

Triggers & Stored Procedures (PL/SQL & MySQL)

Content was adapted from the following sources:

- Presentation slides and figures from the course textbook.

- No conditional execution or loop constructs to invoke TRIGGERS
 - Trigger is either fired based on a particular event (e.g., before a tuple is inserted into a particular table or after tuple is inserted)
 - Stored procedures and triggers can use loop and conditional execution (if statements)
- Persistent Storage Module (PSM)
 - A block of code containing SQL statements and procedural extensions
 - Stored and executed on the DB server
- Procedural language SQL (PL/SQL) ... Oracle (MySQL language is similar)
 - Executed as a unit
 - Triggers
 - Stored Procedures
 - PL/SQL functions

- Oracle SQL*Plus ... code block bracketed by BEGIN and END
- Has loops and conditionals
- Data types

Table 8.4 PL/SQL BASIC DATA TYPES	
DATA TYPE	DESCRIPTION
CHAR	Character values of a fixed length; for example: W_ZIP CHAR(5)
VARCHAR2	Variable-length character values; for example: W_FNAME VARCHAR2(15)
NUMBER	Numeric values; for example: W_PRICE NUMBER(6,2)
DATE	Date values; for example: W_EMP_DOB DATE
%TYPE	Inherits the data type from a variable that you declared previously or from an attribute of a database table; for example: W_PRICE PRODUCT.P_PRICE%TYPE Assigns W_PRICE the same data type as the P_PRICE column in the PRODUCT table

- Procedural SQL code automatically invoked by RDBMS when given data manipulation event occurs or when invoked by an application program, or command line
- Parts of a trigger definition
 - Triggering timing: indicates when trigger's PL/SQL code executes
 - Triggering event: statement that causes the trigger to execute
 - Triggering level: statement- and row-level
 - Triggering action: PL/SQL code enclosed between the BEGIN and END keywords
- DROP TRIGGER trigger_name command
 - Deletes a trigger without deleting the table
- Trigger action based on conditional DML predicates
 - Actions depend on the type of DML statement that fires the trigger

SQL Plus

```
SQL> BEGIN
 2      INSERT INTO VENDOR
 3          VALUES (25678, 'Microsoft Corp.', 'Bill Gates', '765', '546-8484', 'WA', 'N');
 4  END;
 5 /
```

PL/SQL procedure successfully completed.

```
SQL> SET SERVEROUTPUT ON
```

```
SQL>
```

```
SQL> BEGIN
```

```
 2      INSERT INTO VENDOR
 3          VALUES (25772, 'Clue Store', 'Issac Hayes', '456', '323-2009', 'VA', 'N');
 4      DBMS_OUTPUT.PUT_LINE('New Vendor Added!');
 5  END;
 6 /
```

New Vendor Added!

PL/SQL procedure successfully completed.

Procedural Block Example ... continue

```
SQL> BEGIN
 2   INSERT INTO VENDOR
 3   VALUES (25772, 'Clue Store', 'Issac Hayes', '456', '323-2009', 'VA', 'N');
 4   DBMS_OUTPUT.PUT_LINE('New Vendor Added!');
 5 END;
 6 /
New Vendor Added!
PL/SQL procedure successfully completed.
```

```
SQL> SELECT * FROM VENDOR;
```

V_CODE	V_NAME	V_CONTACT	V_A	V_PHONE	V_	V
21225	Bryson, Inc.	Smithson	615	223-3234	TN	Y
21226	SuperLoo, Inc.	Flushing	904	215-8995	FL	N
21231	D&E Supply	Singh	615	228-3245	TN	Y
21344	Gomez Bros.	Ortega	615	889-2546	KY	N
22567	Dome Supply	Smith	901	678-1419	GA	N
23119	Randsets Ltd.	Anderson	901	678-3998	GA	Y
24004	Brackman Bros.	Browning	615	228-1410	TN	N
24288	ORDVA, Inc.	Hakford	615	898-1234	TN	Y
25443	B&K, Inc.	Smith	904	227-0093	FL	N
25501	Damal Supplies	Smythe	615	890-3529	TN	N
25595	Rubicon Systems	Orton	904	456-0092	FL	Y
25678	Microsoft Corp.	Bill Gates	765	546-8484	WA	N
25772	Clue Store	Issac Hayes	456	323-2009	VA	N

```
13 rows selected.
```

```
SQL> -
```

```
DECLARE
    W_P1 NUMBER(3) := 0;
    W_P2 NUMBER(3) := 10;
    W_NUM NUMBER(2) := 0;
BEGIN
    WHILE W_P2 < 300 LOOP
        SELECT COUNT(P_CODE) INTO W_NUM
        FROM PRODUCT
        WHERE P_PRICE BETWEEN W_P1 AND W_P2;
        DBMS_OUTPUT.PUT_LINE('There are ' || W_NUM || ' Products with price between ' || W_P1 || ' and ' || W_P2);
        W_P1 := W_P2 + 1;
        W_P2 := W_P2 + 50;
    END LOOP;
END;
/
```

SQL Plus

```
SQL> DECLARE
  2  W_P1  NUMBER(3)  := 0;
  3  W_P2  NUMBER(3)  := 10;
  4  W_NUM NUMBER(2)  := 0;
  5  BEGIN
  6  WHILE W_P2 < 300 LOOP
  7    SELECT COUNT(P_CODE) INTO W_NUM FROM PRODUCT
  8    WHERE P_PRICE BETWEEN W_P1 AND W_P2;
  9    DBMS_OUTPUT.PUT_LINE('There are ' || W_NUM || ' Products with price between ' || W_P1 || ' and ' || W_
10    W_P1 := W_P2 + 1;
11    W_P2 := W_P2 + 50;
12  END LOOP;
13  END;
14 /
```

```
There are 5 Products with price between 0 and 10
There are 6 Products with price between 11 and 60
There are 3 Products with price between 61 and 110
There are 1 Products with price between 111 and 160
There are 0 Products with price between 161 and 210
There are 1 Products with price between 211 and 260
```

```
PL/SQL procedure successfully completed.
```

```
SQL> -
```

WHILE condition LOOP

PL/SQL statements;

END LOOP

- SELECT statement uses the INTO keyword to assign query output to a PL/SQL variable.
- If the SELECT statement returns more than one value, you will get an error.
- Note the use of the string concatenation symbol (||) to display the output.

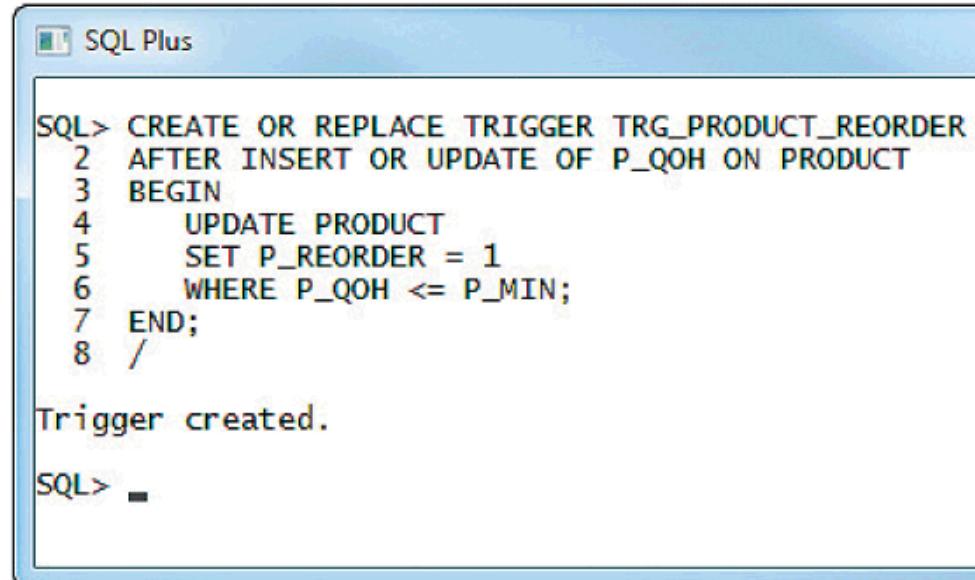
- Trigger is procedural SQL code that is automatically invoked by the RDBMS upon the occurrence of a given data manipulation event.
- A trigger is invoked before or after a data row is inserted, updated, or deleted.
- A trigger is associated with a database table.
- Each database table may have one or more triggers.
- A trigger is executed as part of the transaction that triggered it.
- Triggers are critical to proper database operation and management.
 - Triggers can be used to enforce constraints that cannot be enforced at the DBMS design level
 - Enforcement of referential integrity or to support application constraints
 - Integrity of quantities for inventory control

