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Integrated Cloud Applications & Platform Services

Oracle Database 12*c* R2: Develop PL/SQL Program Units

Activity Guide

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Course Practice Environment: Security Credentials

For OS usernames and passwords, see the following:

- If you are attending a classroom-based or live virtual class, ask your instructor or LVC producer for OS credential information.
- If you are using a self-study format, refer to the communication that you received from Oracle University for this course.

For connection-specific credentials used in this course, see the following table:

Connection-Specific Credentials		
Connection_Name	**Username**	**Password**
myconnection	`ora61`	`ora61`
VideoCompany	`ora62`	`ora62`

Practices for Lesson 1: Introduction

Chapter 1

Practices for Lesson 1: Overview

Overview

In this practice, you learn about the user account, which you will use in this course. You also start SQL Developer, create a new database connection, browse your schema tables, and create and execute a simple anonymous block. You also set some SQL Developer preferences, execute SQL statements, and execute an anonymous PL/SQL block by using SQL Worksheet.

If you miss a step in a practice, please run the appropriate solution script for that practice step before proceeding to the next step or the next practice. The solutions for these practices can be found in “Activity Guide: Practices and Solutions.”

Practice 1-1: Creating and Using a New SQL Developer Database Connection

Overview

In this practice, you start SQL Developer by using your connection information and create a new database connection.

Tasks

1. Start up SQL Developer by using the user ID and password that are provided to you by the instructor, such as `ora61`.
2. Create a database connection by using the following information:
   a. Connection Name: `Myconnection`
   b. Username: `ora61`
   c. Password: `Enter the password from the Course Practice Environment: Security Credentials document`
   d. Hostname: Enter the host name for your PC, or let the default `localhost` remain.
   e. Port: `1521`
   f. Service name: `pdborcl`
3. Test the new connection. If the Status shows as Success, connect to the database by using this new connection. Click the Test button in the New/Select Database Connection window. If the status shows as Success, click Connect.

Solution 1-1: Creating and Using a New SQL Developer Database Connection

In this practice, you start SQL Developer by using your connection information and create a new database connection.

1. Start up SQL Developer by using the user ID and password that are provided to you by the instructor, such as `ora61`.

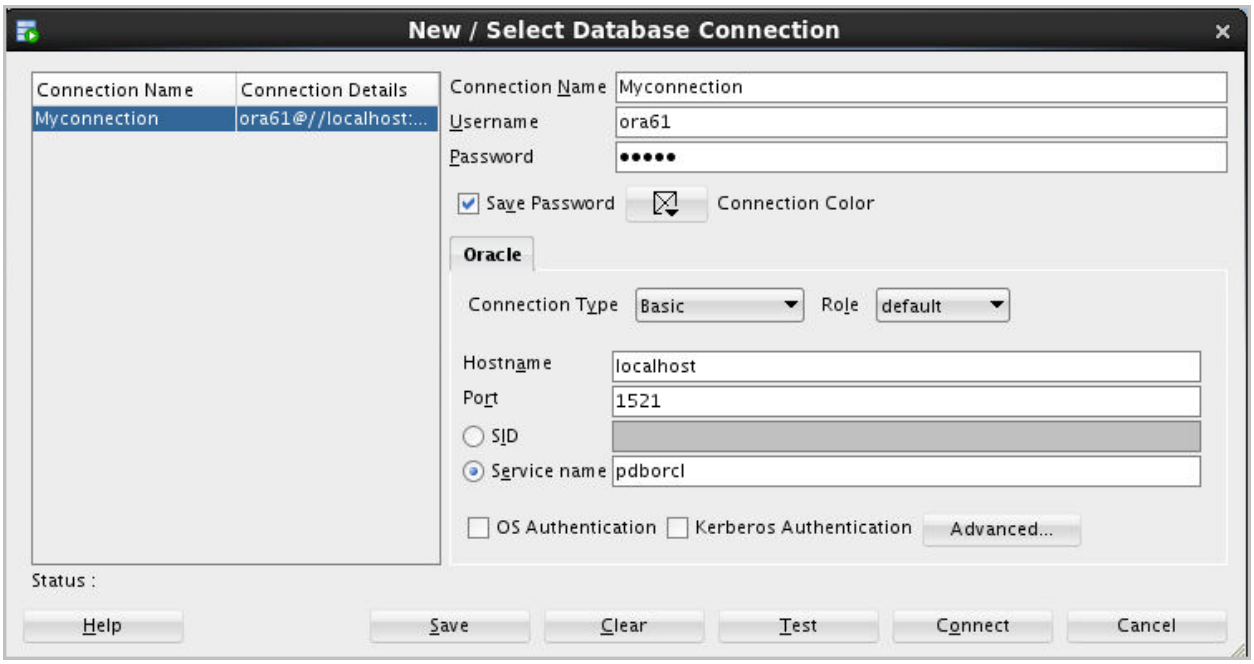
   Click the SQL Developer icon on your desktop.

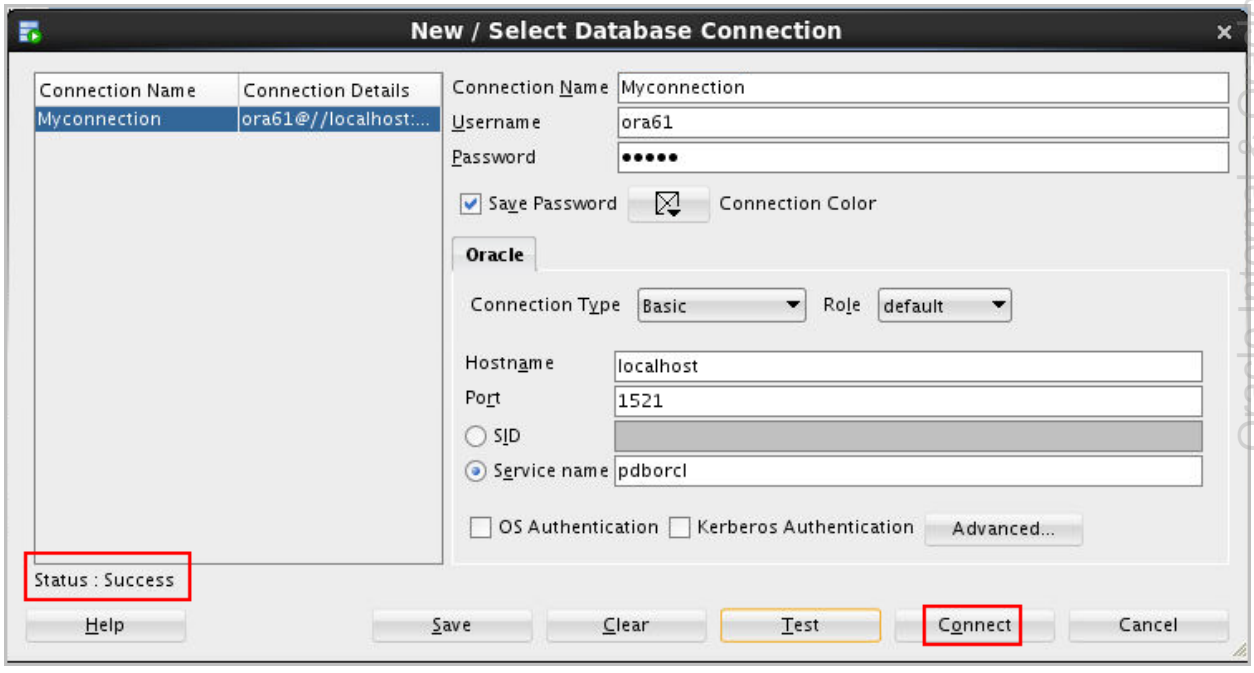
2. Create a database connection by using the following information:
   a. Connection Name: `Myconnection`
   b. Username: `ora61`
   c. Password: `ora61`
   d. Select *Save Password* checkbox to save the connection
   e. Hostname: Enter the host name for your PC or alternatively mention localhost
   f. Port: 1521
   g. Service name: `pdborcl`

   Right-click the Connections icon on the Connections tabbed page, and then select the New Connection option from the shortcut menu. The New/Select Database Connection window is displayed. Use the preceding information provided to create the new database connection.

   Note: To display the properties of the newly created connection, right-click the connection name, and then select Properties from the shortcut menu. Substitute the username, password, host name, and service name with the appropriate information provided by your instructor. The following is a sample of the newly created database connection for student `ora61`:



3. Test the new connection. If the Status shows as Success, connect to the database by using this new connection:
   a. Click the Test button in the New/Select Database Connection window. If the status is Success, click the Connect button.



Practice 1-2: Browsing Your Schema Tables and Creating and Executing a Simple Anonymous Block

Overview

In this practice, you browse your schema tables and create and execute a simple anonymous block.

Tasks

1. Browse the structure of the `EMPLOYEES` table and display its data.
   a. Expand the Myconnection connection by clicking the plus sign next to it.
   b. Expand the Tables icon by clicking the plus sign next to it.
   c. Display the structure of the `EMPLOYEES` table.
2. Browse the `EMPLOYEES` table and display its data.
3. Use the SQL Worksheet to select the last names and salaries of all employees whose annual salary is greater than $10,000. Use both the Execute Statement (or press the F9 key) and the Run Script icon (or press the F5 key) icons to execute the `SELECT` statement. Review the results of both methods of executing the `SELECT` statements in the appropriate tabs.

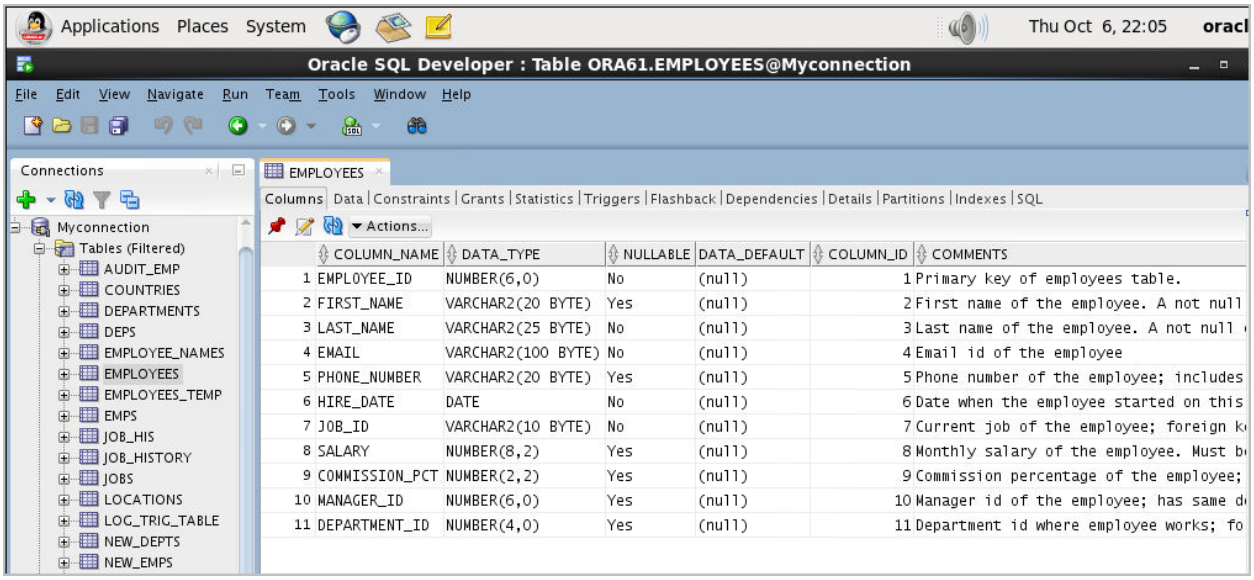
   Note: Take a few minutes to familiarize yourself with the data, or consult Appendix A, which provides the description and data for all the tables in the `HR` schema that you will use in this course.
4. Create and execute a simple anonymous block that outputs “Hello World.”
   a. Enable `SET SERVEROUTPUT ON` to display the output of the `DBMS_OUTPUT` package statements.
   b. Use the SQL Worksheet area to enter the code for your anonymous block.
   c. Click the Run Script (or press the F5 key) icon to run the anonymous block.

Solution 1-2: Browsing Your Schema Tables and Creating and Executing a Simple Anonymous Block

In this practice, you browse your schema tables and create and execute a simple anonymous block.

1. Browse the structure of the `EMPLOYEES` table and display its data.
   a. Expand the `Myconnection` connection by clicking the plus sign next to it.
   b. Expand the Tables icon by clicking the plus sign next to it.
   c. Display the structure of the `EMPLOYEES` table.

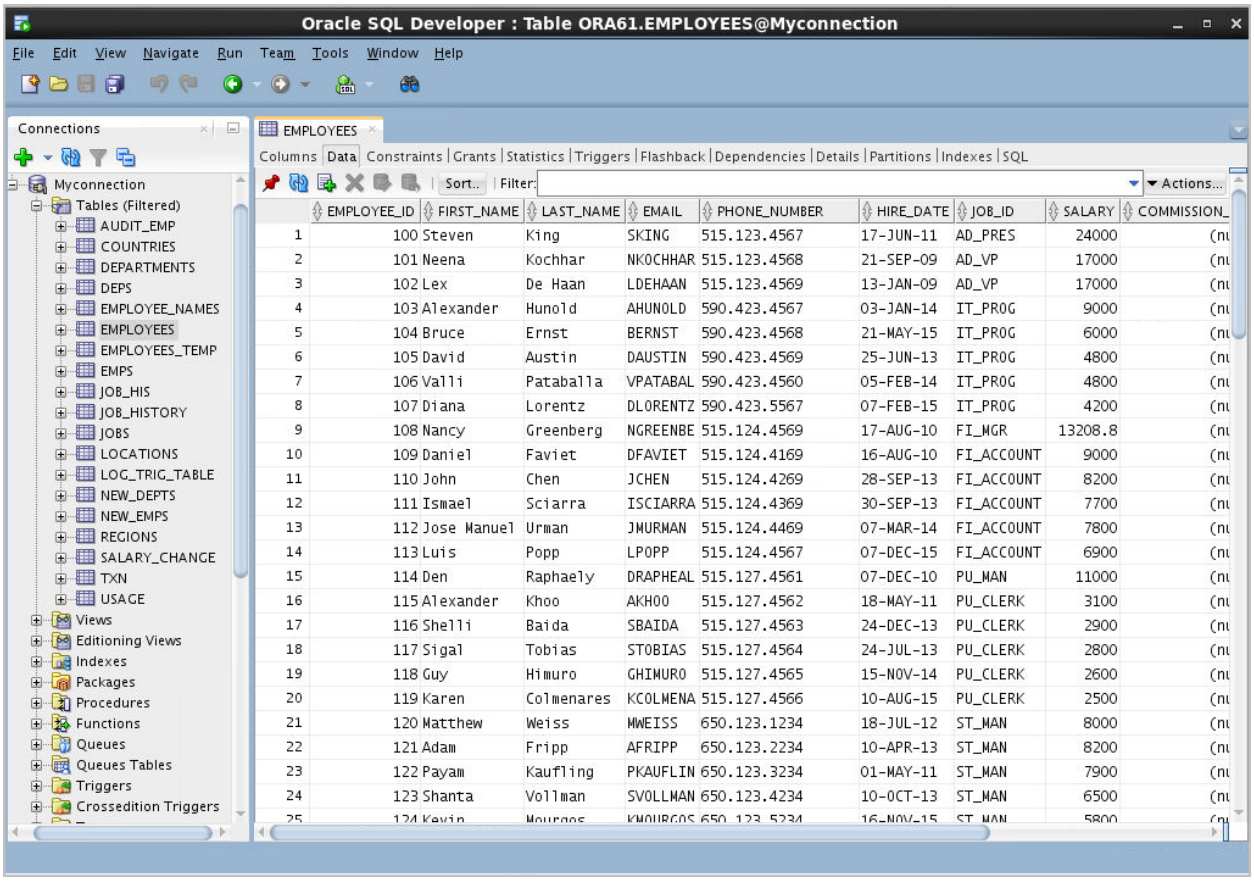
   Double-click the `EMPLOYEES` table. The `Columns` tab displays the columns in the `EMPLOYEES` table as follows:



Note: Please ignore any differences in the screenshot.

2. Browse the `EMPLOYEES` table and display its data.

   To display the employees' data, click the **Data** tab. The `EMPLOYEES` table data is displayed as follows:



3. Use the SQL Worksheet to select the last names and salaries of all employees whose annual salary is greater than $10,000. Click both the Execute Statement (or press F9) and the Run Script (or press F5) icons to execute the `SELECT` statement. Review the results of both methods of executing the `SELECT` statements in the appropriate tabs.

   Note: Take a few minutes to familiarize yourself with the data, or consult Appendix A, which provides the description and data for all the tables in the `HR` schema that you will use in this course.

   Display the SQL Worksheet by using one of the following two methods:

   a. Select Tools > SQL Worksheet or click the Open SQL Worksheet icon. The Select Connection window is displayed.
   b. Select the new `Myconnection` from the Connection drop-down list (if not already selected), and then click OK.

   Open the `sol_01.sql` file in the `/home/oracle/labs/plpu/solns` directory by using one of the following two methods:

   a. On the Files tab, select (or navigate to) the script file that you want to open.
   b. Double-click the file name to open. The code of the script file is displayed in the SQL Worksheet area. Uncomment and select the solution for Task 3.
   c. To run the code, click the Run Script (or press F5) icon on the SQL Worksheet toolbar.

Alternatively, you can also:

a. Select Open from the File menu. The Open dialog box is displayed.
b. In the Open dialog box, select (or navigate to) the script file that you want to open.
c. Click Open. The code of the script file is displayed in the SQL Worksheet area. Uncomment and select the solution for Task 3.
d. To run the code, click the Run Script icon (or press F5) on the SQL Worksheet toolbar.

To run a single `SELECT` statement, click the Execute Statement icon (or press F9), while making sure that the cursor is on any of the `SELECT` statement lines, on the SQL Worksheet toolbar to execute the statement. The code and the result are displayed as follows:

```
SELECT LAST_NAME, SALARY
FROM EMPLOYEES
WHERE SALARY > 10000;
```

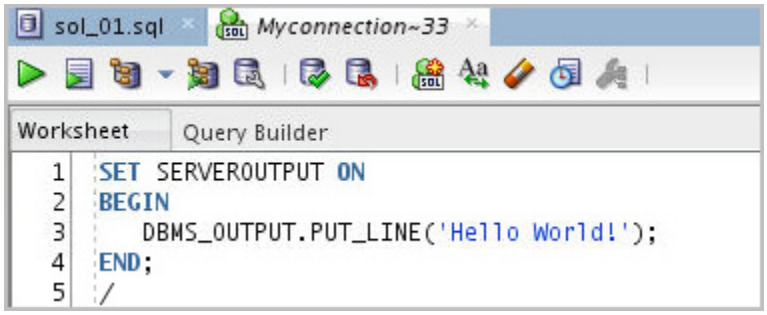
	LAST_NAME	SALARY
1	King	24000
2	Kochhar	17000
3	De Haan	17000
4	Greenberg	12008
5	Raphaely	11000
6	Russell	14000
7	Partners	13500
8	Errazuriz	12000
9	Cambrault	11000
10	Zlotkey	10500
11	Vishney	10500
12	Ozer	11500
13	Abel	11000
14	Hartstein	13000
15	Higgins	12008

4. Create and execute a simple anonymous block that outputs “Hello World.”
   a. Enable `SET SERVEROUTPUT ON` to display the output of the `DBMS_OUTPUT` package statements.

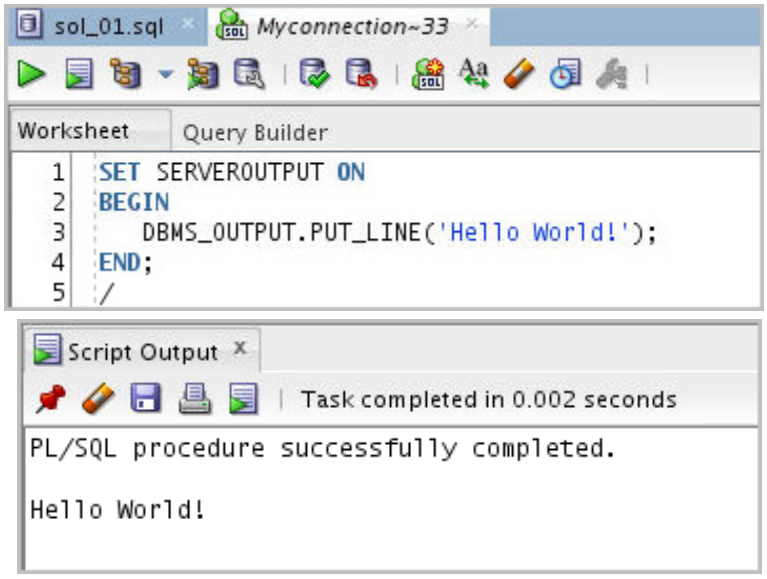
      Enter the following command in the SQL Worksheet area, and then click the Run Script icon (or press F5).

      ```
      SET SERVEROUTPUT ON
      ```

   b. Use the SQL Worksheet area to enter the code for your anonymous block. Open the `sol_01.sql` file in the `/home/oracle/labs/plpu/solns` directory and uncomment and select the code under Task 4. The code is displayed as follows:



c. Click the Run Script icon (or press F5) to run the anonymous block.
The Script Output tab displays the output of the anonymous block as follows:



Practice 1-3: Setting Some SQL Developer Preferences

Overview

In this practice, you set some SQL Developer preferences.

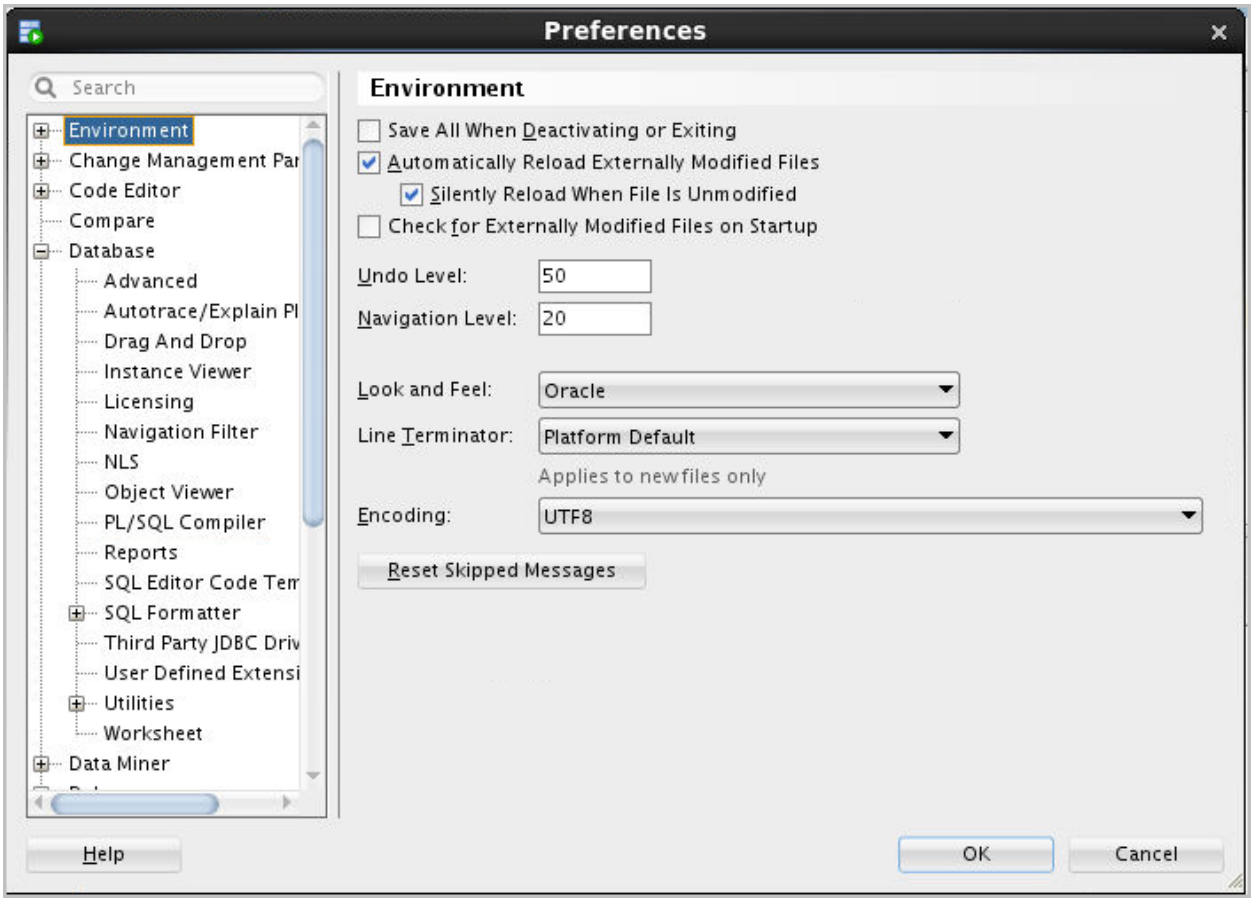
Tasks

1. In the SQL Developer menu, navigate to Tools > Preferences. The Preferences window is displayed.
2. Expand the Code Editor option, and then click the Display option to display the “Code Editor: Display” section. The “Code Editor: Display” section contains general options for the appearance and behavior of the code editor.
   a. Enter `100` in the Right Margin Column text box in the Show Visible Right Margin section. This renders a right margin that you can set to control the length of lines of code.
   b. Click the Line Gutter option. The Line Gutter option specifies options for the line gutter (left margin of the code editor). Select the Show Line Numbers check box to display the code line numbers.
3. Click the Worksheet Parameters option under the Database option. In the “Select default path to look for scripts” text box, specify the `/home/oracle/labs/plpu` directory. This directory contains the solutions scripts, code examples scripts, and any labs or demos used in this course.
4. Click OK to accept your changes and to exit the Preferences window.
5. Familiarize yourself with the `/home/oracle/labs/plpu` directory.
   a. Click the **Files** tab (next to the **Connections** tab).
   b. Navigate to the `/home/oracle/labs/plpu` directory.
   c. How many subdirectories do you see in the `labs` directory?
   d. Navigate through the directories, and open a script file without executing the code.

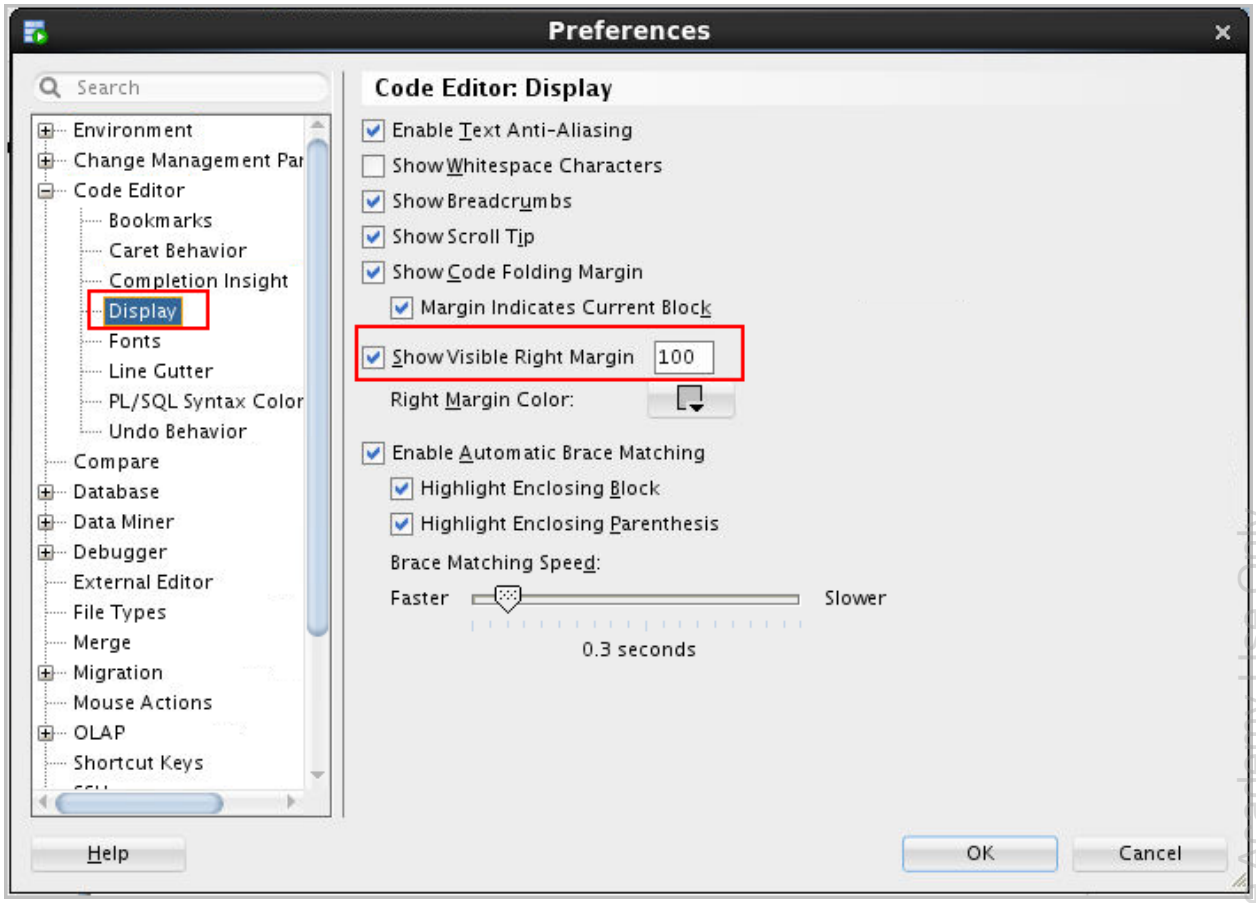
Solution 1-3: Setting Some SQL Developer Preferences

In this practice, you set some SQL Developer preferences.

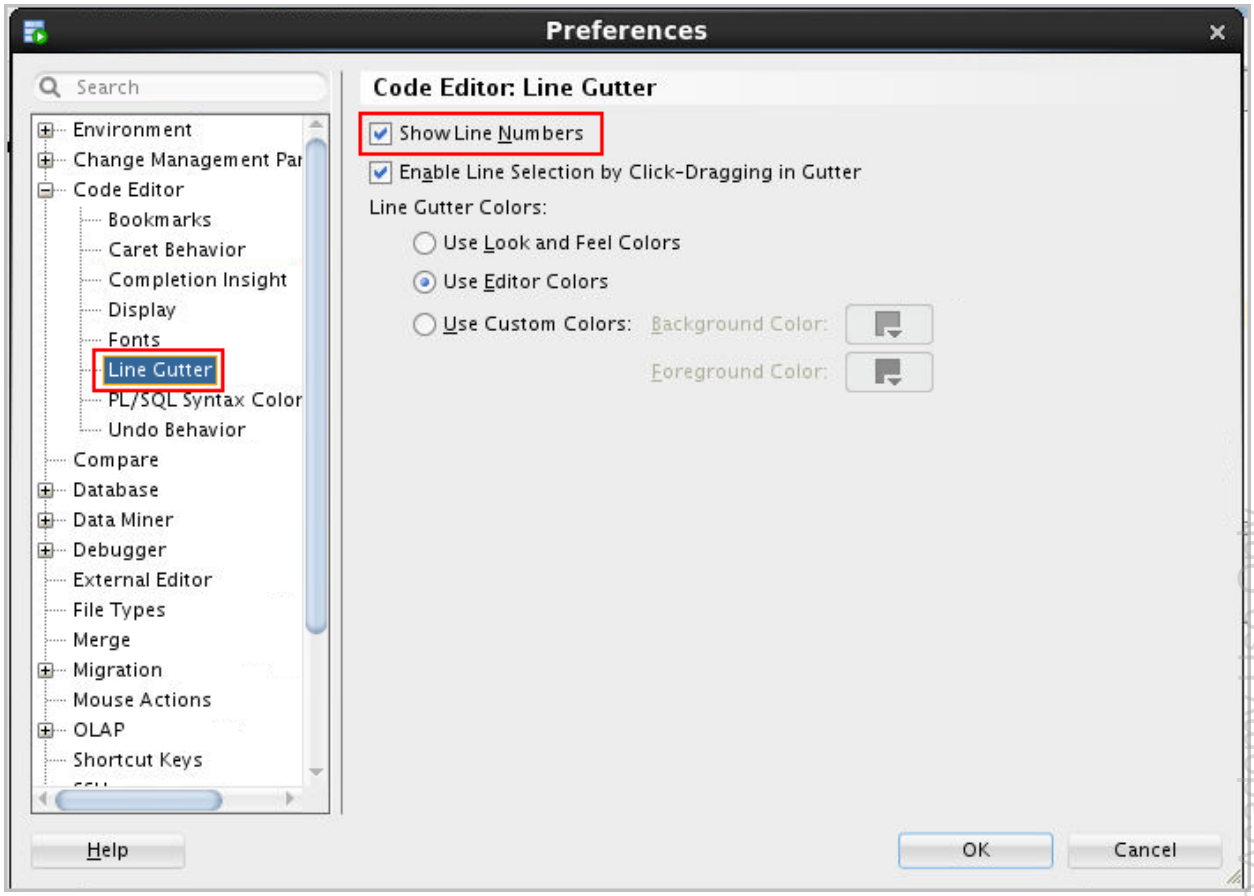
1. In the SQL Developer menu, navigate to Tools > Preferences. The Preferences window is displayed.



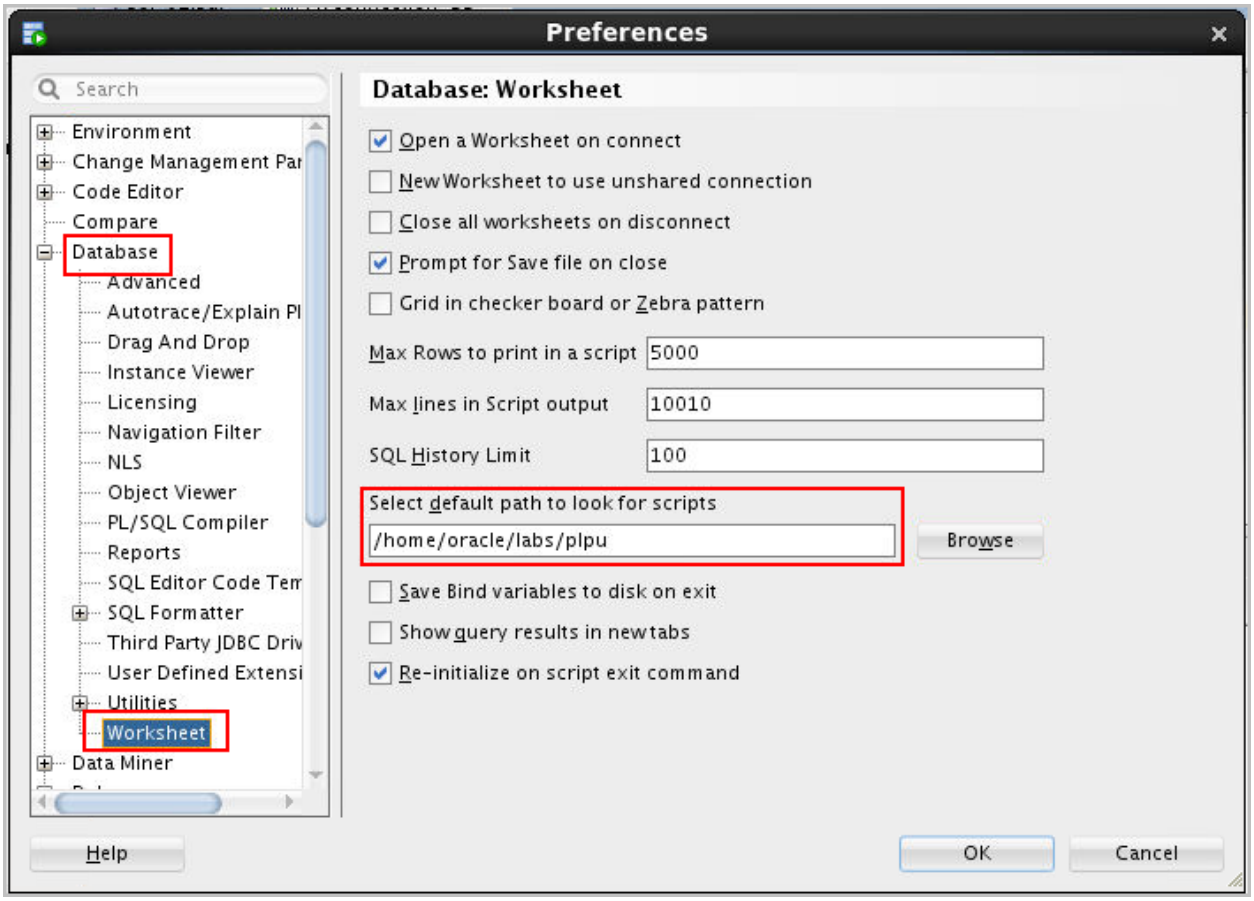
2. Expand the Code Editor option, and then click the Display option to display the “Code Editor: Display” section. The “Code Editor: Display” section contains general options for the appearance and behavior of the code editor.
   a. Enter `100` in the Right Margin Column text box in the Show Visible Right Margin section. This renders a right margin that you can set to control the length of lines of code.



b. Click the Line Gutter option. The Line Gutter option specifies options for the line gutter (left margin of the code editor). Select the Show Line Numbers check box to display the code line numbers.



3. Click the Worksheet Parameters option under the Database option. In the “Select default path to look for scripts” text box, specify the `/home/oracle/labs/plpu` directory. This directory contains the solutions scripts, code examples scripts, and any labs or demos used in this course.



4. Click OK to accept your changes and to exit the Preferences window.
5. Familiarize yourself with the labs directory on the `/home/oracle/labs/plpu` directory.
   a. Click the **Files** tab (next to the **Connections** tab).
   b. Navigate to the `/home/oracle/labs/plpu` directory.
   c. How many subdirectories do you see in the labs directory?
   d. Navigate through the directories, and open a script file without executing the code.

Practices for Lesson 2: Creating Procedures

Chapter 2

Practices for Lesson 2: Overview

Overview

In this practice, you create, compile, and invoke procedures that issue DML and query commands. You also learn how to handle exceptions in procedures.

Note:

1. Before starting this practice, execute the `/home/oracle/labs/plpu/code_ex/cleanup_scripts/cleanup_02.sql` script.
2. If you missed a step in a practice, please run the appropriate solution script for that practice step before proceeding to the next step or the next practice.

