K. J. Somaiya College of Engineering, Mumbai-77
(Autonomous College Affiliated to University of Mumbai)

Batch: A2 **Roll No.: 1911027**

Experiment / assignment / tutorial No. 7

Grade: AA / AB / BB / BC / CC / CD /DD

Title: Implementing procedures and cursors

Objective: To be able to Implementing procedures.

Expected Outcome of Experiment:
CO 3: Use SQL for Relational database creation, maintenance and query processing

Books/ Journals/ Websites referred:

1. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g.Black book, Dreamtech Press
2. www.db-book.com
3. Korth, Slberchatz, Sudarshan : “Database Systems Concept”, 5th Edition , McGraw Hill
4. Elmasri and Navathe,”Fundamentals of database Systems”, 4th Edition,PEARSON Education.

Resources used: Postgresql

Theory

A stored procedure is a set of Structured Query Language (SQL) statements with an assigned name, which are stored in a relational database management system as a group, so it can be reused and shared by multiple programs.

Stored procedures can access or modify data in a database, but it is not tied to a specific database or object, which offers a number of advantages.

Benefits of using stored procedures

A stored procedure provides an important layer of security between the user interface and the database. It supports security through data access controls because end users may enter or change data, but do not write procedures. A stored procedure preserves data integrity because information is entered in a consistent manner. It improves productivity because statements in a stored procedure only must be written once.

Use of stored procedures can reduce network traffic between clients and servers, because the commands are executed as a single batch of code. This means only the call to execute the procedure is sent over a network, instead of every single line of code being sent individually.

Syntax:

```
CREATE [ OR REPLACE ] PROCEDURE
    name ( [ [ argmode ] [ argname ] argtype [ { DEFAULT | = }
default_expr ] [, ...] ] )
  { LANGUAGE lang_name
    | TRANSFORM { FOR TYPE type_name } [, ... ]
    | [ EXTERNAL ] SECURITY INVOKER | [ EXTERNAL ] SECURITY
DEFINER
    | SET configuration_parameter { TO value | = value | FROM
CURRENT }
    | AS 'definition'
    | AS 'obj_file', 'link_symbol'
  } ...
```

Parameters

Name: The name (optionally schema-qualified) of the procedure to create.

Argmode: The mode of an argument: IN, INOUT, or VARIADIC. If omitted, the default is IN. (OUT arguments are currently not supported for procedures. Use INOUT instead.)

Argname: The name of an argument.

Argtype: The data type(s) of the procedure's arguments (optionally schema-qualified), if any. The argument types can be base, composite, or domain types, or can reference the type of a table column.

Depending on the implementation language it might also be allowed to specify “pseudo-types” such as cstring. Pseudo-types indicate that the actual argument type is either incompletely specified, or outside the set of ordinary SQL data types.

The type of a column is referenced by writing table_name.column_name%TYPE. Using this feature can sometimes help make a procedure independent of changes to the definition of a table.

default_expr: An expression to be used as default value if the parameter is not specified. The expression has to be coercible to the argument type of the parameter. All input parameters following a parameter with a default value must have default values as well.

lang_name :The name of the language that the procedure is implemented in. It can be sql, c, internal, or the name of a user-defined procedural language, e.g. plpgsql. Enclosing the name in single quotes is deprecated and requires matching case.

TRANSFORM { FOR TYPE type_name } [, ...] }

Lists which transforms a call to the procedure should apply. Transforms convert between SQL types and language-specific data types; see CREATE TRANSFORM. Procedural language implementations usually have hardcoded knowledge of the built-in types, so those don't need to be listed here. If a procedural language implementation does not know how to handle a type and no transform is supplied, it will fall back to a default behavior for converting data types, but this depends on the implementation.

[EXTERNAL] SECURITY INVOKER

[EXTERNAL] SECURITY DEFINER

SECURITY INVOKER indicates that the procedure is to be executed with the privileges of the user that calls it. That is the default. SECURITY DEFINER specifies that the procedure is to be executed with the privileges of the user that owns it.

The key word EXTERNAL is allowed for SQL conformance, but it is optional since, unlike in SQL, this feature applies to all procedures not only external ones.

A SECURITY DEFINER procedure cannot execute transaction control statements (for example, COMMIT and ROLLBACK, depending on the language).

configuration_parameter

value: The SET clause causes the specified configuration parameter to be set to the specified value when the procedure is entered, and then restored to its prior value when the procedure exits. SET FROM CURRENT saves the value of the parameter that is current when CREATE PROCEDURE is executed as the value to be applied when the procedure is entered.

If a SET clause is attached to a procedure, then the effects of a SET LOCAL command executed inside the procedure for the same variable are restricted to the procedure: the configuration parameter's prior value is still restored at procedure exit. However, an ordinary SET command (without LOCAL) overrides the SET clause, much as it would do for a previous SET LOCAL command: the effects of such a command will persist after procedure exit, unless the current transaction is rolled back.

If a SET clause is attached to a procedure, then that procedure cannot execute transaction control statements (for example, COMMIT and ROLLBACK, depending on the language).

Definition

A string constant defining the procedure; the meaning depends on the language. It can be an internal procedure name, the path to an object file, an SQL command, or text in a procedural language.

It is often helpful to use dollar quoting to write the procedure definition string, rather than the normal single quote syntax. Without dollar quoting, any single quotes or backslashes in the procedure definition must be escaped by doubling them.

obj_file, link_symbol

This form of the AS clause is used for dynamically loadable C language procedures when the procedure name in the C language source code is not the same as the name of the SQL procedure. The string obj_file is the name of the shared library file containing the compiled C procedure, and is interpreted as for the LOAD command. The string link_symbol is the procedure's link symbol, that is, the name of the procedure in the C language source code. If the link symbol is omitted, it is assumed to be the same as the name of the SQL procedure being defined.

When repeated CREATE PROCEDURE calls refer to the same object file, the file is only loaded once per session. To unload and reload the file (perhaps during development), start a new session.