- Trigger in Oracle:

```
CREATE OR REPLACE TRIGGER trigger_name
[BEFORE / AFTER] [DELETE / INSERT / UPDATE OF column_name] ON

[FOR EACH ROW]
[DECLARE] [variable_name data_type[:=initial_value] ]
BEGIN
    PL/SQL instructions; ...
END;
```

- Triggering timing: BEFORE or AFTER
- Triggering event:
 - The statement that causes the trigger to execute (INSERT, UPDATE, or DELETE)
- Row-level trigger requires use of the FOR EACH ROW keywords.
 - MySQL has only FOR EACH ROW triggers (i.e., the phrase "FOR EACH ROW" must be present.
- Trigger action: The PL/SQL code enclosed between the BEGIN and END



```
SQL> CREATE OR REPLACE TRIGGER TRG_PRODUCT_REORDER
2  AFTER INSERT OR UPDATE OF P_QOH ON PRODUCT
3  BEGIN
4      UPDATE PRODUCT
5      SET P_reordered = 1
6      WHERE P_QOH <= P_Min;
7  END;
8 /

Trigger created.

SQL> -
```



```
DELIMITER $$  
CREATE TRIGGER TRG_PRODUCT_REORDER  
AFTER INSERT ON line  
FOR EACH ROW  
BEGIN  
    UPDATE PRODUCT  
    SET P_REORDER = 1  
    WHERE P_QOH <= P_MIN;  
END; $$  
DELIMITER ;  
Show triggers;
```

Note that DELIMITER statement is used to temporarily alter the delimiter from “;” to say “\$\$” so that the whole procedure would be “processed” by the DB Server.

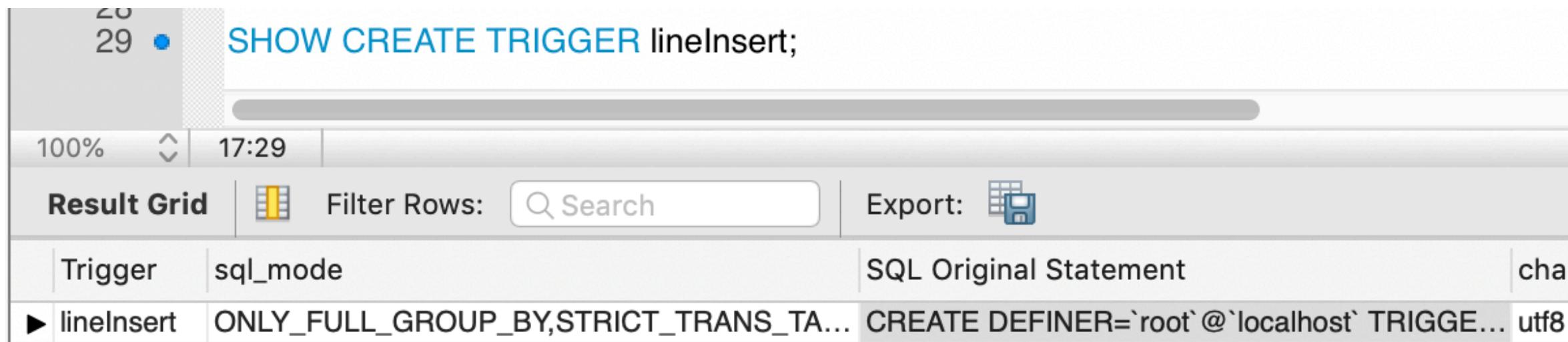
```
54  
95 • DELIMITER $$  
96 CREATE TRIGGER AFTER_INSERT_LINE  
97 AFTER INSERT on line  
98 FOR EACH ROW  
99 BEGIN  
100 UPDATE PRODUCT  
101 SET P_REORDER = 1  
102 WHERE P_QOH <= P_MIN;  
103 END; $$  
104  
105 DELIMITER ;  
106 • Show triggers;  
107  
108
```

100% 15:106

Result Grid | Filter Rows: Export:

Trigger	Event	Table	Statement			Timing
lineInsert	INSERT	LINE	BEGIN	UPDATE invoice	SET inv_amo...	AFTER
AFTER_INSERT_LI...	INSERT	LINE	BEGIN	UPDATE	PRODUCT	SE... AFTER
lineDelete	DELETE	LINE	BEGIN	UPDATE invoice	SET inv_amo...	AFTER

- show triggers; ... to list triggers
- drop trigger linelnsert; ... delete trigger w name linelnsert
- To alter/modify a trigger ... delete it and then create a new one
- SHOW CREATE TRIGGER linelnsert; ... to show the create statement for a trigger



29 • SHOW CREATE TRIGGER linelnsert;

100% 17:29

Result Grid Filter Rows: Search Export:

Trigger	sql_mode	SQL Original Statement	char
► linelnsert	ONLY_FULL_GROUP_BY,STRICT_TRANS_T...	CREATE DEFINER='root'@'localhost' TRIGGE...	utf8

SQL Plus

```
SQL> SELECT P_CODE, P_DESCRIP, P_QOH, P_MIN, P_MIN_ORDER, P_REORDER
  2  FROM PRODUCT
  3 WHERE P_CODE = '11QER/31';
```

P_CODE	P_DESCRIP	P_QOH	P_MIN	P_MIN_ORDER	P_REORDER
11QER/31	Power painter, 15 psi., 3-nozzle	8	5	25	0

```
SQL> UPDATE PRODUCT
  2  SET P_QOH = 4
  3 WHERE P_CODE = '11QER/31';
```