Practice 2-1: Creating, Compiling, and Calling Procedures

Overview

In this practice, you create and invoke the `ADD_JOB` procedure and review the results. You also create and invoke a procedure called `UPD_JOB` to modify a job in the `JOBS` table and create and invoke a procedure called `DEL_JOB` to delete a job from the `JOBS` table. Finally, you create a procedure called `GET_EMPLOYEE` to query the `EMPLOYEES` table, retrieving the salary and job ID for an employee when provided with the employee ID.

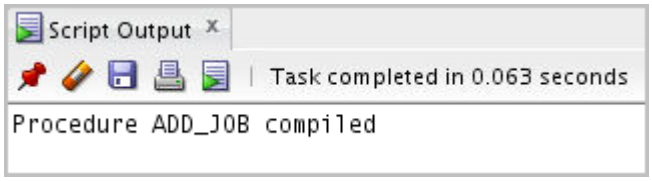
Note: Execute `cleanup_02.sql` from `/home/oracle/labs/plpu/code_ex/cleanup_scripts/` before performing the following task.

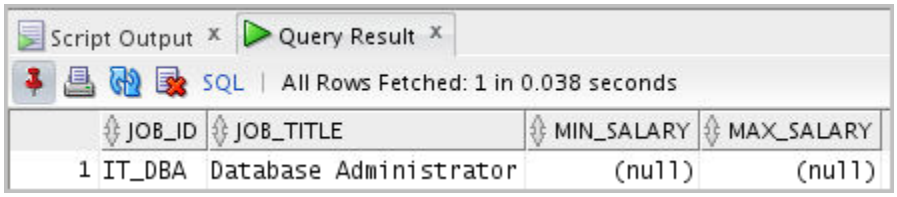
Task

1. Create, compile, and invoke the `ADD_JOB` procedure and review the results.
   a. Create a procedure called `ADD_JOB` to insert a new job into the `JOBS` table. Provide the ID and job title using two parameters.

      Note: You can create the procedure (and other objects) by entering the code in the SQL Worksheet area, and then click the Run Script (F5) icon. This creates and compiles the procedure. To find out whether or not the procedure has any errors, click the procedure name in the procedure node, and then select Compile from the pop-up menu.

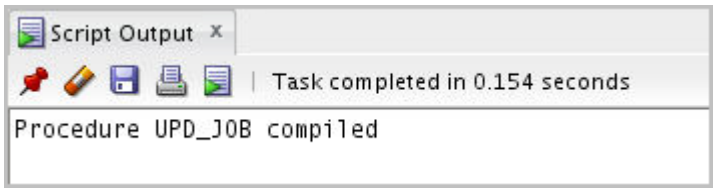
   b. Invoke the procedure with `IT_DBA` as the job ID and `Database Administrator` as the job title. Query the `JOBS` table and view the results.

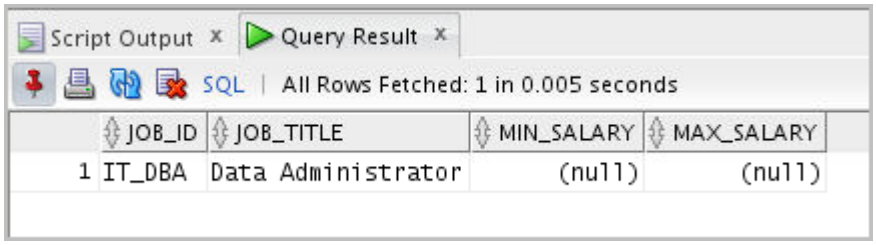




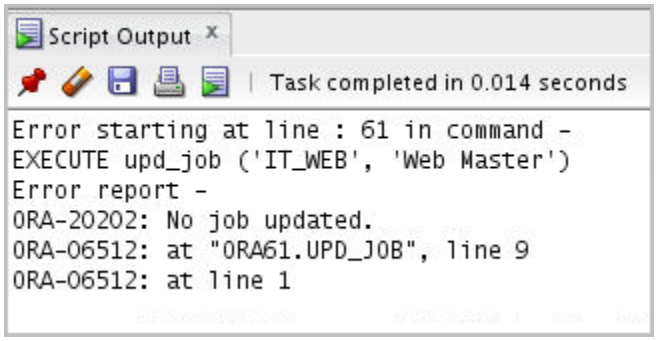
   c. Invoke your procedure again, passing a job ID of `ST_MAN` and a job title of `Stock Manager`. What happens and why?

2. Create a procedure called `UPD_JOB` to modify a job in the `JOBS` table.
   a. Create a procedure called `UPD_JOB` to update the job title. Provide the job ID and a new title using two parameters. Include the necessary exception handling if no update occurs.
   b. Invoke the procedure to change the job title of the job ID `IT_DBA` to `Data Administrator`. Query the `JOBS` table and view the results.

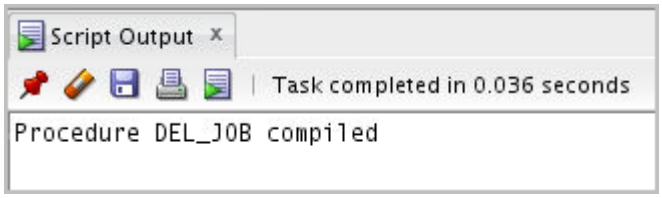




c. Test the exception-handling section of the procedure by trying to update a job that does not exist. You can use the job ID `IT_WEB` and the job title `Web Master`.

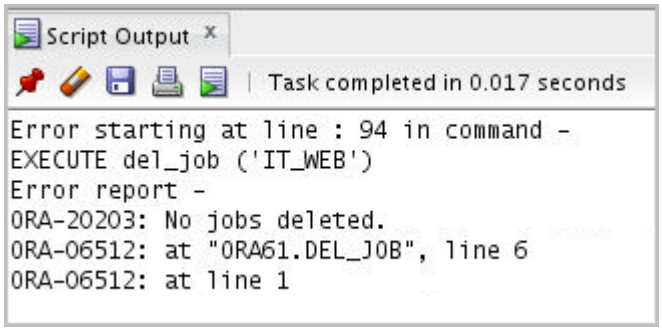


3. Create a procedure called `DEL_JOB` to delete a job from the `JOBS` table.
   a. Create a procedure called `DEL_JOB` to delete a job. Include the necessary exception-handling code if no job is deleted.



   b. Invoke the procedure using the job ID `IT_DBA`. Query the `JOBS` table and view the results.

   c. Test the exception-handling section of the procedure by trying to delete a job that does not exist. Use `IT_WEB` as the job ID. You should get the message that you included in the exception-handling section of the procedure as the output.



4. Create a procedure called `GET_EMPLOYEE` to query the `EMPLOYEES` table, retrieving the salary and job ID for an employee when provided with the employee ID.
   a. Create a procedure that returns a value from the `SALARY` and `JOB_ID` columns for a specified employee ID. Remove syntax errors, if any, and then recompile the code.
   b. Execute the procedure using host variables for the two `OUT` parameters—one for the salary and the other for the job ID. Display the salary and job ID for employee ID 120.

```
PL/SQL procedure successfully completed.


  V_SALARY
----------
      8000
V_JOB
-----
ST_MAN
```

   c. Invoke the procedure again, passing an `EMPLOYEE_ID` of `300`. What happens and why?

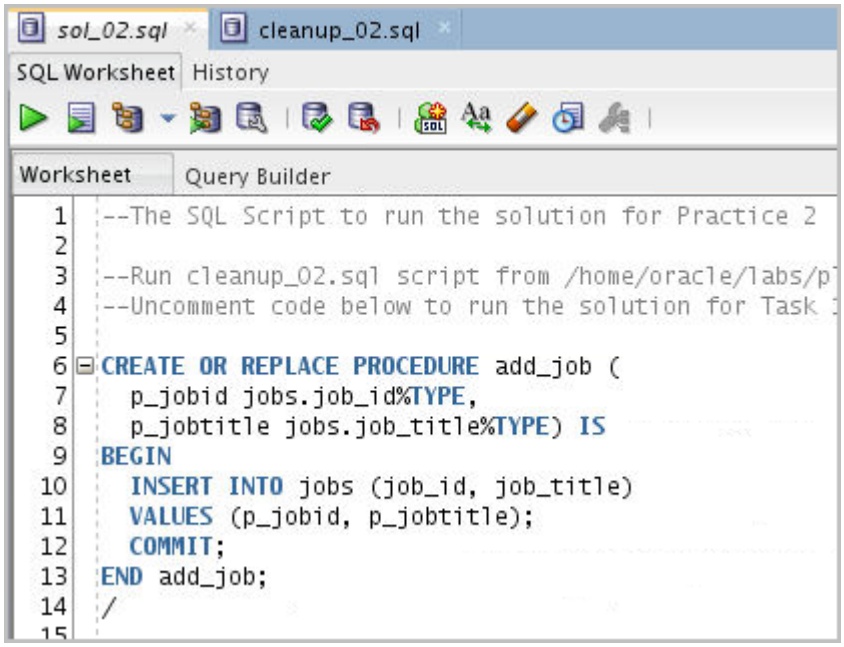
Solution 2-1: Creating, Compiling, and Calling Procedures

In this practice, you create and invoke the ADD_JOB procedure and review the results. You also create and invoke a procedure called UPD_JOB to modify a job in the JOBS table and create and invoke a procedure called DEL_JOB to delete a job from the JOBS table. Finally, you create a procedure called GET_EMPLOYEE to query the EMPLOYEES table, retrieving the salary and job ID for an employee when provided with the employee ID.

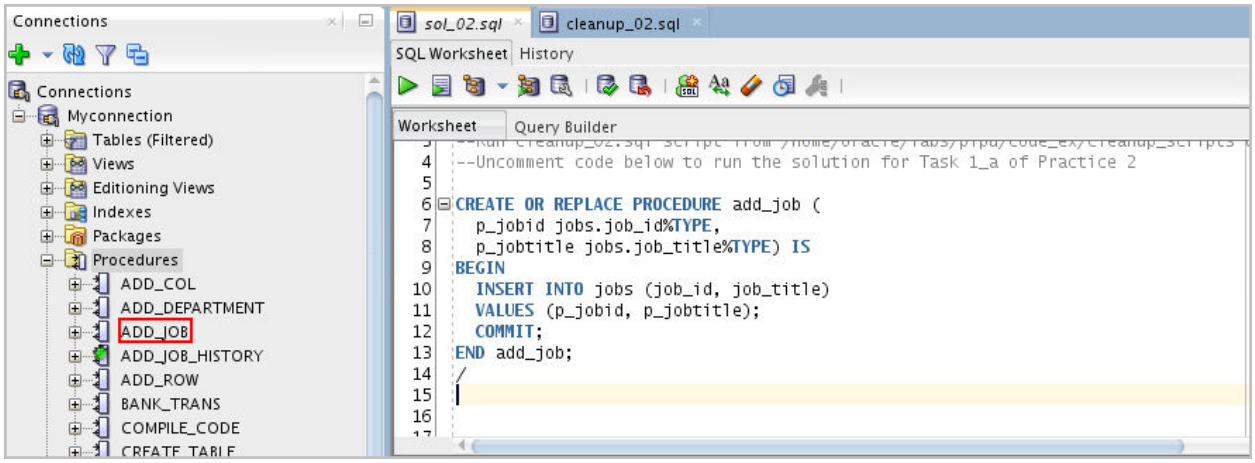
1. Create, compile, and invoke the ADD_JOB procedure and review the results.
   a. Create a procedure called ADD_JOB to insert a new job into the JOBS table. Provide the ID and job title using two parameters.

      Note: You can create the procedure (and other objects) by entering the code in the SQL Worksheet area, and then click the Run Script icon (or press F5). This creates and compiles the procedure. If the procedure generates an error message when you create it, click the procedure name in the procedure node, edit the procedure, and then select Compile from the pop-up menu.

      Open the `sol_02.sql` file in the `/home/oracle/labs/plpu/solns` directory. Uncomment and select the code for task 1_a. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the procedure. The code and the result are displayed as follows:



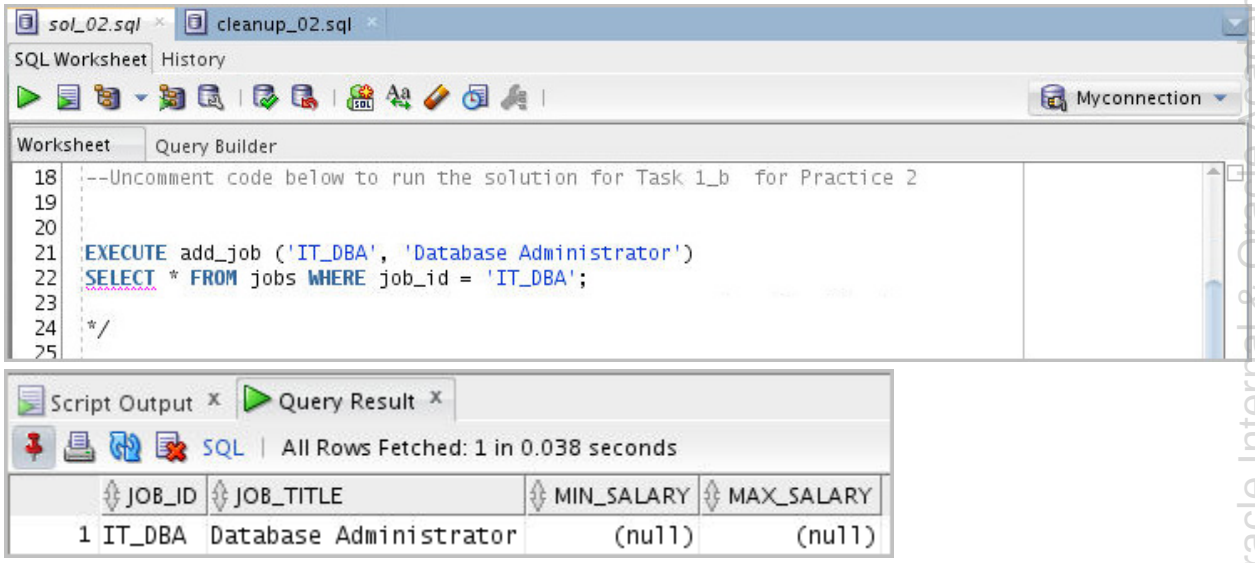
      To view the newly created procedure, click the Procedures node in the Object Navigator. If the newly created procedure is not displayed, right-click the Procedures node, and then select Refresh from the shortcut menu. The new procedure is displayed as follows:



b. Invoke the procedure with `IT_DBA` as the job ID and `Database Administrator` as the job title. Query the `JOBS` table and view the results.

Execute the code for Task 1_b from `sol_02.sql` script. The code and the result are displayed as follows:

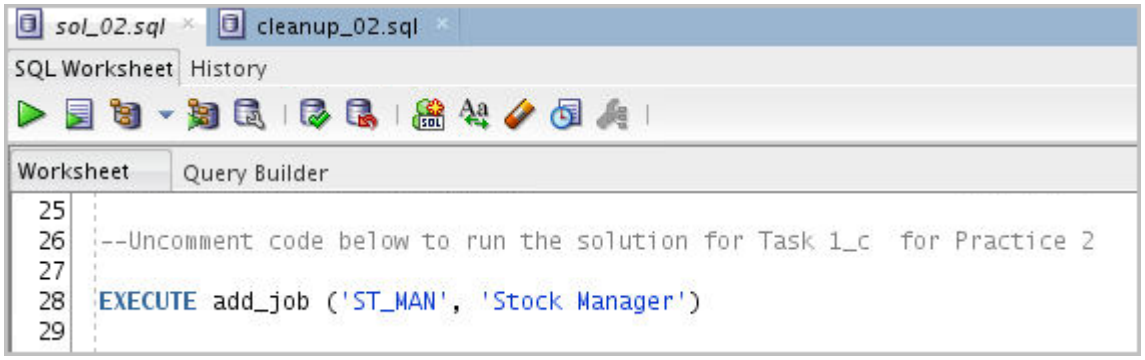
Note: Be sure to comment the previous code before uncommenting the next set of code.



c. Invoke your procedure again, passing a job ID of `ST_MAN` and a job title of `Stock Manager`. What happens and why?

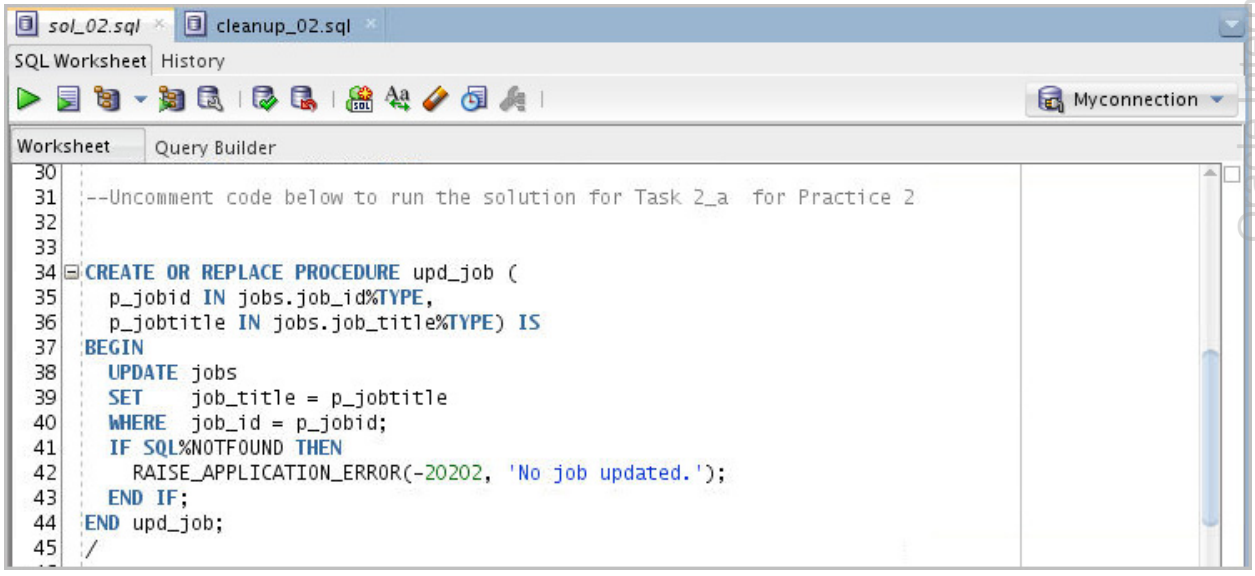
Run the code for Task 1_c from `sol_02.sql` script. The code and the result are displayed as follows:

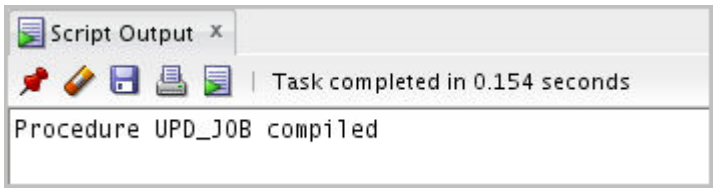
An exception occurs because there is a Unique key integrity constraint on the `JOB_ID` column.



2. Create a procedure called `UPD_JOB` to modify a job in the `JOBS` table.
   a. Create a procedure called `UPD_JOB` to update the job title. Provide the job ID and a new title by using two parameters. Include the necessary exception handling if no update occurs.

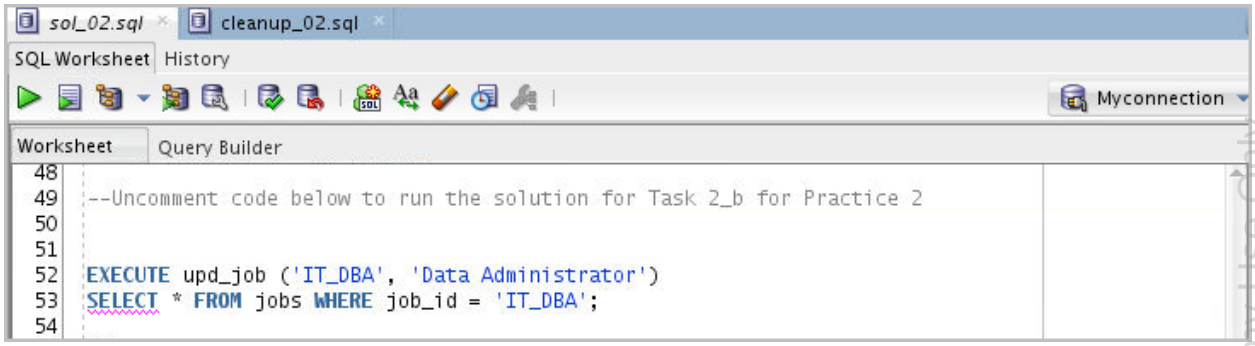
      Run the code for Task 2_a from the `sol_02.sql` script. The code and the result are displayed as follows:

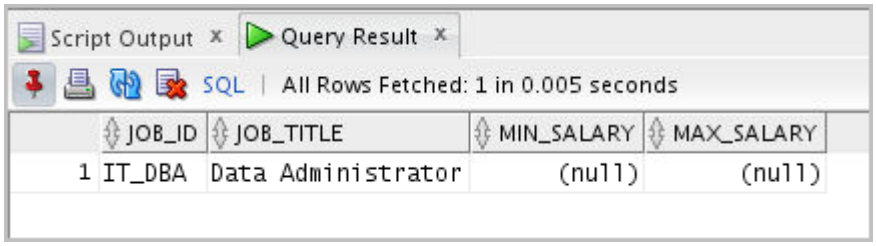




b. Invoke the procedure to change the job title of the job ID `IT_DBA` to `Data Administrator`. Query the `JOBS` table and view the results.

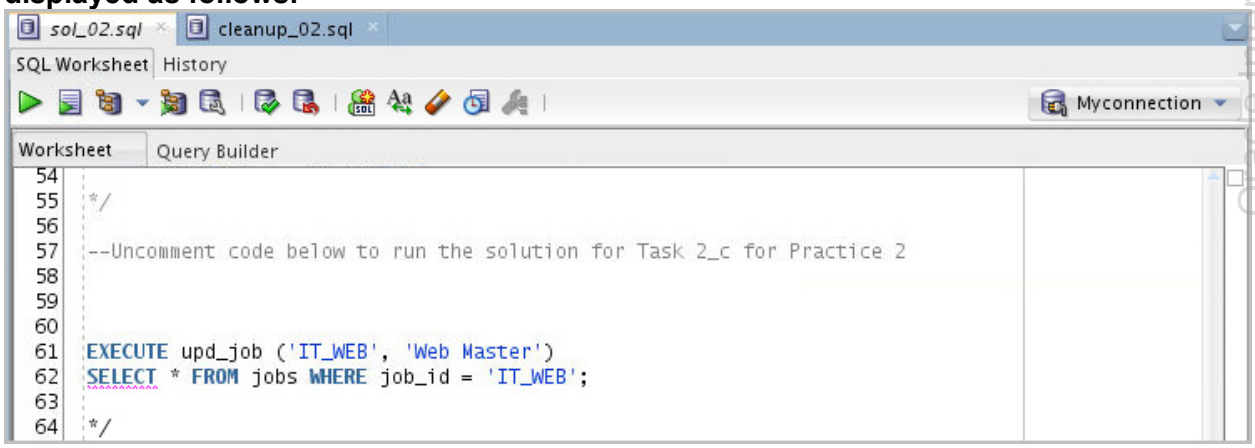
Run the code for Task 2_b from `sol_02.sql` script. The code and the result are displayed as follows:

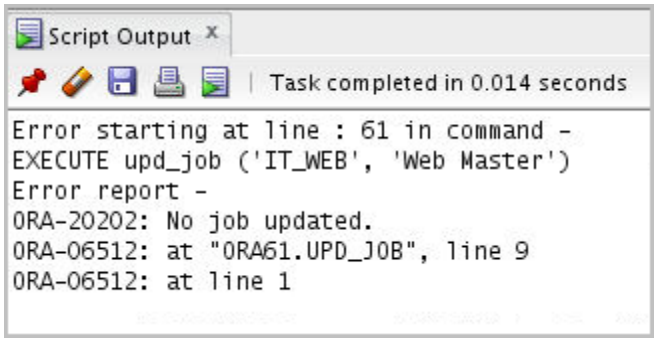


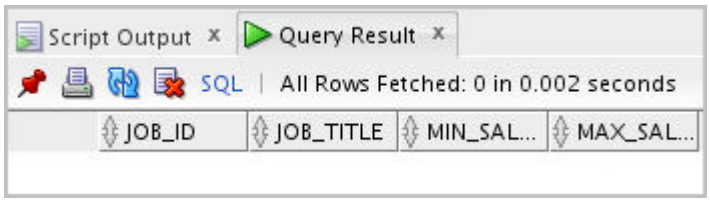


c. Test the exception-handling section of the procedure by trying to update a job that does not exist. You can use the job ID `IT_WEB` and the job title `Web Master`.

Run the code for Task 2_c from `sol_02.sql` script. The code and the result are displayed as follows:

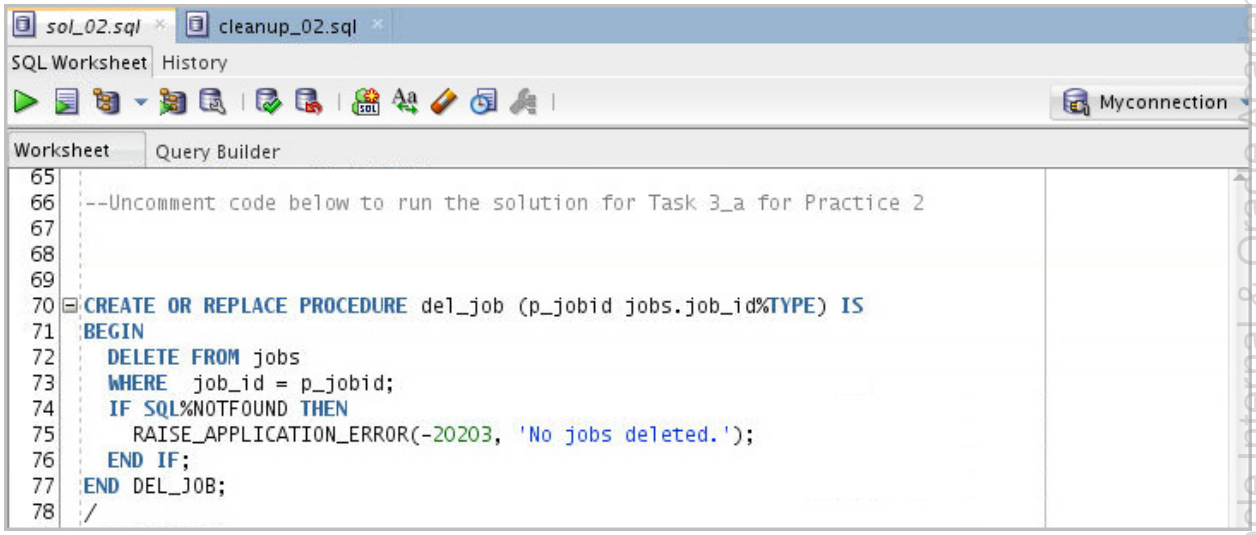


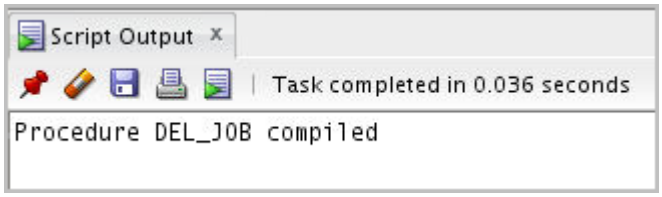




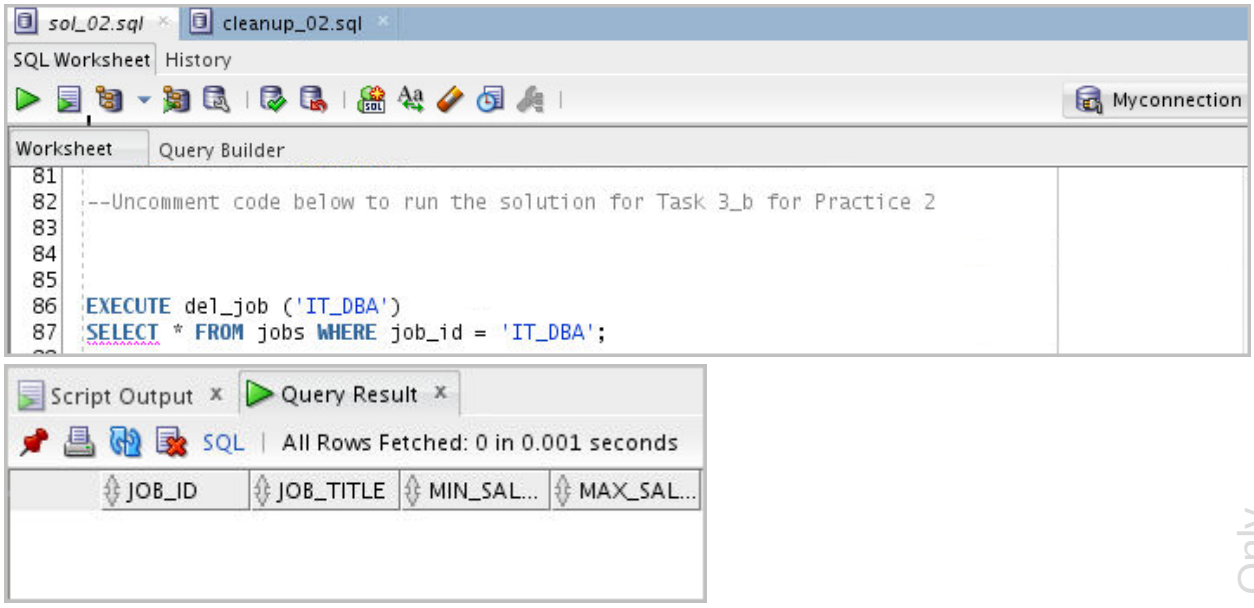
3. Create a procedure called `DEL_JOB` to delete a job from the `JOBS` table.
   a. Create a procedure called `DEL_JOB` to delete a job. Include the necessary exception-handling code if no job is deleted.

      Run the code for Task 3_a from `sol_02.sql` script. The code and the result are displayed as follows:



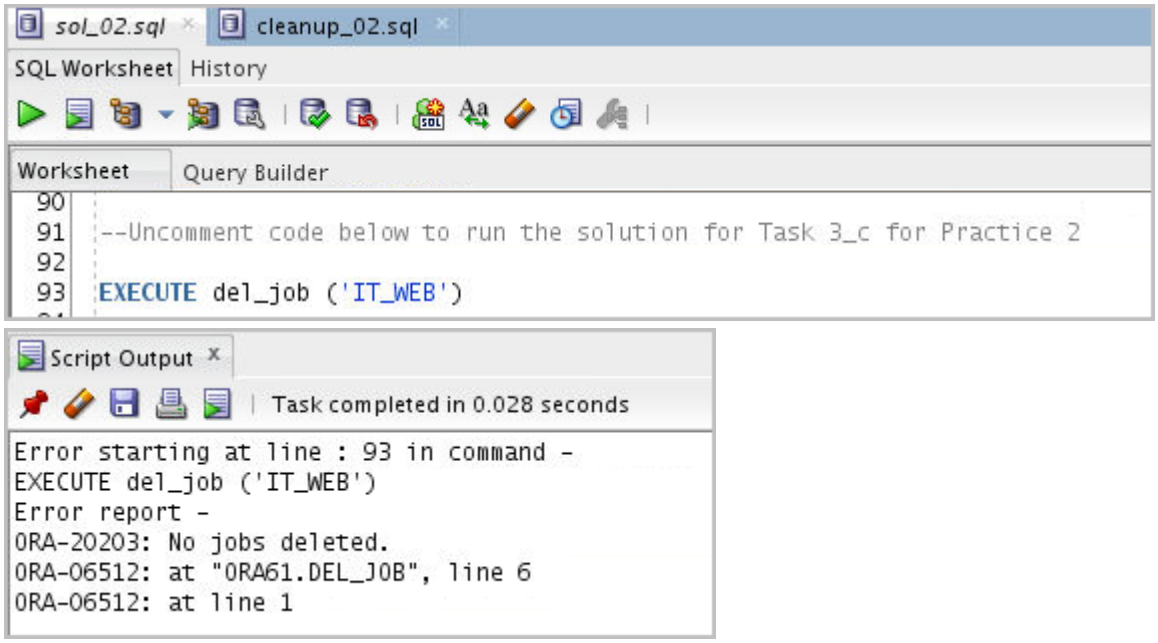


   b. **To invoke the procedure and then query the JOBS table, uncomment and select the code under task 3_b in the `/home/oracle/labs/plpu/solns/sol_02.sql` script. Click the Run Script icon (or press F9) icon on the SQL Worksheet toolbar to invoke the procedure. Click the Query Result tab to see the code and the result displayed as follows:**



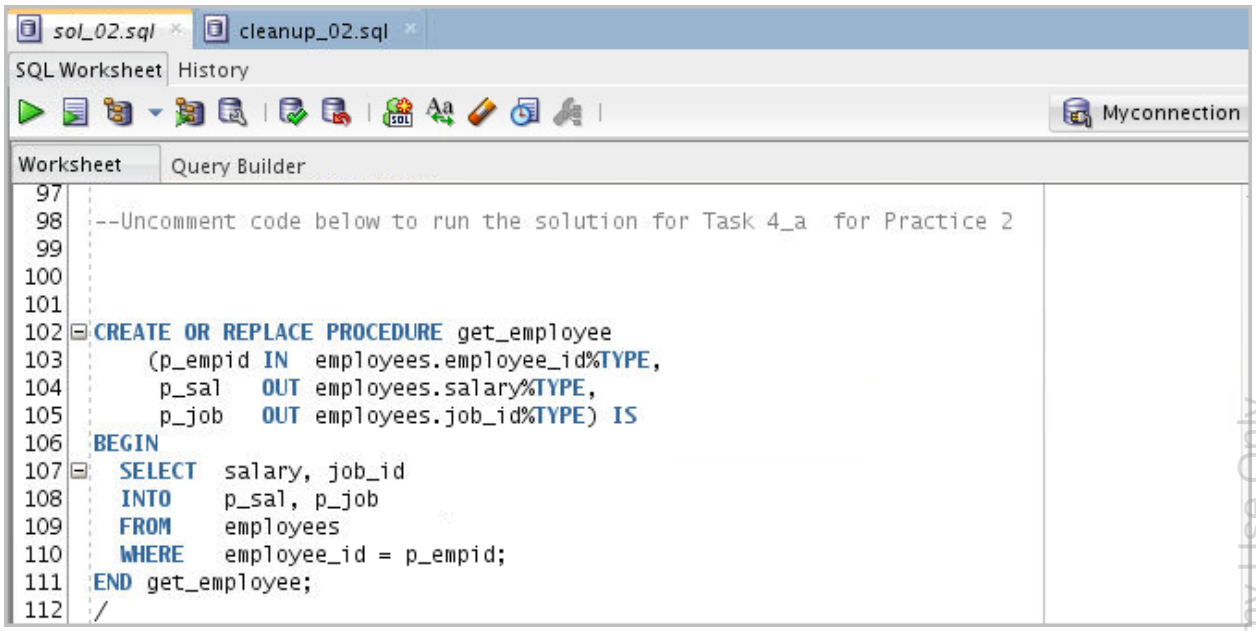
c. Test the exception-handling section of the procedure by trying to delete a job that does not exist. Use `IT_WEB` as the job ID. You should get the message that you included in the exception-handling section of the procedure as the output.

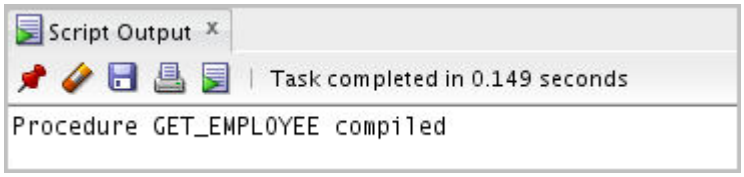
To invoke the procedure and then query the JOBS table, uncomment and select the code under task 3_c in the `/home/oracle/labs/plpu/solns/sol_02.sql` script. Click the Run Script (F5) icon on the SQL Worksheet toolbar to invoke the procedure. The code and the result are displayed as follows:



4. Create a procedure called `GET_EMPLOYEE` to query the `EMPLOYEES` table, retrieving the salary and job ID for an employee when provided with the employee ID.
   a. Create a procedure that returns a value from the `SALARY` and `JOB_ID` columns for a specified employee ID. Remove syntax errors, if any, and then recompile the code.

Uncomment and select the code for Task 4_a from the `sol_02.sql` script. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the procedure. The code and the result are displayed as follows:





Note: If the newly created procedure is not displayed in the Object Navigator, right-click the Procedures node in the Object Navigator, and then select Refresh from the shortcut menu. Right-click the procedure's name in the Object Navigator, and then select Compile from the shortcut menu. The procedure is compiled.

b. Execute the procedure using host variables for the two `OUT` parameters—one for the salary and the other for the job ID. Display the salary and job ID for employee ID 120.