Example:

We will use the following accounts table for the demonstration:

```
CREATE TABLE accounts (
  id INT GENERATED BY DEFAULT AS IDENTITY,
  name VARCHAR(100) NOT NULL,
  balance DEC(15,2) NOT NULL,
  PRIMARY KEY(id)
);
```

```
INSERT INTO accounts(name,balance)
VALUES('Bob',10000);

INSERT INTO accounts(name,balance)
VALUES('Alice',10000);
```

The following example creates stored procedure named transfer that transfer specific amount of money from one account to another.

```
CREATE OR REPLACE PROCEDURE transfer(INT, INT, DEC)
LANGUAGE plpgsql
AS $$
BEGIN
   -- subtracting the amount from the sender's account
   UPDATE accounts
   SET balance = balance - $3
   WHERE id = $1;

   -- adding the amount to the receiver's account
   UPDATE accounts
   SET balance = balance + $3
   WHERE id = $2;

   COMMIT;
END;
$$;


CALL stored_procedure_name(parameter_list);
CALL transfer(1,2,1000);
```

Cursors

Rather than executing a whole query at once, it is possible to set up a cursor that encapsulates the query, and then read the query result a few rows at a time. One reason for doing this is to avoid memory overrun when the result contains a large number of rows. (However, PL/pgSQL users do not normally need to worry about that, since FOR loops automatically use a cursor internally to avoid memory problems.) A more interesting usage is to return a reference to a cursor that a function has created, allowing the caller to read the rows. This provides an efficient way to return large row sets from functions.

Before a cursor can be used to retrieve rows, it must be opened. (This is the equivalent action to the SQL command DECLARE CURSOR.) PL/pgSQL has three forms of the OPEN statement, two of which use unbound cursor variables while the third uses a bound cursor variable.

OPEN FOR query

Syntax: OPEN unbound_cursorvar [[NO] SCROLL] FOR query;

example:

```
OPEN curs1 FOR SELECT * FROM foo WHERE key = mykey;
```

OPEN FOR EXECUTE

Syntax: OPEN unbound_cursorvar [[NO] SCROLL] FOR EXECUTE query_string
                                   [USING expression [, ...]];

example:

```
OPEN curs1 FOR EXECUTE 'SELECT * FROM ' || quote_ident(tabname)
                                   || ' WHERE col1 = $1' USING keyvalue;
```

Opening a Bound Cursor

Syntax: OPEN bound_cursorvar [([argument_name :=] argument_value [, ...])];

Examples (these use the cursor declaration examples above):

```
OPEN curs2;
OPEN curs3(42);
OPEN curs3(key := 42);
```

Because variable substitution is done on a bound cursor's query, there are really two ways to pass values into the cursor: either with an explicit argument to OPEN, or implicitly by referencing a PL/pgSQL variable in the query. However, only variables declared before the bound cursor was declared will be substituted into it. In either case the value to be passed is determined at the time of the OPEN. For example, another way to get the same effect as the curs3 example above is

```
DECLARE
    key integer;
    curs4 CURSOR FOR SELECT * FROM tenk1 WHERE unique1 = key;
BEGIN
    key := 42;
```

OPEN curs4;

Using Cursors

FETCH

Synatx: FETCH [direction { FROM | IN }] cursor INTO target;

Examples:

FETCH curs1 INTO rowvar;

FETCH curs2 INTO foo, bar, baz;

FETCH LAST FROM curs3 INTO x, y;

FETCH RELATIVE -2 FROM curs4 INTO x;

MOVE

MOVE [direction { FROM | IN }] cursor;

MOVE repositions a cursor without retrieving any data. MOVE works exactly like the FETCH command, except it only repositions the cursor and does not return the row moved to. As with SELECT INTO, the special variable FOUND can be checked to see whether there was a next row to move to.

Examples:

MOVE curs1;

MOVE LAST FROM curs3;

MOVE RELATIVE -2 FROM curs4;

MOVE FORWARD 2 FROM curs4;

UPDATE/DELETE WHERE CURRENT OF

UPDATE table SET ... WHERE CURRENT OF cursor;

DELETE FROM table WHERE CURRENT OF cursor;

When a cursor is positioned on a table row, that row can be updated or deleted using the cursor to identify the row. There are restrictions on what the cursor's query can be (in particular, no grouping) and it's best to use FOR UPDATE in the cursor. For more information see the DECLARE reference page.

An example:

UPDATE foo SET dataval = myval WHERE CURRENT OF curs1;

CLOSE

CLOSE cursor;

CLOSE closes the portal underlying an open cursor. This can be used to release resources earlier than end of transaction, or to free up the cursor variable to be opened again.

An example:

CLOSE curs1;

Implementation Screenshots (Problem Statement, Query and Screenshots of Results):

Problem Statement: Online pharmacy management system where user can order medicines from a particular pharmacy by comparing prices from different pharmacies available. And also checking availability of medicines in the pharmacy.

PROCEDURES:

Procedure 1: This procedure is used to retrieve all the tuples from pharmacy table and also to show the number of tuples present in the pharmacy table.

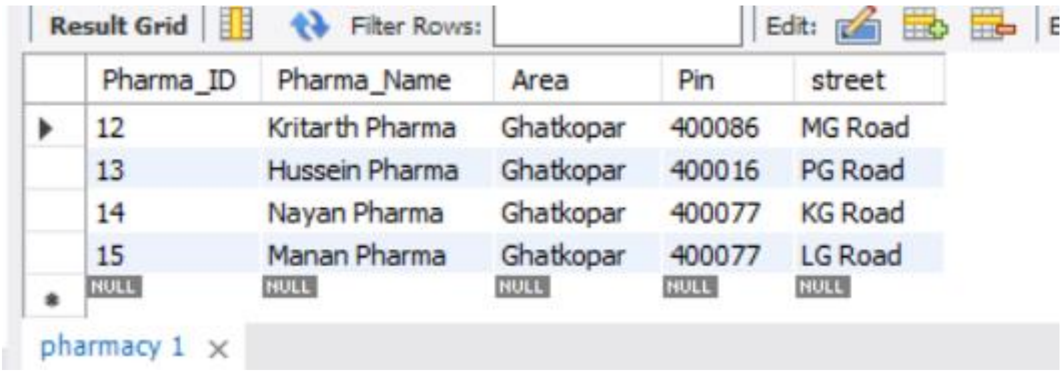
Query:

Without parameter:

```
use medtip;
DELIMITER &&
CREATE PROCEDURE findings1()
BEGIN
SELECT * from pharmacy;
SELECT count(*) from pharmacy;
END &&
DELIMITER ;
```

To call: CALL findings1();

Pharmacy table:



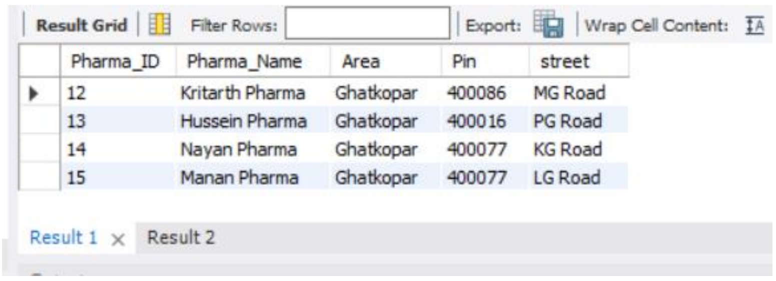
Pharma_ID	Pharma_Name	Area	Pin	street
12	Kritarth Pharma	Ghatkopar	400086	MG Road
13	Hussein Pharma	Ghatkopar	400016	PG Road
14	Nayan Pharma	Ghatkopar	400077	KG Road
15	Manan Pharma	Ghatkopar	400077	LG Road
NULL	NULL	NULL	NULL	NULL

pharmacy 1

Screenshot:

After calling the procedure outputs will be:

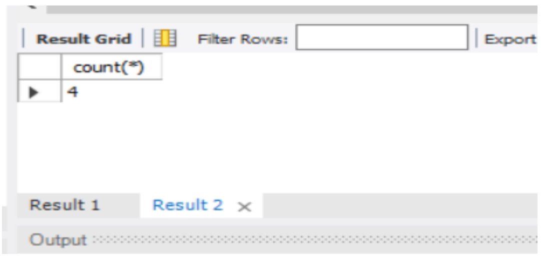
Result 1:



Pharma_ID	Pharma_Name	Area	Pin	street
12	Kritarth Pharma	Ghatkopar	400086	MG Road
13	Hussein Pharma	Ghatkopar	400016	PG Road
14	Nayan Pharma	Ghatkopar	400077	KG Road
15	Manan Pharma	Ghatkopar	400077	LG Road

Result 1 Result 2

Result 2:



count(*)
4

Result 1 Result 2

Procedure 2: This procedure is used to retrieve all the transactions of a particular customer with the help of id of the customer.

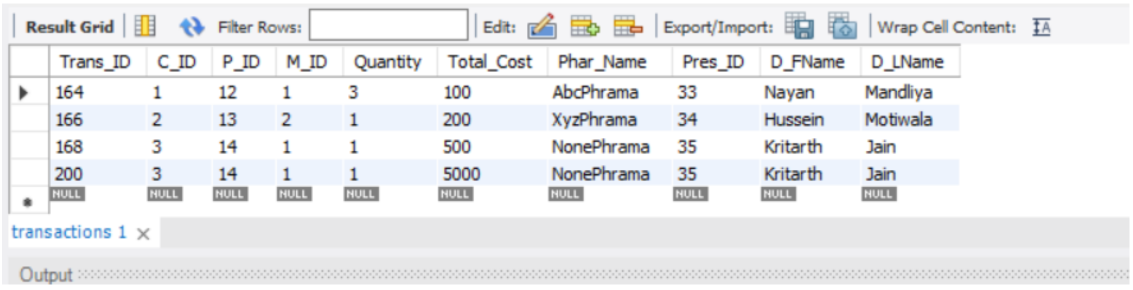
Query:

With in parameter:

```
DELIMITER &&
CREATE PROCEDURE get_customers_transactions(IN id INT)
BEGIN
SELECT * from transactions where C_ID=id;
END &&
DELIMITER ;
```

To call: CALL get_customers_transactions(3);

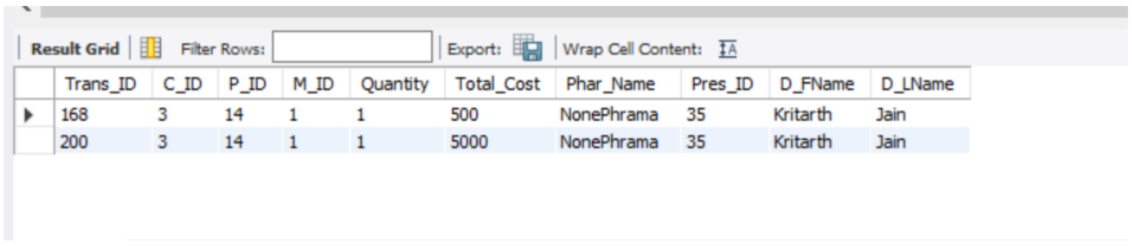
Transactions table:



Trans_ID	C_ID	P_ID	M_ID	Quantity	Total_Cost	Phar_Name	Pres_ID	D_FName	D_LName
164	1	12	1	3	100	AbcPhrama	33	Nayan	Mandliya
166	2	13	2	1	200	XyzPhrama	34	Hussein	Motiwala
168	3	14	1	1	500	NonePhrama	35	Kritarth	Jain
200	3	14	1	1	5000	NonePhrama	35	Kritarth	Jain
NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Screenshot:

After calling the procedure:



Trans_ID	C_ID	P_ID	M_ID	Quantity	Total_Cost	Phar_Name	Pres_ID	D_FName	D_LName
168	3	14	1	1	500	NonePhrama	35	Kritarth	Jain
200	3	14	1	1	5000	NonePhrama	35	Kritarth	Jain

Procedure 3: This procedure is used to return maximum amount which is being paid from all the transactions.