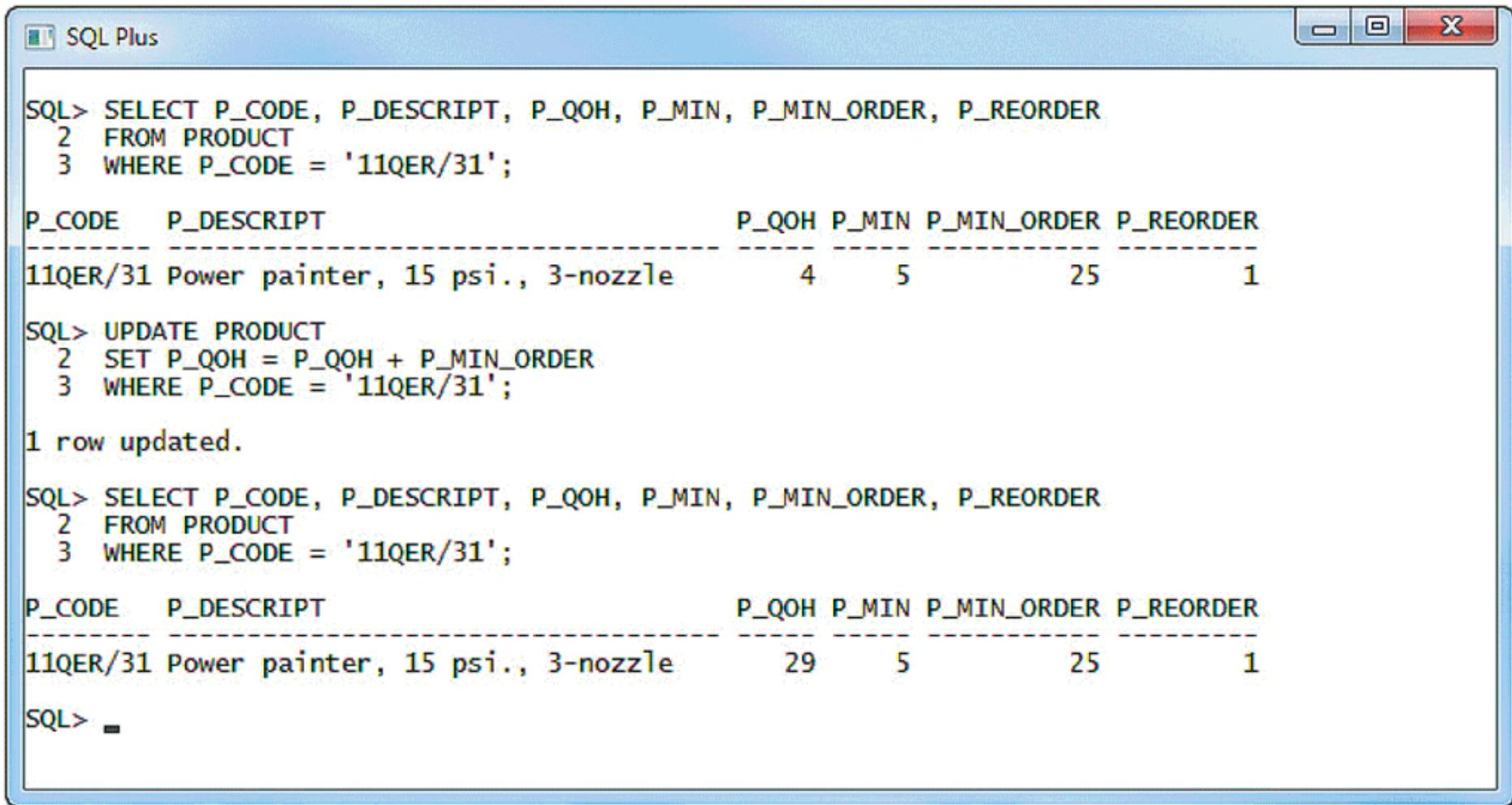
1 row updated.

```
SQL> SELECT P_CODE, P_DESCRIP, P_QOH, P_MIN, P_MIN_ORDER, P_REORDER
  2  FROM PRODUCT
  3 WHERE P_CODE = '11QER/31';
```

P_CODE	P_DESCRIP	P_QOH	P_MIN	P_MIN_ORDER	P_REORDER
11QER/31	Power painter, 15 psi., 3-nozzle	4	5	25	1

```
SQL> _
```

- Update quantity on hand ... but P_REORDER is still = 1



```
SQL> SELECT P_CODE, P_DESCRIP, P_QOH, P_MIN, P_MIN_ORDER, P_REORDER
  2  FROM PRODUCT
  3 WHERE P_CODE = '11QER/31';

P_CODE      P_DESCRIP          P_QOH  P_MIN  P_MIN_ORDER  P_REORDER
-----  -----
11QER/31  Power painter, 15 psi., 3-nozzle        4      5        25      1

SQL> UPDATE PRODUCT
  2  SET P_QOH = P_QOH + P_MIN_ORDER
  3 WHERE P_CODE = '11QER/31';

1 row updated.

SQL> SELECT P_CODE, P_DESCRIP, P_QOH, P_MIN, P_MIN_ORDER, P_REORDER
  2  FROM PRODUCT
  3 WHERE P_CODE = '11QER/31';

P_CODE      P_DESCRIP          P_QOH  P_MIN  P_MIN_ORDER  P_REORDER
-----  -----
11QER/31  Power painter, 15 psi., 3-nozzle        29     5        25      1

SQL> -
```

- Triggers can refer to “new” and “old” values. An “old” value cannot be changed.
 - Old and new values ... due to manipulating DB values in memory ... Stored in a DB

```
110  
111  
112 • DELIMITER $$  
113 CREATE TRIGGER BEFORE_INSERT_LINE  
114 BEFORE INSERT ON PRODUCT  
115 FOR EACH ROW  
116 BEGIN  
117     IF NEW.P_QOH <= NEW.P_MIN THEN  
118         SET NEW.P_REORDER := 1;  
119     ELSE  
120         SET NEW.P_REORDER := 0;  
121     END IF;  
122 END; $$  
123  
124 • DELIMITER ;  
125 Show triggers;  
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```
SQL> CREATE OR REPLACE TRIGGER TRG_PRODUCT_REORDER
  2  BEFORE INSERT OR UPDATE OF P_QOH, P_MIN ON PRODUCT
  3  FOR EACH ROW
  4  BEGIN
  5      IF :NEW.P_QOH <= :NEW.P_MIN THEN
  6          :NEW.P_REORDER := 1;
  7      ELSE
  8          :NEW.P_REORDER := 0;
  9      END IF;
 10 END;
 11 /
```

Trigger created.

```
SQL> -
```

Triggers ... continued

- Trigger to update the product quantity on hand

```

127
128 • DELIMITER $$ 
129 • CREATE TRIGGER BEFORE_INSERT_LINE
130 BEFORE INSERT ON LINE
131 FOR EACH ROW
132 BEGIN
133 UPDATE PRODUCT
134 SET P_QOH = P_QOH + NEW.LINE_UNITS
135 WHERE PRODUCT.P_CODE007 = NEW.P_CODE;
136 END; $$ 
137
138 • DELIMITER ;
139 • Show triggers;

100% 11:139
Result Grid | Filter Rows:  Search | Export: 

| Trigger             | Event  | Table   | Statement | Timing  | Created         |
|---------------------|--------|---------|-----------|---------|-----------------|
| lineInsert          | INSERT | LINE    | BEGIN...  | AFTER   | 2019-03-16 12:1 |
| AFTER_INSERT_LINE   | INSERT | LINE    | BEGIN...  | AFTER   | 2019-03-16 12:4 |
| lineDelete          | DELETE | LINE    | BEGIN...  | AFTER   | 2019-03-16 12:1 |
| BEFORE_INSERT_LI... | INSERT | PRODUCT | BEGIN...  | BEFO... | 2019-03-16 13:2 |