Uncomment and select the code under Task 4_b from `sol_02.sql` script. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to invoke the procedure. The code and the result are displayed as follows:

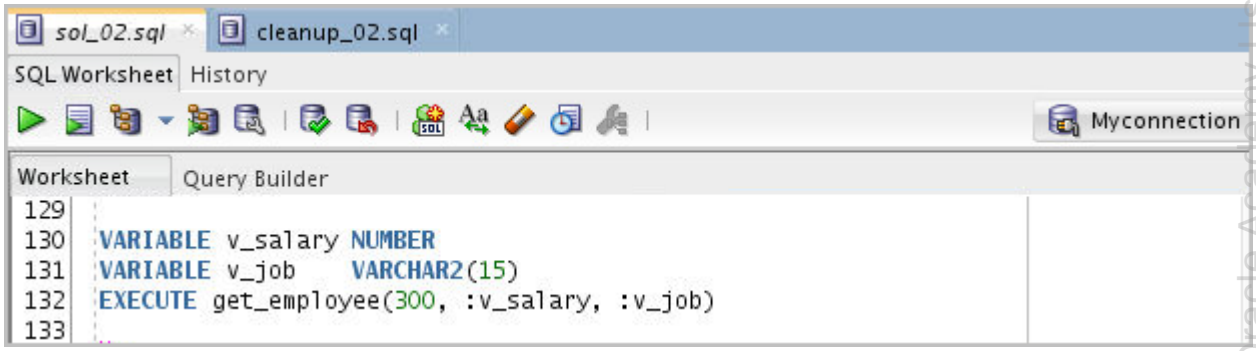
```
--Uncomment code below to run the solution for Task 4_b  for Practice 2



VARIABLE v_salary NUMBER
VARIABLE v_job    VARCHAR2(15)
EXECUTE get_employee(120, :v_salary, :v_job)
PRINT v_salary v_job
*/
```

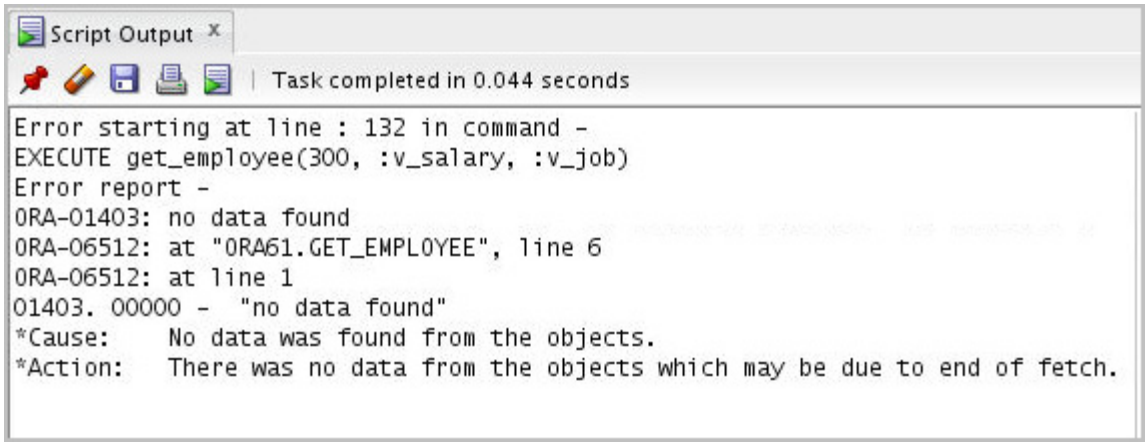
```
PL/SQL procedure successfully completed.


  V_SALARY
----------
      8000
V_JOB
-----
ST_MAN
```

c. Invoke the procedure again, passing an `EMPLOYEE_ID` of `300`. What happens and why?

Uncomment and select the code under Task 4_c from `sol_02.sql` script. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to invoke the procedure. The code and the result are displayed as follows:

There is no employee in the `EMPLOYEES` table with an `EMPLOYEE_ID` of `300`. The `SELECT` statement retrieved no data from the database, resulting in a fatal PL/SQL error: `NO_DATA_FOUND` as follows:





Practices for Lesson 3: Creating Functions

Chapter 3

Practices for Lesson 3: Overview

Overview

In practice 3-1, you create, compile, and use the following:

- A function called `GET_JOB` to return a job title
- A function called `GET_ANNUAL_COMP` to return the annual salary computed from an employee's monthly salary and commission passed as parameters
- A procedure called `ADD_EMPLOYEE` to insert a new employee into the `EMPLOYEES` table

In practice 3-2, you are introduced to the basic functionality of the SQL Developer debugger:

- Create a procedure and a function.
- Insert breakpoints in the newly created procedure.
- Compile the procedure and function for debug mode.
- Debug the procedure and step into the code.
- Display and modify the subprograms' variables.

Note:

1. Before starting this practice, execute `/home/oracle/labs/plpu/code_ex/cleanup_scripts/cleanup_03.sql` script.
2. If you missed a step in a practice, please run the appropriate solution script for that practice step before proceeding to the next step or the next practice.

Practice 3-1: Creating Functions

Overview

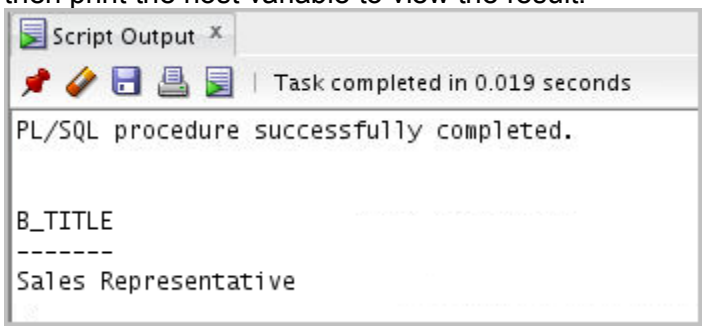
In this practice, you create, compile, and use stored functions and a procedure.

Note: Execute `cleanup_03.sql` from `/home/oracle/labs/plpu/code_ex/cleanup_scripts/` before performing the following tasks.

Task

1. Create and invoke the `GET_JOB` function to return a job title.
   a. Create and compile a function called `GET_JOB` to return a job title.

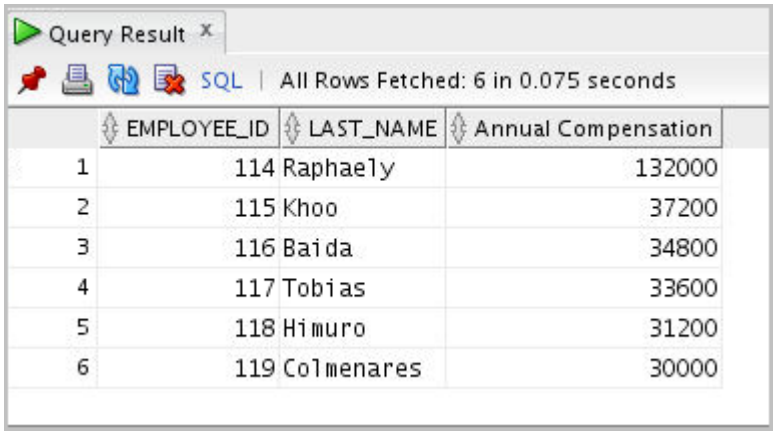
      Create a `VARCHAR2` host variable called `b_title`, allowing a length of 35 characters. Invoke the function with job ID `SA_REP` to return the value in the host variable, and then print the host variable to view the result.



2. Create a function called `GET_ANNUAL_COMP` to return the annual salary computed from an employee's monthly salary and commission passed as parameters.
   a. Create the `GET_ANNUAL_COMP` function, which accepts parameter values for the monthly salary and commission. Either or both values passed can be `NULL`, but the function should still return a non-`NULL` annual salary. Use the following basic formula to calculate the annual salary:

```
(salary*12) + (commission_pct*salary*12)
```

   b. Use the function in a `SELECT` statement against the `EMPLOYEES` table for employees in department 30.



	EMPLOYEE_ID	LAST_NAME	Annual Compensation
1	114	Raphaely	132000
2	115	Khoo	37200
3	116	Baida	34800
4	117	Tobias	33600
5	118	Himuro	31200
6	119	Colmenares	30000

3. Create a procedure, `ADD_EMPLOYEE`, to insert a new employee into the `EMPLOYEES` table. The procedure should call a `VALID_DEPTID` function to check whether the department ID specified for the new employee exists in the `DEPARTMENTS` table.

a. Create a function called VALID_DEPTID to validate a specified department ID and return a BOOLEAN value of TRUE if the department exists.
b. Create the ADD_EMPLOYEE procedure to add an employee to the EMPLOYEES table. The row should be added to the EMPLOYEES table if the VALID_DEPTID function returns TRUE; otherwise, alert the user with an appropriate message. Provide the following parameters:
   - first_name
   - last_name
   - email
   - job: Use 'SA_REP' as the default value.
   - mgr: Use 145 as the default value.
   - sal: Use 1000 as the default value.
   - comm: Use 0 as the default value.
   - deptid: Use 30 as the default value.
   - Use the EMPLOYEES_SEQ sequence to set the employee_id column.
   - Set the hire_date column to TRUNC(SYSDATE).
c. Call ADD_EMPLOYEE for the name 'Jane Harris' in department 15, leaving other parameters with their default values. What is the result?
d. Add another employee named Joe Harris in department 80, leaving the remaining parameters with their default values. What is the result?

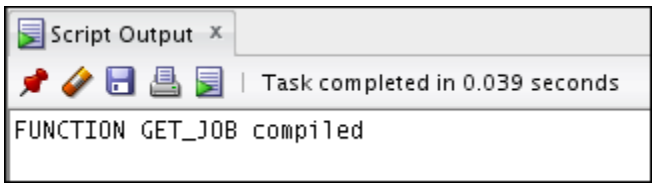
Solution 3-1: Creating Functions

In this practice, you create, compile, and use stored functions and a procedure.

1. Create and invoke the `GET_JOB` function to return a job title.
   a. Create and compile a function called `GET_JOB` to return a job title.

      Open the `/home/oracle/labs/plpu/solns/sol_03.sql` script. Uncomment and select the code under Task 1_a. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the function. The code and the result are displayed as follows:

```
CREATE OR REPLACE FUNCTION get_job (p_jobid IN jobs.job_id%type)
 RETURN jobs.job_title%type IS
  v_title jobs.job_title%type;
BEGIN
  SELECT job_title
  INTO v_title
  FROM jobs
  WHERE job_id = p_jobid;
  RETURN v_title;
END get_job;
/
```



Note: If you encounter an "**access control list (ACL) error**" while executing this step, please perform the following workaround:

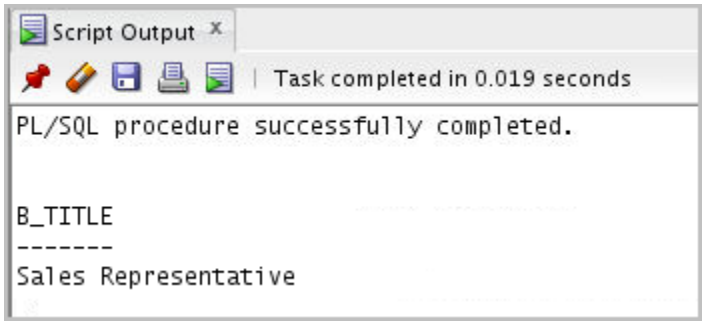
   a. Open SQL*Plus.
   b. Connect as SYSDBA.
   c. Execute the following code:

```
BEGIN
DBMS_NETWORK_ACL_ADMIN.APPEND_HOST_ACE(
host => '127.0.0.1',
ace => xs$ace_type(privilege_list => xs$name_list('jdwp'),
principal_name => 'ora61',
principal_type => xs_acl.ptype_db));
END;
/
```

   b. Create a `VARCHAR2` host variable called `b_title`, allowing a length of 35 characters. Invoke the function with job ID `SA_REP` to return the value in the host variable, and then print the host variable to view the result.

Uncomment and select the code under Task 1_b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the function. The code and the result are displayed as follows:

```
VARIABLE b_title VARCHAR2(35)
EXECUTE :b_title := get_job ('SA_REP');
PRINT b_title
```



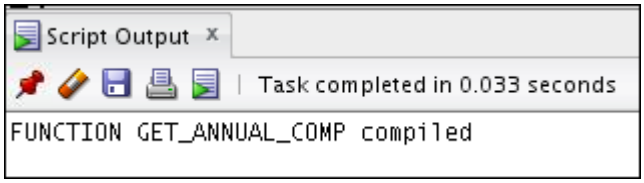
Note: Be sure to add the comments back to the previous code before executing the next set of code. Alternatively, you can select the complete code before using the Run Script icon (or press F5) to execute it.

2. Create a function called `GET_ANNUAL_COMP` to return the annual salary computed from an employee's monthly salary and commission passed as parameters.
   a. Create the `GET_ANNUAL_COMP` function, which accepts parameter values for the monthly salary and commission. Either or both values passed can be `NULL`, but the function should still return a non-`NULL` annual salary. Use the following basic formula to calculate the annual salary:

```
(salary*12) + (commission_pct*salary*12)
```

Uncomment and select the code under Task 2_a. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the function. The code and the result are displayed as follows:

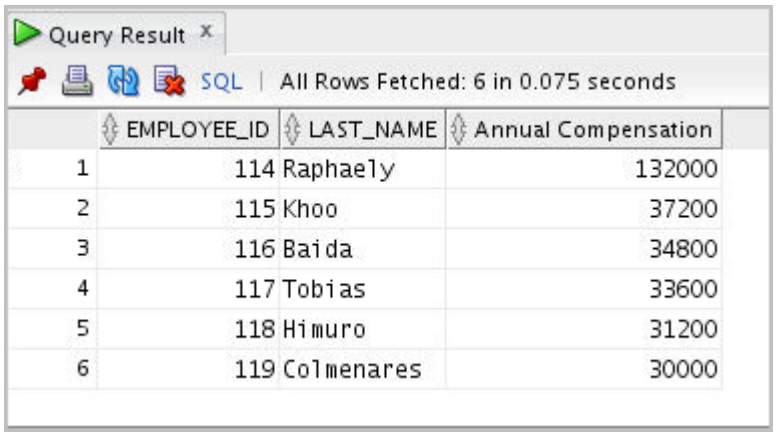
```
CREATE OR REPLACE FUNCTION get_annual_comp(
  p_sal  IN employees.salary%TYPE,
  p_comm IN employees.commission_pct%TYPE)
 RETURN NUMBER IS
BEGIN
  RETURN (NVL(p_sal,0) * 12 + (NVL(p_comm,0) * nvl(p_sal,0) *
12));
END get_annual_comp;
/
```



b. Use the function in a SELECT statement against the EMPLOYEES table for employees in department 30.

Uncomment and select the code under Task 2_b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the function. The code and the result are displayed as follows:

```
SELECT employee_id, last_name,
       get_annual_comp(salary,commission_pct) "Annual
Compensation"
FROM   employees
WHERE department_id=30
/
```



	EMPLOYEE_ID	LAST_NAME	Annual Compensation
1	114	Raphaely	132000
2	115	Khoo	37200
3	116	Baida	34800
4	117	Tobias	33600
5	118	Himuro	31200
6	119	Colmenares	30000

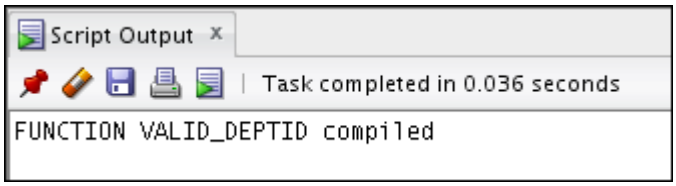
3. Create a procedure, ADD_EMPLOYEE, to insert a new employee into the EMPLOYEES table. The procedure should call a VALID_DEPTID function to check whether the department ID specified for the new employee exists in the DEPARTMENTS table.

   a. Create a function called VALID_DEPTID to validate a specified department ID and return a BOOLEAN value of TRUE if the department exists.

   Uncomment and select the code under Task 3_a. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create the function. The code and the result are displayed as follows:

```
CREATE OR REPLACE FUNCTION valid_deptid(
  p_deptid IN departments.department_id%TYPE)
  RETURN BOOLEAN IS
  v_dummy  PLS_INTEGER;

BEGIN
  SELECT  1
  INTO    v_dummy
  FROM    departments
  WHERE   department_id = p_deptid;
  RETURN  TRUE;
EXCEPTION
  WHEN NO_DATA_FOUND THEN
```

```
    RETURN FALSE;
END valid_deptid;
/
```

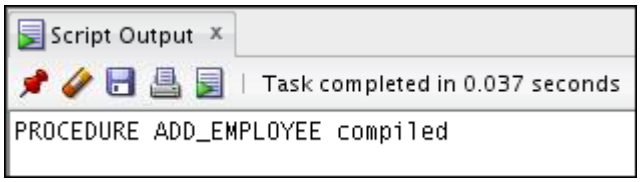


b. Create the `ADD_EMPLOYEE` procedure to add an employee to the `EMPLOYEES` table. The row should be added to the `EMPLOYEES` table if the `VALID_DEPTID` function returns `TRUE`; otherwise, alert the user with an appropriate message. Provide the following parameters:
   - `first_name`
   - `last_name`
   - `email`
   - `job`: Use `'SA_REP'` as the default value.
   - `mgr`: Use 145 as the default value.
   - `sal`: Use 1000 as the default value.
   - `comm`: Use 0 as the default value.
   - `deptid`: Use 30 as the default value.
   - Use the `EMPLOYEES_SEQ` sequence to set the `employee_id` column.
   - Set the `hire_date` column to `TRUNC(SYSDATE)`.

   Uncomment and select the code under Task 3_b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the procedure. The code and the result are displayed as follows:

```
CREATE OR REPLACE PROCEDURE add_employee(
   p_first_name employees.first_name%TYPE,
   p_last_name  employees.last_name%TYPE,
   p_email      employees.email%TYPE,
   p_job        employees.job_id%TYPE        DEFAULT 'SA_REP',
   p_mgr        employees.manager_id%TYPE     DEFAULT 145,
   p_sal        employees.salary%TYPE         DEFAULT 1000,
   p_comm       employees.commission_pct%TYPE DEFAULT 0,
   p_deptid     employees.department_id%TYPE  DEFAULT 30) IS
BEGIN
 IF valid_deptid(p_deptid) THEN
   INSERT INTO employees(employee_id, first_name, last_name,
email,
     job_id, manager_id, hire_date, salary, commission_pct,
department_id)
```

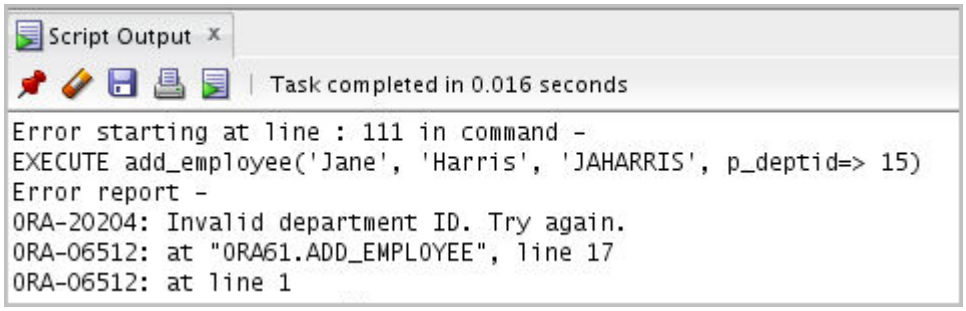
```
   VALUES (employees_seq.NEXTVAL, p_first_name, p_last_name,
p_email,
     p_job, p_mgr, TRUNC(SYSDATE), p_sal, p_comm, p_deptid);
 ELSE
   RAISE_APPLICATION_ERROR (-20204, 'Invalid department ID. Try
again.');
 END IF;
END add_employee;
/
```



c. Call `ADD_EMPLOYEE` for the name `'Jane Harris'` in department 15, leaving other parameters with their default values. What is the result?

Uncomment and select the code under Task 3_c. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to invoke the procedure. The code and the result are displayed as follows:

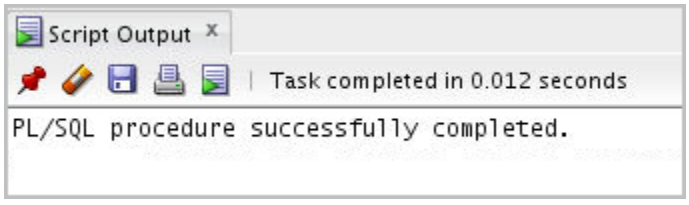
```
EXECUTE add_employee('Jane','Harris','JAHARRIS',p_deptid=> 15)
```



d. Add another employee named Joe Harris in department 80, leaving the remaining parameters with their default values. What is the result?

Uncomment and select the code under Task 3_d. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to invoke the procedure. The code and the result are displayed as follows:

```
EXECUTE add_employee('Joe', 'Harris', 'JOHARRIS', p_deptid=> 80)
```



Practices for Lesson 4: Debugging Subprograms

Chapter 4

Practices for Lesson 4: Overview

Overview

In practice 4-1, you are introduced to the basic functionality of the SQL Developer debugger:

- Create a procedure and a function.
- Insert breakpoints in the newly created procedure.
- Compile the procedure and function for debug mode.
- Debug the procedure and step into the code.
- Display and modify the subprograms' variables.

Note:

1. Before starting this practice, execute `/home/oracle/labs/plpu/code_ex/cleanup_scripts/cleanup_04.sql` script.
2. If you missed a step in a practice, please run the appropriate solution script for that practice step before proceeding to the next step or the next practice.
3. If you encounter an "**access control list (ACL) error**" while executing this step, please perform the following workaround:
   a. Open SQL*Plus.
   b. Connect as SYSDBA.
   c. Execute the following code:

```
BEGIN
DBMS_NETWORK_ACL_ADMIN.APPEND_HOST_ACE(
host => '127.0.0.1',
ace => xs$ace_type(privilege_list => xs$name_list('jdwp'),
principal_name => 'ora61',
principal_type => xs_acl.ptype_db));
END;
/
```

Practice 4-1: Introduction to the SQL Developer Debugger

Overview

In this practice, you experiment with the basic functionality of the SQL Developer debugger.

Tasks

1. Enable `SERVEROUTPUT`.
2. Run the solution under Task 2 of practice 4-1 to create the `emp_list` procedure. Examine the code of the procedure and compile the procedure. Why do you get the compiler error?
3. Run the solution under Task 3 of practice 4-1 to create the `get_location` function. Examine the code of the function, compile the function, and then correct any errors, if any.
4. Re-compile the `emp_list` procedure. The procedure should compile successfully.
5. Edit the `emp_list` procedure and the `get_location` function.
6. Add four breakpoints to the `emp_list` procedure to the following lines of code:
   a. `OPEN cur_emp;`
   b. `WHILE (cur_emp%FOUND) AND (i <= p_maxrows) LOOP`
   c. `v_city := get_location (rec_emp.department_name);`
   d. `CLOSE cur_emp;`
7. Compile the `emp_list` procedure for debugging.
8. Debug the procedure.
9. Enter 100 as the value of the `PMAXROWS` parameter.
10. Examine the value of the variables on the Data tab. What are the values assigned to `REC_EMP` and `EMP_TAB`? Why?
11. Use the Step Into debug option to step into each line of code in `emp_list` and go through the while loop once only.
12. Examine the value of the variables on the Data tab. What are the values assigned to `REC_EMP`?
13. Continue pressing F7 until the `emp_tab(i) := rec_emp;` line is executed. Examine the value of the variables on the Data tab. What are the values assigned to `EMP_TAB`?
14. Use the Data tab to modify the value of the counter i to 98.
15. Continue pressing F7 until you observe the list of employees displayed on the Debugging – Log tab. How many employees are displayed?
16. If you use the Step Over debugger option to step through the code, do you step through the `get_location` function? Why or why not?

Solution 4-1: Introduction to the SQL Developer Debugger

In this practice, you experiment with the basic functionality of the SQL Developer debugger.

1. Enable `SERVEROUTPUT`.

   Enter the following command in the SQL Worksheet area, and then click the Run Script icon (or press F5). Click the icon on the SQL Worksheet toolbar.

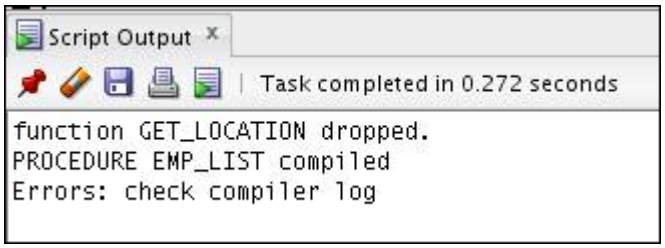
   ```
   SET SERVEROUTPUT ON
   ```

2. Run the solution under Task 2 of practice 4-1 to create the `emp_list` procedure. Examine the code of the procedure and compile the procedure. Why do you get the compiler error?

   Uncomment and select the code under Task 2 of Practice 4-1. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the procedure. The codex and the result are displayed as follows:

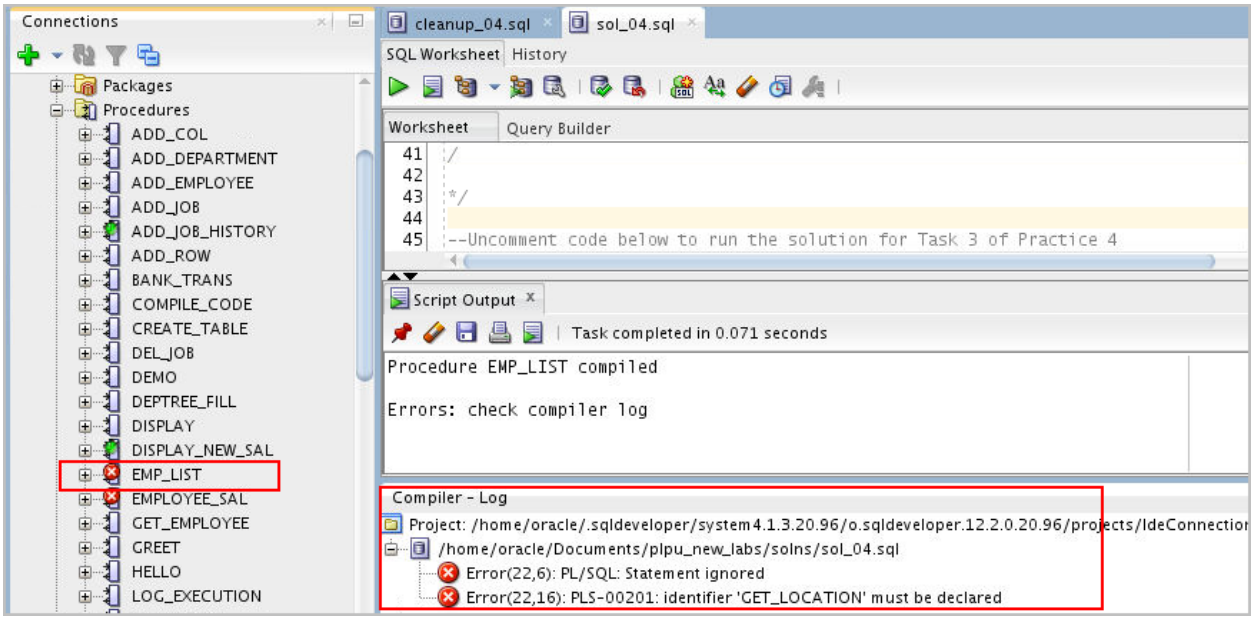
```
DROP FUNCTION get_location;

CREATE OR REPLACE PROCEDURE emp_list
(p_maxrows IN NUMBER)
IS
CURSOR cur_emp IS
  SELECT d.department_name, e.employee_id, e.last_name,
         e.salary, e.commission_pct
  FROM  departments d, employees e
  WHERE d.department_id = e.department_id;
  rec_emp cur_emp%ROWTYPE;
  TYPE emp_tab_type IS TABLE OF cur_emp%ROWTYPE INDEX BY
BINARY_INTEGER;
  emp_tab emp_tab_type;
i NUMBER := 1;
v_city VARCHAR2(30);
BEGIN
  OPEN cur_emp;
  FETCH cur_emp INTO rec_emp;
  emp_tab(i) := rec_emp;
  WHILE (cur_emp%FOUND) AND (i <= p_maxrows) LOOP
     i := i + 1;
     FETCH cur_emp INTO rec_emp;
     emp_tab(i) := rec_emp;
     v_city := get_location (rec_emp.department_name);
     dbms_output.put_line('Employee ' || rec_emp.last_name ||
       ' works in ' || v_city );
  END LOOP;
  CLOSE cur_emp;
```

```
  FOR j IN REVERSE 1..i LOOP
     DBMS_OUTPUT.PUT_LINE(emp_tab(j).last_name);
  END LOOP;
END emp_list;
/
```



Note: You may expect an error message in the output if the `get_location` function does not exist. If the function exists, you get the above output.

The compilation warning is because the `get_location` function is not yet declared. To display the compile error in more detail, right-click the `EMP_LIST` procedure in the Procedures node (you might need to refresh the procedures list in order to view the newly created `EMP_LIST` procedure), and then select Compile from the pop-up menu. The detailed warning message is displayed on the Compiler-Log tab as follows:



3. Run the solution under Task 3 of practice 4-1 to create the `get_location` function. Examine the code of the function, compile the function, and then correct any errors, if any.

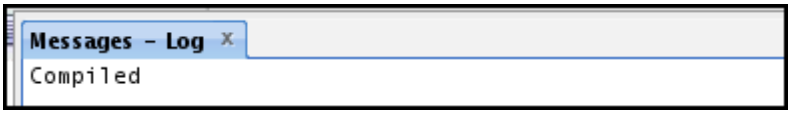
   Uncomment and select the code under Task 3 of Practice 4-1. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the procedure. The codex and the result are displayed as follows:

```
CREATE OR REPLACE FUNCTION get_location
( p_deptname IN VARCHAR2) RETURN VARCHAR2
AS
  v_loc_id NUMBER;
```

```
  v_city   VARCHAR2(30);
BEGIN
  SELECT d.location_id, l.city INTO v_loc_id, v_city
  FROM departments d, locations l
  WHERE upper(department_name) = upper(p_deptname)
  and d.location_id = l.location_id;
  RETURN v_city;
END GET_LOCATION;
/
```

4. Recompile the `emp_list` procedure. The procedure should compile successfully.

   To recompile the procedure, right-click the procedure's name, and then select Compile from the shortcut menu.



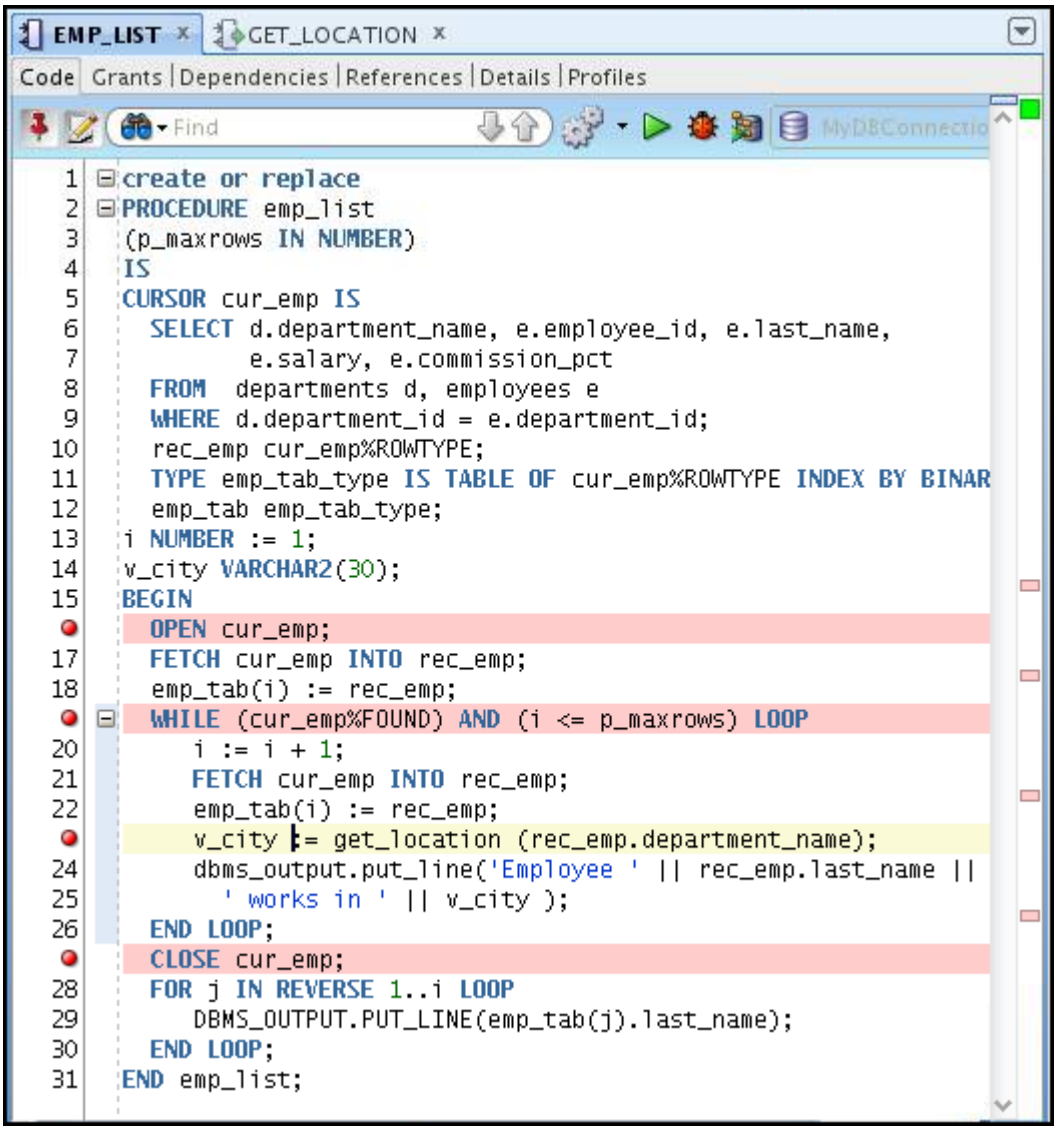
5. Edit the `emp_list` procedure and the `get_location` function.

   Right-click the `emp_list` procedure name in the Object Navigator, and then select Edit. The `emp_list` procedure is opened in edit mode. If the procedure is already displayed in the SQL Worksheet area, but is in read-only mode, click the Edit icon (pencil icon) on the Code tab.

   Right-click the `get_location` function name in the Object Navigator, and then select Edit. The `get_location` function is opened in edit mode. If the function is already displayed in the SQL Worksheet area, but is in read-only mode, click the Edit icon (pencil icon) on the Code tab.

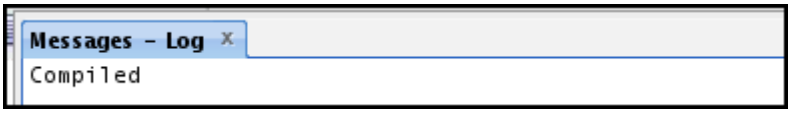
6. Add four breakpoints to the `emp_list` procedure to the following lines of code:
   a. `OPEN cur_emp;`
   b. `WHILE (cur_emp%FOUND) AND (i <= p_maxrows) LOOP`
   c. `v_city := get_location (rec_emp.department_name);`
   d. `CLOSE cur_emp;`

To add a breakpoint, click the line gutter next to each of the lines listed above as shown below:



7. Compile the `emp_list` procedure for debugging.

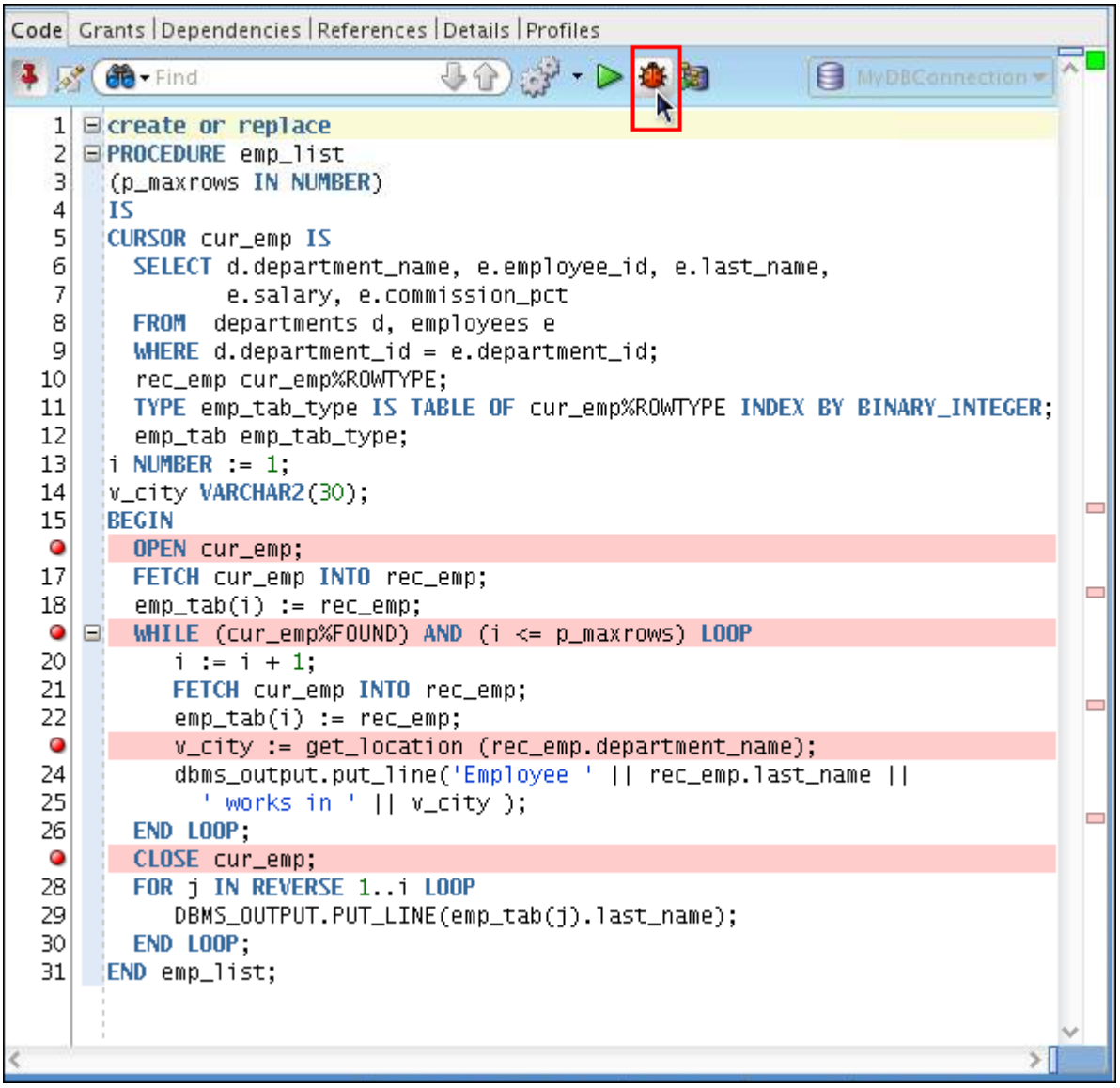
Click the "Compile for Debug" icon on the procedure's toolbar and you get the output as shown below:



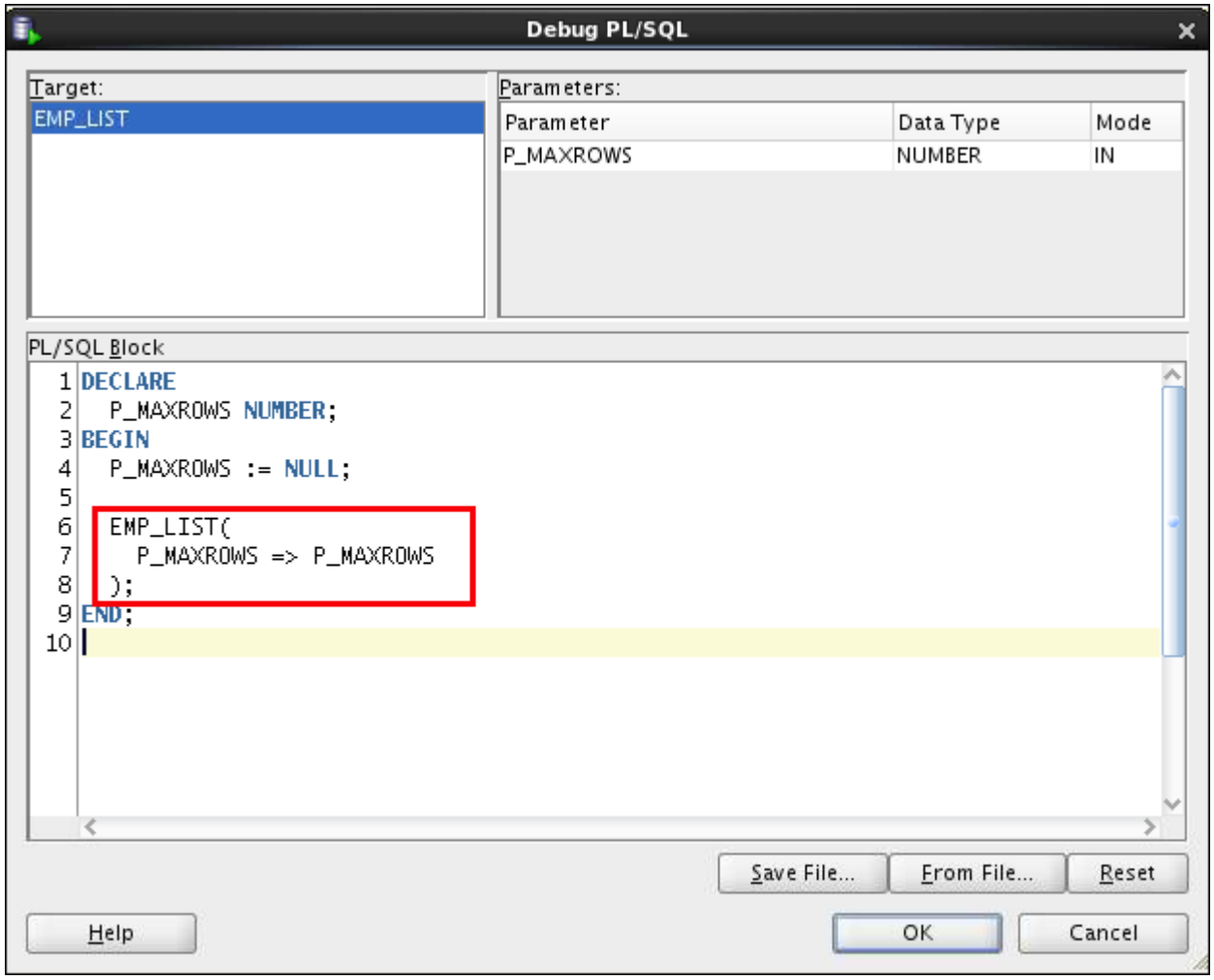
Note: If you get any warnings, it is expected. The two warnings are because the `PLSQL_DEBUG` parameter was deprecated in Oracle Database 11*g*, while SQL Developer is still using that parameter.