Query:

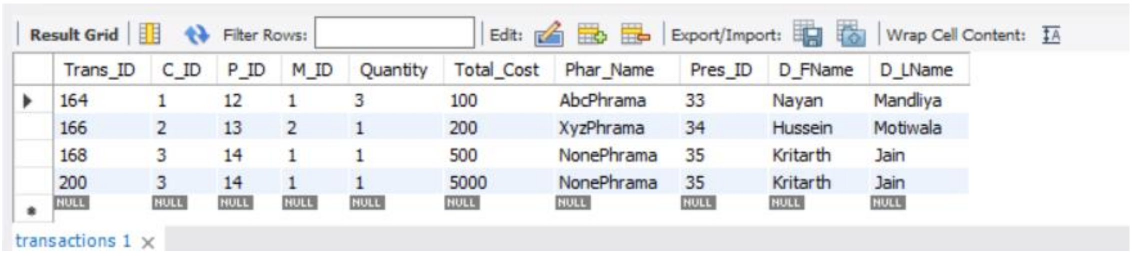
With out parameter:

```
DELIMITER &&
CREATE PROCEDURE max_amount(OUT amount FLOAT)
BEGIN
SELECT max(Total_Cost) INTO amount from transactions;
END &&
DELIMITER ;
```

To call: CALL max_amount(@amount);

To get output: select @amount;

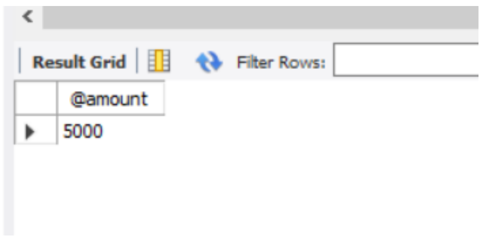
Transactions table:



Trans_ID	C_ID	P_ID	M_ID	Quantity	Total_Cost	Phar_Name	Pres_ID	D_FName	D_LName
164	1	12	1	3	100	AbcPhrama	33	Nayan	Mandliya
166	2	13	2	1	200	XyzPhrama	34	Hussein	Motiwala
168	3	14	1	1	500	NonePhrama	35	Kritarth	Jain
200	3	14	1	1	5000	NonePhrama	35	Kritarth	Jain
NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Screenshot:

After calling procedure:



@amount
5000

Procedure 4: This procedure is a nested procedure. This is used to return a tuple from transactions table which is having maximum amount.

Query:

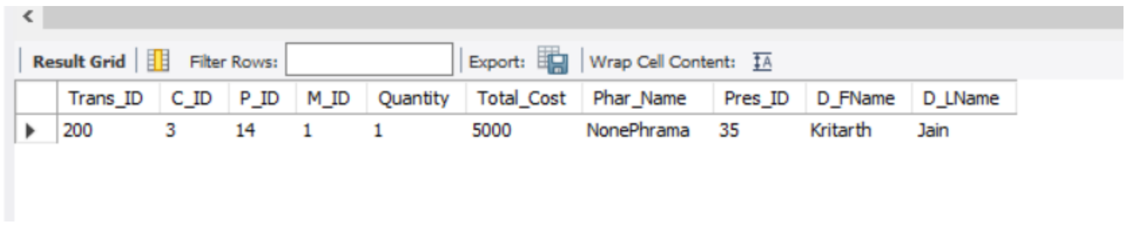
Nested procedure:

```
DELIMITER &&

CREATE PROCEDURE get_customers_transactions_above_max()

BEGIN

CALL max_amount(@amount);

SELECT * from transactions where Total_Cost=@amount;

END &&

DELIMITER ;
```

To call: CALL get_customers_transactions_above_max();

Screenshot:

After calling procedure:



Trans_ID	C_ID	P_ID	M_ID	Quantity	Total_Cost	Phar_Name	Pres_ID	D_FName	D_LName
200	3	14	1	1	5000	NonePhrama	35	Kritarth	Jain

CURSORS:

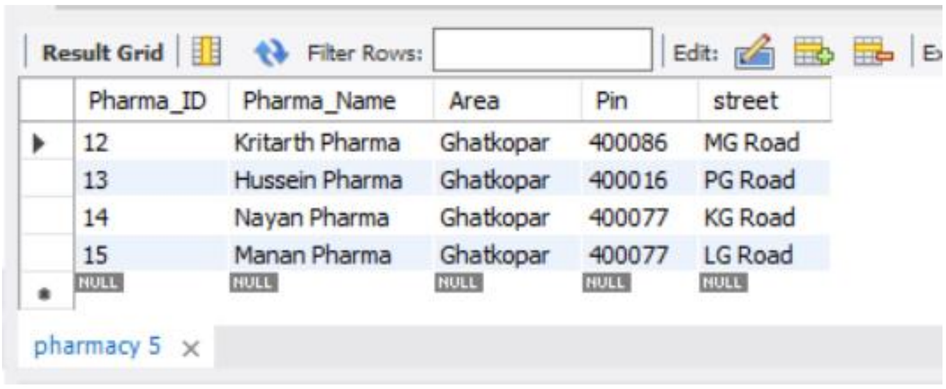
Cursor 1: This cursor is used to print pharmacy names with their corresponding pin code.

Query:

```
DELIMITER &&
CREATE PROCEDURE p1()
BEGIN
DECLARE v_1 varchar(100);
DECLARE v_2 INTEGER;
DECLARE v_3 INTEGER DEFAULT 0;
DECLARE c1 cursor FOR SELECT pharma_name,pin from pharmacy;
DECLARE continue handler for not found set v_3=1;
OPEN c1;
label1: LOOP
   FETCH c1 into v_1,v_2;
   IF v_3=1 THEN
      LEAVE label1;
   END IF;
   SELECT concat(v_1,concat(" ",v_2));
END LOOP label1;
close c1;
END &&
DELIMITER ;
```

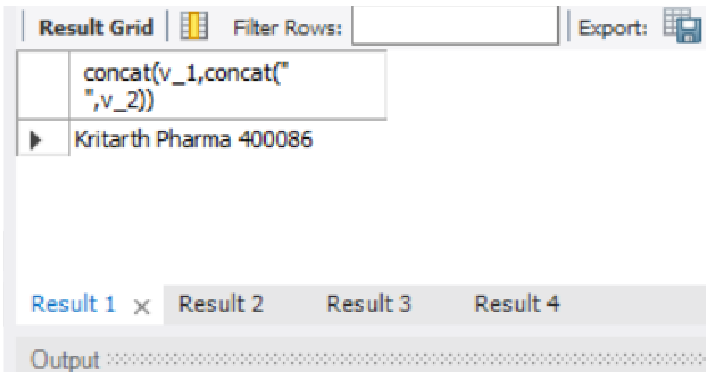
To call procedure: CALL p1();

