Stored Procedures in MySQL

- A stored procedure contains a sequence of SQL commands stored in the database catalog so that it can be invoked later by a program

- Stored procedures are declared using the following syntax:

  Create Procedure <proc-name>

  (param_spec$_1$, param_spec$_2$, …, param_spec$_n$)

  begin

  -- execution code

  end;

  where each param_spec is of the form:

  [in | out | inout] <param_name> <param_type>

  – in mode: allows you to pass values into the procedure,
  – out mode: allows you to pass value back from procedure to the calling program

Example

```
mysql> select * from employee;
+----+------+---------+--------+------------+------+
| id | name | superid | salary | bdate      | dno  |
+----+------+---------+--------+------------+------+
|  1 | john |       3 | 100000 | 1960-01-01 |    1 |
|  2 | mary |       3 |  50000 | 1964-12-01 |    3 |
|  3 | bob  |    NULL |  80000 | 1974-02-07 |    3 |
|  4 | tom  |       1 |  50000 | 1978-01-17 |    2 |
|  5 | bill |    NULL |   NULL | 1985-01-20 |    1 |
+----+------+---------+--------+------------+------+
```

```
mysql> select * from department;
+---------+-------------+
| dnumber | dname       |
+---------+-------------+
|       1 | Payroll     |
|       2 | TechSupport |
|       3 | Research    |
+---------+-------------+
```

- Suppose we want to keep track of the total salaries of employees working for each department

```
mysql> create table deptsal as
    -> select dnumber, 0 as totalsalary from department;
Query OK, 3 rows affected (0.00 sec)
Records: 3  Duplicates: 0  Warnings: 0

mysql> select * from deptsal;
+---------+-------------+
| dnumber | totalsalary |
+---------+-------------+
|       1 |           0 |
|       2 |           0 |
|       3 |           0 |
+---------+-------------+
```

We need to write a procedure to update the salaries in the deptsal table

Example

```
mysql> delimiter //
```

Step 1: Change the delimiter (i.e., terminating character) of SQL statement from semicolon (;) to something else (e.g., //)

So that you can distinguish between the semicolon of the SQL statements in the procedure and the terminating character of the procedure definition

Example

```
mysql> delimiter //
mysql> create procedure updateSalary (IN param1 int)
    -> begin
    ->     update deptsal
    ->     set totalsalary = (select sum(salary) from employee where dno = param1)
    ->     where dnumber = param1;
    -> end; //
Query OK, 0 rows affected (0.01 sec)
```

Step 2:

1. Define a procedure called updateSalary which takes as input a department number.
2. The body of the procedure is an SQL command to update the totalsalary column of the deptsal table.
3. Terminate the procedure definition using the delimiter you had defined in step 1 (//)

Example

```
mysql> delimiter //
mysql> create procedure updateSalary (IN param1 int)
    -> begin
    ->     update deptsal
    ->     set totalsalary = (select sum(salary) from employee where dno = param1)
    ->     where dnumber = param1;
    -> end; //
Query OK, 0 rows affected (0.01 sec)

mysql> delimiter ;
```

Step 3: Change the delimiter back to semicolon (;)

Example

```
mysql> call updateSalary(1);
Query OK, 0 rows affected (0.00 sec)

mysql> call updateSalary(2);
Query OK, 1 row affected (0.00 sec)

mysql> call updateSalary(3);
Query OK, 1 row affected (0.00 sec)
```

Step 4: Call the procedure to update the totalsalary for each department

Example

```
mysql> select * from deptsal;
+---------+-------------+
| dnumber | totalsalary |
+---------+-------------+
|       1 |      100000 |
|       2 |       50000 |
|       3 |      130000 |
+---------+-------------+
3 rows in set (0.00 sec)
```

Step 5: Show the updated total salary in the deptsal table

Stored Procedures in MySQL

- Use show procedure status to display the list of stored procedures you have created

```
mysql> show procedure status;
+------+---------------+-----------+---------+---------------------+---------------------+----------
-----+---------+----------------------+----------------------+--------------------+
| Db   | Name          | Type      | Definer | Modified            | Created             | Security_
type | Comment | character_set_client | collation_connection | Database Collation |
+------+---------------+-----------+---------+---------------------+---------------------+----------
-----+---------+----------------------+----------------------+--------------------+
| ptan | updateSalary0 | PROCEDURE | ptan@%  | 2010-03-16 12:21:55 | 2010-03-16 12:21:55 | DEFINER
     |         | latin1               | latin1_swedish_ci    | latin1_swedish_ci  |
+------+---------------+-----------+---------+---------------------+---------------------+----------
-----+---------+----------------------+----------------------+--------------------+
1 row in set (0.02 sec)
```