8. Debug the procedure.

Click the Debug icon on the procedure's toolbar as shown below:

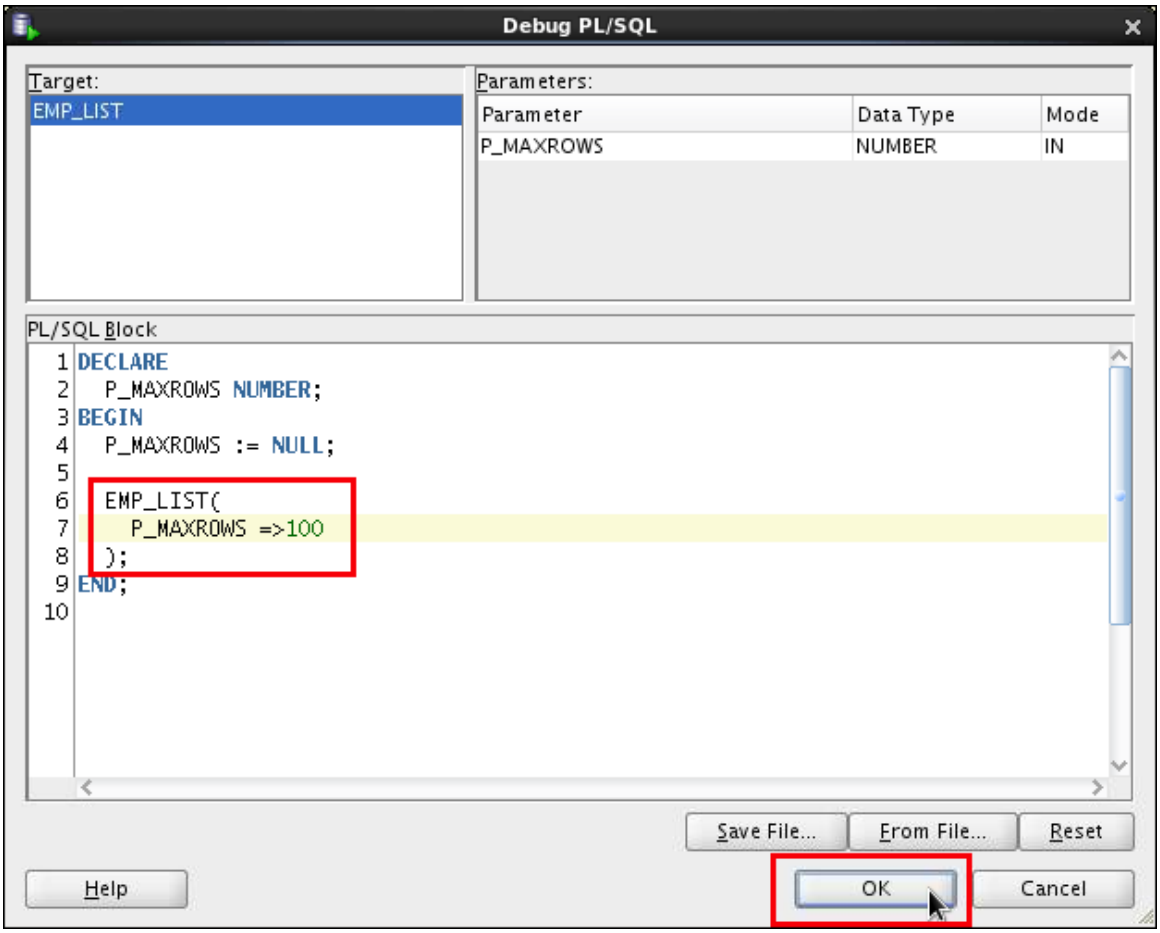


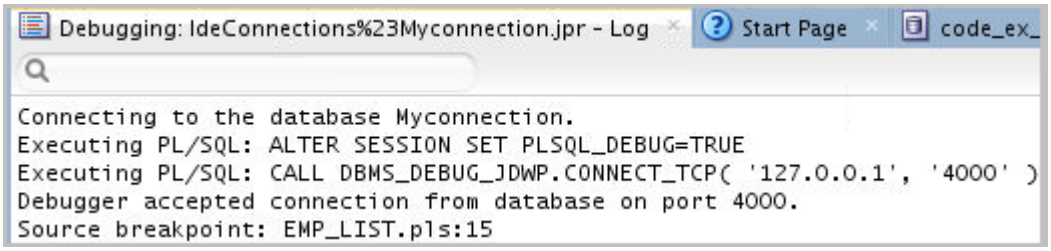
The Debug PL/SQL window is displayed as follows:



9. Enter 100 as the value of the `PMAXROWS` parameter.

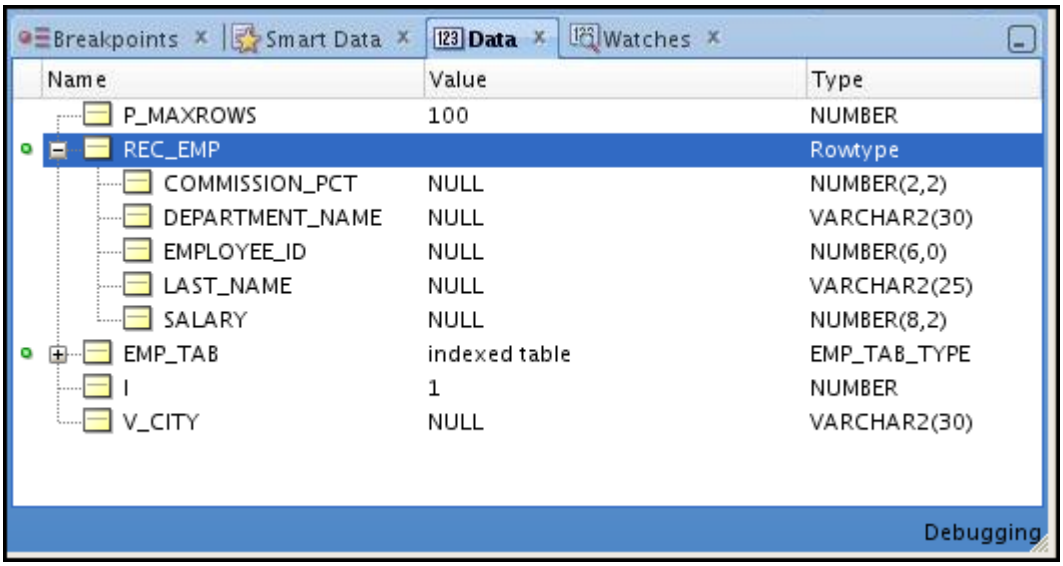
   Replace the second `P_MAXROWS` with 100, and then click OK. Notice how the program control stops at the first breakpoint in the procedure as indicated by the blue highlight color and the red arrow pointing to that line of code. The additional debugging tabs are displayed at the bottom of the page.





10. Examine the value of the variables on the Data tab. What are the values assigned to `REC_EMP` and `EMP_TAB`? Why?

Both are set to `NULL` because the data is not yet fetched into the cursor.

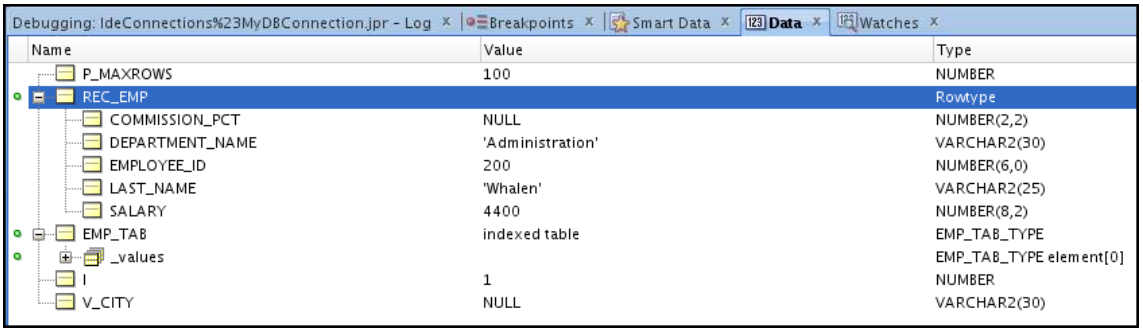


11. Use the Step Into debug option to step in to each line of code in `emp_list` and go through the while loop only once.

    Press F7 to step into the code only once.

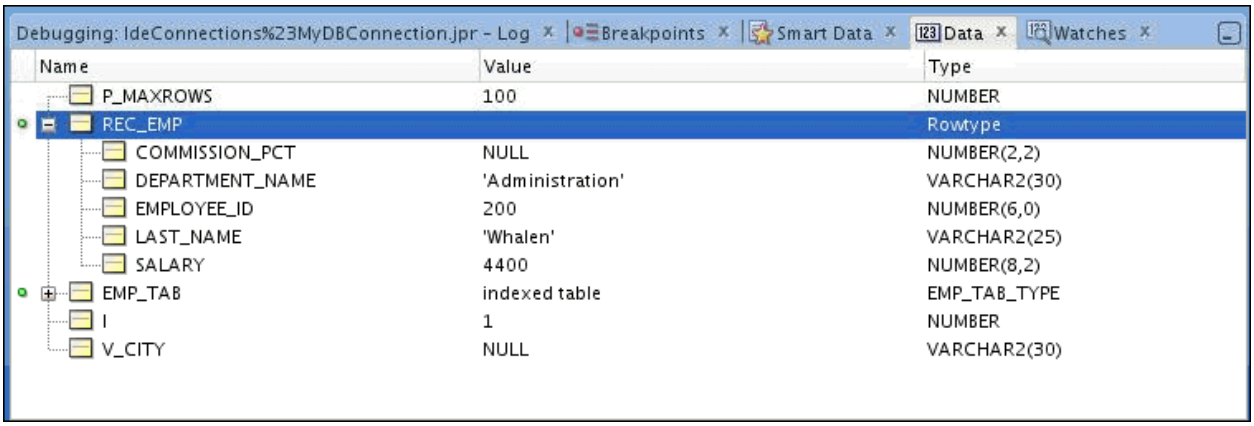
12. Examine the value of the variables on the Data tab. What are the values assigned to `REC_EMP` and `EMP_TAB`?

    Note that when the line `FETCH cur_emp INTO rec_emp;` is executed, `rec_emp` is initialized as shown below:



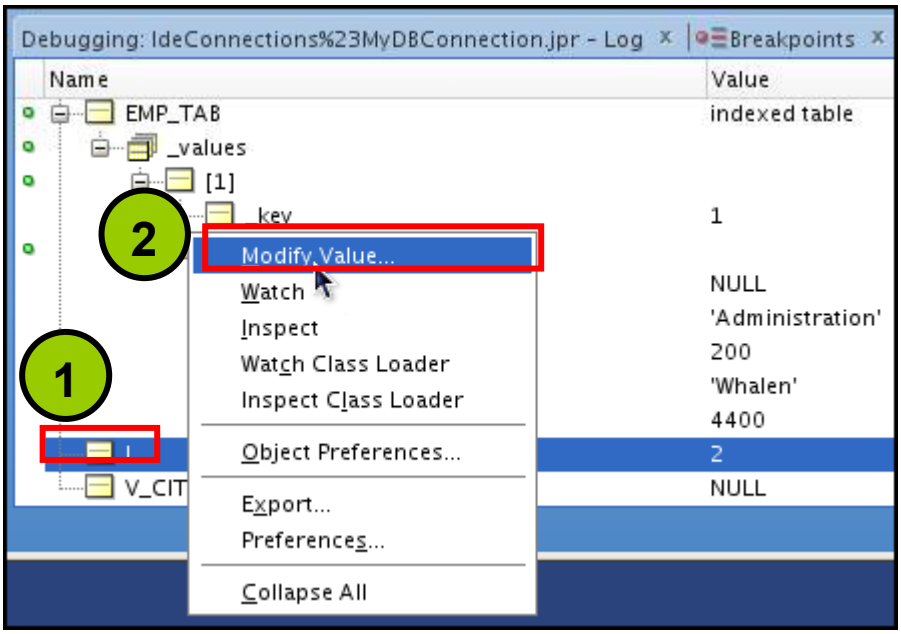
13. Continue pressing F7 until the `emp_tab(i) := rec_emp;` line is executed. Examine the value of the variables on the Data tab. What are the values assigned to `EMP_TAB`?

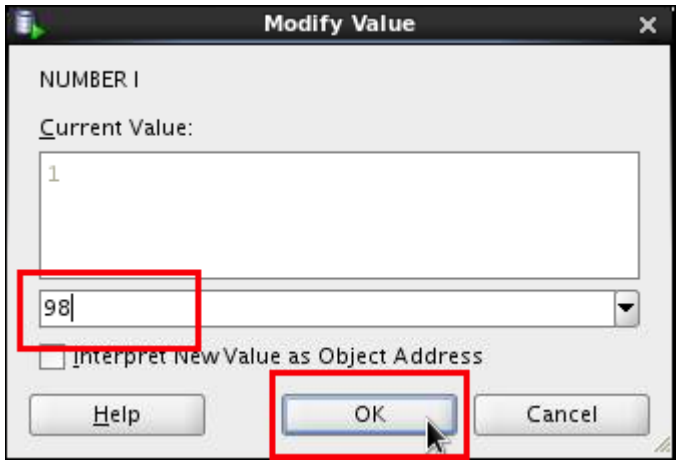
    When the line `emp_tab(i) := rec_emp;` is executed, `emp_tab` is initialized to `rec_emp` as shown below:



14. Use the Data tab to modify the value of the counter i to 98.

On the Data tab, right-click I and select Modify Value from the shortcut menu. The Modify Value window is displayed. Replace the value 1 with 98 in the text box, and then click OK as shown below:





15. Continue pressing F7 until you observe the list of employees displayed on the Debugging – Log tab. How many employees are displayed?

    The output at the end of the debugging session is shown below where it displays three employees:

```
Debugging: IdeConnections%23Myconnection.jpr - Log   Start Page   code_ex_
Connecting to the database Myconnection.
Executing PL/SQL: ALTER SESSION SET PLSQL_DEBUG=TRUE
Executing PL/SQL: CALL DBMS_DEBUG_JDWP.CONNECT_TCP( '127.0.0.1', '4000' )
Debugger accepted connection from database on port 4000.
Source breakpoint: EMP_LIST.pls:15
Source breakpoint: EMP_LIST.pls:18
Source breakpoint: EMP_LIST.pls:22
Source breakpoint: EMP_LIST.pls:18
Source breakpoint: EMP_LIST.pls:22
Source breakpoint: EMP_LIST.pls:18
Source breakpoint: EMP_LIST.pls:22
Source breakpoint: EMP_LIST.pls:18
Source breakpoint: EMP_LIST.pls:26
Exception breakpoint: EMP_LIST.pls:28, $Oracle.EXCEPTION_ORA_1403,
ORA-01403: no data found
ORA-06512: at "ORA61.EMP_LIST", line 28
ORA-06512: at line 6
Executing PL/SQL: CALL DBMS_DEBUG_JDWP.DISCONNECT()
Employee Hartstein works in Toronto
Employee Fay works in Toronto
Employee Baida works in Seattle
Baida
Fay
Hartstein
Whalen
Process exited.
Disconnecting from the database Myconnection.
Debugger disconnected from database.
```

16. If you use the Step Over debugger option to step through the code, do you step through the `get_location` function? Why or why not?

Although the line of code where the third breakpoint is set contains a call to the `get_location` function, the Step Over (F8) executes the line of code and retrieves the returned value of the function (same as [F7]); however, control is not transferred to the `get_location` function.

Practices for Lesson 5: Creating Packages

Chapter 5

Practices for Lesson 5: Overview

Overview

In this practice, you create a package specification and body called `JOB_PKG`, containing a copy of your `ADD_JOB`, `UPD_JOB`, and `DEL_JOB` procedures as well as your `GET_JOB` function. You also create and invoke a package that contains private and public constructs by using sample data.

Note:

1. Before starting this practice, execute `/home/oracle/labs/plpu/code_ex/cleanup_scripts/cleanup_05.sql` script.
2. If you missed a step in a practice, please run the appropriate solution script for that practice step before proceeding to the next step or the next practice.

Practice 5-1: Creating and Using Packages

Overview

In this practice, you create package specifications and package bodies. You then invoke the constructs in the packages by using sample data.

Note: Execute `cleanup_05.sql script` from `/home/oracle/labs/plpu/code_ex/cleanup_scripts/` before performing the following tasks.

Task

1. Create a package specification and body called `JOB_PKG`, containing a copy of your `ADD_JOB`, `UPD_JOB`, and `DEL_JOB` procedures as well as your `GET_JOB` function.

   Note: Use the code from your previously saved procedures and functions when creating the package. You can copy the code in a procedure or function, and then paste the code into the appropriate section of the package.

   a. Create the package specification including the procedures and function headings as public constructs.

   b. Create the package body with the implementations for each of the subprograms.

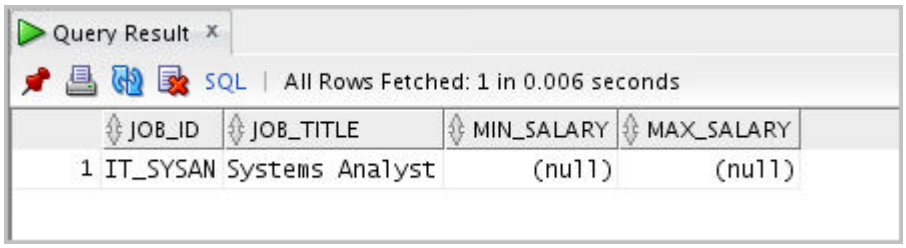
   c. Delete the following stand-alone procedures and function you just packaged using the Procedures and Functions nodes in the Object Navigation tree:

      1) The `ADD_JOB`, `UPD_JOB`, and `DEL_JOB` procedures

      2) The `GET_JOB` function

   d. Invoke your `ADD_JOB` package procedure by passing the values `IT_SYSAN` and `SYSTEMS ANALYST` as parameters.

   e. Query the `JOBS` table to see the result.



2. Create and invoke a package that contains private and public constructs.

   a. Create a package specification and a package body called `EMP_PKG` that contains the following procedures and function that you created earlier:

      1) `ADD_EMPLOYEE` procedure as a public construct

      2) `GET_EMPLOYEE` procedure as a public construct

      3) `VALID_DEPTID` function as a private construct

   b. Invoke the `EMP_PKG.ADD_EMPLOYEE` procedure, using department ID 15 for employee Jane Harris with the email ID `JAHARRIS`. Because department ID 15 does not exist, you should get an error message as specified in the exception handler of your procedure.

c. Invoke the `ADD_EMPLOYEE` package procedure by using department ID 80 for employee David Smith with the email ID `DASMITH`.

d. Query the `EMPLOYEES` table to verify that the new employee was added.

Solution 5-1: Creating and Using Packages

In this practice, you create package specifications and package bodies. You then invoke the constructs in the packages by using sample data.

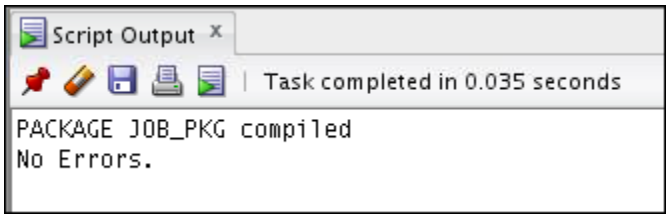
1. Create a package specification and body called `JOB_PKG`, containing a copy of your `ADD_JOB`, `UPD_JOB`, and `DEL_JOB` procedures as well as your `GET_JOB` function.

   Note: Use the code from your previously saved procedures and functions when creating the package. You can copy the code in a procedure or function, and then paste the code into the appropriate section of the package.

   a. Create the package specification including the procedures and function headings as public constructs.

      Open the `/home/oracle/labs/plpu/solns/sol_05.sql` script. Uncomment and select the code under Task 1_a. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the package specification. The code and the result are displayed as follows:

```
CREATE OR REPLACE PACKAGE job_pkg IS
  PROCEDURE add_job (p_jobid jobs.job_id%TYPE, p_jobtitle
jobs.job_title%TYPE);
  PROCEDURE del_job (p_jobid jobs.job_id%TYPE);
  FUNCTION get_job (p_jobid IN jobs.job_id%type) RETURN
jobs.job_title%type;
  PROCEDURE upd_job(p_jobid IN jobs.job_id%TYPE, p_jobtitle IN
jobs.job_title%TYPE);
END job_pkg;
/
SHOW ERRORS
```

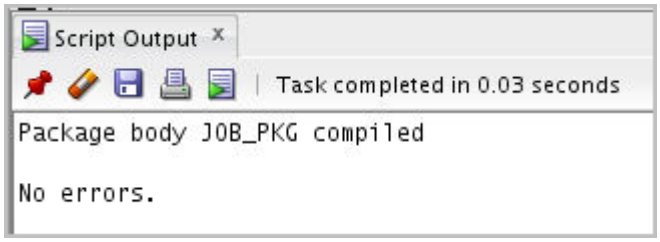


   b. Create the package body with the implementations for each of the subprograms.

      Uncomment and select the code under Task 1_b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the package body. The code and the result are displayed as follows:

```
CREATE OR REPLACE PACKAGE BODY job_pkg IS
  PROCEDURE add_job (
    p_jobid jobs.job_id%TYPE,
    p_jobtitle jobs.job_title%TYPE) IS
  BEGIN
    INSERT INTO jobs (job_id, job_title)
    VALUES (p_jobid, p_jobtitle);
    COMMIT;
```

```
  END add_job;

  PROCEDURE del_job (p_jobid jobs.job_id%TYPE) IS
    BEGIN
      DELETE FROM jobs
      WHERE job_id = p_jobid;
      IF SQL%NOTFOUND THEN
        RAISE_APPLICATION_ERROR(-20203, 'No jobs deleted.');
      END IF;
    END DEL_JOB;

  FUNCTION get_job (p_jobid IN jobs.job_id%type)
    RETURN jobs.job_title%type IS
    v_title jobs.job_title%type;
    BEGIN
      SELECT job_title
      INTO v_title
      FROM jobs
      WHERE job_id = p_jobid;
      RETURN v_title;
    END get_job;

  PROCEDURE upd_job(
    p_jobid IN jobs.job_id%TYPE,
    p_jobtitle IN jobs.job_title%TYPE) IS
    BEGIN
      UPDATE jobs
      SET job_title = p_jobtitle
      WHERE job_id = p_jobid;
      IF SQL%NOTFOUND THEN
        RAISE_APPLICATION_ERROR(-20202, 'No job updated.');
      END IF;
    END upd_job;

END job_pkg;
/

SHOW ERRORS
```



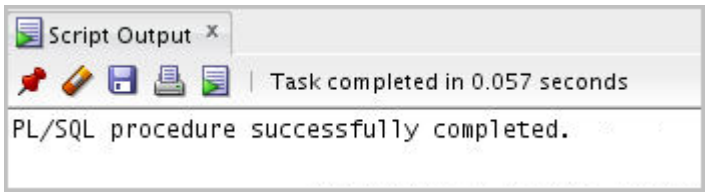
c. Delete the following stand-alone procedures and functions you just packaged by using the Procedures and Functions nodes in the Object Navigation tree:
   1) The `ADD_JOB`, `UPD_JOB`, and `DEL_JOB` procedures
   2) The `GET_JOB` function

   To delete a procedure or a function, right-click the procedure's name or function's name in the Object Navigation tree, and then select Drop from the pop-up menu. The Drop window is displayed. Click Apply to drop the procedure or function. A confirmation window is displayed. Click OK.

d. Invoke your `ADD_JOB` package procedure by passing the values `IT_SYSAN` and `SYSTEMS ANALYST` as parameters.

   Uncomment and select the code under Task 1_d. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to invoke the package's procedure. The code and the result are displayed as follows:

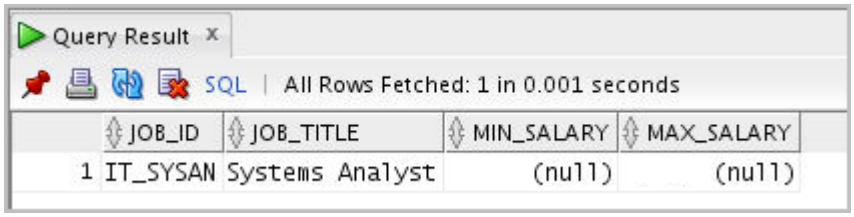
```
EXECUTE job_pkg.add_job('IT_SYSAN', 'Systems Analyst')
```



e. Query the `JOBS` table to see the result.

   Uncomment and select the code under Task 1_e. Click the Run Script icon (or press F5) or the Execute Statement (or press F9) on the SQL Worksheet toolbar to query the `JOBS` table. The code and the result are displayed as follows:

```
SELECT *
FROM jobs
WHERE job_id = 'IT_SYSAN';
```



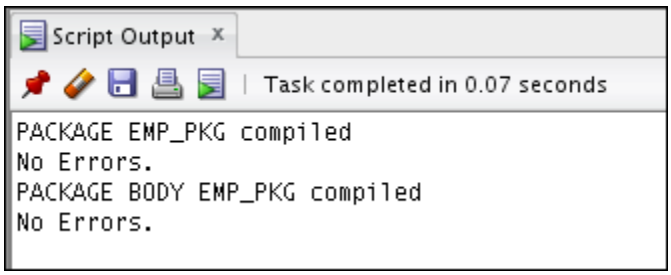
2. Create and invoke a package that contains private and public constructs.
   a. Create a package specification and a package body called `EMP_PKG` that contains the following procedures and function that you created earlier:

1) ADD_EMPLOYEE procedure as a public construct
2) GET_EMPLOYEE procedure as a public construct
3) VALID_DEPTID function as a private construct

Uncomment and select the code under Task 2_a. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to invoke the package's procedure. The code and the result are displayed as follows:

```
CREATE OR REPLACE PACKAGE emp_pkg IS
  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30);
PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE);
END emp_pkg;
/
SHOW ERRORS

CREATE OR REPLACE PACKAGE BODY emp_pkg IS
  FUNCTION valid_deptid(p_deptid IN
departments.department_id%TYPE) RETURN BOOLEAN IS
    v_dummy PLS_INTEGER;
  BEGIN
    SELECT 1
    INTO v_dummy
    FROM departments
    WHERE department_id = p_deptid;
    RETURN TRUE;
  EXCEPTION
    WHEN NO_DATA_FOUND THEN
    RETURN FALSE;

END valid_deptid;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
```

```
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30) IS
  BEGIN
    IF valid_deptid(p_deptid) THEN
      INSERT INTO employees(employee_id, first_name, last_name,
email,
        job_id, manager_id, hire_date, salary, commission_pct,
department_id)
      VALUES (employees_seq.NEXTVAL, p_first_name, p_last_name,
p_email,
        p_job, p_mgr, TRUNC(SYSDATE), p_sal, p_comm, p_deptid);
    ELSE
      RAISE_APPLICATION_ERROR (-20204, 'Invalid department ID.
Try again.');
    END IF;
  END add_employee;

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE) IS
  BEGIN
    SELECT salary, job_id
    INTO p_sal, p_job
    FROM employees
    WHERE employee_id = p_empid;
  END get_employee;
END emp_pkg;
/
SHOW ERRORS
```



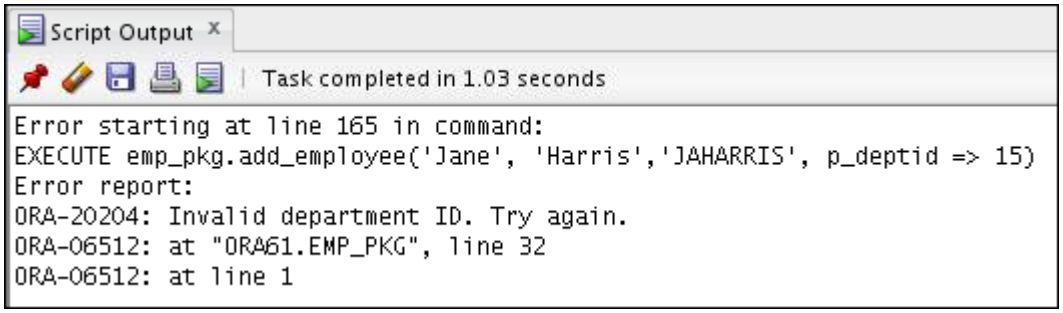
b. Invoke the `EMP_PKG.ADD_EMPLOYEE` procedure, using department ID 15 for employee Jane Harris with the email ID `JAHARRIS`. Because department ID 15 does

not exist, you should get an error message as specified in the exception handler of your procedure.

Uncomment and select the code under Task 2_b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to invoke the package's procedure. The code and the result are displayed as follows:

Note: You must complete step 5-2-a before performing this step. If you didn't complete step 5-2-a, run the code under Task 2_a first.

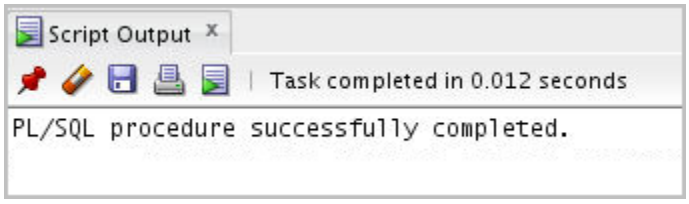
```
EXECUTE emp_pkg.add_employee('Jane', 'Harris','JAHARRIS',
p_deptid => 15)
```



c. Invoke the `ADD_EMPLOYEE` package procedure by using department ID 80 for employee David Smith with the email ID `DASMITH`.

Uncomment and select the code under Task 2_c. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to invoke the package's procedure. The code and the result are displayed as follows:

```
EXECUTE emp_pkg.add_employee('David', 'Smith','DASMITH',
p_deptid => 80)
```

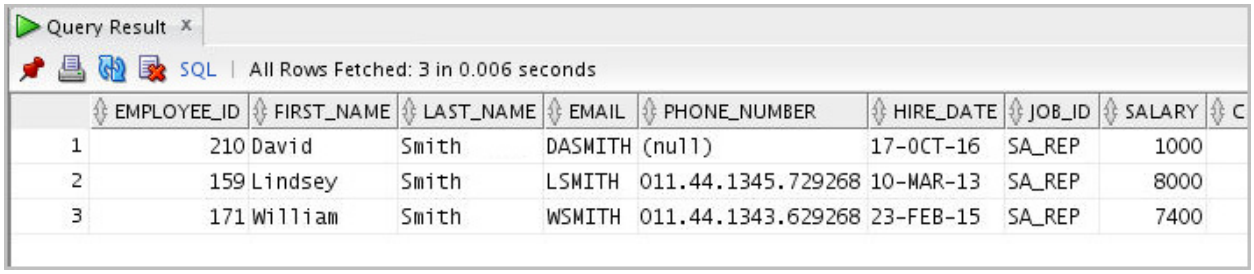


d. Query the `EMPLOYEES` table to verify that the new employee was added.

Uncomment and select the code under Task 2_d. Click the Run Script icon (or press F5) or the Execute Statement icon (or press F9), while making sure the cursor is on any of the `SELECT` statement code, on the SQL Worksheet toolbar to query the `EMPLOYEES` table. The code and the result (Execute Statement icon) are displayed as follows:

```
SELECT *
FROM employees
WHERE last_name = 'Smith';
```

The following output is displayed in the Results tab because we executed the code using the F9 icon.


Query Result

SQL | All Rows Fetched: 3 in 0.006 seconds

	EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALARY	C
1	210	David	Smith	DASMITH	(null)	17-OCT-16	SA_REP	1000	
2	159	Lindsey	Smith	LSMITH	011.44.1345.729268	10-MAR-13	SA_REP	8000	
3	171	William	Smith	WSMITH	011.44.1343.629268	23-FEB-15	SA_REP	7400	

Practices for Lesson 6: Working with Packages

Chapter 6

Practices for Lesson 6: Overview

Overview

In this practice, you modify an existing package to contain overloaded subprograms and you use forward declarations. You also create a package initialization block within a package body to populate a PL/SQL table.

Note:

1. Before starting this practice, execute `/home/oracle/labs/plpu/code_ex/cleanup_scripts/cleanup_06.sql` script.
2. If you missed a step in a practice, please run the appropriate solution script for that practice step before proceeding to the next step or the next practice.

Practice 6-1: Working with Packages

Overview

In this practice, you modify the code for the EMP_PKG package that you created earlier, and then overload the ADD_EMPLOYEE procedure. Next, you create two overloaded functions called GET_EMPLOYEE in the EMP_PKG package. You also add a public procedure to EMP_PKG to populate a private PL/SQL table of valid department IDs and modify the VALID_DEPTID function to use the private PL/SQL table contents to validate department ID values. You also change the VALID_DEPTID validation processing function to use the private PL/SQL table of department IDs. Finally, you reorganize the subprograms in the package specification and the body so that they are in alphabetical sequence.

Note: Execute `cleanup_06.sql script` from `/home/oracle/labs/plpu/code_ex/cleanup_scripts/` before performing the following tasks.

Task

1. Modify the code for the EMP_PKG package that you created in Practice 5, and overload the ADD_EMPLOYEE procedure.
   a. In the package specification, add a new procedure called ADD_EMPLOYEE that accepts the following three parameters:
      1) First name
      2) Last name
      3) Department ID
   b. Click the Run Script icon (or press F5) to create and compile the package.
   c. Implement the new ADD_EMPLOYEE procedure in the package body as follows:
      1) Format the email address in uppercase characters, using the first letter of the first name concatenated with the first seven letters of the last name.
      2) The procedure should call the existing ADD_EMPLOYEE procedure to perform the actual INSERT operation using its parameters and formatted email to supply the values.
      3) Click Run Script to create the package. Compile the package.
   d. Invoke the new ADD_EMPLOYEE procedure using the name `Samuel Joplin` to be added to department 30.
   e. Confirm that the new employee was added to the EMPLOYEES table.
2. In the EMP_PKG package, create two overloaded functions called GET_EMPLOYEE:
   a. In the package specification, add the following functions:
      1) The GET_EMPLOYEE function that accepts the parameter called `p_emp_id` based on the `employees.employee_id%TYPE` type. This function should return EMPLOYEES%ROWTYPE.
      2) The GET_EMPLOYEE function that accepts the parameter called `p_family_name` of type `employees.last_name%TYPE`. This function should return EMPLOYEES%ROWTYPE.
   b. Click Run Script to re-create and compile the package.
   c. In the package body:

1) Implement the first GET_EMPLOYEE function to query an employee using the employee's ID.
2) Implement the second GET_EMPLOYEE function to use the equality operator on the value supplied in the p_family_name parameter.

d. Click Run Script to re-create and compile the package.

e. Add a utility procedure PRINT_EMPLOYEE to the EMP_PKG package as follows:
1) The procedure accepts an EMPLOYEES%ROWTYPE as a parameter.
2) The procedure displays the following for an employee on one line, using the DBMS_OUTPUT package:
   - department_id
   - employee_id
   - first_name
   - last_name
   - job_id
   - salary

f. Click the Run Script icon (or press F5) to create and compile the package.

g. Use an anonymous block to invoke the EMP_PKG.GET_EMPLOYEE function with an employee ID of 100 and family name of 'Joplin'. Use the PRINT_EMPLOYEE procedure to display the results for each row returned.

3. Because the company does not frequently change its departmental data, you can improve performance of your EMP_PKG by adding a public procedure, INIT_DEPARTMENTS, to populate a private PL/SQL table of valid department IDs. Modify the VALID_DEPTID function to use the private PL/SQL table contents to validate department ID values.