Pharmacy table:

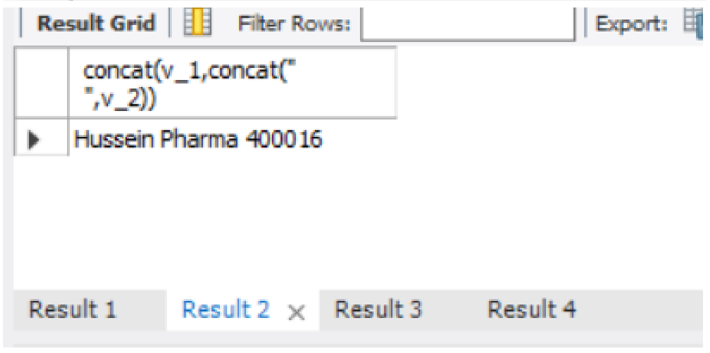


Pharma_ID	Pharma_Name	Area	Pin	street
12	Kritarth Pharma	Ghatkopar	400086	MG Road
13	Hussein Pharma	Ghatkopar	400016	PG Road
14	Nayan Pharma	Ghatkopar	400077	KG Road
15	Manan Pharma	Ghatkopar	400077	LG Road
NULL	NULL	NULL	NULL	NULL

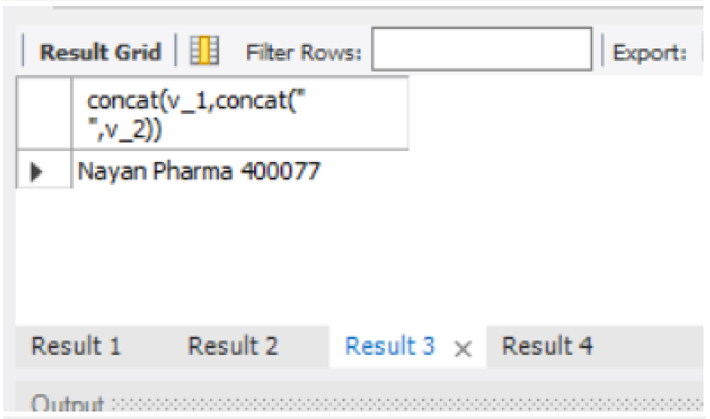
Screenshot:



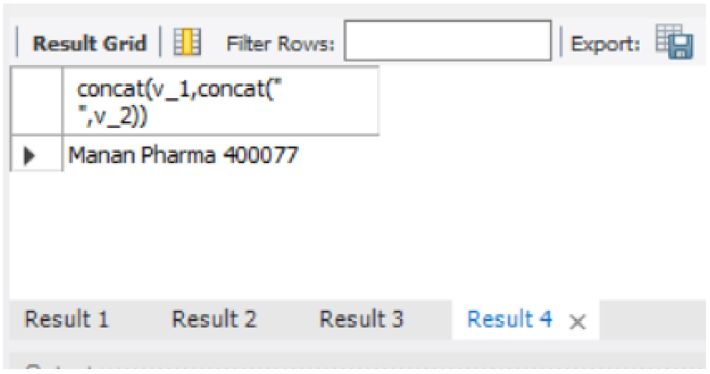
```
concat(v_1,concat("
",v_2))
Kritarth Pharma 400086
```



```
concat(v_1,concat("
",v_2))
Hussein Pharma 400016
```



```
concat(v_1,concat("
",v_2))
Nayan Pharma 400077
```



```
concat(v_1,concat("
",v_2))
Manan Pharma 400077
```

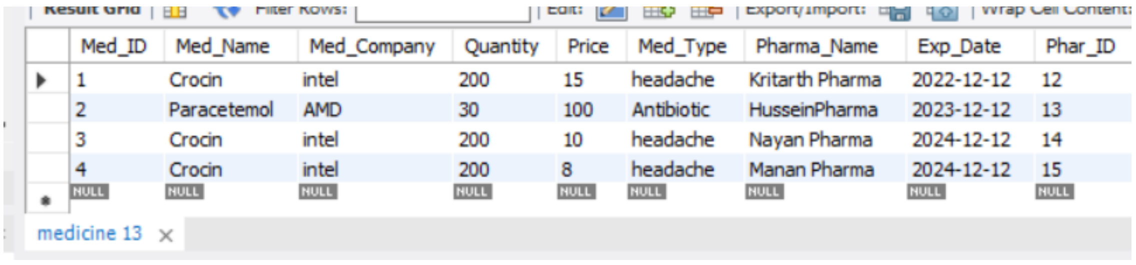
Cursor 2: This cursor is used to fetch the medicine available in different pharmacies in increasing order of their price.

Query:

```
DELIMITER &&
CREATE PROCEDURE p2(IN m_name VARCHAR(30))
BEGIN
DECLARE v_1 VARCHAR(30);
DECLARE v_2 INTEGER;
DECLARE v_3 INTEGER DEFAULT 0;
DECLARE c2 cursor FOR SELECT Pharma_Name, Price from medicine where Med_Name=m_name ORDER BY Price;
DECLARE continue handler for not found set v_3=1;
OPEN c2;
label1: LOOP
   FETCH c2 into v_1,v_2;
   IF v_3=1 THEN
      LEAVE label1;
   END IF;
   SELECT concat(v_1,concat(" ",v_2));
END LOOP label1;
close c2;
END &&
DELIMITER ;
```

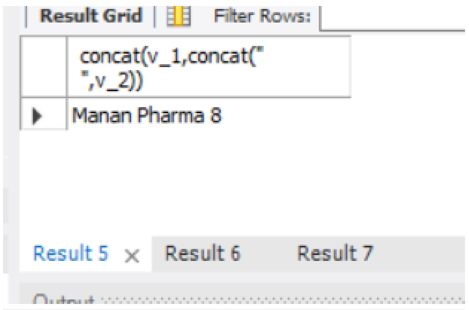
To call: CALL p2(name);

Medicine Table:

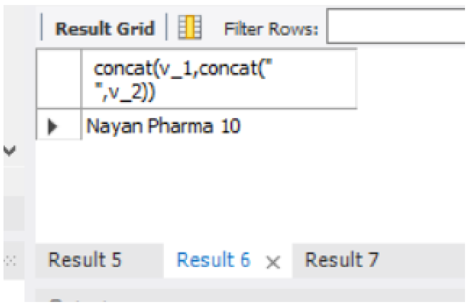


Med_ID	Med_Name	Med_Company	Quantity	Price	Med_Type	Pharma_Name	Exp_Date	Phar_ID
1	Crocin	intel	200	15	headache	Kritarth Pharma	2022-12-12	12
2	Paracetemol	AMD	30	100	Antibiotic	HusseinPharma	2023-12-12	13
3	Crocin	intel	200	10	headache	Nayan Pharma	2024-12-12	14
4	Crocin	intel	200	8	headache	Manan Pharma	2024-12-12	15
NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

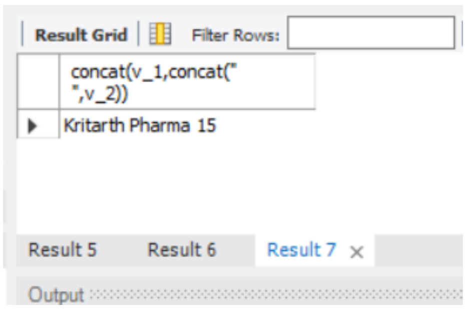
Screenshot:



```
Result Grid | Filter Rows:
concat(v_1,concat(" ",v_2))
Manan Pharma 8
Result 5 × | Result 6 | Result 7
```



```
Result Grid | Filter Rows:
concat(v_1,concat(" ",v_2))
Nayan Pharma 10
Result 5 | Result 6 × | Result 7
```



```
Result Grid | Filter Rows:
concat(v_1,concat(" ",v_2))
Kritarth Pharma 15
Result 5 | Result 6 | Result 7 ×
Output
```

Cursor 3: This cursor is used to give full name of the customers from customer table.

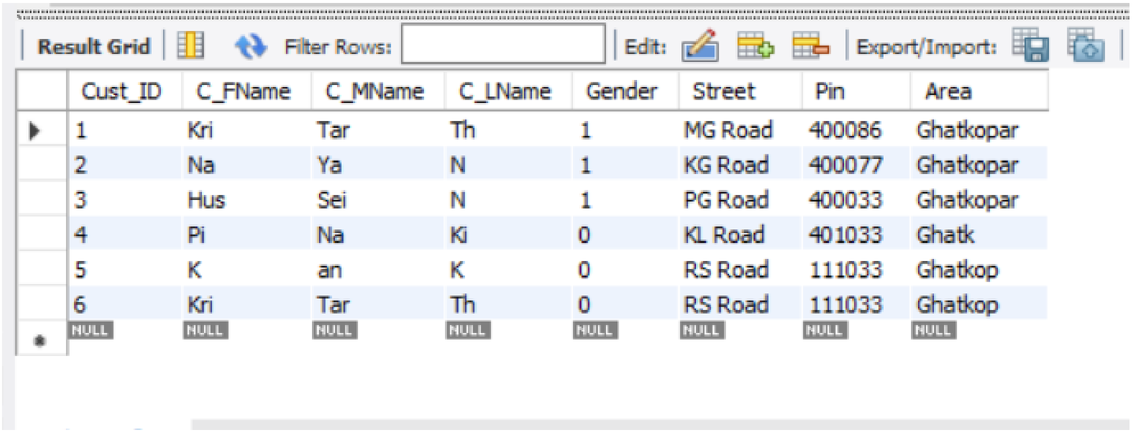
Query:

```
DELIMITER &&
CREATE PROCEDURE p3()
BEGIN
DECLARE v_1 VARCHAR(30);
DECLARE v_2 VARCHAR(30);
DECLARE v_3 VARCHAR(30);
DECLARE v_4 INTEGER DEFAULT 0;
DECLARE c3 cursor FOR SELECT C_FName, C_MName, C_LName from customer;
DECLARE continue handler for not found set v_4=1;
OPEN c3;
label1: LOOP
```

```
    FETCH c3 into v_1,v_2,v_3;
    IF v_4=1 THEN
        LEAVE label1;
    END IF;
    SELECT concat(v_1,concat(" ",concat(v_2,concat(" ",v_3))));
END LOOP label1;
close c3;
END &&
DELIMITER ;
```

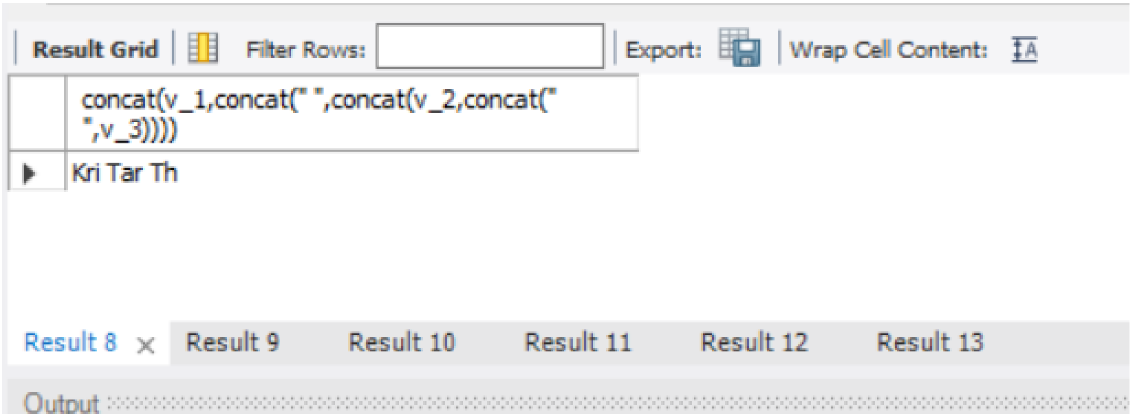
To call: CALL p3();

Customer table:

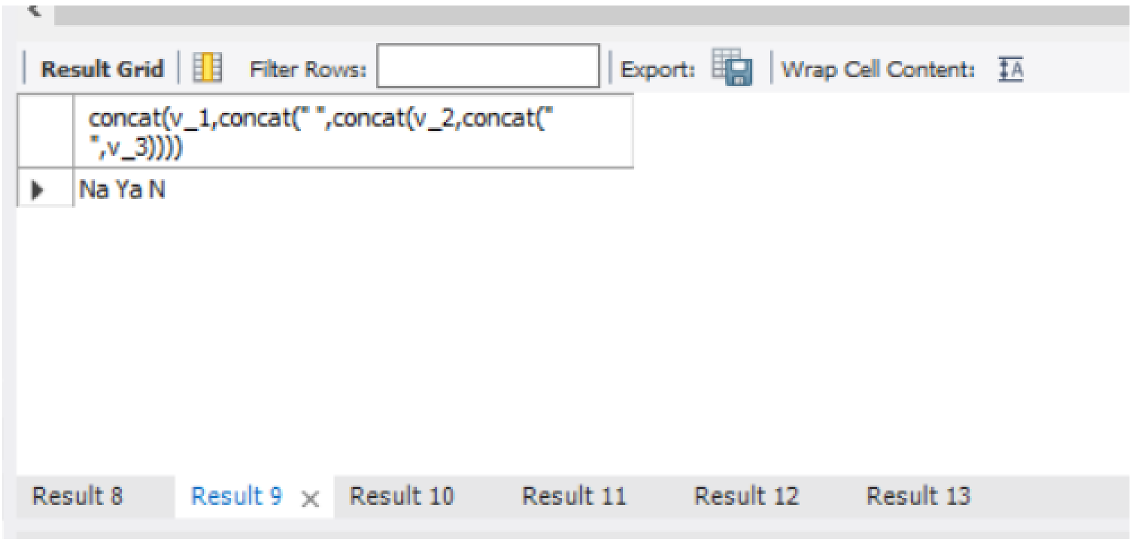


Cust_ID	C_FName	C_MName	C_LName	Gender	Street	Pin	Area
1	Kri	Tar	Th	1	MG Road	400086	Ghatkopar
2	Na	Ya	N	1	KG Road	400077	Ghatkopar
3	Hus	Sei	N	1	PG Road	400033	Ghatkopar
4	Pi	Na	Ki	0	KL Road	401033	Ghatk
5	K	an	K	0	RS Road	111033	Ghatkop
6	Kri	Tar	Th	0	RS Road	111033	Ghatkop
NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

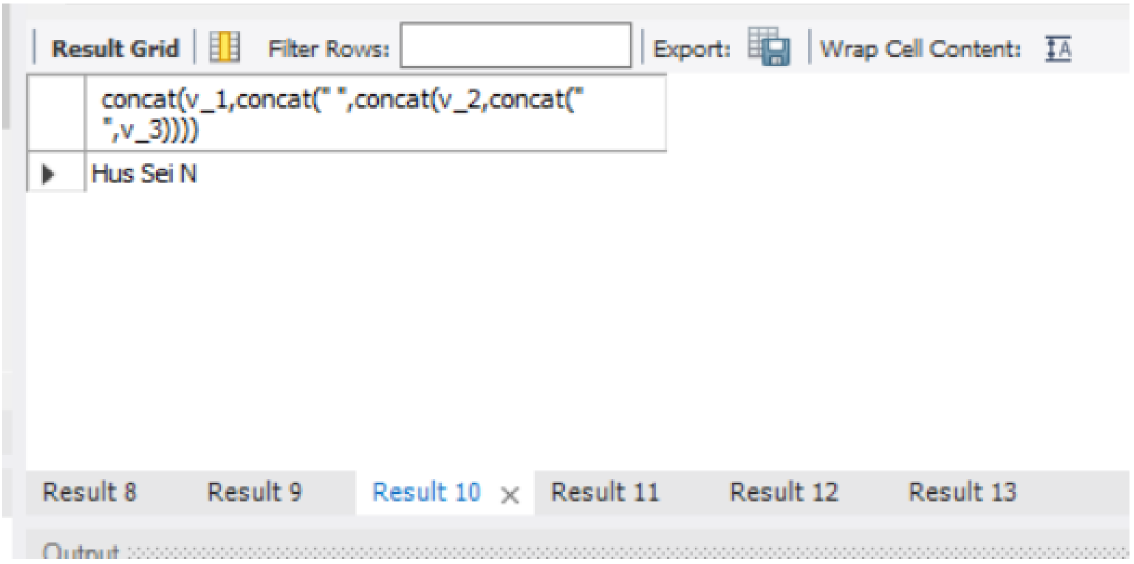
Screenshot:



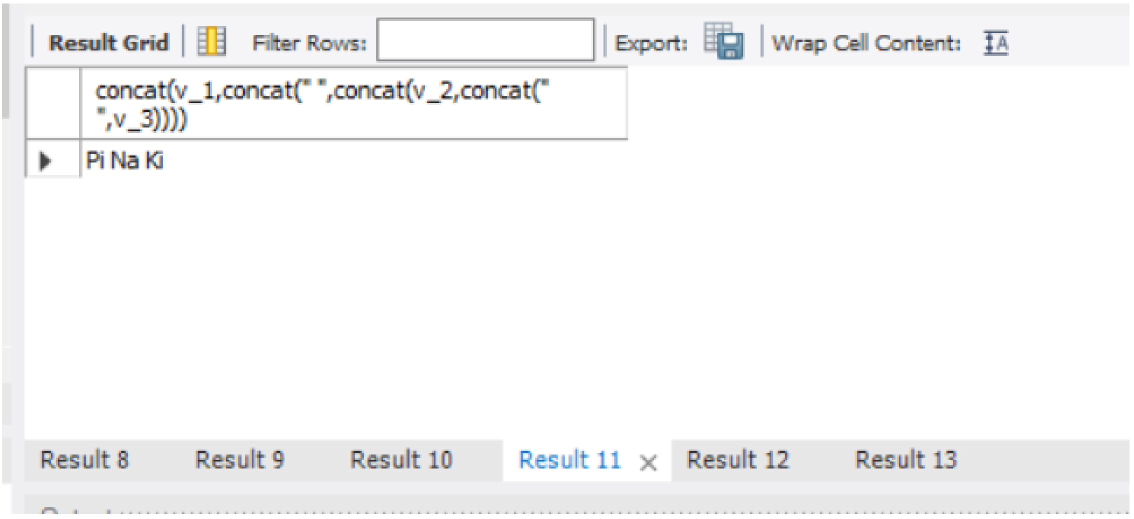
```
concat(v_1,concat(" ",concat(v_2,concat(" ",v_3))))
Kri Tar Th
```