- Use drop procedure to remove a stored procedure

```
mysql> drop procedure updateSalary;
Query OK, 0 rows affected (0.00 sec)
```

Stored Procedures in MySQL

- You can declare variables in stored procedures
- You can use flow control statements (conditional IF-THEN-ELSE or loops such as WHILE and REPEAT)
- MySQL also supports cursors in stored procedures.
  - A cursor is used to iterate through a set of rows returned by a query so that we can process each individual row.
- To learn more about stored procedures, go to:

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

SQL Triggers

- To monitor a database and take a corrective action when a condition occurs
  - Examples:
    - Charge $10 overdraft fee if the balance of an account after a withdrawal transaction is less than $500
    - Limit the salary increase of an employee to no more than 5% raise

```
CREATE TRIGGER trigger-name
    trigger-time trigger-event
    ON table-name
    FOR EACH ROW
          trigger-action;
```

  - trigger-time ∈ {BEFORE, AFTER}
  - trigger-event ∈ {INSERT,DELETE,UPDATE}

SQL Triggers: An Example

```
mysql> select * from employee;
+----+------+---------+--------+------------+------+
| id | name | superid | salary | bdate      | dno  |
+----+------+---------+--------+------------+------+
|  1 | john |       3 | 100000 | 1960-01-01 |    1 |
|  2 | mary |       3 |  50000 | 1964-12-01 |    3 |
|  3 | bob  |    NULL |  80000 | 1974-02-07 |    3 |
|  4 | tom  |       1 |  50000 | 1970-01-17 |    2 |
|  5 | bill |    NULL |   NULL | 1985-01-20 |    1 |
+----+------+---------+--------+------------+------+
5 rows in set (0.00 sec)

mysql> select * from deptsal;
+---------+-------------+
| dnumber | totalsalary |
+---------+-------------+
|       1 |      100000 |
|       2 |       50000 |
|       3 |      130000 |
+---------+-------------+
3 rows in set (0.00 sec)
```

- We want to create a trigger to update the total salary of a department when a new employee is hired

SQL Triggers: An Example

- Create a trigger to update the total salary of a department when a new employee is hired:

```
mysql> delimiter ¦
mysql> create trigger update_salary
    -> after insert on employee
    -> for each row
    -> begin
    ->       if new.dno is not null then
    ->           update deptsal
    ->           set totalsalary = totalsalary + new.salary
    ->           where dnumber = new.dno;
    ->       end if;
    -> end ¦
Query OK, 0 rows affected (0.06 sec)

mysql> delimiter ;
```

- The keyword “new” refers to the new row inserted

SQL Triggers: An Example

```
mysql> select * from deptsal;
+---------+-------------+
| dnumber | totalsalary |
+---------+-------------+
|       1 |      100000 |
|       2 |       50000 |
|       3 |      130000 |
+---------+-------------+
3 rows in set (0.00 sec)

mysql> insert into employee values (6,'lucy',null,90000,'1981-01-01',1);
Query OK, 1 row affected (0.08 sec)

mysql> select * from deptsal;
+---------+-------------+
| dnumber | totalsalary |
+---------+-------------+
|       1 |      190000 |
|       2 |       50000 |
|       3 |      130000 |
+---------+-------------+
3 rows in set (0.00 sec)

mysql> insert into employee values (7,'george',null,45000,'1971-11-11',null);
Query OK, 1 row affected (0.02 sec)

mysql> select * from deptsal;
+---------+-------------+
| dnumber | totalsalary |
+---------+-------------+
|       1 |      190000 |
|       2 |       50000 |
|       3 |      130000 |
+---------+-------------+
3 rows in set (0.00 sec)

mysql> drop trigger update_salary;
Query OK, 0 rows affected (0.00 sec)
```

totalsalary increases by 90K

totalsalary did not change

SQL Triggers: An Example

- A trigger to update the total salary of a department when an employee tuple is modified:

```
mysql> delimiter !
mysql> create trigger update_salary2
    -> after update on employee
    -> for each row
    -> begin
    ->       if old.dno is not null then
    ->          update deptsal
    ->          set totalsalary = totalsalary - old.salary
    ->          where dnumber = old.dno;
    ->       end if;
    ->       if new.dno is not null then
    ->          update deptsal
    ->          set totalsalary = totalsalary + new.salary
    ->          where dnumber = new.dno;
    ->       end if;
    -> end !
Query OK, 0 rows affected (0.06 sec)
```