Note: The code under Task 3 contains the solution for steps a, b, and c.

a. In the package specification, create a procedure called INIT_DEPARTMENTS with no parameters by adding the following to the package specification section before the PRINT_EMPLOYEES specification:

```
PROCEDURE init_departments;
```

b. In the package body, implement the INIT_DEPARTMENTS procedure to store all department IDs in a private PL/SQL index-by table named valid_departments containing BOOLEAN values.
1) Declare the valid_departments variable and its type definition boolean_tab_type before all procedures in the body. Enter the following at the beginning of the package body:

```
TYPE boolean_tab_type IS TABLE OF BOOLEAN
INDEX BY BINARY_INTEGER;
valid_departments boolean_tab_type;
```

2) Use the department_id column value as the index to create the entry in the index-by table to indicate its presence, and assign the entry a value of TRUE. Enter the INIT_DEPARTMENTS procedure declaration at the end of the package body (right after the print_employees procedure) as follows:

```
PROCEDURE init_departments IS
BEGIN
```

```
    FOR rec IN (SELECT department_id FROM departments)
      LOOP
        valid_departments(rec.department_id) := TRUE;
      END LOOP;
  END;
```

c. In the body, create an initialization block that calls the `INIT_DEPARTMENTS` procedure to initialize the table as follows:

```
BEGIN
  init_departments;
END;
```

d. Click the Run Script icon (or press F5) to create and compile the package.

4. Change the `VALID_DEPTID` validation processing function to use the private index-by table of department IDs.
   a. Modify the `VALID_DEPTID` function to perform its validation by using the index-by table of department ID values. Click the Run Script icon (or press F5) to create the package. Compile the package.
   b. Test your code by calling `ADD_EMPLOYEE` using the name `James Bond` in department `15`. What happens?
   c. Insert a new department. Specify 15 for the department ID and `'Security'` for the department name. Commit and verify the changes.
   d. Test your code again, by calling `ADD_EMPLOYEE` using the name `James Bond` in department 15. What happens?
   e. Execute the `EMP_PKG.INIT_DEPARTMENTS` procedure to update the internal index-by table with the latest departmental data.
   f. Test your code by calling `ADD_EMPLOYEE` by using the employee name `James Bond`, who works in department `15`. What happens?
   g. Delete employee `James Bond` and department `15` from their respective tables, commit the changes, and refresh the department data by invoking the `EMP_PKG.INIT_DEPARTMENTS` procedure. Make sure you enter `SET SERVEROUTPUT ON` first.
5. Reorganize the subprograms in the package specification and the body so that they are in alphabetical sequence.
   – Edit the package specification and reorganize subprograms alphabetically. Click Run Script to re-create the package specification. Compile the package specification. What happens?
   – Edit the package body and reorganize all subprograms alphabetically. Click Run Script to re-create the package specification. Re-compile the package specification. What happens?
   – Correct the compilation error using a forward declaration in the body for the appropriate subprogram reference. Click Run Script to re-create the package, and then recompile the package. What happens?

Solution 6-1: Working with Packages

In this practice, you modify the code for the EMP_PKG package that you created earlier, and then overload the ADD_EMPLOYEE procedure. Next, you create two overloaded functions called GET_EMPLOYEE in the EMP_PKG package. You also add a public procedure to EMP_PKG to populate a private PL/SQL table of valid department IDs and modify the VALID_DEPTID function to use the private PL/SQL table contents to validate department ID values. You also change the VALID_DEPTID validation processing function to use the private PL/SQL table of department IDs. Finally, you reorganize the subprograms in the package specification and the body so that they are in alphabetical sequence.

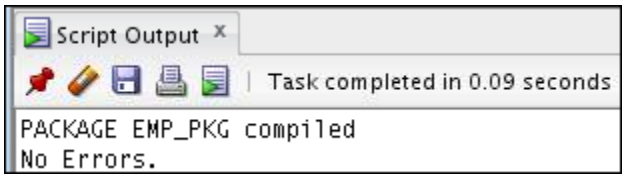
1. Modify the code for the EMP_PKG package that you created in Practice 5 step 2, and overload the ADD_EMPLOYEE procedure.
   a. In the package specification, add a new procedure called ADD_EMPLOYEE that accepts the following three parameters:
      1) First name
      2) Last name
      3) Department ID

      Open the /home/oracle/labs/plpu/solns/sol_06.sql file. Uncomment and select the code under Task 1_a. The code is displayed as follows:

```
CREATE OR REPLACE PACKAGE emp_pkg IS
  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30);

-- New overloaded add_employee

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE);

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE);
END emp_pkg;
/
```

```
SHOW ERRORS
```

b. **Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the package.**



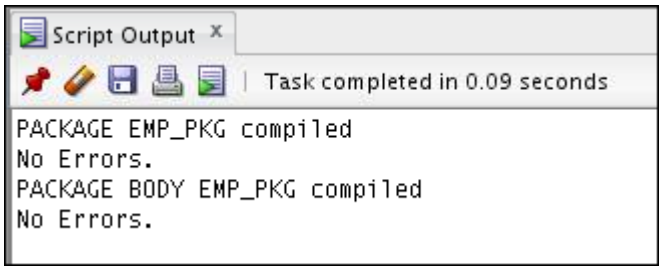
c. Implement the new ADD_EMPLOYEE procedure in the package body as follows:
   1) Format the email address in uppercase characters, using the first letter of the first name concatenated with the first seven letters of the last name.
   2) The procedure should call the existing ADD_EMPLOYEE procedure to perform the actual INSERT operation using its parameters and formatted email to supply the values.
   3) Click Run Script to create the package. Compile the package.

   Uncomment and select the code under Task 1_c. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to invoke the package's procedure. The code and the result are displayed as follows (the newly added code is highlighted in bold face text in the code box below):

```
CREATE OR REPLACE PACKAGE emp_pkg IS
  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30);

-- New overloaded add_employee

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE);

-- End of the spec of the new overloaded add_employee

PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
```

```
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE);
END emp_pkg;
/
SHOW ERRORS
CREATE OR REPLACE PACKAGE BODY emp_pkg IS
  FUNCTION valid_deptid(p_deptid IN
departments.department_id%TYPE) RETURN BOOLEAN IS
    v_dummy PLS_INTEGER;
  BEGIN
    SELECT 1
    INTO v_dummy
    FROM departments
    WHERE department_id = p_deptid;
    RETURN TRUE;
  EXCEPTION
    WHEN NO_DATA_FOUND THEN
    RETURN FALSE;
END valid_deptid;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,


    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30) IS


BEGIN
  IF valid_deptid(p_deptid) THEN
    INSERT INTO employees(employee_id, first_name, last_name,
      email, job_id, manager_id, hire_date, salary,
      commission_pct, department_id)
      VALUES (employees_seq.NEXTVAL, p_first_name, p_last_name,
      p_email, p_job, p_mgr, TRUNC(SYSDATE), p_sal, p_comm,
      p_deptid);
  ELSE
    RAISE_APPLICATION_ERROR (-20204, 'Invalid department ID. Try
```

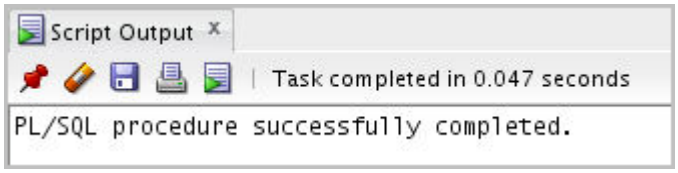
```
      again.');
  END IF;
  END add_employee;

-- New overloaded add_employee procedure

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE) IS
    p_email employees.email%type;
  BEGIN
    p_email := UPPER(SUBSTR(p_first_name, 1,
                    1)||SUBSTR(p_last_name, 1, 7));
    add_employee(p_first_name, p_last_name, p_email, p_deptid =>
                 p_deptid);
  END;

-- End declaration of the overloaded add_employee procedure
  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE) IS
  BEGIN
    SELECT salary, job_id
    INTO p_sal, p_job
    FROM employees
    WHERE employee_id = p_empid;
  END get_employee;
END emp_pkg;
/
SHOW ERRORS
```



d. Invoke the new `ADD_EMPLOYEE` procedure using the name `Samuel Joplin` to be added to department 30.

Uncomment and select the code under Task 1_d. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to invoke the package's procedure. The code and the result are displayed as follows:

```
EXECUTE emp_pkg.add_employee('Samuel', 'Joplin', 30)
```



e. Confirm that the new employee was added to the `EMPLOYEES` table.

Uncomment and select the code under Task 1_e. Click anywhere on the `SELECT` statement, and then click the Execute Statement icon (or press F5) on the SQL Worksheet toolbar to execute the query. The code and the result are displayed as follows:

```
SELECT *
FROM employees
WHERE last_name = 'Joplin';
```

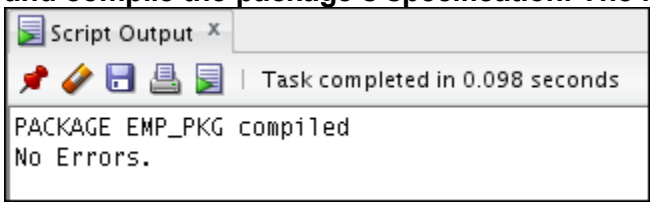
2. In the `EMP_PKG` package, create two overloaded functions called `GET_EMPLOYEE`:
   a. In the package specification, add the following functions:
      1) The `GET_EMPLOYEE` function that accepts the parameter called `p_emp_id` based on the `employees.employee_id%TYPE` type. This function should return `EMPLOYEES%ROWTYPE`.
      2) The `GET_EMPLOYEE` function that accepts the parameter called `p_family_name` of type `employees.last_name%TYPE`. This function should return `EMPLOYEES%ROWTYPE`.

   Uncomment and select the code under Task 2_a.

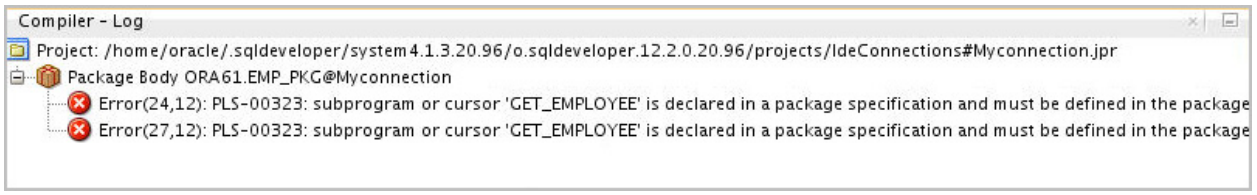
```
CREATE OR REPLACE PACKAGE emp_pkg IS
  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30);
```

```
  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE);

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE);

-- New overloaded get_employees functions specs starts here:

  FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype;

-- New overloaded get_employees functions specs ends here.

END emp_pkg;
/
SHOW ERRORS
```

b. Click Run Script to re-create and compile the package specification.
Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to re-create and compile the package's specification. The result is shown below:



Note: As mentioned earlier, if your code contains an error message, you can recompile the code using the following procedure to view the details of the error or warning in the Compiler – Log tab: To compile the package specification, right-click the package's specification (or the entire package) name in the Object Navigator tree, and then select Compile from the shortcut menu. The warning is expected and is for informational purposes only.



c. In the package body:

1) Implement the first `GET_EMPLOYEE` function to query an employee using the employee's ID.
2) Implement the second `GET_EMPLOYEE` function to use the equality operator on the value supplied in the `p_family_name` parameter.

Uncomment and select the code under Task 2_c. The newly added functions are highlighted in the following code box.

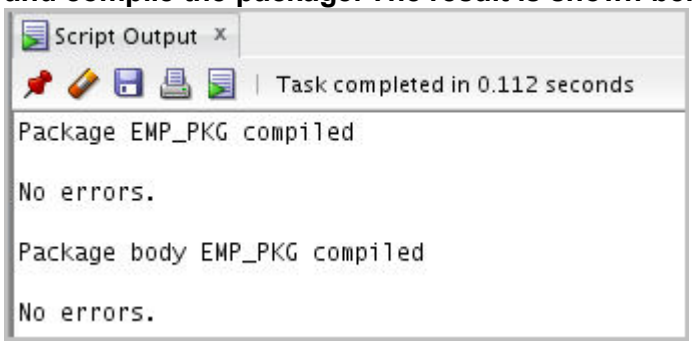
```
CREATE OR REPLACE PACKAGE emp_pkg IS
  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30);

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE);


PROCEDURE get_employee(


    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE);

-- New overloaded get_employees functions specs starts here:

  FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype;
```

```
  FUNCTION get_employee(p_family_name
employees.last_name%type)
    return employees%rowtype;

-- New overloaded get_employees functions specs ends here.

END emp_pkg;
/
SHOW ERRORS

-- package body

CREATE OR REPLACE PACKAGE BODY emp_pkg IS
  FUNCTION valid_deptid(p_deptid IN
departments.department_id%TYPE) RETURN BOOLEAN IS
    v_dummy PLS_INTEGER;
  BEGIN
    SELECT 1
    INTO v_dummy
    FROM departments
    WHERE department_id = p_deptid;
    RETURN TRUE;
  EXCEPTION
    WHEN NO_DATA_FOUND THEN
    RETURN FALSE;
END valid_deptid;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30) IS
  BEGIN
    IF valid_deptid(p_deptid) THEN
      INSERT INTO employees(employee_id, first_name,
last_name,
   email, job_id, manager_id, hire_date, salary,
   commission_pct, department_id)
```

```
      VALUES (employees_seq.NEXTVAL, p_first_name,
p_last_name,
        p_email, p_job, p_mgr, TRUNC(SYSDATE), p_sal, p_comm,
        p_deptid);
    ELSE
      RAISE_APPLICATION_ERROR (-20204, 'Invalid department
ID.
                                Try again.');
    END IF;
  END add_employee;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE) IS
    p_email employees.email%type;
  BEGIN
    p_email := UPPER(SUBSTR(p_first_name, 1,
1)||SUBSTR(p_last_name, 1, 7));
    add_employee(p_first_name, p_last_name, p_email, p_deptid
=> p_deptid);
  END;

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE) IS
  BEGIN
    SELECT salary, job_id
    INTO p_sal, p_job
    FROM employees
    WHERE employee_id = p_empid;
  END get_employee;

-- New get_employee function declaration starts here

FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE employee_id = p_emp_id;
```

```
    RETURN rec_emp;
  END;

  FUNCTION get_employee(p_family_name
employees.last_name%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE last_name = p_family_name;
    RETURN rec_emp;
  END;

-- New overloaded get_employee function declaration ends here

END emp_pkg;
/
SHOW ERRORS
```

d. Click Run Script to re-create the package. Compile the package.
Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to re-create and compile the package. The result is shown below:



e. Add a utility procedure `PRINT_EMPLOYEE` to the `EMP_PKG` package as follows:
   1) The procedure accepts an `EMPLOYEES%ROWTYPE` as a parameter.
   2) The procedure displays the following for an employee on one line, by using the `DBMS_OUTPUT` package:
      - `department_id`
      - `employee_id`
      - `first_name`
      - `last_name`
      - `job_id`
      - `salary`

Uncomment and select the code under Task 2_e. The newly added code is highlighted in the following code box.

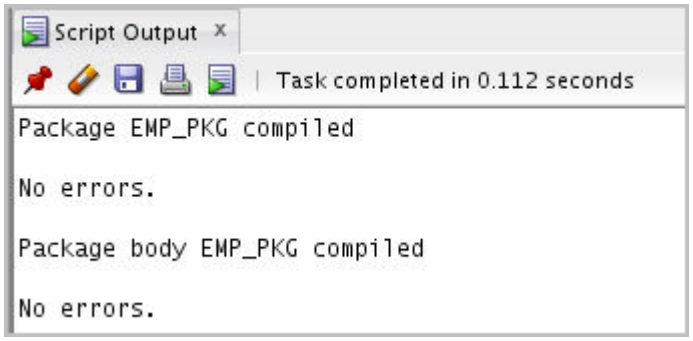
```
-- Package SPECIFICATION

CREATE OR REPLACE PACKAGE emp_pkg IS
  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30);

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE);

PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE);

  FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype;

-- New print_employee print_employee procedure spec

PROCEDURE print_employee(p_rec_emp employees%rowtype);

END emp_pkg;
/
SHOW ERRORS

-- Package BODY

CREATE OR REPLACE PACKAGE BODY emp_pkg IS
```

```
  FUNCTION valid_deptid(p_deptid IN
departments.department_id%TYPE) RETURN BOOLEAN IS
    v_dummy PLS_INTEGER;
  BEGIN
    SELECT 1
    INTO v_dummy
    FROM departments
    WHERE department_id = p_deptid;
    RETURN TRUE;
  EXCEPTION
    WHEN NO_DATA_FOUND THEN
    RETURN FALSE;
END valid_deptid;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30) IS
  BEGIN
    IF valid_deptid(p_deptid) THEN
      INSERT INTO employees(employee_id, first_name, last_name,
email,
        job_id, manager_id, hire_date, salary, commission_pct,
department_id)
      VALUES (employees_seq.NEXTVAL, p_first_name, p_last_name,
p_email,
        p_job, p_mgr, TRUNC(SYSDATE), p_sal, p_comm, p_deptid);
    ELSE
      RAISE_APPLICATION_ERROR (-20204, 'Invalid department ID.
Try again.');
    END IF;
  END add_employee;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE) IS
    p_email employees.email%type;
```

```
  BEGIN
    p_email := UPPER(SUBSTR(p_first_name, 1,
1)||SUBSTR(p_last_name, 1, 7));
    add_employee(p_first_name, p_last_name, p_email, p_deptid =>
p_deptid);
  END;

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE) IS
  BEGIN
    SELECT salary, job_id
    INTO p_sal, p_job
    FROM employees
    WHERE employee_id = p_empid;
  END get_employee;

FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE employee_id = p_emp_id;
    RETURN rec_emp;
  END;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE last_name = p_family_name;
    RETURN rec_emp;
  END;

-- New print_employees procedure declaration.

PROCEDURE print_employee(p_rec_emp employees%rowtype) IS
  BEGIN
    DBMS_OUTPUT.PUT_LINE(p_rec_emp.department_id ||' '||
```

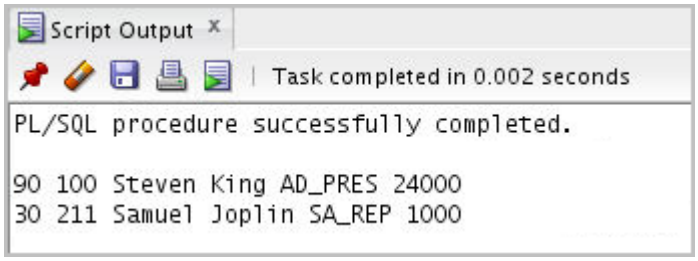
```
                                p_rec_emp.employee_id||' '||
                                p_rec_emp.first_name||' '||
                                p_rec_emp.last_name||' '||
                                p_rec_emp.job_id||' '||
                                p_rec_emp.salary);
  END;

END emp_pkg;
/
SHOW ERRORS
```

f. Click the Run Script icon (or press F5) to create and compile the package.
Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to re-create and compile the package.



g. Use an anonymous block to invoke the `EMP_PKG.GET_EMPLOYEE` function with an employee ID of `100` and family name of `'Joplin'`. Use the `PRINT_EMPLOYEE` procedure to display the results for each row returned. Make sure you enter `SET SERVEROUTPUT ON` first.
Uncomment and select the code under Task 2_g.

```
SET SERVEROUTPUT ON
BEGIN
  emp_pkg.print_employee(emp_pkg.get_employee(100));
  emp_pkg.print_employee(emp_pkg.get_employee('Joplin'));
END;
/
```



3. Because the company does not frequently change its departmental data, you can improve performance of your EMP_PKG by adding a public procedure, INIT_DEPARTMENTS, to populate a private PL/SQL table of valid department IDs. Modify the VALID_DEPTID function to use the private PL/SQL table contents to validate department ID values.

   Note: The code under Task 3 contains the solutions for steps a, b, and c.

   a. In the package specification, create a procedure called INIT_DEPARTMENTS with no parameters by adding the following to the package specification section before the PRINT_EMPLOYEES specification:

      ```
      PROCEDURE init_departments;
      ```

   b. In the package body, implement the INIT_DEPARTMENTS procedure to store all department IDs in a private PL/SQL index-by table named valid_departments containing BOOLEAN values.

      1) Declare the valid_departments variable and its type definition boolean_tab_type before all procedures in the body. Enter the following at the beginning of the package body:

         ```
         TYPE boolean_tab_type IS TABLE OF BOOLEAN
         INDEX BY BINARY_INTEGER;
         valid_departments boolean_tab_type;
         ```

      2) Use the department_id column value as the index to create the entry in the index-by table to indicate its presence, and assign the entry a value of TRUE. Enter the INIT_DEPARTMENTS procedure declaration at the end of the package body (right after the print_employees procedure) as follows:

         ```
         PROCEDURE init_departments IS
         BEGIN
           FOR rec IN (SELECT department_id FROM departments)
             LOOP
               valid_departments(rec.department_id) := TRUE;
             END LOOP;
         END;
         ```

   c. In the body, create an initialization block that calls the INIT_DEPARTMENTS procedure to initialize the table as follows:

      ```
      BEGIN
        init_departments;
      END;
      ```

      Uncomment and select the code under Task 3. The newly added code is highlighted in the following code box:

      ```
      -- Package SPECIFICATION

      CREATE OR REPLACE PACKAGE emp_pkg IS
        PROCEDURE add_employee(
          p_first_name employees.first_name%TYPE,
          p_last_name employees.last_name%TYPE,
          p_email employees.email%TYPE,
      ```

```
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30);

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE);

PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE);

  FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype;

-- New procedure init_departments spec
PROCEDURE init_departments;

PROCEDURE print_employee(p_rec_emp employees%rowtype);

END emp_pkg;
/
SHOW ERRORS


-- Package BODY

CREATE OR REPLACE PACKAGE BODY emp_pkg IS

-- New type
TYPE boolean_tab_type IS TABLE OF BOOLEAN
            INDEX BY BINARY_INTEGER;
  valid_departments boolean_tab_type;
```

```
FUNCTION valid_deptid(p_deptid IN
departments.department_id%TYPE) RETURN BOOLEAN IS
    v_dummy PLS_INTEGER;
  BEGIN
    SELECT 1
    INTO v_dummy
    FROM departments
    WHERE department_id = p_deptid;
    RETURN TRUE;
  EXCEPTION
    WHEN NO_DATA_FOUND THEN
    RETURN FALSE;
END valid_deptid;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30) IS
  BEGIN
    IF valid_deptid(p_deptid) THEN

INSERT INTO employees(employee_id, first_name, last_name,
   email, job_id, manager_id, hire_date, salary,
   commission_pct, department_id)
   VALUES (employees_seq.NEXTVAL, p_first_name, p_last_name,
      p_email, p_job, p_mgr, TRUNC(SYSDATE), p_sal, p_comm,
      p_deptid);
    ELSE
      RAISE_APPLICATION_ERROR (-20204, 'Invalid department ID.
                               Try again.');
    END IF;
  END add_employee;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE) IS
    p_email employees.email%type;
```

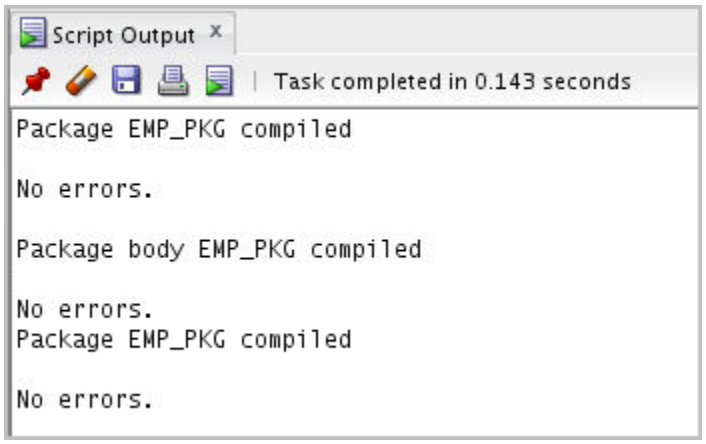
```
  BEGIN
    p_email := UPPER(SUBSTR(p_first_name, 1,
1)||SUBSTR(p_last_name, 1, 7));
    add_employee(p_first_name, p_last_name, p_email, p_deptid =>
p_deptid);
  END;

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE) IS
  BEGIN
    SELECT salary, job_id
    INTO p_sal, p_job
    FROM employees
    WHERE employee_id = p_empid;
  END get_employee;

FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE employee_id = p_emp_id;
    RETURN rec_emp;
  END;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE last_name = p_family_name;
    RETURN rec_emp;
  END;

PROCEDURE print_employee(p_rec_emp employees%rowtype) IS
  BEGIN
    DBMS_OUTPUT.PUT_LINE(p_rec_emp.department_id ||' '||
                         P_rec_emp.employee_id||' '||
                         P_rec_emp.first_name||' '||
```

```
                          P_rec_emp.last_name||' '||
                          P_rec_emp.job_id||' '||
                          P_rec_emp.salary);
  END;

-- New init_departments procedure declaration.

PROCEDURE init_departments IS
  BEGIN
    FOR rec IN (SELECT department_id FROM departments)
    LOOP
      valid_departments(rec.department_id) := TRUE;
    END LOOP;
  END;

-- call the new init_departments procedure.

BEGIN
  init_departments;
END emp_pkg;
/
SHOW ERRORS

CREATE OR REPLACE PACKAGE emp_pkg IS
  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30);

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE);

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE);

  FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype;

  FUNCTION get_employee(p_family_name
      employees.last_name%type)
    return employees%rowtype;
```

```
--New procedure init_departments spec

PROCEDURE init_departments;

PROCEDURE print_employee(p_rec_emp employees%rowtype);

END emp_pkg;
/
SHOW ERRORS
```

d. Click the Run Script icon (or press F5) to re-create and compile the package.

Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to re-create and compile the package.



4. Change the `VALID_DEPTID` validation processing function to use the private PL/SQL table of department IDs.

   a. Modify the `VALID_DEPTID` function to perform its validation by using the PL/SQL table of department ID values. Click the Run Script icon (or press F5) to create and compile the package.

   Uncomment and select the code under Task 4_a. Click the Run Script icon (or press F5) to create and compile the package. The newly added code is highlighted in the following code box.

```
-- Package SPECIFICATION

CREATE OR REPLACE PACKAGE emp_pkg IS
  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30);
```

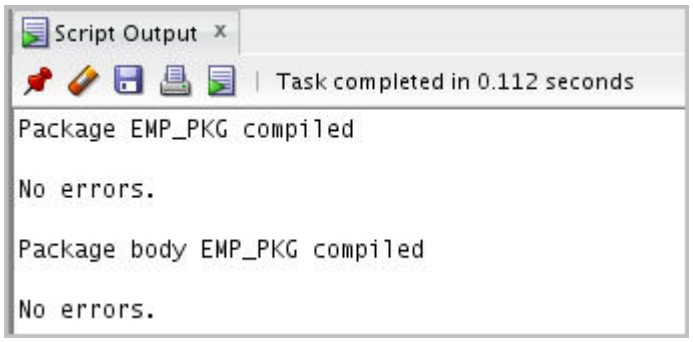
```
  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE);

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE);

  FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype;

  FUNCTION get_employee(p_family_name
      employees.last_name%type)
    return employees%rowtype;

-- New procedure init_departments spec
PROCEDURE init_departments;

PROCEDURE print_employee(p_rec_emp employees%rowtype);

END emp_pkg;
/
SHOW ERRORS
```

```
-- Package BODY

CREATE OR REPLACE PACKAGE BODY emp_pkg IS

TYPE boolean_tab_type IS TABLE OF BOOLEAN
     INDEX BY BINARY_INTEGER;
valid_departments boolean_tab_type;

  FUNCTION valid_deptid(p_deptid IN
departments.department_id%TYPE) RETURN BOOLEAN IS
    v_dummy PLS_INTEGER;
  BEGIN
    RETURN valid_departments.exists(p_deptid);
  EXCEPTION
```

```
    WHEN NO_DATA_FOUND THEN
    RETURN FALSE;
END valid_deptid;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30) IS
  BEGIN
    IF valid_deptid(p_deptid) THEN
      INSERT INTO employees(employee_id, first_name,
        last_name, email, job_id, manager_id, hire_date,
        salary, commission_pct, department_id)
      VALUES (employees_seq.NEXTVAL, p_first_name,
        p_last_name, p_email,
        p_job, p_mgr, TRUNC(SYSDATE), p_sal, p_comm,p_deptid);
    ELSE
      RAISE_APPLICATION_ERROR (-20204, 'Invalid department ID.
                               Try again.');
    END IF;
  END add_employee;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE) IS
    p_email employees.email%type;
  BEGIN
    p_email := UPPER(SUBSTR(p_first_name, 1,
1)||SUBSTR(p_last_name, 1, 7));
    add_employee(p_first_name, p_last_name, p_email, p_deptid =>
p_deptid);
  END;

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE) IS
```

```
  BEGIN
    SELECT salary, job_id
    INTO p_sal, p_job
    FROM employees
    WHERE employee_id = p_empid;
  END get_employee;

FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE employee_id = p_emp_id;
    RETURN rec_emp;
  END;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE last_name = p_family_name;
    RETURN rec_emp;
  END;
PROCEDURE print_employee(p_rec_emp employees%rowtype) IS
  BEGIN
    DBMS_OUTPUT.PUT_LINE(p_rec_emp.department_id ||' '||
                         p_rec_emp.employee_id||' '||
                         p_rec_emp.first_name||' '||
                         p_rec_emp.last_name||' '||
                         p_rec_emp.job_id||' '||
                         p_rec_emp.salary);
  END;

-- New init_departments procedure declaration.

PROCEDURE init_departments IS
  BEGIN
    FOR rec IN (SELECT department_id FROM departments)
    LOOP
```

```
      valid_departments(rec.department_id) := TRUE;
    END LOOP;
  END;

-- call the new init_departments procedure.
BEGIN
  init_departments;
END emp_pkg;

/
SHOW ERRORS
```

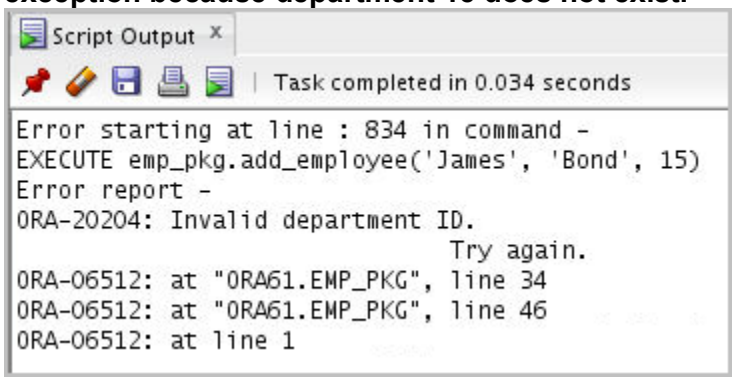


b. Test your code by calling `ADD_EMPLOYEE` using the name `James Bond` in department `15`. What happens?

Uncomment and select the code under Task 4_b.

```
EXECUTE emp_pkg.add_employee('James', 'Bond', 15)
```

Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to test inserting a new employee. The insert operation to add the employee fails with an exception because department 15 does not exist.

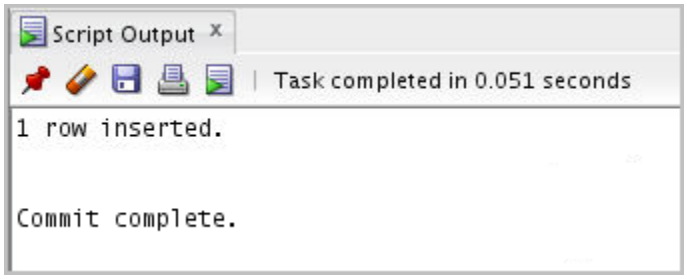


c. Insert a new department. Specify 15 for the department ID and `'Security'` for the department name. Commit and verify the changes.

Uncomment and select the code under Task 4_c. The code and result are displayed as follows:

```
INSERT INTO departments (department_id, department_name)
VALUES (15, 'Security');
```

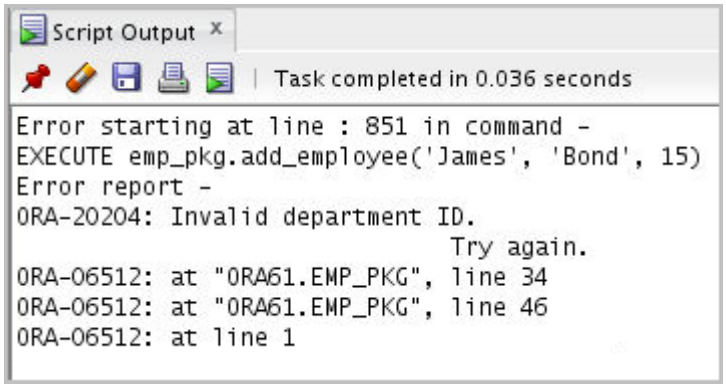
```
COMMIT;
```



d. Test your code again, by calling `ADD_EMPLOYEE` using the name `James Bond` in department 15. What happens?

Uncomment and select the code under Task 4_d. The code and the result are displayed as follows:

```
EXECUTE emp_pkg.add_employee('James', 'Bond', 15)
```

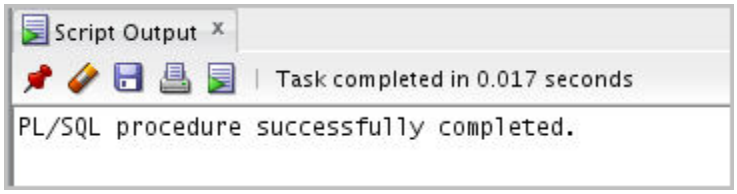


The insert operation to add the employee fails with an exception. Department 15 does not exist as an entry in the PL/SQL associative array (index-by table) package state variable.

e. Execute the `EMP_PKG.INIT_DEPARTMENTS` procedure to update the index-by table with the latest departmental data.

Uncomment and select the code under Task 4_e. The code and result are displayed as follows:

```
EXECUTE EMP_PKG.INIT_DEPARTMENTS
```



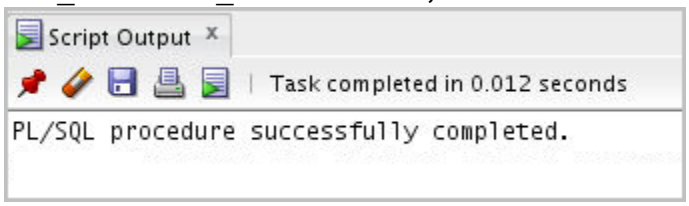
f. Test your code by calling `ADD_EMPLOYEE` using the employee name James Bond, who works in department 15. What happens?

Uncomment and select the code under Task 4_f. The code and the result are displayed as follows.

```
EXECUTE emp_pkg.add_employee('James', 'Bond', 15)
```

The row is finally inserted because the department 15 record exists in the database and the package's PL/SQL index-by table, due to invoking

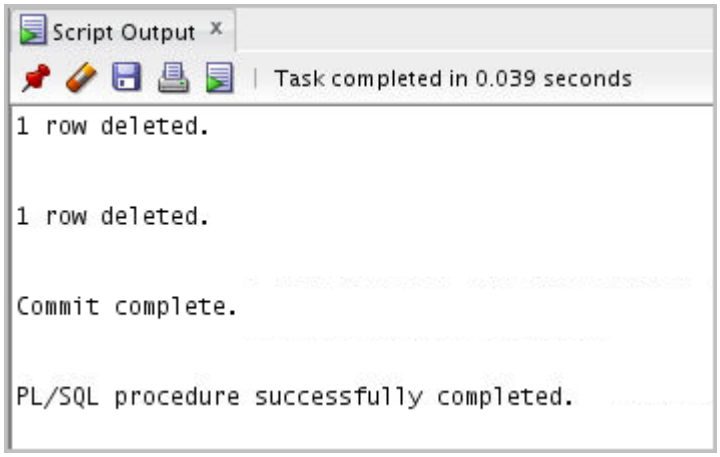
EMP_PKG.INIT_DEPARTMENTS, which refreshes the package state data.



g. Delete employee `James Bond` and department `15` from their respective tables, commit the changes, and refresh the department data by invoking the `EMP_PKG.INIT_DEPARTMENTS` procedure.

Open Uncomment and select the code under Task 4_g. The code and the result are displayed as follows.

```
DELETE FROM employees
WHERE first_name = 'James' AND last_name = 'Bond';
DELETE FROM departments WHERE department_id = 15;
COMMIT;
EXECUTE EMP_PKG.INIT_DEPARTMENTS
```



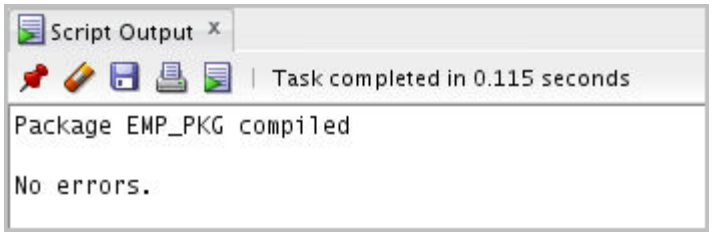
5. Reorganize the subprograms in the package specification and the body so that they are in alphabetical sequence.

a. Edit the package specification and reorganize subprograms alphabetically. Click Run Script to re-create the package specification. Compile the package specification. What happens?

Uncomment and select the code under Task 5_a. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to re-create and compile the package. The code and the result are displayed as follows. The package's specification subprograms are already in an alphabetical order.

```
CREATE OR REPLACE PACKAGE emp_pkg IS

-- the package spec is already in an alphabetical order.

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
```

```
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30);

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE);

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE);

  FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype;

PROCEDURE init_departments;

PROCEDURE print_employee(p_rec_emp employees%rowtype);

END emp_pkg;
/
SHOW ERRORS
```



b. Edit the package body and reorganize all subprograms alphabetically. Click Run Script to re-create the package specification. Re-compile the package specification. What happens?

