-stored-procedure-tutorial.aspx

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