SQL Triggers: An Example

```
mysql> delimiter ;
mysql> select * from employee;
+----+--------+---------+--------+------------+------+
| id | name   | superid | salary | bdate      | dno  |
+----+--------+---------+--------+------------+------+
|  1 | john   |       3 | 100000 | 1960-01-01 |    1 |
|  2 | mary   |       3 |  50000 | 1964-12-01 |    3 |
|  3 | bob    |    NULL |  80000 | 1974-02-07 |    3 |
|  4 | tom    |       1 |  50000 | 1970-01-17 |    2 |
|  5 | bill   |    NULL |   NULL | 1985-01-20 |    1 |
|  6 | lucy   |    NULL |  90000 | 1981-01-01 |    1 |
|  7 | george |    NULL |  45000 | 1971-11-11 | NULL |
+----+--------+---------+--------+------------+------+
7 rows in set (0.00 sec)

mysql> select * from deptsal;
+---------+-------------+
| dnumber | totalsalary |
+---------+-------------+
|       1 |      190000 |
|       2 |       50000 |
|       3 |      130000 |
+---------+-------------+
3 rows in set (0.00 sec)

mysql> update employee set salary = 100000 where id = 6;
Query OK, 1 row affected (0.03 sec)
Rows matched: 1  Changed: 1  Warnings: 0

mysql> select * from deptsal;
+---------+-------------+
| dnumber | totalsalary |
+---------+-------------+
|       1 |      200000 |
|       2 |       50000 |
|       3 |      130000 |
+---------+-------------+
3 rows in set (0.00 sec)
```

SQL Triggers: An Example

- A trigger to update the total salary of a department when an employee tuple is deleted:

```
mysql> delimiter !
mysql> create trigger update_salary3
    -> before delete on employee
    -> for each row
    -> begin
    ->       if (old.dno is not null) then
    ->           update deptsal
    ->           set totalsalary = totalsalary - old.salary
    ->           where dnumber = old.dno;
    ->       end if;
    -> end !
Query OK, 0 rows affected (0.08 sec)

mysql> delimiter ;
```

SQL Triggers: An Example

```
mysql> select * from employee;
+----+--------+---------+--------+------------+------+
| id | name   | superid | salary | bdate      | dno  |
+----+--------+---------+--------+------------+------+
|  1 | john   |       3 | 100000 | 1960-01-01 |    1 |
|  2 | mary   |       3 |  50000 | 1964-12-01 |    3 |
|  3 | bob    |    NULL |  80000 | 1974-02-07 |    3 |
|  4 | tom    |       1 |  50000 | 1970-01-17 |    2 |
|  5 | bill   |    NULL |   NULL | 1985-01-20 |    1 |
|  6 | lucy   |    NULL | 100000 | 1981-01-01 |    1 |
|  7 | george |    NULL |  45000 | 1971-11-11 | NULL |
+----+--------+---------+--------+------------+------+
7 rows in set (0.00 sec)
```

```
mysql> select * from deptsal;
+---------+-------------+
| dnumber | totalsalary |
+---------+-------------+
|       1 |      200000 |
|       2 |       50000 |
|       3 |      130000 |
+---------+-------------+
3 rows in set (0.00 sec)
```

```
mysql> delete from employee where id = 6;
Query OK, 1 row affected (0.02 sec)

mysql> delete from employee where id = 7;
Query OK, 1 row affected (0.03 sec)

mysql> select * from deptsal;
+---------+-------------+
| dnumber | totalsalary |
+---------+-------------+
|       1 |      100000 |
|       2 |       50000 |
|       3 |      130000 |
+---------+-------------+
3 rows in set (0.00 sec)
```

SQL Triggers

- To list all the triggers you have created:

```
mysql> show triggers;
```