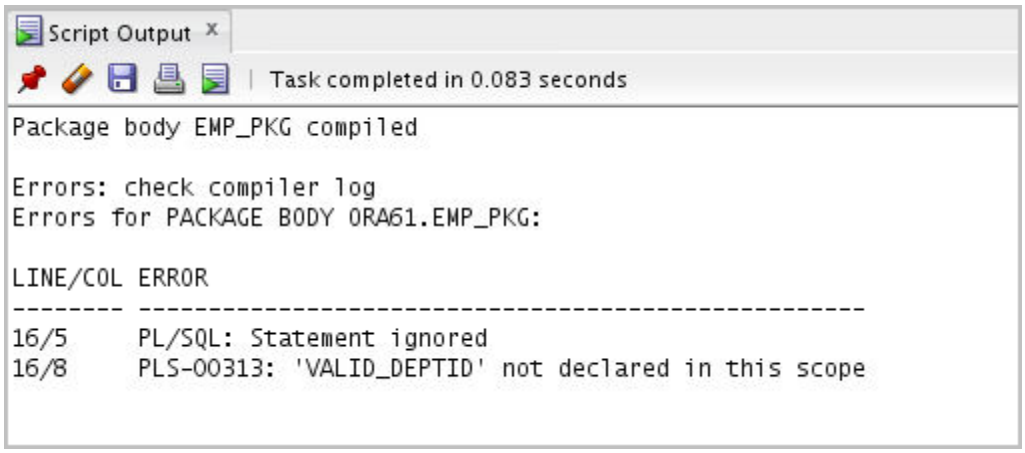
Uncomment and select the code under Task 5_b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to re-create the package. The code and the result are displayed as follows.

```
-- Package BODY
CREATE OR REPLACE PACKAGE BODY emp_pkg IS
  TYPE boolean_tab_type IS TABLE OF BOOLEAN
     INDEX BY BINARY_INTEGER;
  valid_departments boolean_tab_type;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30) IS
  BEGIN
    IF valid_deptid(p_deptid) THEN
      INSERT INTO employees(employee_id, first_name, last_name,
email,
        job_id, manager_id, hire_date, salary, commission_pct,
department_id)
      VALUES (employees_seq.NEXTVAL, p_first_name, p_last_name,
p_email,
        p_job, p_mgr, TRUNC(SYSDATE), p_sal, p_comm, p_deptid);
    ELSE
      RAISE_APPLICATION_ERROR (-20204, 'Invalid department ID.
Try again.');
    END IF;
  END add_employee;

PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE) IS
    p_email employees.email%type;
  BEGIN
    p_email := UPPER(SUBSTR(p_first_name, 1,
1)||SUBSTR(p_last_name, 1, 7));
    add_employee(p_first_name, p_last_name, p_email, p_deptid =>
p_deptid);
  END;

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
```

```
  p_sal OUT employees.salary%TYPE,
  p_job OUT employees.job_id%TYPE) IS
BEGIN
  SELECT salary, job_id
  INTO p_sal, p_job
  FROM employees
  WHERE employee_id = p_empid;
END get_employee;

FUNCTION get_employee(p_emp_id employees.employee_id%type)
  return employees%rowtype IS
  rec_emp employees%rowtype;
BEGIN
  SELECT * INTO rec_emp
  FROM employees
  WHERE employee_id = p_emp_id;
  RETURN rec_emp;
END;

FUNCTION get_employee(p_family_name employees.last_name%type)
  return employees%rowtype IS
  rec_emp employees%rowtype;
BEGIN
  SELECT * INTO rec_emp
  FROM employees
  WHERE last_name = p_family_name;
  RETURN rec_emp;
END;

PROCEDURE init_departments IS
BEGIN
  FOR rec IN (SELECT department_id FROM departments)
  LOOP
    valid_departments(rec.department_id) := TRUE;
  END LOOP;
END;

PROCEDURE print_employee(p_rec_emp employees%rowtype) IS
BEGIN
  DBMS_OUTPUT.PUT_LINE(p_rec_emp.department_id ||' '||
                       p_rec_emp.employee_id||' '||
                       p_rec_emp.first_name||' '||
                       p_rec_emp.last_name||' '||
```

```
                              p_rec_emp.job_id||' '||
                              p_rec_emp.salary);
  END;

  FUNCTION valid_deptid(p_deptid IN
departments.department_id%TYPE) RETURN BOOLEAN IS
    v_dummy PLS_INTEGER;
  BEGIN
    RETURN valid_departments.exists(p_deptid);
  EXCEPTION
    WHEN NO_DATA_FOUND THEN
    RETURN FALSE;
END valid_deptid;


BEGIN
  init_departments;
END emp_pkg;

/
SHOW ERRORS
```

The package does not compile successfully because the `VALID_DEPTID` function is referenced before it is declared.



c. Correct the compilation error using a forward declaration in the body for the appropriate subprogram reference. Click Run Script to re-create the package, and then recompile the package. What happens?

Uncomment and select the code under Task 5_c. The function's forward declaration is highlighted in the code box below. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to re-create and compile the package. The code and the result are displayed as follows.

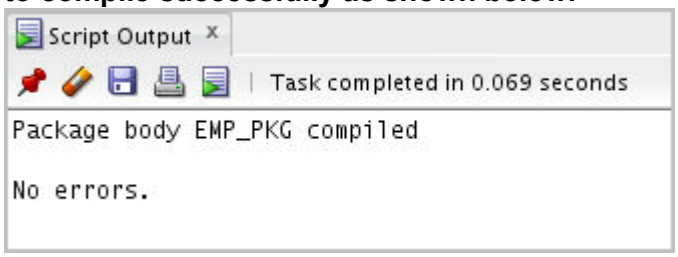
```
-- Package BODY
```

```
CREATE OR REPLACE PACKAGE BODY emp_pkg IS
  TYPE boolean_tab_type IS TABLE OF BOOLEAN
      INDEX BY BINARY_INTEGER;
  valid_departments boolean_tab_type;

 -- forward declaration of valid_deptid

  FUNCTION valid_deptid(p_deptid IN
     departments.department_id%TYPE)
   RETURN BOOLEAN;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30) IS
  BEGIN
    IF valid_deptid(p_deptid) THEN -- valid_deptid function
referenced
      INSERT INTO employees(employee_id, first_name, last_name,
email,
        job_id, manager_id, hire_date, salary, commission_pct,
department_id)
      VALUES (employees_seq.NEXTVAL, p_first_name, p_last_name,
p_email,
        p_job, p_mgr, TRUNC(SYSDATE), p_sal, p_comm, p_deptid);
    ELSE
      RAISE_APPLICATION_ERROR (-20204, 'Invalid department ID.
Try again.');
    END IF;
  END add_employee;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE) IS
    p_email employees.email%type;
  BEGIN
```

```
    p_email := UPPER(SUBSTR(p_first_name, 1,
1)||SUBSTR(p_last_name, 1, 7));
    add_employee(p_first_name, p_last_name, p_email, p_deptid =>
p_deptid);
  END;

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE) IS
  BEGIN
    SELECT salary, job_id
    INTO p_sal, p_job
    FROM employees
    WHERE employee_id = p_empid;
  END get_employee;

FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE employee_id = p_emp_id;
    RETURN rec_emp;
  END;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE last_name = p_family_name;
    RETURN rec_emp;
  END;

-- New alphabetical location of function init_departments.

PROCEDURE init_departments IS
  BEGIN
    FOR rec IN (SELECT department_id FROM departments)
    LOOP
```

```
      valid_departments(rec.department_id) := TRUE;
    END LOOP;
  END;

PROCEDURE print_employee(p_rec_emp employees%rowtype) IS
  BEGIN
    DBMS_OUTPUT.PUT_LINE(p_rec_emp.department_id ||' '||
                         p_rec_emp.employee_id||' '||
                         p_rec_emp.first_name||' '||
                         p_rec_emp.last_name||' '||
                         p_rec_emp.job_id||' '||
                         p_rec_emp.salary);
  END;

-- New alphabetical location of function valid_deptid.

FUNCTION valid_deptid(p_deptid IN
departments.department_id%TYPE) RETURN BOOLEAN IS
    v_dummy PLS_INTEGER;
  BEGIN
    RETURN valid_departments.exists(p_deptid);
  EXCEPTION
    WHEN NO_DATA_FOUND THEN
    RETURN FALSE;
END valid_deptid;


BEGIN
  init_departments;
END emp_pkg;

/
SHOW ERRORS
```

A forward declaration for the `VALID_DEPTID` function enables the package body to compile successfully as shown below:



Practices for Lesson 7: Using Oracle-Supplied Packages in Application Development

Chapter 7

Practices for Lesson 7: Overview

Overview

In this practice, you use the `UTL_FILE` package to generate a text file report of employees in each department.

Note:

1. Before starting this practice, execute `/home/oracle/labs/plpu/code_ex/cleanup_scripts/cleanup_07.sql` script.
2. If you missed a step in a practice, please run the appropriate solution script for that practice step before proceeding to the next step or the next practice.

Practice 7-1: Using the UTL_FILE Package

Overview

In this practice, you use the UTL_FILE package to generate a text file report of employees in each department. You first create and execute a procedure called EMPLOYEE_REPORT that generates an employee report in a file in the operating system, using the UTL_FILE package. The report should generate a list of employees who have exceeded the average salary of their departments. Finally, you view the generated output text file.

Note: Execute `cleanup_07.sql script` from `/home/oracle/labs/plpu/code_ex/cleanup_scripts/` before performing the following tasks.

Task

1. Create a procedure called EMPLOYEE_REPORT that generates an employee report in a file in the operating system, using the UTL_FILE package. The report should generate a list of employees who have exceeded the average salary of their departments.
   a. Your program should accept two parameters. The first parameter is the output directory. The second parameter is the name of the text file that is written.

      Note: Use the directory location value UTL_FILE. Add an exception-handling section to handle errors that may be encountered when using the UTL_FILE package.
   b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the procedure.
2. Invoke the procedure using the following two arguments:
   a. Use REPORTS_DIR as the alias for the directory object as the first parameter.
   b. Use `sal_rpt71.txt` as the second parameter.
3. View the generated output text file as follows:
   a. Double-click the **Terminal** icon on your desktop. The **Terminal** window is displayed.
   b. At the **$** prompt, change to the **`/home/oracle/labs/plpu/reports`** directory that contains the generated output file, `sal_rpt71.txt` using the `cd` command.

      Note: You can use the `pwd` command to list the current working directory.
   c. List the contents of the current directory using the `ls` command.
   d. Open the transferred the `sal_rpt71.txt`, file using `gedit` or an editor of your choice.

Solution 7-1: Using the UTL_FILE Package

In this practice, you use the UTL_FILE package to generate a text file report of employees in each department. You first create and execute a procedure called EMPLOYEE_REPORT that generates an employee report in a file in the operating system, using the UTL_FILE package. The report should generate a list of employees who have exceeded the average salary of their departments. Finally, you view the generated output text file.

1. Create a procedure called EMPLOYEE_REPORT that generates an employee report in a file in the operating system, using the UTL_FILE package. The report should generate a list of employees who have exceeded the average salary of their departments.
   a. Your program should accept two parameters. The first parameter is the output directory. The second parameter is the name of the text file that is written.

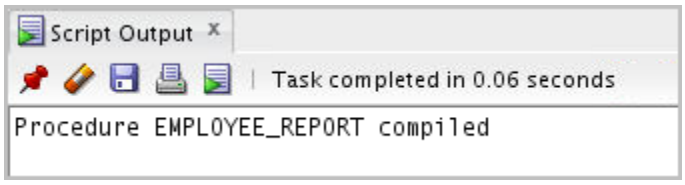
      Note: Use the directory location value UTL_FILE. Add an exception-handling section to handle errors that may be encountered when using the UTL_FILE package.

      Open the file in the `/home/oracle/labs/plpu/solns/sol_07.sql` script. Uncomment and select the code under Task 1.

```
-- Verify with your instructor that the database initSID.ora
-- file has the directory path you are going to use with this --
procedure.
-- For example, there should be an entry such as:
-- UTL_FILE_DIR = /home1/teachX/UTL_FILE in your initSID.ora
-- (or the SPFILE)
-- HOWEVER: The course has a directory alias provided called
-- "REPORTS_DIR" that is associated with an appropriate
-- directory. Use the directory alias name in quotes for the
-- first parameter to create a file in the appropriate
-- directory.

CREATE OR REPLACE PROCEDURE employee_report(
  p_dir IN VARCHAR2, p_filename IN VARCHAR2) IS
  f UTL_FILE.FILE_TYPE;
  CURSOR cur_avg IS
    SELECT last_name, department_id, salary
    FROM employees outer
    WHERE salary > (SELECT AVG(salary)
                    FROM  employees inner
                    Where department_id = outer.department_id)
    ORDER BY department_id;
BEGIN
  f := UTL_FILE.FOPEN(p_dir, p_filename,'W');
```

```
 UTL_FILE.PUT_LINE(f, 'Employees who earn more than average
   salary: ');
  UTL_FILE.PUT_LINE(f, 'REPORT GENERATED ON ' ||SYSDATE);
  UTL_FILE.NEW_LINE(f);
  FOR emp IN cur_avg
  LOOP

    UTL_FILE.PUT_LINE(f,
    RPAD(emp.last_name, 30) || ' ' ||
    LPAD(NVL(TO_CHAR(emp.department_id,'9999'),'-'), 5) || ' '
||
    LPAD(TO_CHAR(emp.salary, '$99,999.00'), 12));
  END LOOP;
  UTL_FILE.NEW_LINE(f);
  UTL_FILE.PUT_LINE(f, '*** END OF REPORT ***');
  UTL_FILE.FCLOSE(f);
END employee_report;
/
```

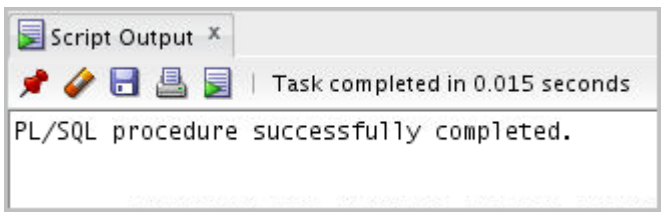
b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the procedure.



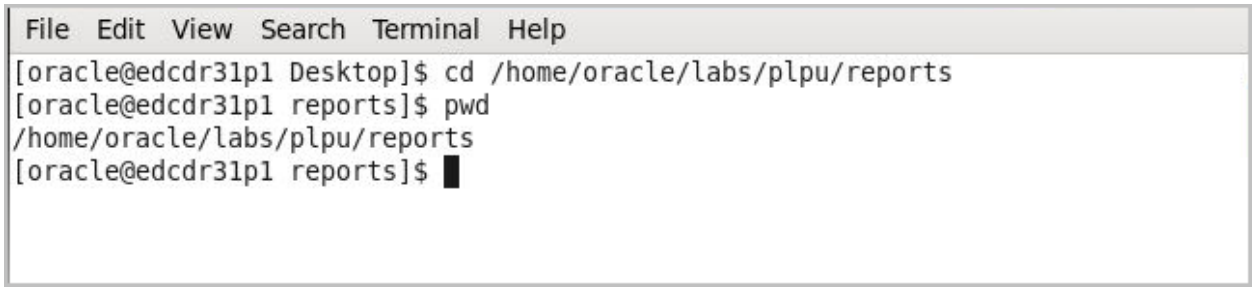
2. Invoke the procedure using the following as arguments:
   a. Use `REPORTS_DIR` as the alias for the directory object as the first parameter.
   b. Use `sal_rpt71.txt` as the second parameter.

   Uncomment and select the code under Task 2. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to execute the procedure. The result is shown below. Ensure that the external file and the database are on the same PC.

```
-- For example, if you are student ora61, use 61 as a prefix

EXECUTE employee_report('REPORTS_DIR','sal_rpt71.txt')
```

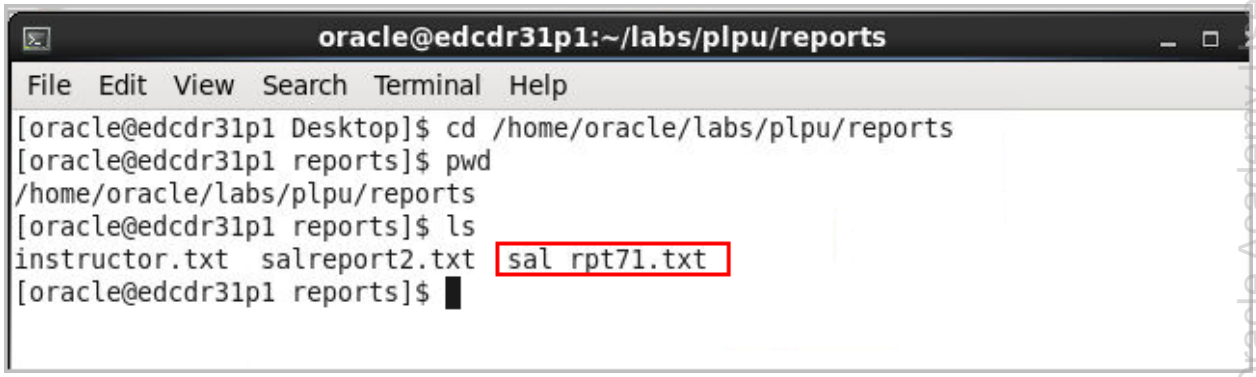


3. View the generated output text file as follows:
   a. Double-click the **Terminal** icon on your desktop. The **Terminal** window is displayed.
   b. At the **$** prompt, change to the **`/home/oracle/labs/plpu/reports`** directory that contains the generated output file, `sal_rpt61.txt` using the `cd` command as follows:



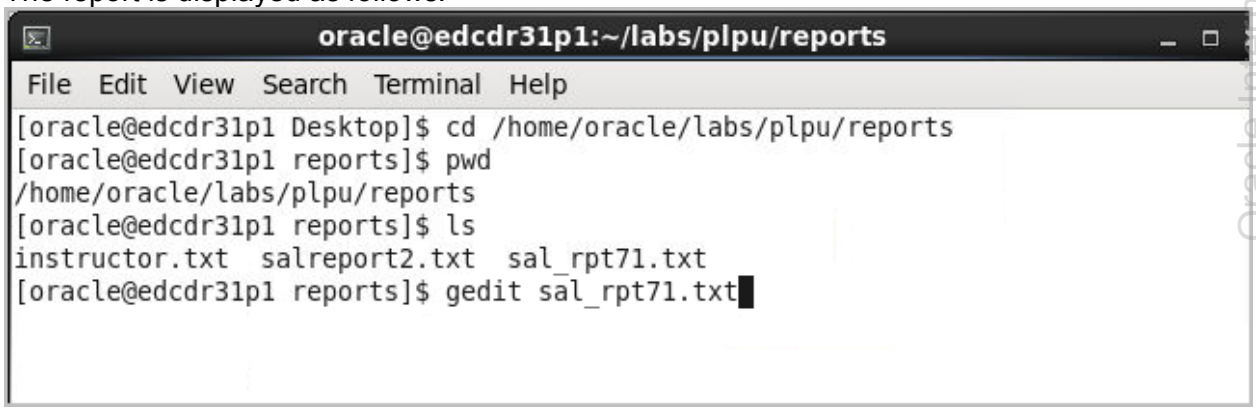
Note: You can use the `pwd` command to list the current working directory as shown in the screenshot above.

   c. List the contents of the current directory using the `ls` command as follows:



Note the generated output file, `sal_rpt61.txt`.

Open the transferred `sal_rpt61.txt` file by using `gedit` or an editor of your choice. The report is displayed as follows:



```
Employees who earn more than average salary:
REPORT GENERATED ON 17-OCT-16

Hartstein                          20   $13,000.00
Raphaely                           30   $11,000.00
Rajs                               50    $3,500.00
Ladwig                             50    $3,600.00
Dilly                              50    $3,600.00
Chung                              50    $3,800.00
Everett                            50    $3,900.00
Bell                               50    $4,000.00
Bull                               50    $4,100.00
Sarchand                           50    $4,200.00
Mourgos                            50    $5,800.00
Vollman                            50    $6,500.00
Kaufling                           50    $7,900.00
Weiss                              50    $8,000.00
Fripp                              50    $8,200.00
Ernst                              60    $6,000.00
Hunold                             60    $9,000.00
Taylor                             80    $8,600.00
Hutton                             80    $8,800.00
Hall                               80    $9,000.00
McEwen                             80    $9,000.00
Bernstein                          80    $9,500.00
Sully                              80    $9,500.00
Greene                             80    $9,500.00
Fox                                80    $9,600.00
Tucker                             80   $10,000.00
King                               80   $10,000.00
Bloom                              80   $10,000.00
Zlotkey                            80   $10,500.00
Vishney                            80   $10,500.00
Cambrault                          80   $11,000.00
Abel                               80   $11,000.00
Ozer                               80   $11,500.00
Errazuriz                          80   $12,000.00
Partners                           80   $13,500.00
Russell                            80   $14,000.00
King                               90   $24,000.00
Faviet                            100    $9,000.00
Greenberg                         100   $13,208.80
Higgins                           110   $12,008.00

*** END OF REPORT ***
```

Note: The output may slightly vary based on the data in the employees table.

Practices for Lesson 8: Using Dynamic SQL

Chapter 8

Practices for Lesson 8: Overview

Overview

In this practice, you create a package that uses Native Dynamic SQL to create or drop a table, and to populate, modify, and delete rows from the table. In addition, you create a package that compiles the PL/SQL code in your schema, either all the PL/SQL code or only code that has an `INVALID` status in the `USER_OBJECTS` table.

Note:

1. Before starting this practice, execute `/home/oracle/labs/plpu/code_ex/cleanup_scripts/cleanup_08.sql` script.
2. If you missed a step in a practice, please run the appropriate solution script for that practice step before proceeding to the next step or the next practice.

Practice 8-1: Using Native Dynamic SQL

Overview

In this practice, you create a package that uses Native Dynamic SQL to create or drop a table, and to populate, modify, and delete rows from the table. In addition, you create a package that compiles the PL/SQL code in your schema, either all the PL/SQL code or only code that has an `INVALID` status in the `USER_OBJECTS` table.

Note: Execute `cleanup_08.sql script` from `/home/oracle/labs/plpu/code_ex/cleanup_scripts/` before performing the following tasks.

Task

1. Create a package called `TABLE_PKG` that uses Native Dynamic SQL to create or drop a table, and to populate, modify, and delete rows from the table. The subprograms should manage optional default parameters with `NULL` values.
   a. Create a package specification with the following procedures:

```
PROCEDURE make(p_table_name VARCHAR2, p_col_specs VARCHAR2)
PROCEDURE add_row(p_table_name VARCHAR2, p_col_values
  VARCHAR2, p_cols VARCHAR2 := NULL)
PROCEDURE upd_row(p_table_name VARCHAR2, p_set_values
  VARCHAR2, p_conditions VARCHAR2 := NULL)
PROCEDURE del_row(p_table_name VARCHAR2,
    p_conditions VARCHAR2 := NULL);
PROCEDURE remove(p_table_name VARCHAR2)
```

   b. Create the package body that accepts the parameters and dynamically constructs the appropriate SQL statements that are executed using Native Dynamic SQL, except for the remove procedure. This procedure should be written using the `DBMS_SQL` package.
   c. Execute the `MAKE` package procedure to create a table as follows:

```
make('my_contacts', 'id number(4), name varchar2(40)');
```

   d. Describe the `MY_CONTACTS` table structure.
   e. Execute the `ADD_ROW` package procedure to add the following rows. Enable `SERVEROUTPUT`.

```
add_row('my_contacts','1,''Lauran Serhal''','id, name');
add_row('my_contacts','2,''Nancy''','id, name');
add_row('my_contacts','3,''Sunitha Patel''','id,name');
add_row('my_contacts','4,''Valli Pataballa''','id,name');
```

   f. Query the `MY_CONTACTS` table contents to verify the additions.
   g. Execute the `DEL_ROW` package procedure to delete a contact with an ID value of `3`.
   h. Execute the `UPD_ROW` procedure with the following row data:

```
upd_row('my_contacts','name=''Nancy Greenberg''','id=2');
```

   i. Query the `MY_CONTACTS` table contents to verify the changes.
   j. Drop the table by using the remove procedure and describe the `MY_CONTACTS` table.

2. Create a COMPILE_PKG package that compiles the PL/SQL code in your schema.
   a. In the specification, create a package procedure called MAKE that accepts the name of a PL/SQL program unit to be compiled.
   b. In the package body, include the following:
      1) The EXECUTE procedure used in the TABLE_PKG procedure in step 1 of this practice.
      2) A private function named GET_TYPE to determine the PL/SQL object type from the data dictionary.
         – The function returns the type name (use PACKAGE for a package with a body) if the object exists; otherwise, it should return a NULL.
         – In the WHERE clause condition, add the following to the condition to ensure that only one row is returned if the name represents a PACKAGE, which may also have a PACKAGE BODY. In this case, you can only compile the complete package, but not the specification or body as separate components:
           ```
           rownum = 1
           ```
      3) Create the MAKE procedure by using the following information:
         – The MAKE procedure accepts one argument, name, which represents the object name.
         – The MAKE procedure should call the GET_TYPE function. If the object exists, MAKE dynamically compiles it with the ALTER statement.
   c. Use the COMPILE_PKG.MAKE procedure to compile the following:
      1) The EMPLOYEE_REPORT procedure
      2) The EMP_PKG package
      3) A nonexistent object called EMP_DATA

Solution 8-1: Using Native Dynamic SQL

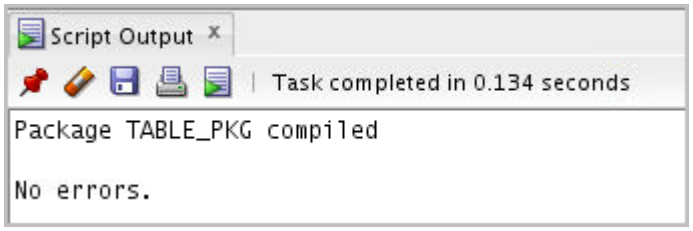
In this practice, you create a package that uses Native Dynamic SQL to create or drop a table, and to populate, modify, and delete rows from the table. In addition, you create a package that compiles the PL/SQL code in your schema, either all the PL/SQL code or only code that has an `INVALID` status in the `USER_OBJECTS` table.

1. Create a package called `TABLE_PKG` that uses Native Dynamic SQL to create or drop a table, and to populate, modify, and delete rows from the table. The subprograms should manage optional default parameters with `NULL` values.
   a. Create a package specification with the following procedures:

```
PROCEDURE make(p_table_name VARCHAR2, p_col_specs VARCHAR2)
PROCEDURE add_row(p_table_name VARCHAR2, p_col_values
  VARCHAR2, p_cols VARCHAR2 := NULL)
PROCEDURE upd_row(p_table_name VARCHAR2, p_set_values
  VARCHAR2, p_conditions VARCHAR2 := NULL)
PROCEDURE del_row(p_table_name VARCHAR2,
    p_conditions VARCHAR2 := NULL);
PROCEDURE remove(p_table_name VARCHAR2)
```

Open the `/home/oracle/labs/plpu/solns/sol_08.sql` script. Uncomment and select the code under Task 1_a. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the package specification. The code and the result are displayed as follows:

```
CREATE OR REPLACE PACKAGE table_pkg IS
  PROCEDURE make(p_table_name VARCHAR2, p_col_specs
      VARCHAR2);
  PROCEDURE add_row(p_table_name VARCHAR2, p_col_values
      VARCHAR2, p_cols VARCHAR2 := NULL);
  PROCEDURE upd_row(p_table_name VARCHAR2, p_set_values
      VARCHAR2, p_conditions VARCHAR2 := NULL);
  PROCEDURE del_row(p_table_name VARCHAR2, p_conditions
      VARCHAR2 := NULL);
  PROCEDURE remove(p_table_name VARCHAR2);
END table_pkg;
/
SHOW ERRORS
```

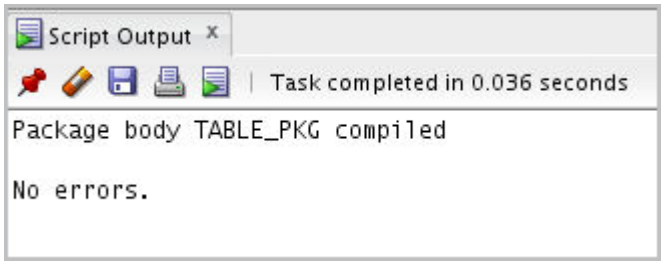


b. Create the package body that accepts the parameters and dynamically constructs the appropriate SQL statements that are executed using Native Dynamic SQL, except for the remove procedure. This procedure should be written using the `DBMS_SQL` package.

Uncomment and select the code under Task 1_b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the package specification. The code and the result are shown below.

```
CREATE OR REPLACE PACKAGE BODY table_pkg IS
  PROCEDURE execute(p_stmt VARCHAR2) IS
  BEGIN
    DBMS_OUTPUT.PUT_LINE(p_stmt);
    EXECUTE IMMEDIATE p_stmt;
  END;

  PROCEDURE make(p_table_name VARCHAR2, p_col_specs VARCHAR2)
  IS
    v_stmt VARCHAR2(200) := 'CREATE TABLE '|| p_table_name ||
                          ' (' || p_col_specs || ')';
  BEGIN
    execute(v_stmt);
  END;

  PROCEDURE add_row(p_table_name VARCHAR2, p_col_values
                    VARCHAR2, p_cols VARCHAR2 := NULL) IS
    v_stmt VARCHAR2(200) := 'INSERT INTO '|| p_table_name;
  BEGIN
    IF p_cols IS NOT NULL THEN
       v_stmt := v_stmt || ' (' || p_cols || ')';
    END IF;
    v_stmt := v_stmt || ' VALUES (' || p_col_values || ')';
    execute(v_stmt);
  END;

  PROCEDURE upd_row(p_table_name VARCHAR2, p_set_values
                   VARCHAR2, p_conditions VARCHAR2 := NULL) IS


   v_stmt VARCHAR2(200) := 'UPDATE '|| p_table_name || ' SET '
|| p_set_values;
  BEGIN
    IF p_conditions IS NOT NULL THEN
       v_stmt := v_stmt || ' WHERE ' || p_conditions;
    END IF;
```

```
    execute(v_stmt);
  END;


  PROCEDURE del_row(p_table_name VARCHAR2, p_conditions

                    VARCHAR2 := NULL) IS
    v_stmt VARCHAR2(200) := 'DELETE FROM '|| p_table_name;
  BEGIN
    IF p_conditions IS NOT NULL THEN
       v_stmt := v_stmt || ' WHERE ' || p_conditions;
    END IF;
    execute(v_stmt);
  END;

  PROCEDURE remove(p_table_name VARCHAR2) IS
    cur_id INTEGER;
    v_stmt VARCHAR2(100) := 'DROP TABLE '||p_table_name;
  BEGIN
    cur_id := DBMS_SQL.OPEN_CURSOR;
    DBMS_OUTPUT.PUT_LINE(v_stmt);
    DBMS_SQL.PARSE(cur_id, v_stmt, DBMS_SQL.NATIVE);
    -- Parse executes DDL statements,no EXECUTE is required.
    DBMS_SQL.CLOSE_CURSOR(cur_id);
  END;

END table_pkg;
/
SHOW ERRORS
```

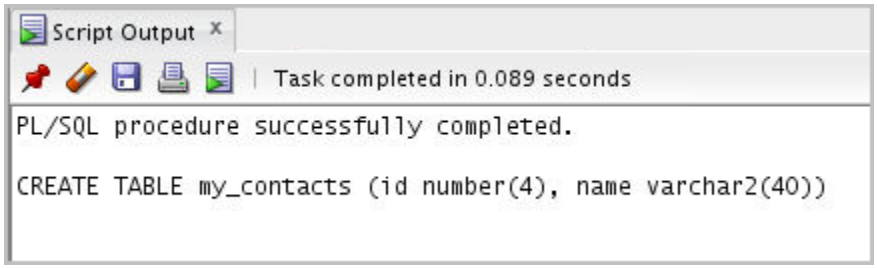


c. Execute the `MAKE` package procedure to create a table as follows:

```
make('my_contacts', 'id number(4), name varchar2(40)');
```

Uncomment and select the code under Task 1_c. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create the package specification. The code and the results are displayed as follows:

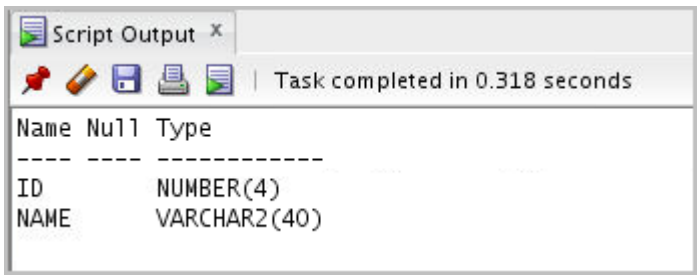
```
EXECUTE table_pkg.make('my_contacts', 'id number(4), name
varchar2(40)')
```



d. Describe the `MY_CONTACTS` table structure.

```
DESCRIBE my_contacts
```

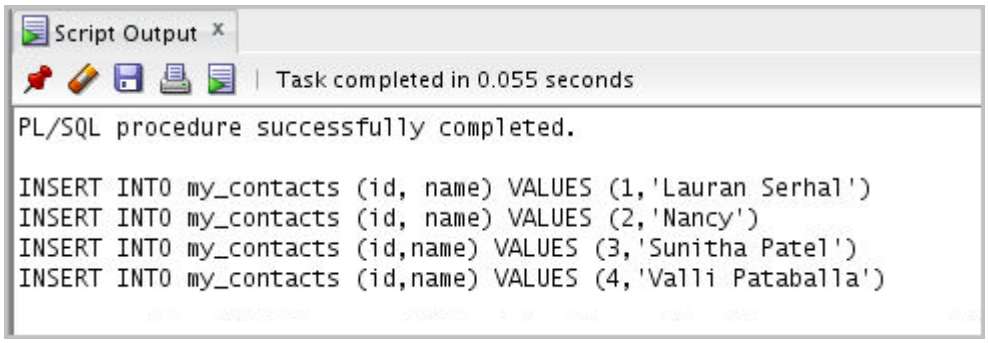
The result is displayed as follows:



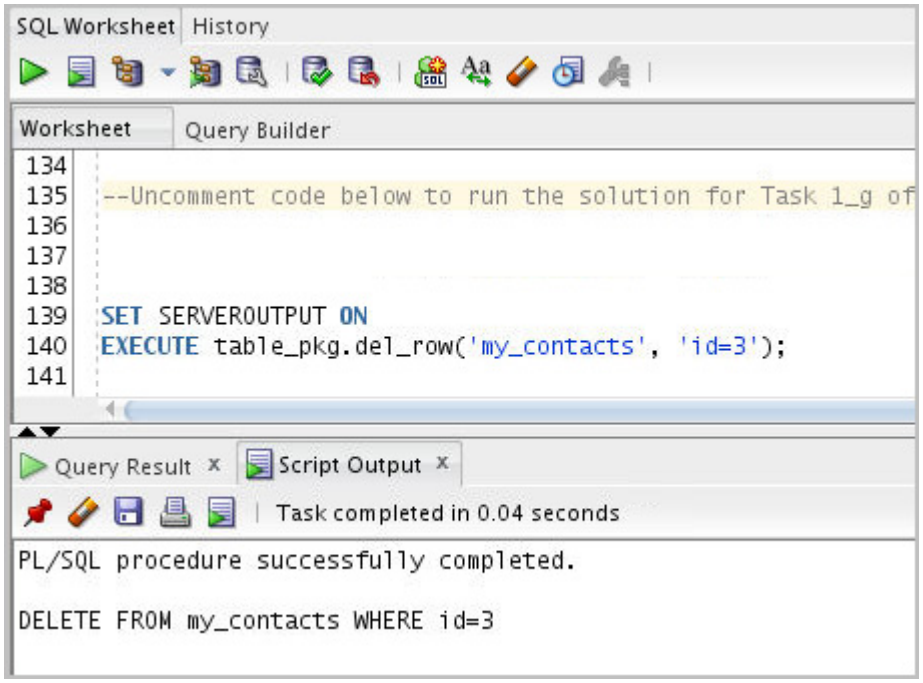
e. Execute the `ADD_ROW` package procedure to add the following rows.

```
SET SERVEROUTPUT ON

BEGIN
  table_pkg.add_row('my_contacts','1,''Lauran Serhal''','id,
   name');
  table_pkg.add_row('my_contacts','2,''Nancy''','id, name');
  table_pkg.add_row('my_contacts','3,''Sunitha
   Patel''','id,name');
  table_pkg.add_row('my_contacts','4,''Valli
   Pataballa''','id,name');
END;
/
```

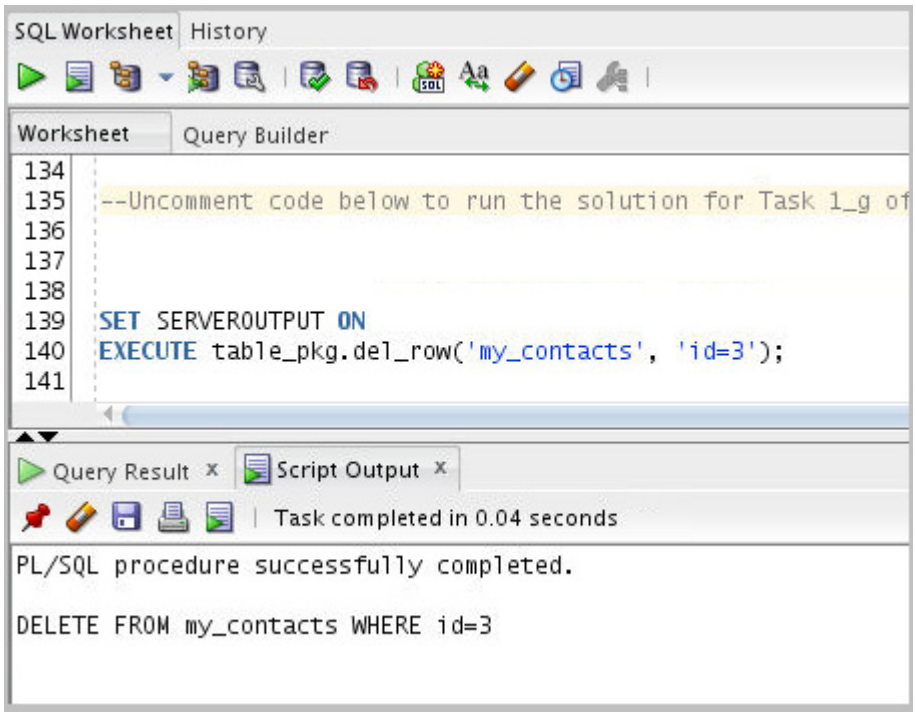
Uncomment and select the code under Task 1_e. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to execute the script.