```

SQL Plus

```

SQL> CREATE OR REPLACE TRIGGER TRG_LINE_PROD
  2 AFTER INSERT ON LINE
  3 FOR EACH ROW
  4 BEGIN
  5   UPDATE PRODUCT
  6   SET P_QOH = P_QOH - :NEW.LINE_UNITS
  7   WHERE PRODUCT.P_CODE = :NEW.P_CODE;
  8 END;
  9 /

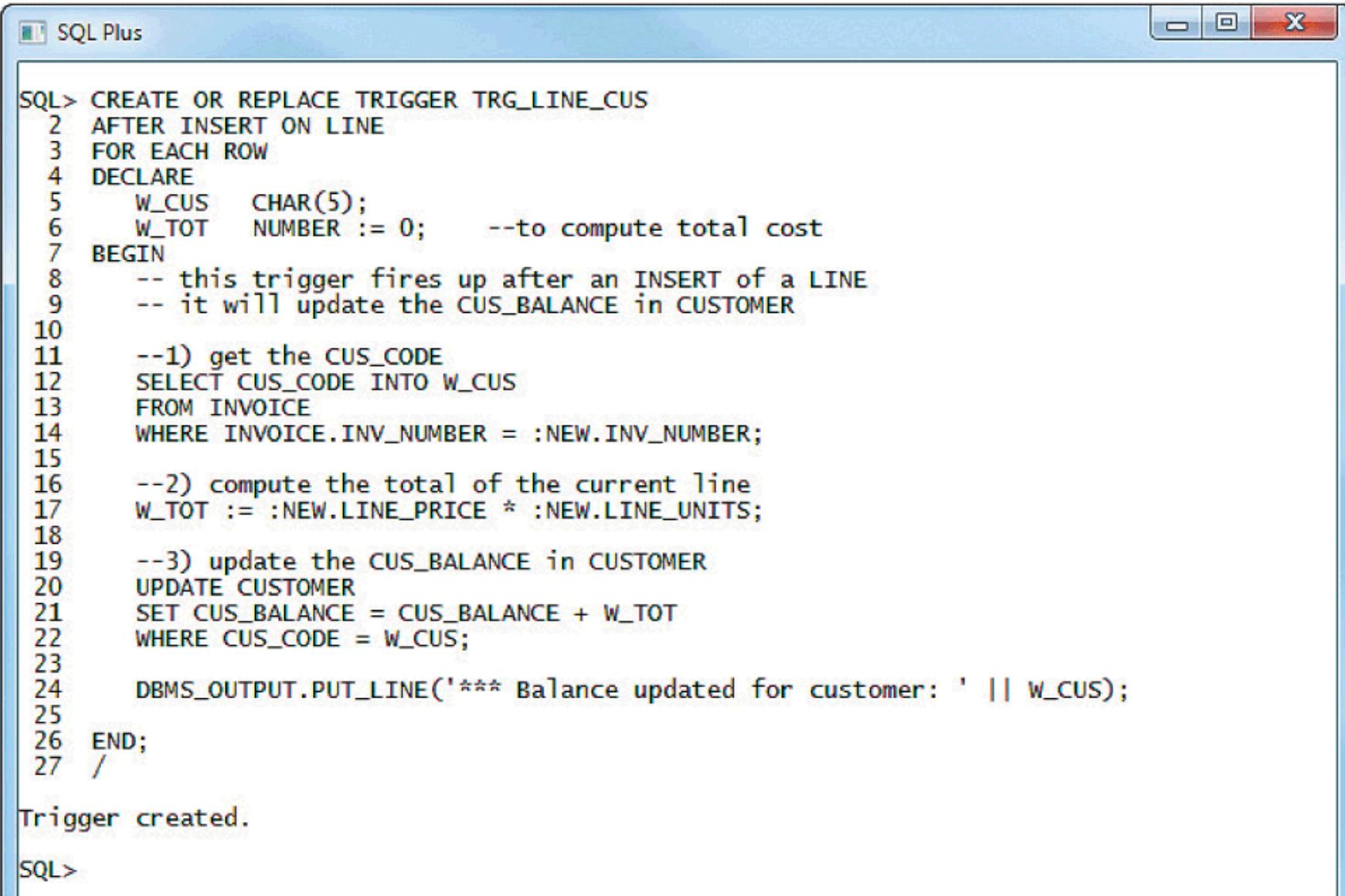
```

Trigger created.

SQL> ■

Triggers ... continued

- Trigger to update the customer balance (CUS_BALANCE in CUSTOMER TABLE)



```
SQL> CREATE OR REPLACE TRIGGER TRG_LINE_CUS
  2  AFTER INSERT ON LINE
  3  FOR EACH ROW
  4  DECLARE
  5      W_CUS    CHAR(5);
  6      W_TOT    NUMBER := 0;      --to compute total cost
  7  BEGIN
  8      -- this trigger fires up after an INSERT of a LINE
  9      -- it will update the CUS_BALANCE in CUSTOMER
 10
 11      --1) get the CUS_CODE
 12      SELECT CUS_CODE INTO W_CUS
 13      FROM INVOICE
 14      WHERE INVOICE.INV_NUMBER = :NEW.INV_NUMBER;
 15
 16      --2) compute the total of the current line
 17      W_TOT := :NEW.LINE_PRICE * :NEW.LINE_UNITS;
 18
 19      --3) update the CUS_BALANCE in CUSTOMER
 20      UPDATE CUSTOMER
 21      SET CUS_BALANCE = CUS_BALANCE + W_TOT
 22      WHERE CUS_CODE = W_CUS;
 23
 24      DBMS_OUTPUT.PUT_LINE('*** Balance updated for customer: ' || W_CUS);
 25
 26  END;
 27 /
```

Trigger created.

Triggers ... continued

- SAME with MySQL Trigger to update the customer balance (CUS_BALANCE in CUSTOMER TABLE)

```

155
156
157 • DELIMITER $$ CREATE TRIGGER AFTER3_INSERT_LINE
158 AFTER INSERT ON LINE FOR EACH ROW
159 BEGIN
160 •     DECLARE W_CUS CHAR(4);
161     DECLARE W_TOT DECIMAL(6,2);
162     SELECT CUS_CODE INTO W_CUS
163     FROM INVOICE
164     WHERE INVOICE.INV_NUMBER007 = NEW.INV_NUMBER007;
165     SET W_TOT = NEW.LINE_UNITS * NEW.LINE_PRICE;
166     UPDATE CUSTOMER
167     SET CUS_BALANCE = W_TOT
168     WHERE CUS.CUS_CODE007 = W_CUS;
169
170 END; $$

171
172 • DELIMITER ;
173 • Show triggers;

```

100% 15:173

Trigger	Event	Table	Statement	Timing	Created
lineInsert	INSERT	LINE	BEGIN...	AFTER	2019-03-16 12:15:30.40
AFTER_INSERT_LINE	INSERT	LINE	BEGIN...	AFTER	2019-03-16 12:45:39.97
AFTER2_INSERT_LI...	INSERT	LINE	BEGIN...	AFTER	2019-03-16 13:47:47.94
AFTER3_INSERT_LI...	INSERT	LINE	BEGIN...	AFTER	2019-03-16 14:00:47.12
lineDelete	DELETE	LINE	BEGIN...	AFTER	2019-03-16 12:12:40.33
BEFORE_INSERT_LI...	INSERT	PRODUCT	BEGIN...	BEFO...	2019-03-16 13:24:32.42

- References to tutorials on triggers in MySQL
 - <http://www.mysqltutorial.org/mysql-trigger-implementation.aspx>
 - <http://www.mysqltutorial.org/mysql-triggers.aspx>

<https://www.w3resource.com/mysql/mysql-triggers.php>

- MySQL documentation on triggers
 - <https://dev.mysql.com/doc/refman/5.5/en/trigger-syntax.html>

- Stored in a DB
- Represent business logic
- Benefits
 - Reduce traffic
 - Avoid code duplication
- Syntax

```
CREATE OR REPLACE PROCEDURE procedure_name [(argument  
[IN/OUT] data-type, ... )]
```

```
[IS/AS]
```