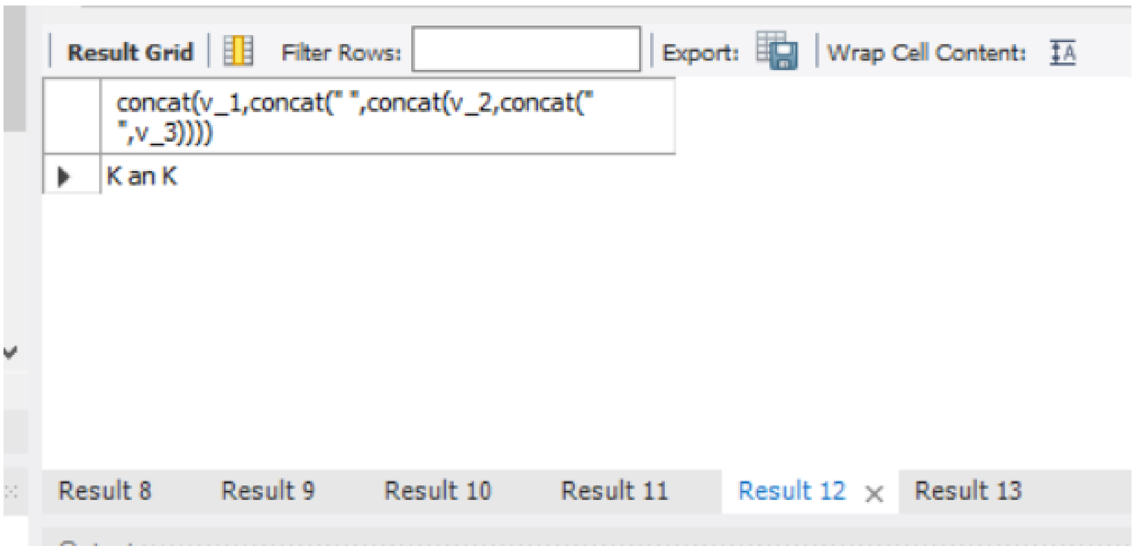
```
concat(v_1,concat(" ",concat(v_2,concat(" ",v_3))))
Na Ya N
```



```
concat(v_1,concat(" ",concat(v_2,concat(" ",v_3))))
Hus Sei N
```



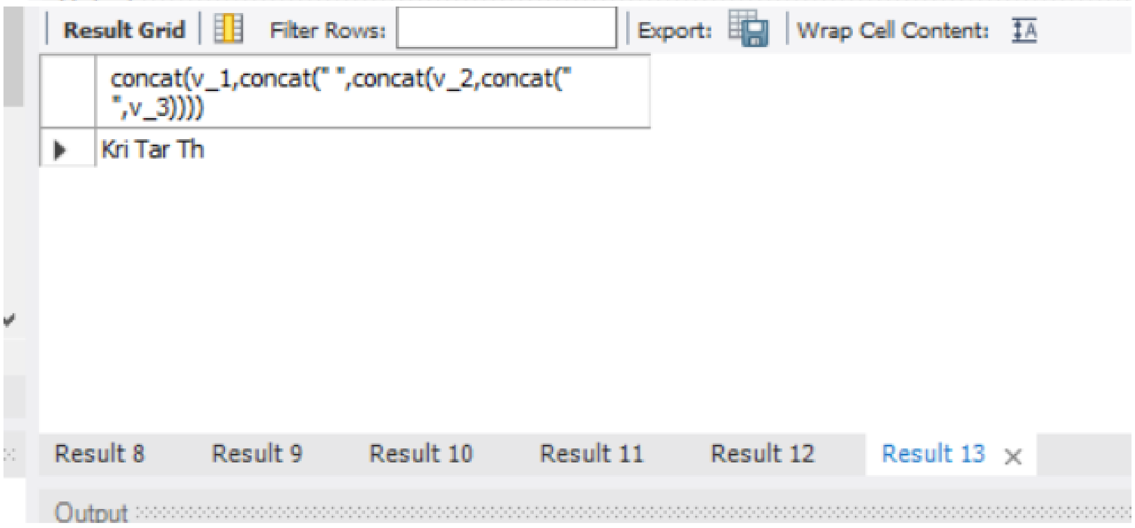
```
concat(v_1,concat(" ",concat(v_2,concat(" ",v_3))))
Pi Na Ki
```



Result Grid | Filter Rows: | Export: | Wrap Cell Content:

```
concat(v_1,concat(" ",concat(v_2,concat(" ",v_3))))
K an K
```

Result 8 | Result 9 | Result 10 | Result 11 | Result 12 | Result 13



Result Grid | Filter Rows: | Export: | Wrap Cell Content:

```
concat(v_1,concat(" ",concat(v_2,concat(" ",v_3))))
Kri Tar Th
```

Result 8 | Result 9 | Result 10 | Result 11 | Result 12 | Result 13

Output

Conclusion: Successfully understood the concepts of procedures and cursors. Implemented procedures without having parameters and with having IN and OUT parameters. Also implemented cursors on our case study.

Post Lab Questions:

1. **Does Storing Of Data In Stored Procedures Increase The Access Time? Explain?**

ANS) Data stored in stored procedures can be retrieved much faster than the data stored in SQL database. Data can be precompiled and stored in Stored procedures. This reduces the time gap between query and compiling as the data has been precompiled and stored in the procedure. To avoid repetitive nature of the data base statement caches are used.

2. **Point out the wrong statement.**

   a) We should use cursor in all cases
   b) A static cursor can move forward and backward direction
   c) A forward only cursor is the fastest cursor
   d) All of the mentioned

ANS) a) We should use cursor in all cases