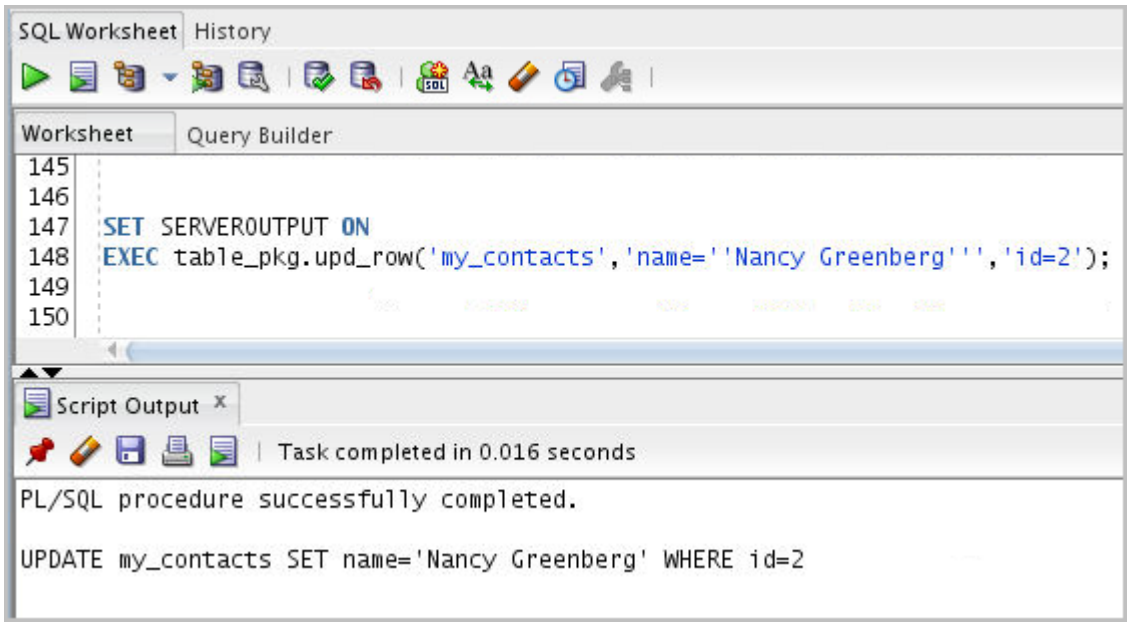
f. Query the `MY_CONTACTS` table contents to verify the additions.
The code and the results are displayed as follows:



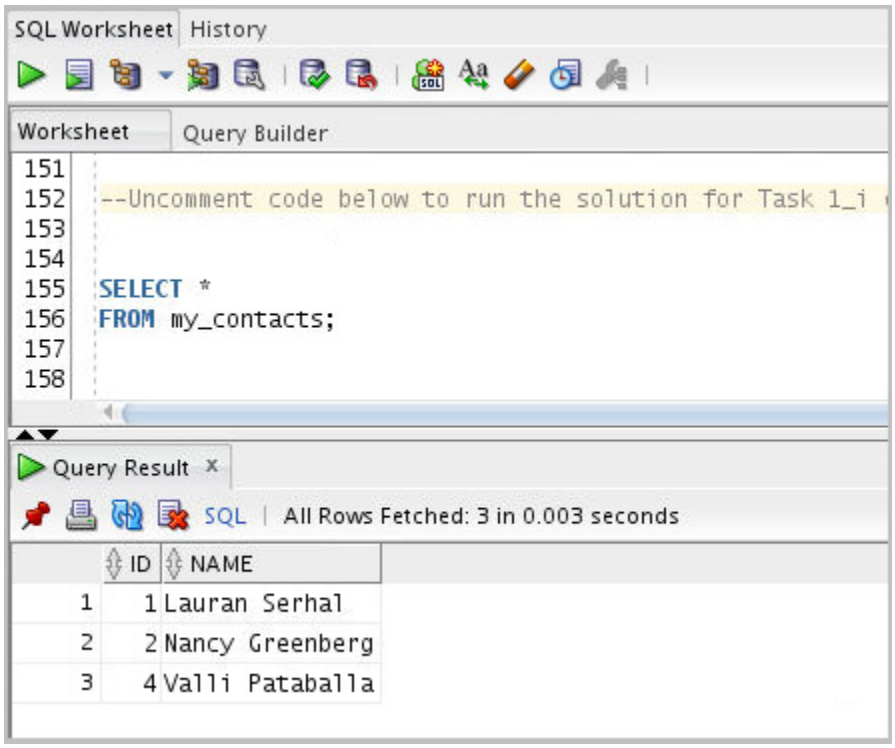
g. Execute the `DEL_ROW` package procedure to delete a contact with an ID value of `3`.
The code and the results are displayed as follows:



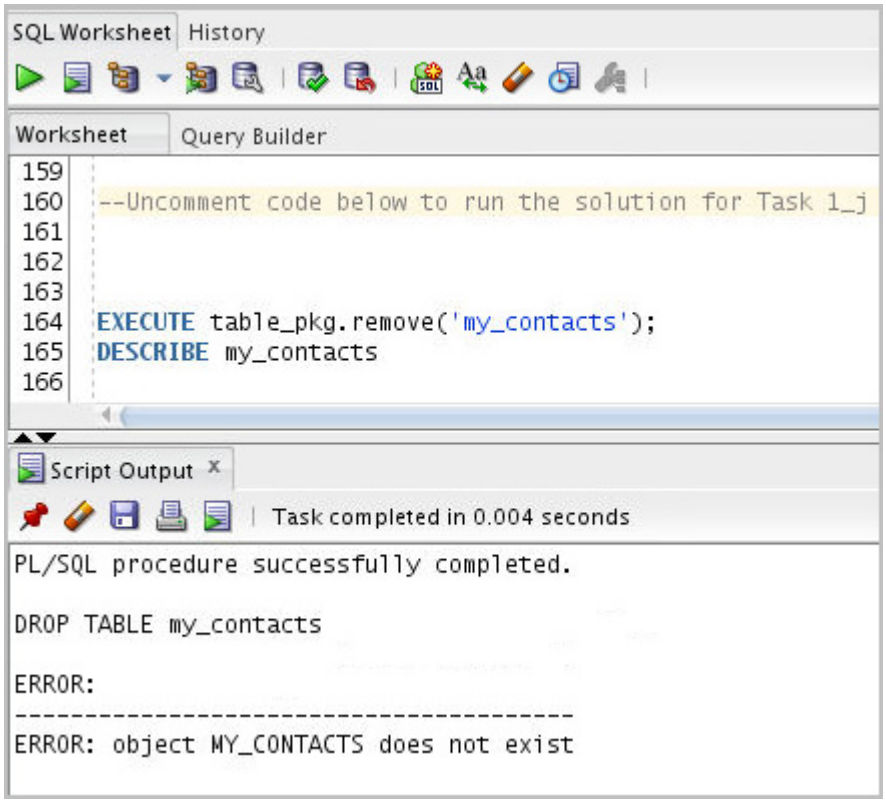
h. Execute the `UPD_ROW` procedure with the following row data:
`upd_row('my_contacts','name=''Nancy Greenberg''','id=2');`
The code and the results are displayed as follows:



i. Query the `MY_CONTACTS` table contents to verify the changes.
The code and the results are displayed as follows:



j. Drop the table by using remove procedure and describe the `MY_CONTACTS` table.
The code and the results are displayed as follows:

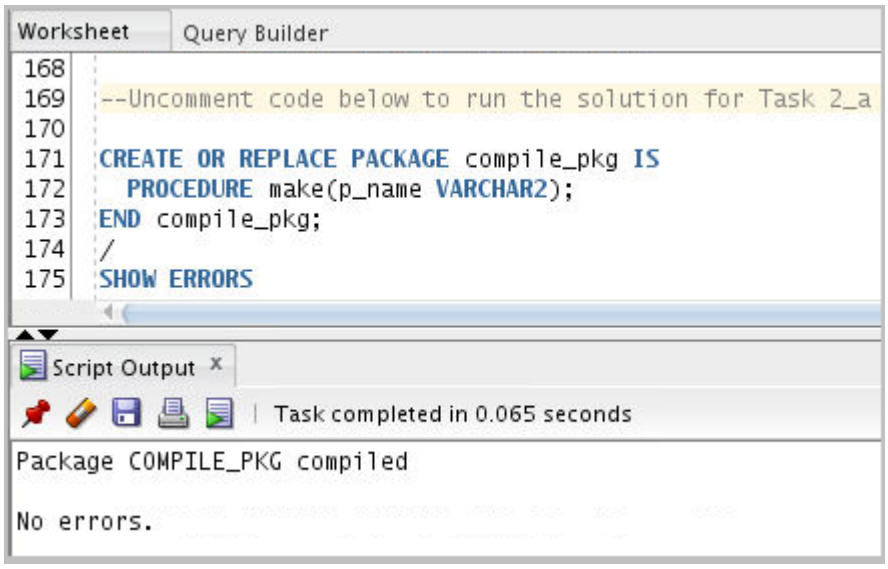


2. Create a `COMPILE_PKG` package that compiles the PL/SQL code in your schema.

a. In the specification, create a package procedure called MAKE that accepts the name of a PL/SQL program unit to be compiled.

Uncomment and select the code under Task 2_a. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the package specification. The code and the results are shown below.

```
CREATE OR REPLACE PACKAGE compile_pkg IS
  PROCEDURE make(p_name VARCHAR2);
END compile_pkg;
/
SHOW ERRORS
```



b. In the package body, include the following:

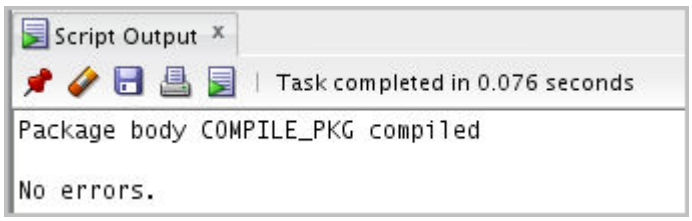
1) The EXECUTE procedure used in the TABLE_PKG procedure in step 1 of this practice.
2) A private function named GET_TYPE to determine the PL/SQL object type from the data dictionary.
   - The function returns the type name (use PACKAGE for a package with a body) if the object exists; otherwise, it should return a NULL.
   - In the WHERE clause condition, add the following to the condition to ensure that only one row is returned if the name represents a PACKAGE, which may also have a PACKAGE BODY. In this case, you can only compile the complete package, but not the specification or body as separate components:

     ```
     rownum = 1
     ```
3) Create the MAKE procedure by using the following information:
   - The MAKE procedure accepts one argument, name, which represents the object name.
   - The MAKE procedure should call the GET_TYPE function. If the object exists, MAKE dynamically compiles it with the ALTER statement.

Uncomment and select the code under Task 2_b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the package body. The code and the results are displayed as follows:

```
CREATE OR REPLACE PACKAGE BODY compile_pkg IS

  PROCEDURE execute(p_stmt VARCHAR2) IS
  BEGIN
    DBMS_OUTPUT.PUT_LINE(p_stmt);
    EXECUTE IMMEDIATE p_stmt;
  END;

  FUNCTION get_type(p_name VARCHAR2) RETURN VARCHAR2 IS
    v_proc_type VARCHAR2(30) := NULL;
  BEGIN

    -- The ROWNUM = 1 is added to the condition
    -- to ensure only one row is returned if the
    -- name represents a PACKAGE, which may also
    -- have a PACKAGE BODY. In this case, we can
    -- only compile the complete package, but not
    -- the specification or body as separate
    -- components.

    SELECT object_type INTO v_proc_type
    FROM user_objects
    WHERE object_name = UPPER(p_name)
    AND ROWNUM = 1;
    RETURN v_proc_type;
  EXCEPTION
    WHEN NO_DATA_FOUND THEN
      RETURN NULL;
  END;

  PROCEDURE make(p_name VARCHAR2) IS
    v_stmt       VARCHAR2(100);
    v_proc_type  VARCHAR2(30) := get_type(p_name);
  BEGIN
    IF v_proc_type IS NOT NULL THEN
      v_stmt := 'ALTER '|| v_proc_type ||' '|| p_name ||'
COMPILE';
      execute(v_stmt);
    ELSE
      RAISE_APPLICATION_ERROR(-20001,
```

```
            'Subprogram '''|| p_name ||''' does not exist');
    END IF;
  END make;
END compile_pkg;
/
SHOW ERRORS
```

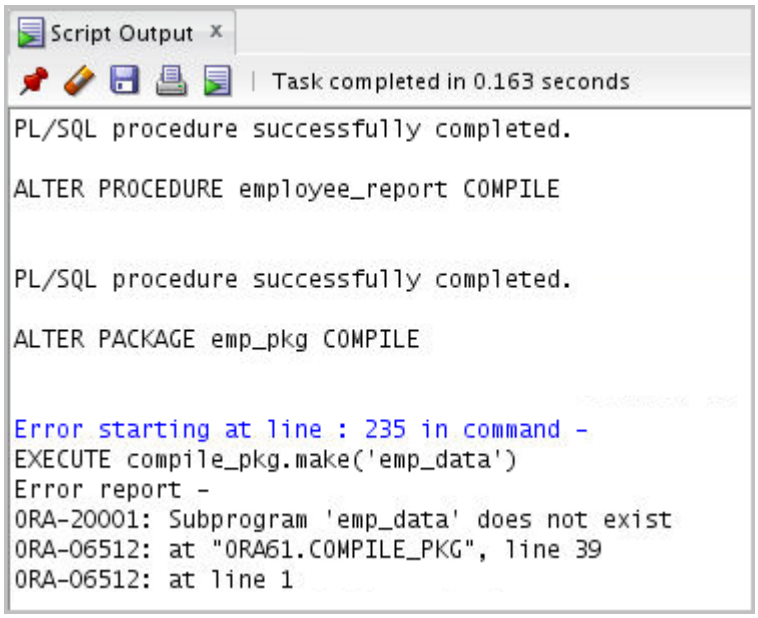


c. Use the `COMPILE_PKG.MAKE` procedure to compile the following:

1) The `EMPLOYEE_REPORT` procedure
2) The `EMP_PKG` package
3) A nonexistent object called `EMP_DATA`

Uncomment and select the code under task 2_c. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to execute the package's procedure. The result is shown below.

```
SET SERVEROUTPUT ON
EXECUTE compile_pkg.make('employee_report')
EXECUTE compile_pkg.make('emp_pkg')
EXECUTE compile_pkg.make('emp_data')
```



Practices for Lesson 9: Creating Triggers

Chapter 9

Practices for Lesson 9: Overview

Overview

In this practice, you create statement and row triggers. You also create procedures that are invoked from within the triggers.

Note:

1. Before starting this practice, execute `/home/oracle/labs/plpu/code_ex/cleanup_scripts/cleanup_09.sql` script.
2. If you missed a step in a practice, please run the appropriate solution script for that practice step before proceeding to the next step or the next practice.

Practice 9-1: Creating Statement and Row Triggers

Overview

In this practice, you create statement and row triggers. You also create procedures that are invoked from within the triggers.

Note: Execute `cleanup_09.sql script` from `/home/oracle/labs/plpu/code_ex/cleanup_scripts/` before performing the following tasks.

Task

1. The rows in the `JOBS` table store a minimum and maximum salary allowed for different `JOB_ID` values. You are asked to write code to ensure that employees' salaries fall in the range allowed for their job type, for insert and update operations.
   a. Create a procedure called `CHECK_SALARY` as follows:
      1) The procedure accepts two parameters, one for an employee's job ID string and the other for the salary.
      2) The procedure uses the job ID to determine the minimum and maximum salary for the specified job.
      3) If the salary parameter does not fall within the salary range of the job, inclusive of the minimum and maximum, then it should raise an application exception, with the message "`Invalid salary <sal>. Salaries for job <jobid> must be between <min> and <max>.`" Replace the various items in the message with values supplied by parameters and variables populated by queries. Save the file.
   b. Create a trigger called `CHECK_SALARY_TRG` on the `EMPLOYEES` table that fires before an `INSERT` or `UPDATE` operation on each row:
      1) The trigger must call the `CHECK_SALARY` procedure to carry out the business logic.
      2) The trigger should pass the new job ID and salary to the procedure parameters.
2. Test the `CHECK_SALARY_TRG` trigger using the following cases:
   a. Using your `EMP_PKG.ADD_EMPLOYEE` procedure, add employee `Eleanor Beh` to department 30. What happens and why?
   b. Update the salary of employee 115 to $2,000. In a separate update operation, change the employee job ID to `HR_REP`. What happens in each case?
   c. Update the salary of employee 115 to $2,800. What happens?
3. Update the `CHECK_SALARY_TRG` trigger to fire only when the job ID or salary values have actually changed.
   a. Implement the business rule using a `WHEN` clause to check whether the `JOB_ID` or `SALARY` values have changed.

      Note: Make sure that the condition handles the `NULL` in the `OLD.column_name` values if an `INSERT` operation is performed; otherwise, an insert operation will fail.
   b. Test the trigger by executing the `EMP_PKG.ADD_EMPLOYEE` procedure with the following parameter values:
      - `p_first_name: 'Eleanor'`
      - `p_last name: 'Beh'`

- p_Email: 'EBEH'
- p_Job: 'IT_PROG'
- p_Sal: 5000

c. Update employees with the IT_PROG job by incrementing their salary by $2,000. What happens?

d. Update the salary to $9,000 for Eleanor Beh.

Hint: Use an UPDATE statement with a subquery in the WHERE clause. What happens?

e. Change the job of Eleanor Beh to ST_MAN using another UPDATE statement with a subquery. What happens?

4. You are asked to prevent employees from being deleted during business hours.

a. Write a statement trigger called DELETE_EMP_TRG on the EMPLOYEES table to prevent rows from being deleted during weekday business hours, which are from 9:00 AM to 6:00 PM.

b. Attempt to delete employees with JOB_ID of SA_REP who are not assigned to a department.

Hint: This is employee Grant with ID 178.

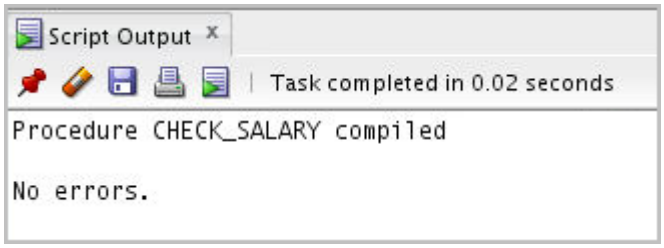
Solution 9-1: Creating Statement and Row Triggers

In this practice, you create statement and row triggers. You also create procedures that are invoked from within the triggers.

1. The rows in the JOBS table store a minimum and maximum salary allowed for different JOB_ID values. You are asked to write code to ensure that employees' salaries fall in the range allowed for their job type, for insert and update operations.
   a. Create a procedure called CHECK_SALARY as follows:
      1) The procedure accepts two parameters, one for an employee's job ID string and the other for the salary.
      2) The procedure uses the job ID to determine the minimum and maximum salary for the specified job.
      3) If the salary parameter does not fall within the salary range of the job, inclusive of the minimum and maximum, then it should raise an application exception, with the message "Invalid salary <sal>. Salaries for job <jobid> must be between <min> and <max>". Replace the various items in the message with values supplied by parameters and variables populated by queries. Save the file.

      Open sol_09.sql script from /home/oracle/labs/plpu/soln directory. Uncomment and select the code under Task 1_a. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
CREATE OR REPLACE PROCEDURE check_salary (p_the_job VARCHAR2,
p_the_salary NUMBER) IS
  v_minsal jobs.min_salary%type;
  v_maxsal jobs.max_salary%type;
BEGIN
  SELECT min_salary, max_salary INTO v_minsal, v_maxsal
  FROM jobs
  WHERE job_id = UPPER(p_the_job);
  IF p_the_salary NOT BETWEEN v_minsal AND v_maxsal THEN
    RAISE_APPLICATION_ERROR(-20100,
      'Invalid salary $' ||p_the_salary ||'. '||
      'Salaries for job '|| p_the_job ||
      ' must be between $'|| v_minsal ||' and $' || v_maxsal);
  END IF;
END;
/
SHOW ERRORS
```

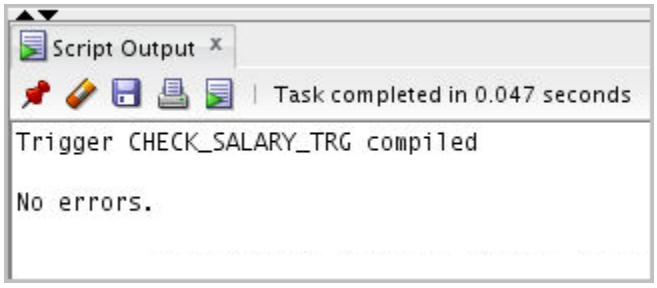


b. Create a trigger called `CHECK_SALARY_TRG` on the `EMPLOYEES` table that fires before an `INSERT` or `UPDATE` operation on each row:

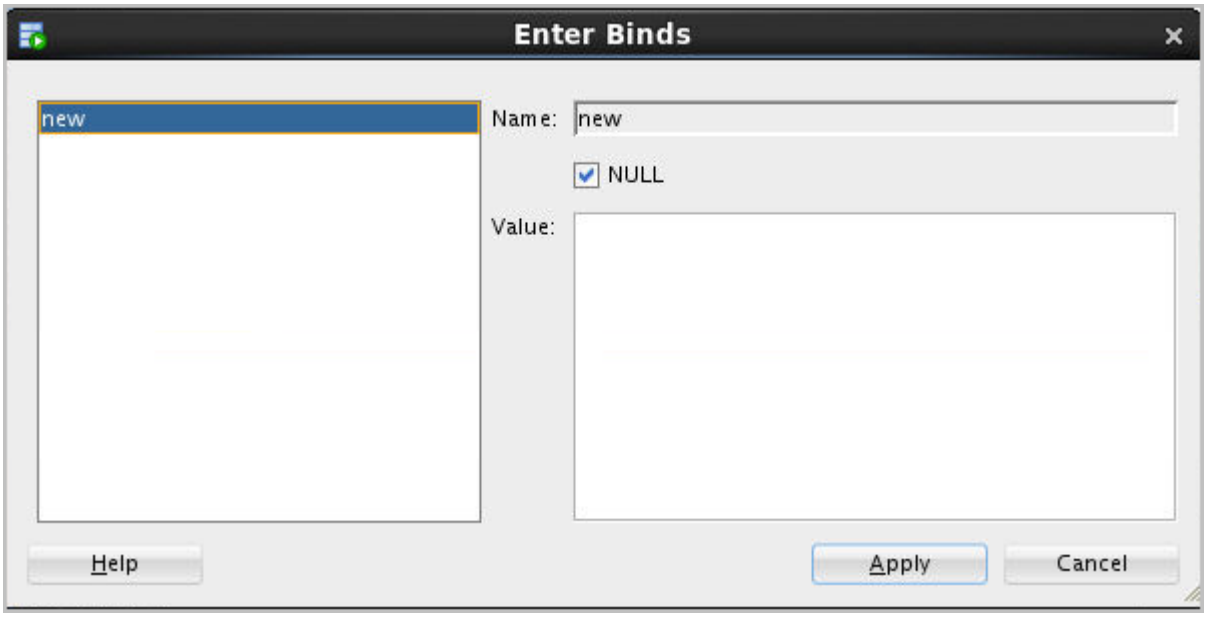
1) The trigger must call the `CHECK_SALARY` procedure to carry out the business logic.
2) The trigger should pass the new job ID and salary to the procedure parameters.

Uncomment and select the code under Task 1_b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
CREATE OR REPLACE TRIGGER check_salary_trg
BEFORE INSERT OR UPDATE OF job_id, salary
ON employees
FOR EACH ROW
BEGIN
  check_salary(:new.job_id, :new.salary);
END;
/
SHOW ERRORS
```



Note: The trigger compilation might ask for values of bind variables while compiling. You may encounter a wizard as the one below. Click Apply.



2. Test the `CHECK_SALARY_TRG` trigger using the following cases:
   a. Using your `EMP_PKG.ADD_EMPLOYEE` procedure, add employee `Eleanor Beh` to department 30. What happens and why?

      Uncomment and select the code under Task 2_a. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
EXECUTE emp_pkg.add_employee('Eleanor', 'Beh', 30)
```

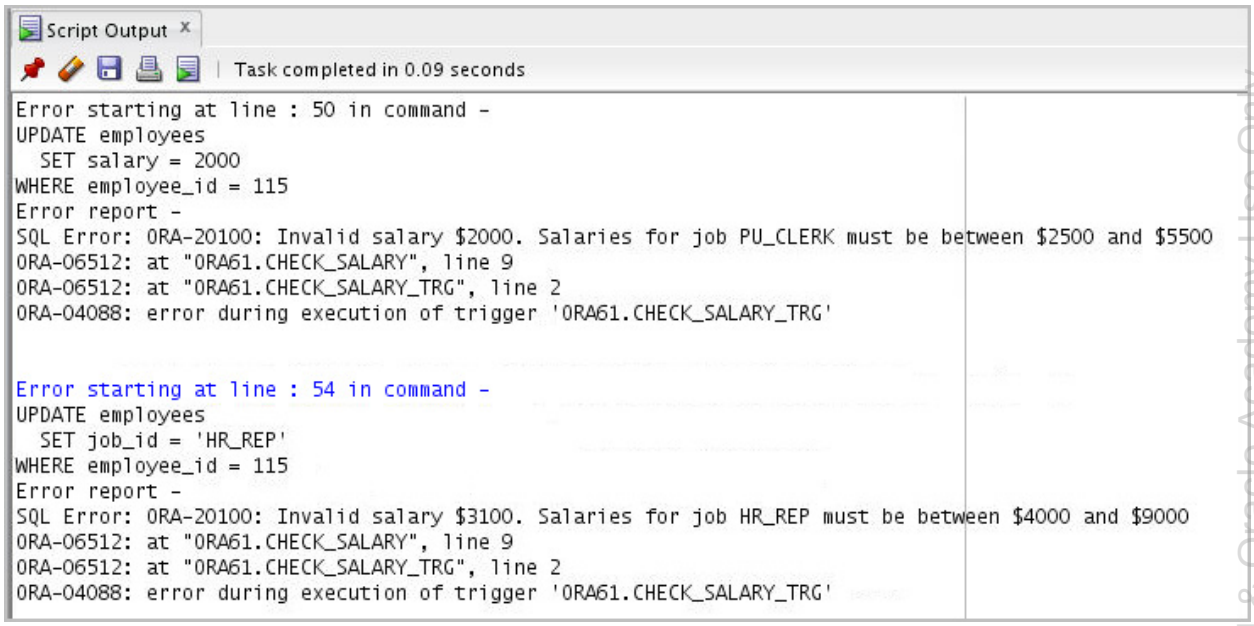
```
Script Output
Task completed in 0.067 seconds
Error starting at line : 43 in command -
EXECUTE emp_pkg.add_employee('Eleanor', 'Beh', 30)
Error report -
ORA-20100: Invalid salary $1000. Salaries for job SA_REP must be between $6000 and $12008
ORA-06512: at "ORA61.CHECK_SALARY", line 9
ORA-06512: at "ORA61.CHECK_SALARY_TRG", line 2
ORA-04088: error during execution of trigger 'ORA61.CHECK_SALARY_TRG'
ORA-06512: at "ORA61.EMP_PKG", line 24
ORA-06512: at "ORA61.EMP_PKG", line 40
ORA-06512: at line 1
```

      The trigger raises an exception because the `EMP_PKG.ADD_EMPLOYEE` procedure invokes an overloaded version of itself that uses the default salary of $1,000 and a default job ID of `SA_REP`. However, the `JOBS` table stores a minimum salary of $6,000 for the `SA_REP` type.

   b. Update the salary of employee 115 to $2,000. In a separate update operation, change the employee job ID to `HR_REP`. What happens in each case?

Uncomment and select the code under Task 2_b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
UPDATE employees
  SET salary = 2000
WHERE employee_id = 115;

UPDATE employees
  SET job_id = 'HR_REP'
WHERE employee_id = 115;
```



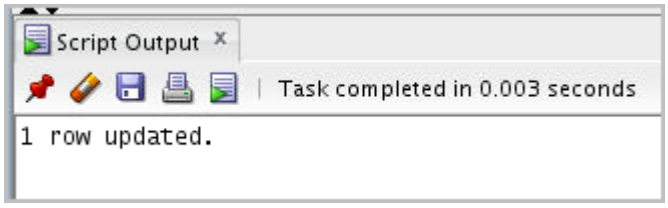
The first update statement fails to set the salary to $2,000. The check salary trigger rule fails the update operation because the new salary for employee 115 is less than the minimum allowed for the `PU_CLERK` job ID.

The second update fails to change the employee's job because the current employee's salary of $3,100 is less than the minimum for the new `HR_REP` job ID.

c. Update the salary of employee 115 to $2,800. What happens?

Uncomment and select the code under Task 2_c. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
UPDATE employees
  SET salary = 2800
WHERE employee_id = 115;
```



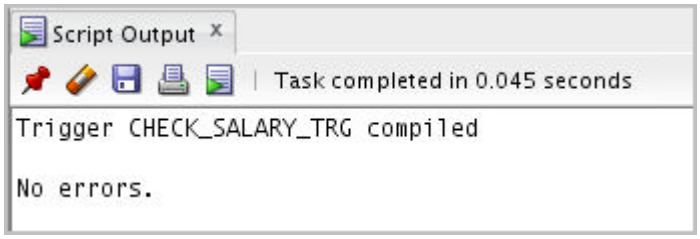
The update operation is successful because the new salary falls within the acceptable range for the current job ID.

3. Update the `CHECK_SALARY_TRG` trigger to fire only when the job ID or salary values have actually changed.
   a. Implement the business rule using a `WHEN` clause to check whether the `JOB_ID` or `SALARY` values have changed.

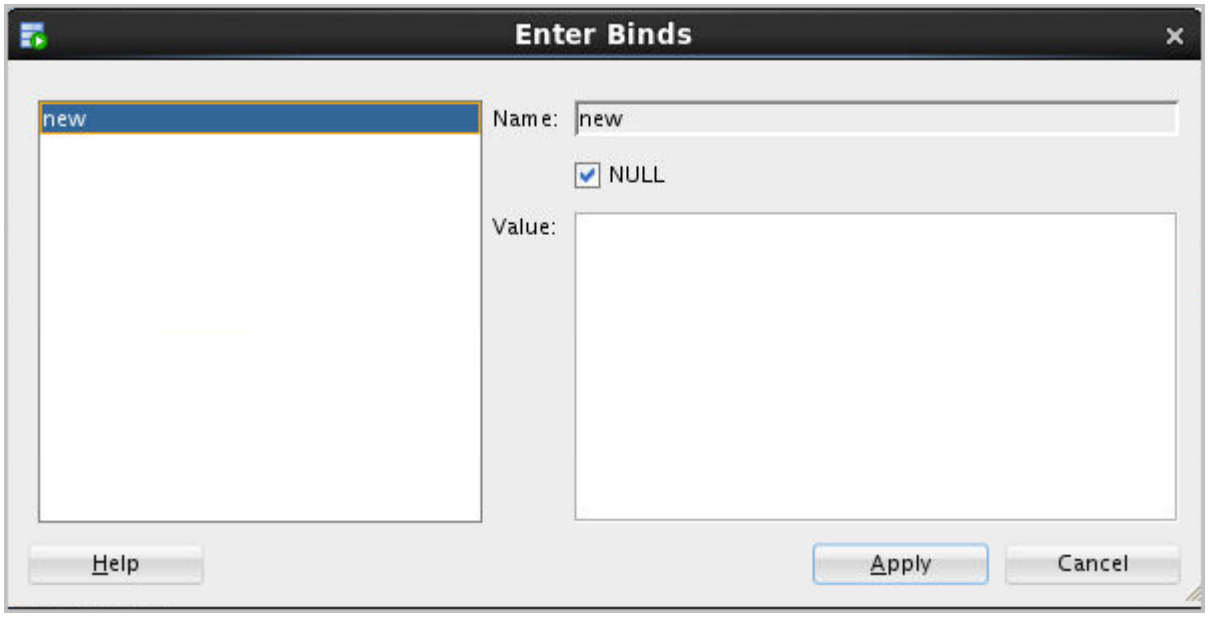
      Note: Make sure that the condition handles the `NULL` in the `OLD.column_name` values if an `INSERT` operation is performed; otherwise, an insert operation will fail.

      Uncomment and select the code under Task 3_a. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
CREATE OR REPLACE TRIGGER check_salary_trg
BEFORE INSERT OR UPDATE OF job_id, salary
ON employees FOR EACH ROW
WHEN (new.job_id <> NVL(old.job_id,'?') OR
      new.salary <> NVL(old.salary,0))
BEGIN
  check_salary(:new.job_id, :new.salary);
END;
/
SHOW ERRORS
```



Note: The trigger compilation might ask for values of bind variables while compiling. You may encounter a wizard as the one below. Click Apply.

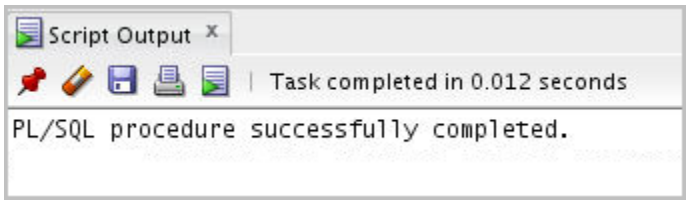


b. Test the trigger by executing the `EMP_PKG.ADD_EMPLOYEE` procedure with the following parameter values:

- `p_first_name: 'Eleanor'`
- `p_last name: 'Beh'`
- `p_Email: 'EBEH'`
- `p_Job: 'IT_PROG'`
- `p_Sal: 5000`

Uncomment and select the code under Task 3_b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

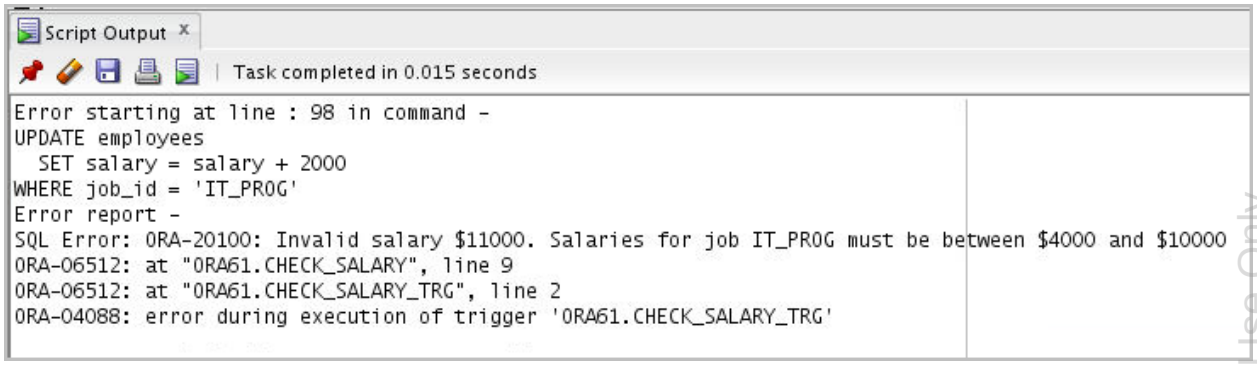
```
BEGIN
  emp_pkg.add_employee('Eleanor', 'Beh', 'EBEH',
                       p_job => 'IT_PROG', p_sal => 5000);
END;
/
```



c. Update employees with the `IT_PROG` job by incrementing their salary by $2,000. What happens?

Uncomment and select the code under Task 3_c. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
UPDATE employees
  SET salary = salary + 2000
WHERE job_id = 'IT_PROG';
```



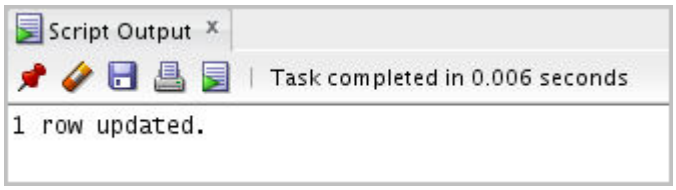
An employee's salary in the specified job type exceeds the maximum salary for that job type. No employee salaries in the `IT_PROG` job type are updated.

d. Update the salary to $9,000 for `Eleanor Beh`.

Hint: Use an `UPDATE` statement with a subquery in the `WHERE` clause. What happens?

Uncomment and select the code under Task 3_d. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

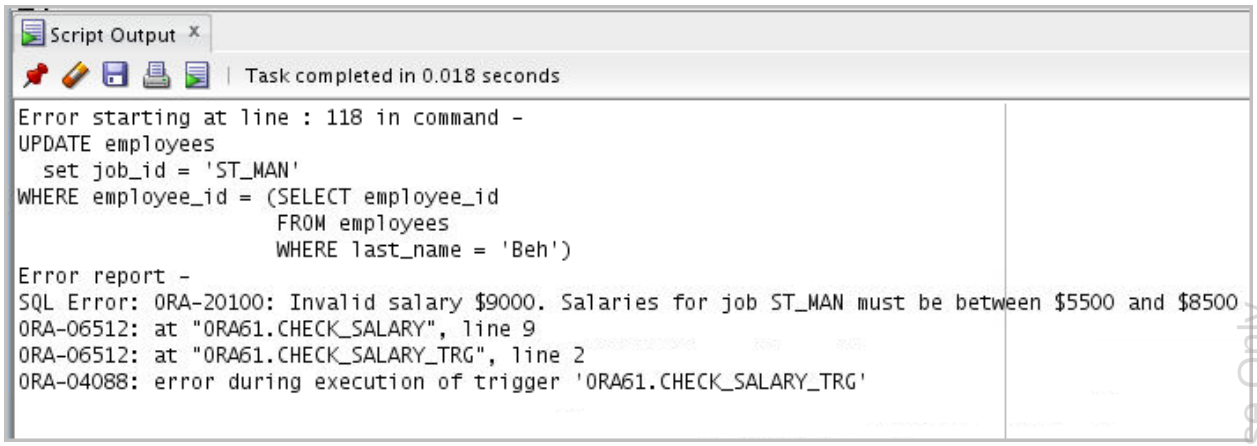
```
UPDATE employees
  SET salary = 9000
WHERE employee_id = (SELECT employee_id
                     FROM employees
                     WHERE last_name = 'Beh');
```



e. Change the job of `Eleanor Beh` to `ST_MAN` using another `UPDATE` statement with a subquery. What happens?

Uncomment and select the code under Task 3_e. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
UPDATE employees
  set job_id = 'ST_MAN'
WHERE employee_id = (SELECT employee_id
                     FROM employees
                     WHERE last_name = 'Beh');
```

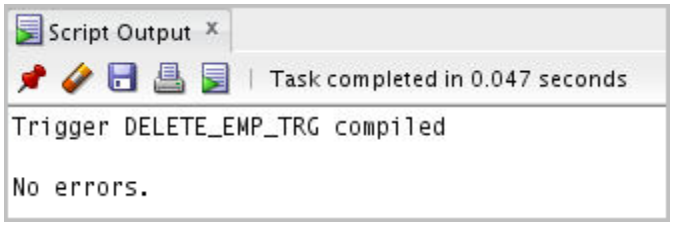


The maximum salary of the new job type is less than the employee's current salary; therefore, the update operation fails.

4. You are asked to prevent employees from being deleted during business hours.
   a. Write a statement trigger called `DELETE_EMP_TRG` on the `EMPLOYEES` table to prevent rows from being deleted during weekday business hours, which are from 9:00 AM to 6:00 PM.