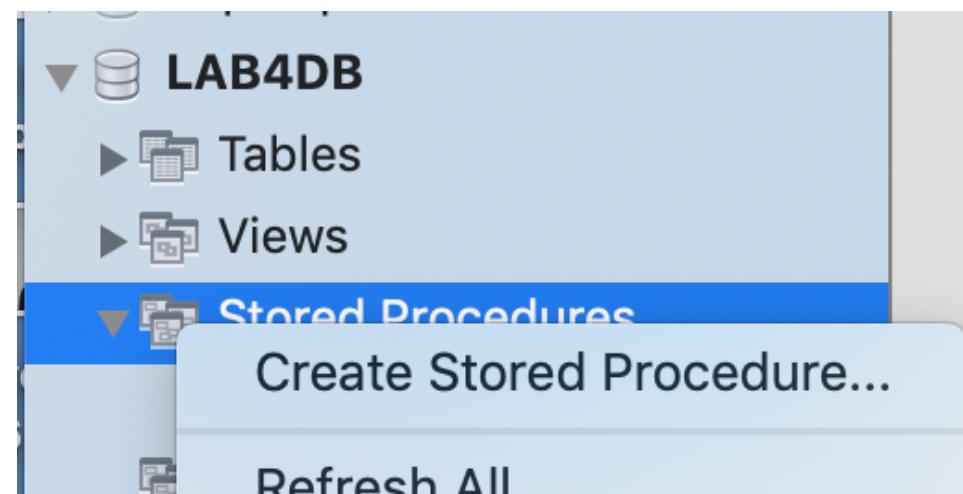
```
[variable_name data type[:initial_value] ]
```

```
BEGIN
```

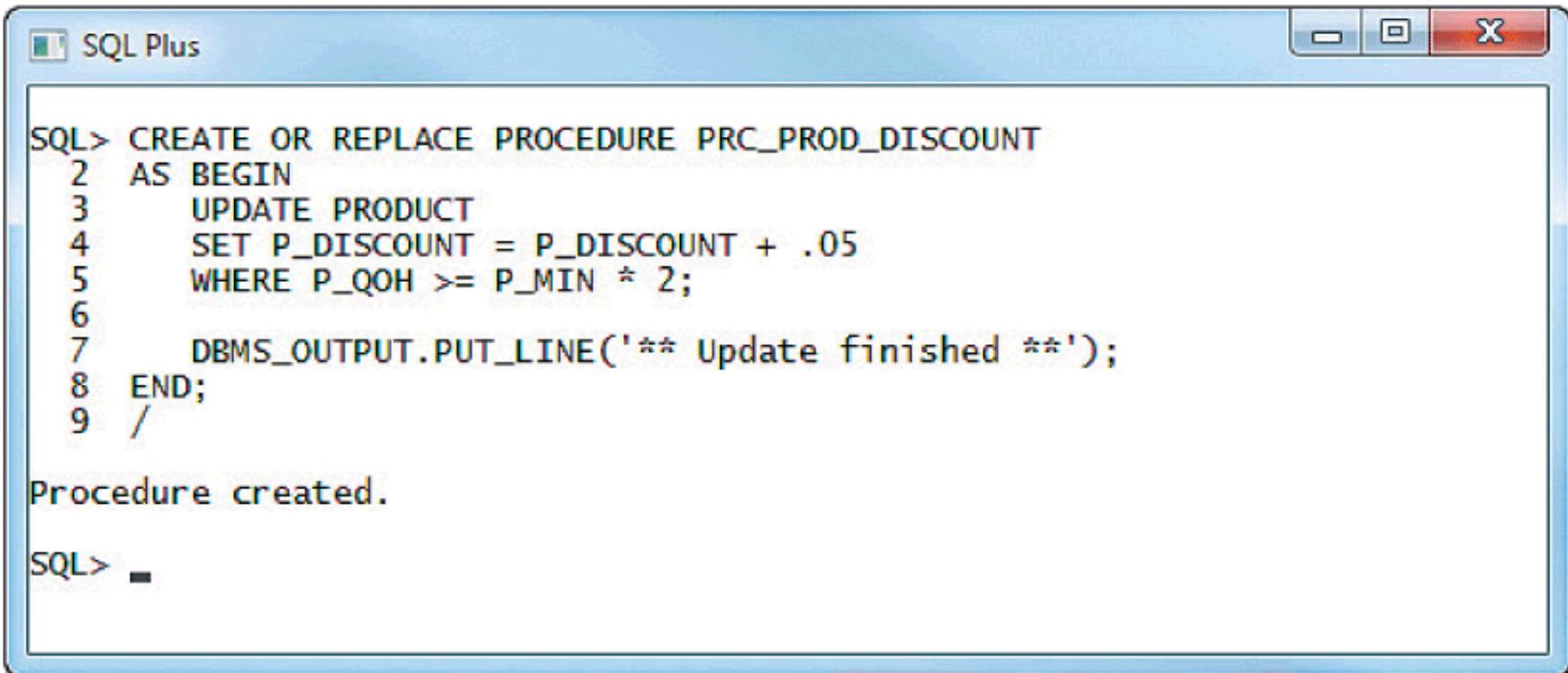
```
PL/SQL or SQL statements; ...
```

```
END;
```

To create a procedure in MySQL
you may also right click on “Stored
Procedures”



- Example: Assign an additional 5 percent discount for all products when the quantity on hand is more than or equal to twice the minimum quantity



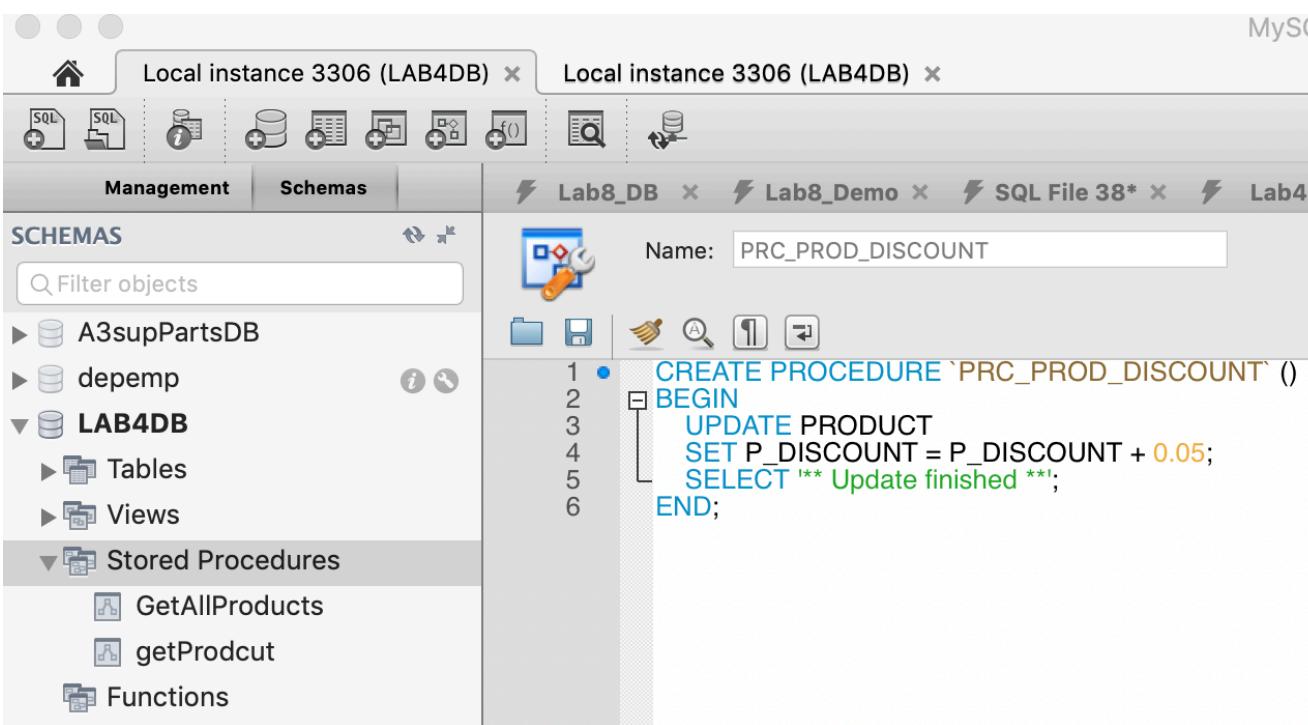
```
SQL> CREATE OR REPLACE PROCEDURE PRC_PROD_DISCOUNT
  2  AS BEGIN
  3    UPDATE PRODUCT
  4    SET P_DISCOUNT = P_DISCOUNT + .05
  5    WHERE P_QOH >= P_MIN * 2;
  6
  7    DBMS_OUTPUT.PUT_LINE('** Update finished **');
  8  END;
  9 /
```

Procedure created.

SQL> -

- Same example in MySQL: Assign an additional 5 percent discount for all products when the quantity on hand is more than or equal to twice the minimum quantity.

Right Click on Stored Procedures to code

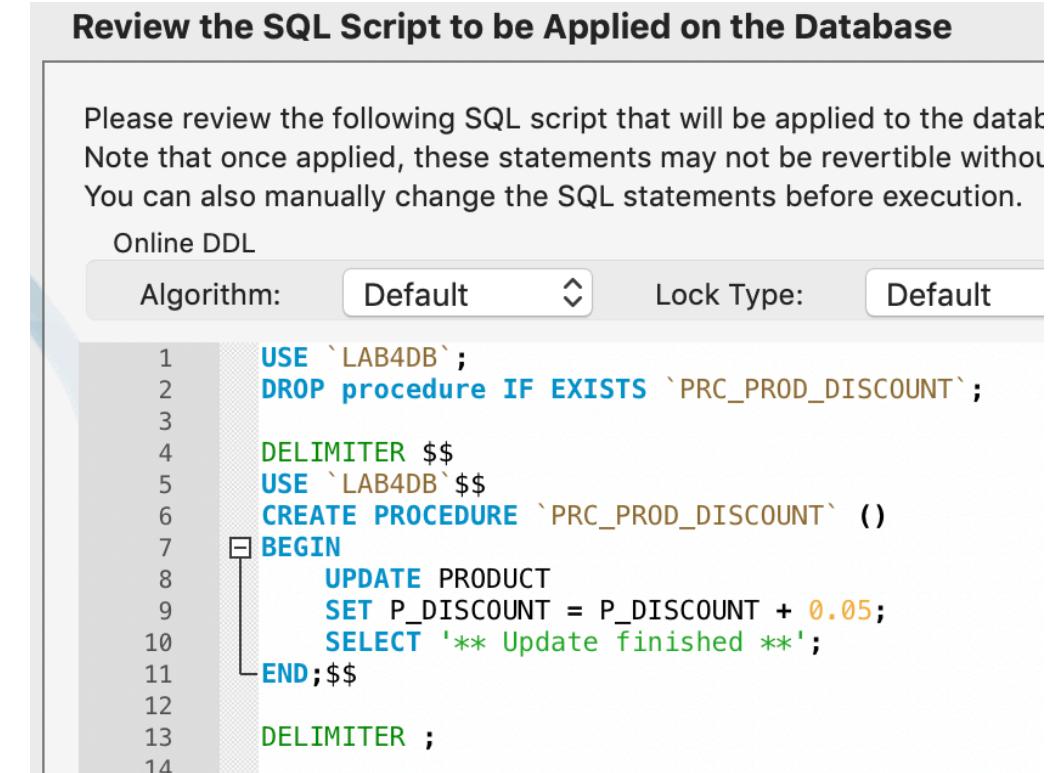


The screenshot shows the MySQL Workbench interface. In the top navigation bar, there are two tabs: "Local instance 3306 (LAB4DB)" and "Lab8_DB". Below the tabs, there are buttons for Management, Schemas, and other database operations. On the left, the "SCHEMAS" panel lists several databases, with "LAB4DB" expanded to show "Tables", "Views", and "Stored Procedures". Under "Stored Procedures", there are three entries: "GetAllProducts", "getProdct", and "Functions". The main workspace displays the SQL code for creating the stored procedure:

```

CREATE PROCEDURE `PRC_PROD_DISCOUNT`()
BEGIN
    UPDATE PRODUCT
    SET P_DISCOUNT = P_DISCOUNT + 0.05;
    SELECT ** Update finished **;
END;
  
```

After clicking on Apply button



The screenshot shows the "Review the SQL Script to be Applied on the Database" dialog. It contains a message asking the user to review the SQL script before applying it. The script is displayed in a code editor with line numbers from 1 to 14. The "Online DDL" section includes dropdowns for "Algorithm: Default" and "Lock Type: Default".

```

1 USE `LAB4DB`;
2 DROP procedure IF EXISTS `PRC_PROD_DISCOUNT`;
3
4
5
6
7
8
9
10
11
12
13
14
  
```

The SQL script itself is:

```

USE `LAB4DB`;
DROP procedure IF EXISTS `PRC_PROD_DISCOUNT`;

DELIMITER $$
USE `LAB4DB`$$
CREATE PROCEDURE `PRC_PROD_DISCOUNT`()
BEGIN
    UPDATE PRODUCT
    SET P_DISCOUNT = P_DISCOUNT + 0.05;
    SELECT '** Update finished **';
END;$$

DELIMITER ;
  
```

- To list stored procedures:
 - <http://www.mysqltutorial.org/listing-stored-procedures-in-mysql-database.aspx>
 - Use: SHOW PROCEDURE STATUS [LIKE 'pattern' | WHERE expr];
 - SHOW PROCEDURE STATUS; ... to list all store procedures
 - SHOW PROCEDURE STATUS WHERE db = 'LAB4DB'; ... to list procedures in a DB schema
 - SHOW PROCEDURE STATUS WHERE name LIKE '%product%'; ... to list procedures with pattern in names
 - SHOW CREATE PROCEDURE getProduct; ... to display procedure's code

Stored Procedures - Example

To call a procedure in MySQL

```
17 • SHOW PROCEDURE STATUS WHERE name LIKE '%product%';
18
19 • SHOW CREATE PROCEDURE getProdcut;
20
21 • CALL GetAllProducts();
22 • CALL getProdcut('13-Q2/P2');
```

00% 32:22

Result Grid | Filter Rows: Search | Export:

P_CODE	P_DESCRIPTOR	P_INDATE	P_QOH	P_MIN	P_PRICE	P_DISCOUNT
13-Q2/P2	7.25-in. pwr. saw blade	2015-12-13 00:00:00	32	40	14.99	0.05

To call a procedure in MySQL

SQL Plus

```
SQL> SELECT P_CODE, P_DESCRIPTOR, P_QOH, P_MIN, P_DISCOUNT FROM PRODUCT;
```

P_CODE	P_DESCRIPTOR	P_QOH	P_MIN	P_DISCOUNT
11QER/31	Power painter, 15 psi., 3-nozzle	29	5	0.00
13-Q2/P2	7.25-in. pwr. saw blade	32	15	0.05
14-Q1/L3	9.00-in. pwr. saw blade	18	12	0.00
1546-QQ2	Hrd. cloth, 1/4-in., 2x50	15	8	0.00
1558-QW1	Hrd. cloth, 1/2-in., 3x50	23	5	0.00
2232/QTY	B&D jigsaw, 12-in. blade	8	5	0.05
2232/QWE	B&D jigsaw, 8-in. blade	6	7	0.05
2238/QPD	B&D cordless drill, 1/2-in.	12	5	0.05
23109-HB	Claw hammer	23	10	0.10
23114-AA	Sledge hammer, 12 lb.	8	10	0.05
54778-2T	Rat-tail file, 1/8-in. fine	43	20	0.00
89-WRE-Q	Hicut chain saw, 16 in.	11	5	0.05
PVC23DRT	PVC pipe, 3.5-in., 8-ft	188	75	0.00
SM-18277	1.25-in. metal screw, 25	172	75	0.00
SW-23116	2.5-in. wd. screw, 50	237	100	0.00
WR3/TT3	Steel matting, 4'x8'x1/6", .5" mesh	18	5	0.10

16 rows selected.

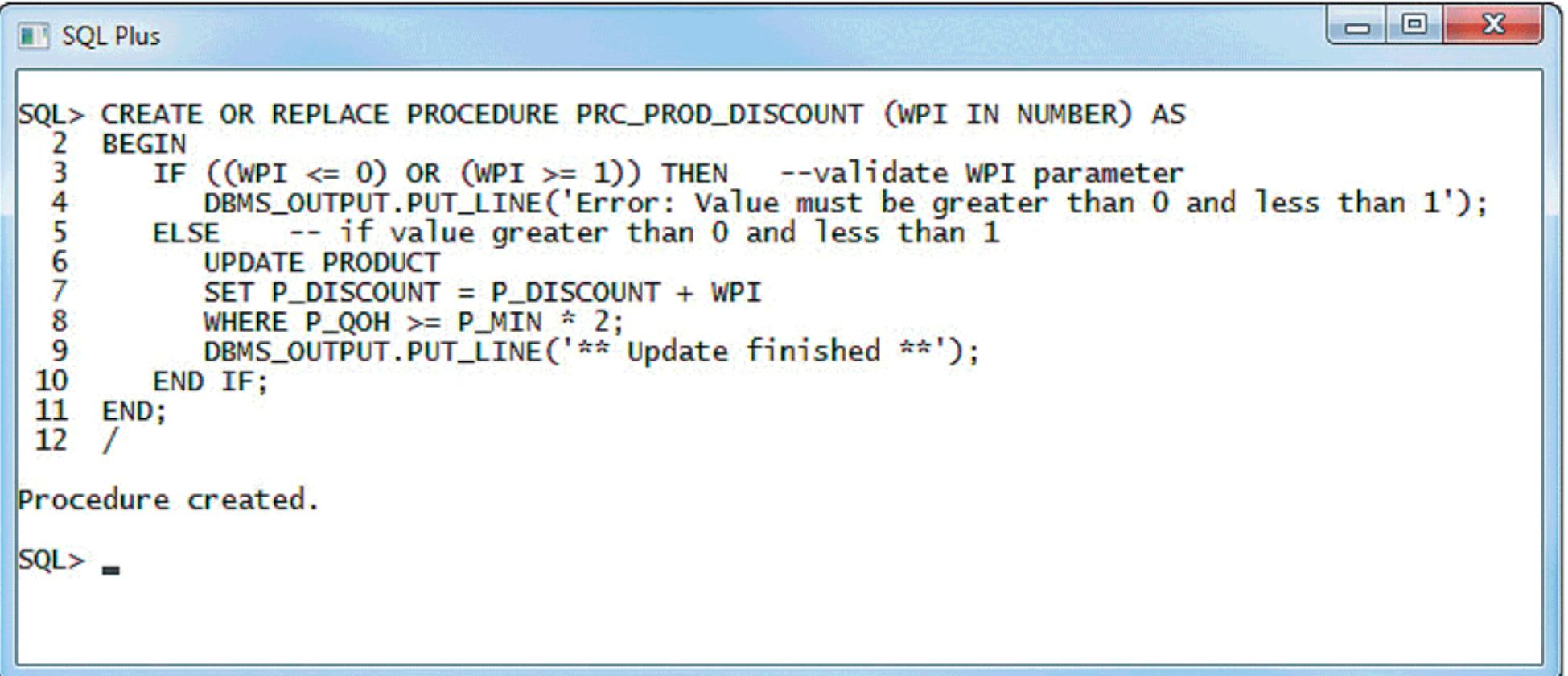
```
SQL> EXEC PRC_PROD_DISCOUNT;
** Update finished **
```

PL/SQL procedure successfully completed.

```
SQL> SELECT P_CODE, P_DESCRIPTOR, P_QOH, P_MIN, P_DISCOUNT FROM PRODUCT;
```

P_CODE	P_DESCRIPTOR	P_QOH	P_MIN	P_DISCOUNT
11QER/31	Power painter, 15 psi., 3-nozzle	29	5	0.05
13-Q2/P2	7.25-in. pwr. saw blade	32	15	0.10
14-Q1/L3	9.00-in. pwr. saw blade	18	12	0.00
1546-QQ2	Hrd. cloth, 1/4-in., 2x50	15	8	0.00

- Same example, but the discount is passed as a parameter



The screenshot shows a Windows-style window titled "SQL Plus". Inside, SQL code is being entered to create a stored procedure named PRC_PROD_DISCOUNT. The procedure takes a parameter WPI (NUMBER) and performs validation (WPI must be between 0 and 1). If valid, it updates the PRODUCT table by adding WPI to P_DISCOUNT where P_QOH is greater than or equal to P_MIN * 2. A success message is output. The code is as follows:

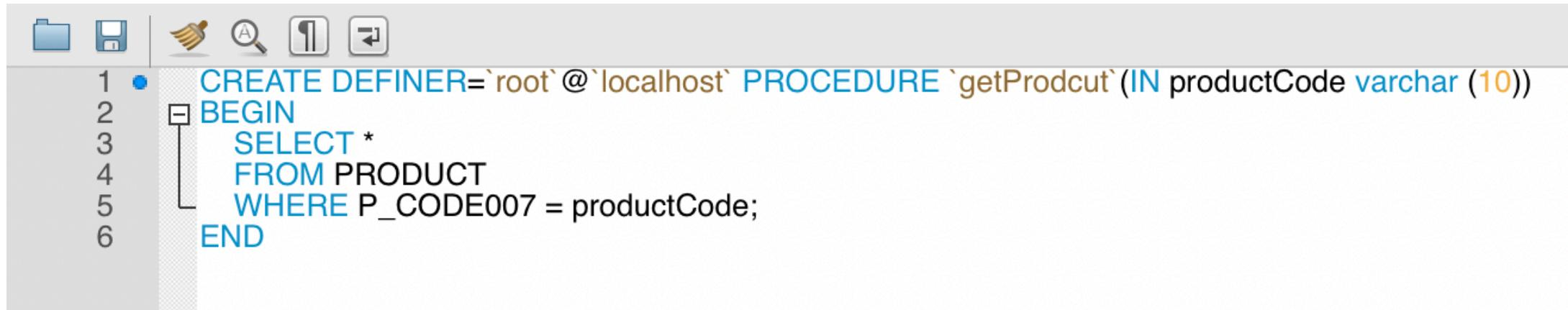
```
SQL> CREATE OR REPLACE PROCEDURE PRC_PROD_DISCOUNT (WPI IN NUMBER) AS
 2 BEGIN
 3   IF ((WPI <= 0) OR (WPI >= 1)) THEN    --validate WPI parameter
 4     DBMS_OUTPUT.PUT_LINE('Error: Value must be greater than 0 and less than 1');
 5   ELSE    -- if value greater than 0 and less than 1
 6     UPDATE PRODUCT
 7     SET P_DISCOUNT = P_DISCOUNT + WPI
 8     WHERE P_QOH >= P_MIN * 2;
 9     DBMS_OUTPUT.PUT_LINE('** Update finished **');
10   END IF;
11 END;
12 /
```

Procedure created.

SQL> =

Stored Procedures – Example with Parameter in MySQL

- Same example, but the discount is passed as a parameter – in MySQL



```
CREATE DEFINER=`root`@`localhost` PROCEDURE `getProdcut` (IN productCode varchar (10))
BEGIN
    SELECT *
    FROM PRODUCT
    WHERE P_CODE007 = productCode;
END
```

```
SHOW PROCEDURE STATUS WHERE name LIKE '%product%';
SHOW CREATE PROCEDURE getProdcut;
CALL GetAllProducts();
CALL getProdcut ('13-Q2/P2');
```

- Triggers can call stored procedures --MySQL Examples
- Example: Procedure to update reorder status invoked by triggers

Procedure

```
1 • CREATE DEFINER=`root`@`localhost` PROCEDURE `updateReorder`(P_CODE_IN varchar(10))
2   BEGIN
3     DECLARE W_QOH    int;
4     DECLARE W_MIN    int;
5
6     SELECT P_QOH INTO W_QOH
7     FROM   PRODUCT
8     WHERE  P_CODE007 = P_CODE_IN;
9
10    SELECT P_MIN INTO W_MIN
11    FROM   PRODUCT
12    WHERE  P_CODE007 = P_CODE_IN;
13
14    IF (W_QOH < W_MIN) THEN
15      UPDATE PRODUCT
16      SET   P_REORDER = 1
17      WHERE  PRODUCT.P_CODE007 = P_CODE_IN;
18    ELSE
19      UPDATE PRODUCT
20      SET   P_REORDER = 0
21      WHERE  PRODUCT.P_CODE007 = P_CODE_IN;
22    END IF;
23  END
```

- Procedure to update reorder status invoked by triggers

- The procedure should also update QOH in product by the difference in update (using NEW.LINE_UNITS and OLD.LINE_UNITS)

```
CREATE ` PROCEDURE `updateReorder`(P_CODE_IN varchar(10))
```

```
BEGIN
```

```
    DECLARE W_QOH          int;
    DECLARE W_MIN          int;
```

```
    SELECT P_QOH INTO W_QOH
    FROM   PRODUCT
    WHERE  P_CODE007 = P_CODE_IN;
```

```
    SELECT P_MIN INTO W_MIN
    FROM   PRODUCT
    WHERE  P_CODE007 = P_CODE_IN;
```

```
    IF (W_QOH < W_MIN) THEN
        UPDATE   PRODUCT
        SET           P_REORDER = 1
        WHERE      PRODUCT.P_CODE007 = P_CODE_IN;
```

```
    ELSE
        UPDATE   PRODUCT
        SET           P_REORDER = 0
        WHERE      PRODUCT.P_CODE007 = P_CODE_IN;
```

```
END IF;
```

```
END
```

```
1 • CREATE DEFINER='root'@'localhost' PROCEDURE `updateReorder`(P_CODE_IN
2 BEGIN
3     DECLARE W_QOH          int;
4     DECLARE W_MIN          int;
5
6     SELECT P_QOH INTO W_QOH
7     FROM   PRODUCT
8     WHERE  P_CODE007 = P_CODE_IN;
9
10    SELECT P_MIN INTO W_MIN
11    FROM   PRODUCT
12    WHERE  P_CODE007 = P_CODE_IN;
13
14    IF (W_QOH < W_MIN) THEN
15        UPDATE   PRODUCT
16        SET           P_REORDER = 1
17        WHERE      PRODUCT.P_CODE007 = P_CODE_IN;
18    ELSE
19        UPDATE   PRODUCT
20        SET           P_REORDER = 0
21        WHERE      PRODUCT.P_CODE007 = P_CODE_IN;
22    END IF;
23 END
```

After Insert on Line Trigger to update reorder

```

33
34 • DELIMITER $$ 
35 CREATE TRIGGER after_line_insert
36   AFTER INSERT ON line
37   FOR EACH ROW
38 BEGIN
39   DECLARE W_PRODUCT_CODE varchar (10);
40   SET W_PRODUCT_CODE = NEW.P_CODE;
41   CALL updateReorder (W_PRODUCT_CODE);
42 END$$
43 DELIMITER ;
44
45 • show triggers;

```

0% 15:45

result Grid Filter Rows: Search Edit: Export/Import:

P_CODE	P_DESCRPT	P_INDATE	P_QOH	P_MIN	P_PRICE	P_DISCOUNT	V_CODE	P_REORDER
007	7.25-in. pwr. saw blade	2015-12-13 00:00:00	32	40	14.99	0.05	21344	1
NUL	NUL	NUL	NUL	NUL	NUL	NUL	NUL	NUL

```

DELIMITER $$

CREATE TRIGGER after_line_insert
AFTER INSERT ON line
FOR EACH ROW
BEGIN
  DECLARE W_PRODUCT_CODE varchar (10);
  SET W_PRODUCT_CODE = NEW.P_CODE;
  CALL updateReorder (W_PRODUCT_CODE);
END$$
DELIMITER ;

show triggers;

```

After Update on Line Trigger to update reorder

```

46
47   DELIMITER $$*
48 • CREATE TRIGGER after_line_update
49     AFTER UPDATE ON line
50       FOR EACH ROW
51   BEGIN
52     DECLARE W_PRODUCT_CODE varchar (10);
53     SET W_PRODUCT_CODE = NEW.P_CODE;
54     CALL updateReorder (W_PRODUCT_CODE);
55   END$$
56
57   DELIMITER ;
58 • show triggers;

```

result Grid | Filter Rows: Search | Export:

Trigger	Event	Table	Statement	Timing	Create
after_line_insert	INSERT	LINE	BEGIN...	AFTER	2019-0
after_line_update	UPDATE	LINE	BEGIN...	AFTER	2019-0

```

DELIMITER $$*
CREATE TRIGGER after_line_update
  AFTER update ON line
  FOR EACH ROW
BEGIN
  DECLARE W_PRODUCT_CODE varchar (10);
  SET W_PRODUCT_CODE = NEW.P_CODE;
  CALL updateReorder (W_PRODUCT_CODE);
END$$
DELIMITER ;
show triggers;

```

- References to tutorials for stored procedures in MySQL
 - <http://www.mysqltutorial.org/mysql-stored-procedure-tutorial.aspx>
 - <http://www.mysqltutorial.org/getting-started-with-mysql-stored-procedures.aspx>
 - <https://www.w3resource.com/mysql/mysql-procedure.php>
 - <https://www.google.ca/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=2ahUKEwiDzcu25obhAhVLSN8KHSXgBNMQFjABegQIAxAK&url=https%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DWGHcZ1MuPE8&usg=AOvVaw2hur5gXHAkLsSe2AgeWHNr>
- MySQL documentation on stored procedures
 - <https://dev.mysql.com/doc/refman/8.0/en/create-procedure.html>

Questions and Answers (Q/A)