      Uncomment and select the code under Task 4_a. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
CREATE OR REPLACE TRIGGER delete_emp_trg
BEFORE DELETE ON employees
DECLARE
  the_day VARCHAR2(3) := TO_CHAR(SYSDATE, 'DY');
  the_hour PLS_INTEGER := TO_NUMBER(TO_CHAR(SYSDATE, 'HH24'));
BEGIN
   IF (the_hour BETWEEN 9 AND 18) AND (the_day NOT IN
('SAT','SUN')) THEN
     RAISE_APPLICATION_ERROR(-20150,
      'Employee records cannot be deleted during the business
       hours of 9AM and 6PM');
   END IF;
END;
/
SHOW ERRORS
```

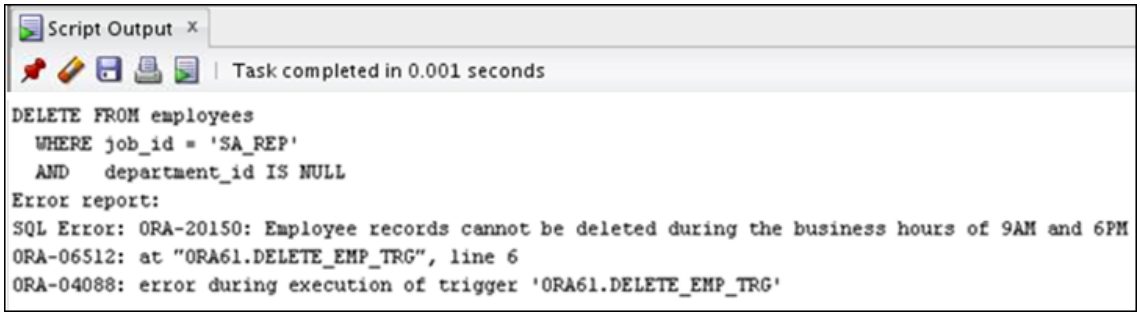


b. Attempt to delete employees with `JOB_ID` of `SA_REP` who are not assigned to a department.

Hint: This is employee Grant with ID 178.

Uncomment and select the code under Task 4_b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
DELETE FROM employees
WHERE job_id = 'SA_REP'
  AND   department_id IS NULL;
```



Note: Depending on the current time on your host machine in the classroom, you may or may not be able to perform the delete operations. For example, in the screen capture above, the delete operation failed as it was performed outside the allowed business hours (based on the host machine time).

Practices for Lesson 10: Creating Compound, DDL, and Event Database Triggers

Chapter 10

Practices for Lesson 10: Overview

Overview

In this practice, you implement a simple business rule for ensuring data integrity of employees' salaries with respect to the valid salary range for their jobs. You create a trigger for this rule. During this process, your new triggers cause a cascading effect with triggers created in the practice section of the previous lesson. The cascading effect results in a mutating table exception on the `JOBS` table. You then create a PL/SQL package and additional triggers to solve the mutating table issue.

Note:

1. Before starting this practice, execute `/home/oracle/labs/plpu/code_ex/cleanup_scripts/cleanup_10.sql` script.
2. If you missed a step in a practice, please run the appropriate solution script for that practice step before proceeding to the next step or the next practice.

Practice 10-1: Managing Data Integrity Rules and Mutating Table Exceptions

Overview

In this practice, you implement a simple business rule for ensuring data integrity of employees' salaries with respect to the valid salary range for their jobs. You create a trigger for this rule. During this process, your new triggers cause a cascading effect with triggers created in the practice section of the previous lesson. The cascading effect results in a mutating table exception on the JOBS table. You then create a PL/SQL package and additional triggers to solve the mutating table issue.

Note: Execute `cleanup_10.sql script` from `/home/oracle/labs/plpu/code_ex/cleanup_scripts/` before performing the following tasks.

Task

1. Employees receive an automatic increase in salary if the minimum salary for a job is increased to a value larger than their current salaries. Implement this requirement through a package procedure called by a trigger on the JOBS table. When you attempt to update the minimum salary in the JOBS table and try to update the employees' salaries, the CHECK_SALARY trigger attempts to read the JOBS table, which is subject to change, and you get a mutating table exception that is resolved by creating a new package and additional triggers.
   a. Update your EMP_PKG package (that you last updated in the practice titled 'Creating Triggers") as follows:
      1) Add a procedure called SET_SALARY that updates the employees' salaries.
      2) The SET_SALARY procedure accepts the following two parameters: The job ID for those salaries that may have to be updated, and the new minimum salary for the job ID
   b. Create a row trigger named UPD_MINSALARY_TRG on the JOBS table that invokes the EMP_PKG.SET_SALARY procedure, when the minimum salary in the JOBS table is updated for a specified job ID.
   c. Write a query to display the employee ID, last name, job ID, current salary, and minimum salary for employees who are programmers—that is, their JOB_ID is 'IT_PROG'. Then, update the minimum salary in the JOBS table to increase it by $1,000. What happens?
2. To resolve the mutating table issue, create a JOBS_PKG package to maintain in memory a copy of the rows in the JOBS table. Next, modify the CHECK_SALARY procedure to use the package data rather than issue a query on a table that is mutating to avoid the exception. However, you must create a BEFORE INSERT OR UPDATE statement trigger on the EMPLOYEES table to initialize the JOBS_PKG package state before the CHECK_SALARY row trigger is fired.
   a. Create a new package called JOBS_PKG with the following specification:

```
PROCEDURE initialize;
FUNCTION get_minsalary(p_jobid VARCHAR2) RETURN NUMBER;
FUNCTION get_maxsalary(p_jobid VARCHAR2) RETURN NUMBER;
PROCEDURE set_minsalary(p_jobid VARCHAR2,min_salary
```

```
                                    NUMBER);
PROCEDURE set_maxsalary(p_jobid VARCHAR2,max_salary
                                    NUMBER);
```

b. Implement the body of `JOBS_PKG` as follows:
   1) Declare a private PL/SQL index-by table called `jobs_tab_type` that is indexed by a string type based on the `JOBS.JOB_ID%TYPE`.
   2) Declare a private variable called `jobstab` based on the `jobs_tab_type`.
   3) The `INITIALIZE` procedure reads the rows in the `JOBS` table by using a cursor loop, and uses the `JOB_ID` value for the `jobstab` index that is assigned its corresponding row.
   4) The `GET_MINSALARY` function uses a `p_jobid` parameter as an index to the `jobstab` and returns the `min_salary` for that element.
   5) The `GET_MAXSALARY` function uses a `p_jobid` parameter as an index to the `jobstab` and returns the `max_salary` for that element.
   6) The `SET_MINSALARY` procedure uses its `p_jobid` as an index to the `jobstab` to set the `min_salary` field of its element to the value in the `min_salary` parameter.
   7) The `SET_MAXSALARY` procedure uses its `p_jobid` as an index to the `jobstab` to set the `max_salary` field of its element to the value in the `max_salary` parameter.

c. Copy the `CHECK_SALARY` procedure from Practice 9, Exercise 1a, and modify the code by replacing the query on the `JOBS` table with statements to set the local `minsal` and `maxsal` variables with values from the `JOBS_PKG` data by calling the appropriate `GET_*SALARY` functions. This step should eliminate the mutating trigger exception.

d. Implement a `BEFORE INSERT OR UPDATE` statement trigger called `INIT_JOBPKG_TRG` that uses the `CALL` syntax to invoke the `JOBS_PKG.INITIALIZE` procedure to ensure that the package state is current before the DML operations are performed.

e. Test the code changes by executing the query to display the employees who are programmers, and then issue an update statement to increase the minimum salary of the `IT_PROG` job type by 1,000 in the `JOBS` table. Follow this up with a query on the employees with the `IT_PROG` job type to check the resulting changes. Which employees' salaries have been set to the minimum for their jobs?

3. Because the `CHECK_SALARY` procedure is fired by `CHECK_SALARY_TRG` before inserting or updating an employee, you must check whether this still works as expected.

   a. Test this by adding a new employee using `EMP_PKG.ADD_EMPLOYEE` with the following parameters: (`'Steve'`, `'Morse'`, `'SMORSE'`, and `sal => 6500`). What happens?

   b. To correct the problem encountered when adding or updating an employee:
      1) Create a `BEFORE INSERT OR UPDATE` statement trigger called `EMPLOYEE_INITJOBS_TRG` on the `EMPLOYEES` table that calls the `JOBS_PKG.INITIALIZE` procedure.
      2) Use the `CALL` syntax in the trigger body.

c. Test the trigger by adding employee Steve Morse again. Confirm the inserted record in the `EMPLOYEES` table by displaying the employee ID, first and last names, salary, job ID, and department ID.

Solution 10-1: Managing Data Integrity Rules and Mutating Table Exceptions

In this practice, you implement a simple business rule for ensuring data integrity of employees' salaries with respect to the valid salary range for their jobs. You create a trigger for this rule. During this process, your new triggers cause a cascading effect with triggers created in the practice section of the previous lesson. The cascading effect results in a mutating table exception on the JOBS table. You then create a PL/SQL package and additional triggers to solve the mutating table issue.

1. Employees receive an automatic increase in salary if the minimum salary for a job is increased to a value larger than their current salaries. Implement this requirement through a package procedure called by a trigger on the JOBS table. When you attempt to update the minimum salary in the JOBS table and try to update the employees' salaries, the CHECK_SALARY trigger attempts to read the JOBS table, which is subject to change, and you get a mutating table exception that is resolved by creating a new package and additional triggers.
   a. Update your EMP_PKG package (that you last updated in Practice 9) as follows:
      1) Add a procedure called SET_SALARY that updates the employees' salaries.
      2) The SET_SALARY procedure accepts the following two parameters: The job ID for those salaries that may have to be updated, and the new minimum salary for the job ID

      Open sol_10.sql script from /home/oracle/labs/plpu/soln directory. Uncomment and select the code under Task 1_a. Click the Run Script (F5) icon on the SQL Worksheet toolbar to run the script. The code and the results are shown as follows. The newly added code is highlighted in bold letters in the following code box.

```
-- Package SPECIFICATION

CREATE OR REPLACE PACKAGE emp_pkg IS


  TYPE emp_tab_type IS TABLE OF employees%ROWTYPE;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30);

  PROCEDURE add_employee(
```

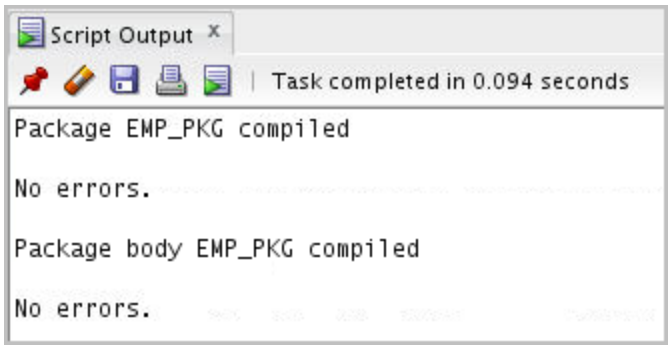
```
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE);

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE);

  FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype;

  PROCEDURE get_employees(p_dept_id
employees.department_id%type);

  PROCEDURE init_departments;

  PROCEDURE print_employee(p_rec_emp employees%rowtype);

  PROCEDURE show_employees;

  -- New set_salary procedure

  PROCEDURE set_salary(p_jobid VARCHAR2, p_min_salary NUMBER);

END emp_pkg;
/
SHOW ERRORS

-- Package BODY

CREATE OR REPLACE PACKAGE BODY emp_pkg IS
  TYPE boolean_tab_type IS TABLE OF BOOLEAN
     INDEX BY BINARY_INTEGER;

  valid_departments boolean_tab_type;
  emp_table         emp_tab_type;

  FUNCTION valid_deptid(p_deptid IN
departments.department_id%TYPE)
```

```
    RETURN BOOLEAN;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30) IS


  BEGIN -- add_employee
    IF valid_deptid(p_deptid) THEN
      INSERT INTO employees(employee_id, first_name, last_name,
email,
        job_id, manager_id, hire_date, salary, commission_pct,
department_id)
      VALUES (employees_seq.NEXTVAL, p_first_name, p_last_name,
p_email,
        p_job, p_mgr, TRUNC(SYSDATE), p_sal, p_comm, p_deptid);
    ELSE
      RAISE_APPLICATION_ERROR (-20204, 'Invalid department ID.
Try again.');
    END IF;
  END add_employee;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE) IS
    p_email employees.email%type;
  BEGIN
    p_email := UPPER(SUBSTR(p_first_name, 1,
1)||SUBSTR(p_last_name, 1, 7));
    add_employee(p_first_name, p_last_name, p_email, p_deptid =>
p_deptid);
  END;

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE) IS
```

```
  BEGIN
    SELECT salary, job_id
    INTO p_sal, p_job
    FROM employees
    WHERE employee_id = p_empid;
  END get_employee;

  FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE employee_id = p_emp_id;
    RETURN rec_emp;
  END;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE last_name = p_family_name;
    RETURN rec_emp;
  END;

  PROCEDURE get_employees(p_dept_id
employees.department_id%type) IS
  BEGIN
    SELECT * BULK COLLECT INTO emp_table
    FROM EMPLOYEES
    WHERE department_id = p_dept_id;
  END;

  PROCEDURE init_departments IS
  BEGIN
    FOR rec IN (SELECT department_id FROM departments)
    LOOP
      valid_departments(rec.department_id) := TRUE;
    END LOOP;
  END;
```

```
  PROCEDURE print_employee(p_rec_emp employees%rowtype) IS
  BEGIN
    DBMS_OUTPUT.PUT_LINE(p_rec_emp.department_id ||' '||
                         p_rec_emp.employee_id||' '||
                         p_rec_emp.first_name||' '||
                         p_rec_emp.last_name||' '||
                         p_rec_emp.job_id||' '||
                         p_rec_emp.salary);
  END;

  PROCEDURE show_employees IS
  BEGIN
    IF emp_table IS NOT NULL THEN
      DBMS_OUTPUT.PUT_LINE('Employees in Package table');
      FOR i IN 1 .. emp_table.COUNT
      LOOP
        print_employee(emp_table(i));
      END LOOP;
    END IF;
  END show_employees;

  FUNCTION valid_deptid(p_deptid IN
departments.department_id%TYPE)
   RETURN BOOLEAN IS
    v_dummy PLS_INTEGER;
  BEGIN
    RETURN valid_departments.exists(p_deptid);
  EXCEPTION
    WHEN NO_DATA_FOUND THEN
    RETURN FALSE;
END valid_deptid;

-- New set_salary procedure
PROCEDURE set_salary(p_jobid VARCHAR2, p_min_salary NUMBER) IS
    CURSOR cur_emp IS
      SELECT employee_id
      FROM employees
      WHERE job_id = p_jobid AND salary < p_min_salary;
  BEGIN
    FOR rec_emp IN cur_emp
    LOOP
      UPDATE employees
        SET salary = p_min_salary
```

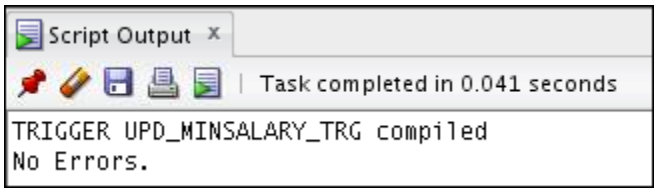
```
      WHERE employee_id = rec_emp.employee_id;
    END LOOP;
  END set_salary;

BEGIN
  init_departments;
END emp_pkg;
/
SHOW ERRORS
```



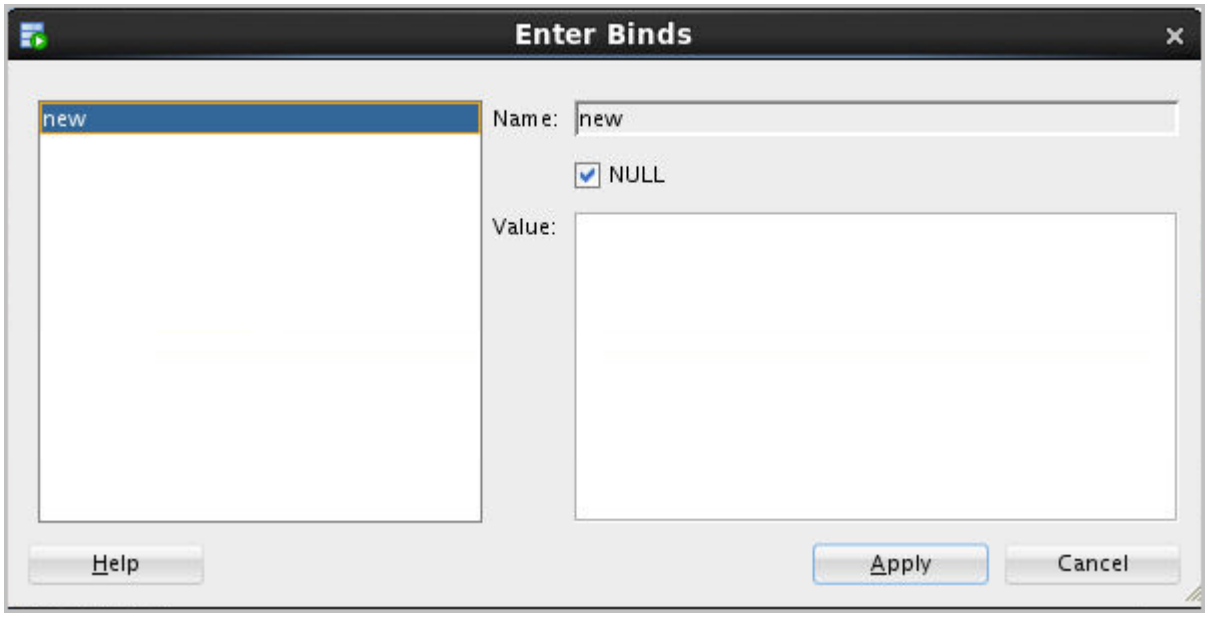
b. Create a row trigger named `UPD_MINSALARY_TRG` on the `JOBS` table that invokes the `EMP_PKG.SET_SALARY` procedure, when the minimum salary in the `JOBS` table is updated for a specified job ID.

Uncomment and select the code under Task 1_b. Click the Run Script (F5) icon on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
CREATE OR REPLACE TRIGGER upd_minsalary_trg
AFTER UPDATE OF min_salary ON JOBS
FOR EACH ROW
BEGIN
  emp_pkg.set_salary(:new.job_id, :new.min_salary);
END;
/
SHOW ERRORS
```



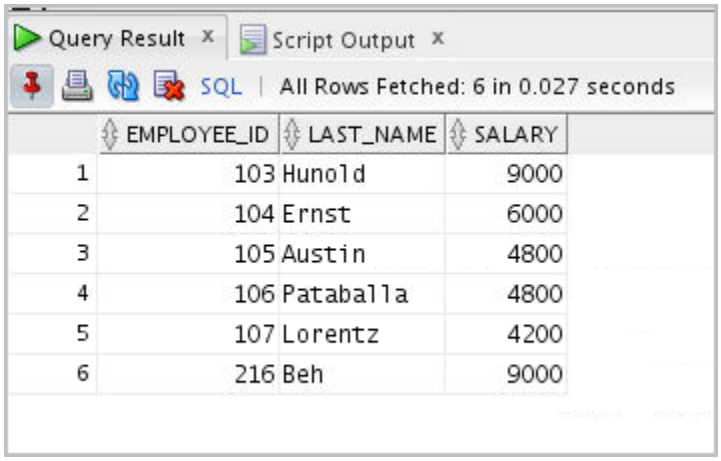
Note: The trigger compilation might ask for values of bind variables while compiling. You may encounter a wizard as the one below. Click Apply.



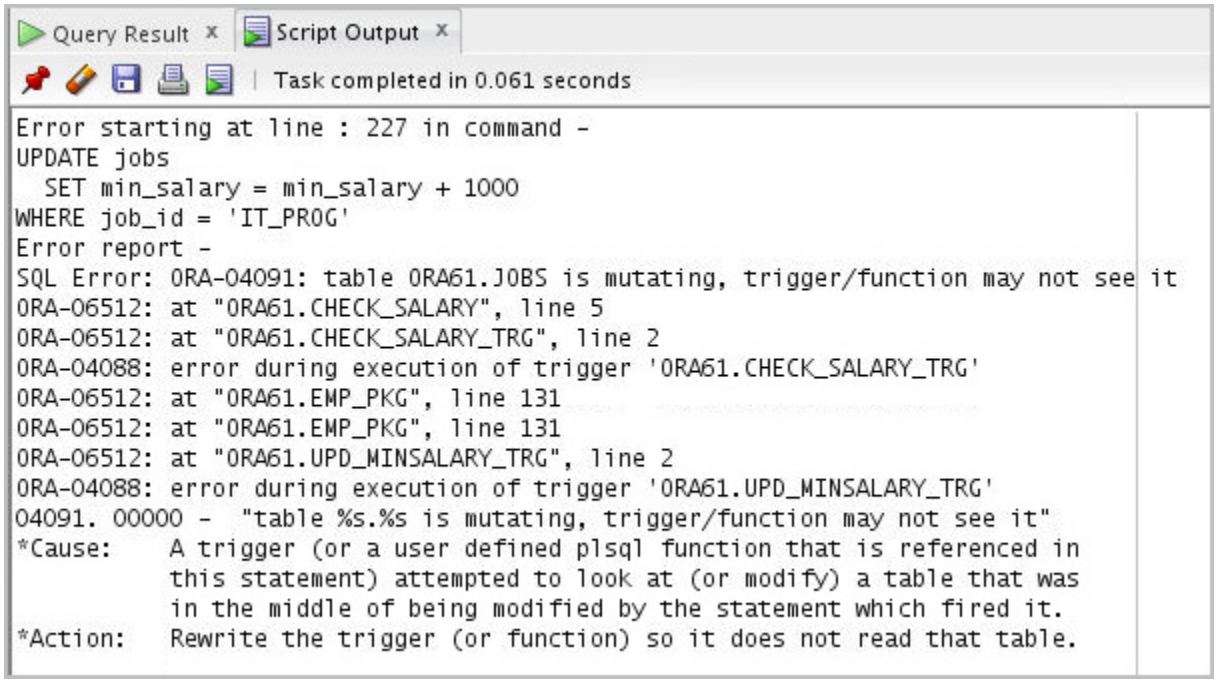
c. Write a query to display the employee ID, last name, job ID, current salary, and minimum salary for employees who are programmers—that is, their `JOB_ID` is `'IT_PROG'`. Then, update the minimum salary in the `JOBS` table to increase it by $1,000. What happens?

Uncomment and select the code under Task 1_c. Click the Run Script (F5) icon on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
SELECT employee_id, last_name, salary
FROM employees
WHERE job_id = 'IT_PROG';

UPDATE jobs
  SET min_salary = min_salary + 1000
WHERE job_id = 'IT_PROG';
```



	EMPLOYEE_ID	LAST_NAME	SALARY
1	103	Hunold	9000
2	104	Ernst	6000
3	105	Austin	4800
4	106	Pataballa	4800
5	107	Lorentz	4200
6	216	Beh	9000




```
Error starting at line : 227 in command -
UPDATE jobs
  SET min_salary = min_salary + 1000
WHERE job_id = 'IT_PROG'
Error report -
SQL Error: ORA-04091: table ORA61.JOBS is mutating, trigger/function may not see it
ORA-06512: at "ORA61.CHECK_SALARY", line 5
ORA-06512: at "ORA61.CHECK_SALARY_TRG", line 2
ORA-04088: error during execution of trigger 'ORA61.CHECK_SALARY_TRG'
ORA-06512: at "ORA61.EMP_PKG", line 131
ORA-06512: at "ORA61.EMP_PKG", line 131
ORA-06512: at "ORA61.UPD_MINSALARY_TRG", line 2
ORA-04088: error during execution of trigger 'ORA61.UPD_MINSALARY_TRG'
04091. 00000 -  "table %s.%s is mutating, trigger/function may not see it"
*Cause:    A trigger (or a user defined plsql function that is referenced in
           this statement) attempted to look at (or modify) a table that was
           in the middle of being modified by the statement which fired it.
*Action:   Rewrite the trigger (or function) so it does not read that table.
```

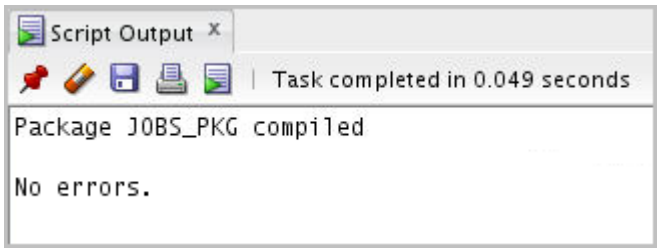
The update of the `min_salary` column for job `'IT_PROG'` fails because the `UPD_MINSALARY_TRG` trigger on the `JOBS` table attempts to update the employees' salaries by calling the `EMP_PKG.SET_SALARY` procedure. The `SET_SALARY` procedure causes the `CHECK_SALARY_TRG` trigger to fire (a cascading effect). The `CHECK_SALARY_TRG` calls the `CHECK_SALARY` procedure, which attempts to read the `JOBS` table data. While reading the `JOBS` table, the `CHECK_SALARY` procedure encounters the mutating table exception.

2. To resolve the mutating table issue, create a `JOBS_PKG` package to maintain in memory a copy of the rows in the `JOBS` table. Next, modify the `CHECK_SALARY` procedure to use the package data rather than issue a query on a table that is mutating to avoid the exception. However, you must create a `BEFORE INSERT OR UPDATE` statement trigger on the `EMPLOYEES` table to initialize the `JOBS_PKG` package state before the `CHECK_SALARY` row trigger is fired.
   a. Create a new package called `JOBS_PKG` with the following specification:

```
PROCEDURE initialize;
FUNCTION get_minsalary(p_jobid VARCHAR2) RETURN NUMBER;
FUNCTION get_maxsalary(p_jobid VARCHAR2) RETURN NUMBER;
PROCEDURE set_minsalary(p_jobid VARCHAR2,min_salary
                        NUMBER);
PROCEDURE set_maxsalary(p_jobid VARCHAR2,max_salary
                        NUMBER);
```

Uncomment and select the code under Task 2_a, or copy and paste the following code in the SQL Worksheet area. Click the Run Script (F5) icon on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
CREATE OR REPLACE PACKAGE jobs_pkg IS
  PROCEDURE initialize;
  FUNCTION get_minsalary(p_jobid VARCHAR2) RETURN NUMBER;
  FUNCTION get_maxsalary(p_jobid VARCHAR2) RETURN NUMBER;
  PROCEDURE set_minsalary(p_jobid VARCHAR2, p_min_salary
NUMBER);
  PROCEDURE set_maxsalary(p_jobid VARCHAR2, p_max_salary
NUMBER);
END jobs_pkg;
/
SHOW ERRORS
```



b. Implement the body of `JOBS_PKG` as follows:

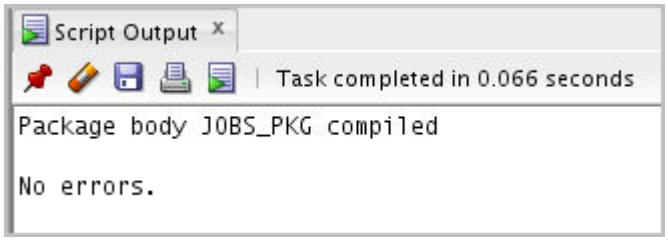
1) Declare a private PL/SQL index-by table called `jobs_tab_type` that is indexed by a string type based on the `JOBS.JOB_ID%TYPE`.
2) Declare a private variable called `jobstab` based on the `jobs_tab_type`.
3) The `INITIALIZE` procedure reads the rows in the `JOBS` table by using a cursor loop, and uses the `JOB_ID` value for the `jobstab` index that is assigned its corresponding row.
4) The `GET_MINSALARY` function uses a `p_jobid` parameter as an index to the `jobstab` and returns the `min_salary` for that element.
5) The `GET_MAXSALARY` function uses a `p_jobid` parameter as an index to the `jobstab` and returns the `max_salary` for that element.
6) The `SET_MINSALARY` procedure uses its `p_jobid` as an index to the `jobstab` to set the `min_salary` field of its element to the value in the `min_salary` parameter.

7) The `SET_MAXSALARY` procedure uses its `p_jobid` as an index to the `jobstab` to set the `max_salary` field of its element to the value in the `max_salary` parameter.

Uncomment and select the code under Task 2_b. Click the Run Script (F5) icon on the SQL Worksheet toolbar to run the script. The code and the results are shown below. To compile the package's body, right-click the package's name or body in the Object Navigator tree, and then select Compile.

```
CREATE OR REPLACE PACKAGE BODY jobs_pkg IS
  TYPE jobs_tab_type IS TABLE OF jobs%rowtype
    INDEX BY jobs.job_id%type;
  jobstab jobs_tab_type;

  PROCEDURE initialize IS
  BEGIN
    FOR rec_job IN (SELECT * FROM jobs)
    LOOP
      jobstab(rec_job.job_id) := rec_job;
    END LOOP;
  END initialize;

  FUNCTION get_minsalary(p_jobid VARCHAR2) RETURN NUMBER IS
  BEGIN
    RETURN jobstab(p_jobid).min_salary;
  END get_minsalary;

  FUNCTION get_maxsalary(p_jobid VARCHAR2) RETURN NUMBER IS
  BEGIN
    RETURN jobstab(p_jobid).max_salary;
  END get_maxsalary;

  PROCEDURE set_minsalary(p_jobid VARCHAR2, p_min_salary NUMBER)
IS
  BEGIN
    jobstab(p_jobid).max_salary := p_min_salary;
  END set_minsalary;

  PROCEDURE set_maxsalary(p_jobid VARCHAR2, p_max_salary NUMBER)
IS
  BEGIN
    jobstab(p_jobid).max_salary := p_max_salary;
  END set_maxsalary;
```

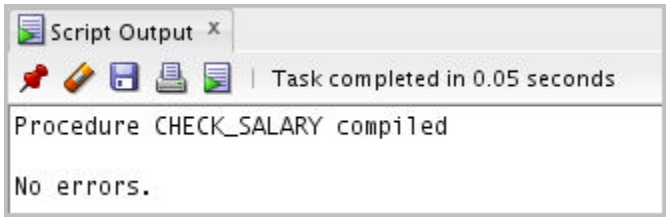
```
END jobs_pkg;
/
SHOW ERRORS
```



c. Copy the `CHECK_SALARY` procedure from the practice titled "Creating Triggers," Practice 9-1, and modify the code by replacing the query on the `JOBS` table with statements to set the local `minsal` and `maxsal` variables with values from the `JOBS_PKG` data by calling the appropriate `GET_*SALARY` functions. This step should eliminate the mutating trigger exception.

Uncomment and select the code under Task 2_c. Click the Run Script (F5) icon on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

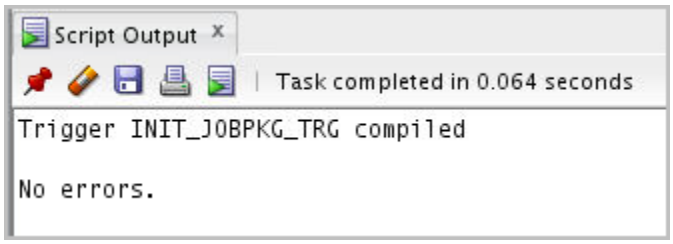
```
CREATE OR REPLACE PROCEDURE check_salary (p_the_job VARCHAR2,
p_the_salary NUMBER) IS
  v_minsal jobs.min_salary%type;
  v_maxsal jobs.max_salary%type;
BEGIN

  -- Commented out to avoid mutating trigger exception on the
JOBS table
  --SELECT min_salary, max_salary INTO v_minsal, v_maxsal
  --FROM jobs
  --WHERE job_id = UPPER(p_the_job);

  v_minsal := jobs_pkg.get_minsalary(UPPER(p_the_job));
  v_maxsal := jobs_pkg.get_maxsalary(UPPER(p_the_job));
  IF p_the_salary NOT BETWEEN v_minsal AND v_maxsal THEN
    RAISE_APPLICATION_ERROR(-20100,
      'Invalid salary $'||p_the_salary||'. '||
      'Salaries for job '|| p_the_job ||
      ' must be between $'|| v_minsal ||' and $' || v_maxsal);
  END IF;
END;
/
SHOW ERRORS
```



d. Implement a `BEFORE INSERT OR UPDATE` statement trigger called `INIT_JOBPKG_TRG` that uses the `CALL` syntax to invoke the `JOBS_PKG.INITIALIZE` procedure to ensure that the package state is current before the DML operations are performed.

Uncomment and select the code under Task 2_d. Click the Run Script (F5) icon on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
CREATE OR REPLACE TRIGGER init_jobpkg_trg
BEFORE INSERT OR UPDATE ON jobs
CALL jobs_pkg.initialize
/
SHOW ERRORS
```

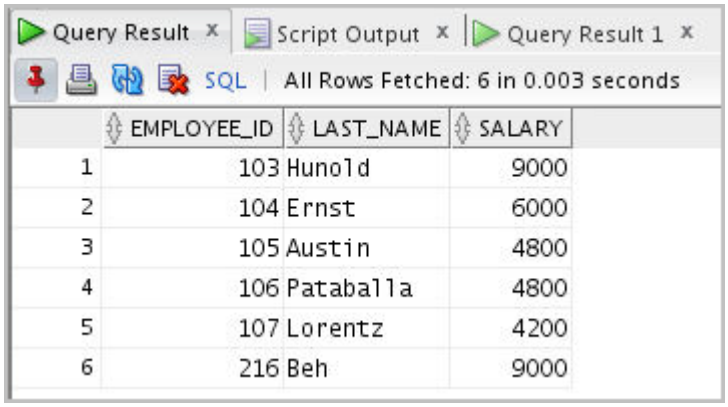


e. Test the code changes by executing the query to display the employees who are programmers, and then issue an update statement to increase the minimum salary of the `IT_PROG` job type by 1,000 in the `JOBS` table. Follow this up with a query on the employees with the `IT_PROG` job type to check the resulting changes. Which employees' salaries have been set to the minimum for their jobs?

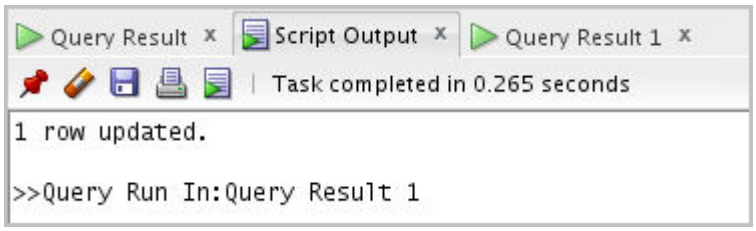
Uncomment and select the code under Task 2_e. Click the Run Script (F5) icon on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

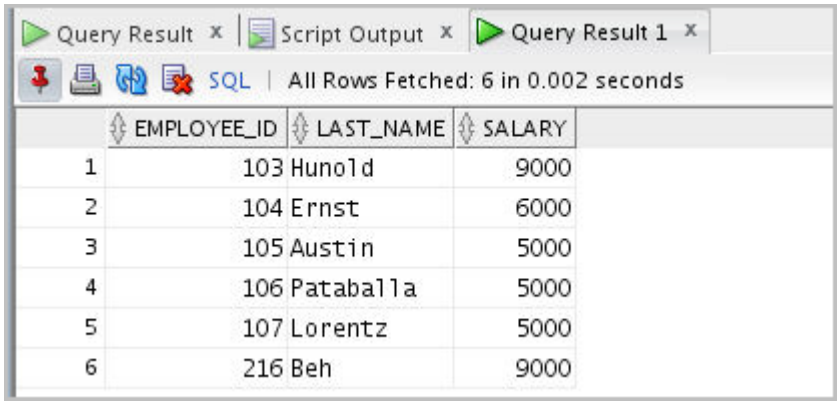
```
SELECT employee_id, last_name, salary
FROM employees
WHERE job_id = 'IT_PROG';

UPDATE jobs
  SET min_salary = min_salary + 1000
WHERE job_id = 'IT_PROG';
```

```
SELECT employee_id, last_name, salary
FROM employees
WHERE job_id = 'IT_PROG';
```



	EMPLOYEE_ID	LAST_NAME	SALARY
1	103	Hunold	9000
2	104	Ernst	6000
3	105	Austin	4800
4	106	Pataballa	4800
5	107	Lorentz	4200
6	216	Beh	9000





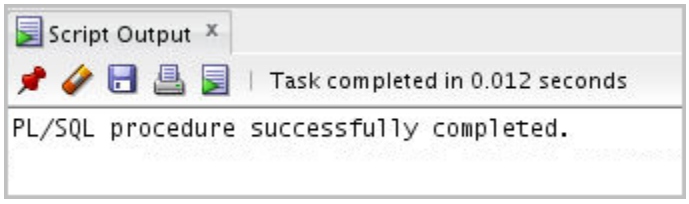
	EMPLOYEE_ID	LAST_NAME	SALARY
1	103	Hunold	9000
2	104	Ernst	6000
3	105	Austin	5000
4	106	Pataballa	5000
5	107	Lorentz	5000
6	216	Beh	9000

The employees with last names `Austin`, `Pataballa`, and `Lorentz` have all had their salaries updated. No exception occurred during this process, and you implemented a solution for the mutating table trigger exception.

3. Because the `CHECK_SALARY` procedure is fired by `CHECK_SALARY_TRG` before inserting or updating an employee, you must check whether this still works as expected.
   a. Test this by adding a new employee using `EMP_PKG.ADD_EMPLOYEE` with the following parameters: (`'Steve'`, `'Morse'`, `'SMORSE'`, and `sal => 6500`). What happens?

Uncomment and select the code under Task 3_a. Click the Run Script (F5) icon on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

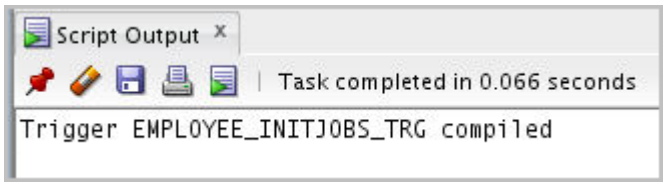
```
EXECUTE emp_pkg.add_employee('Steve', 'Morse', 'SMORSE', p_sal
=> 6500)
```



b. To correct the problem encountered when adding or updating an employee:
   1) Create a `BEFORE INSERT OR UPDATE` statement trigger called `EMPLOYEE_INITJOBS_TRG` on the `EMPLOYEES` table that calls the `JOBS_PKG.INITIALIZE` procedure.
   2) Use the `CALL` syntax in the trigger body.

Uncomment and select the code under Task 3_b. Click the Run Script (F5) icon on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

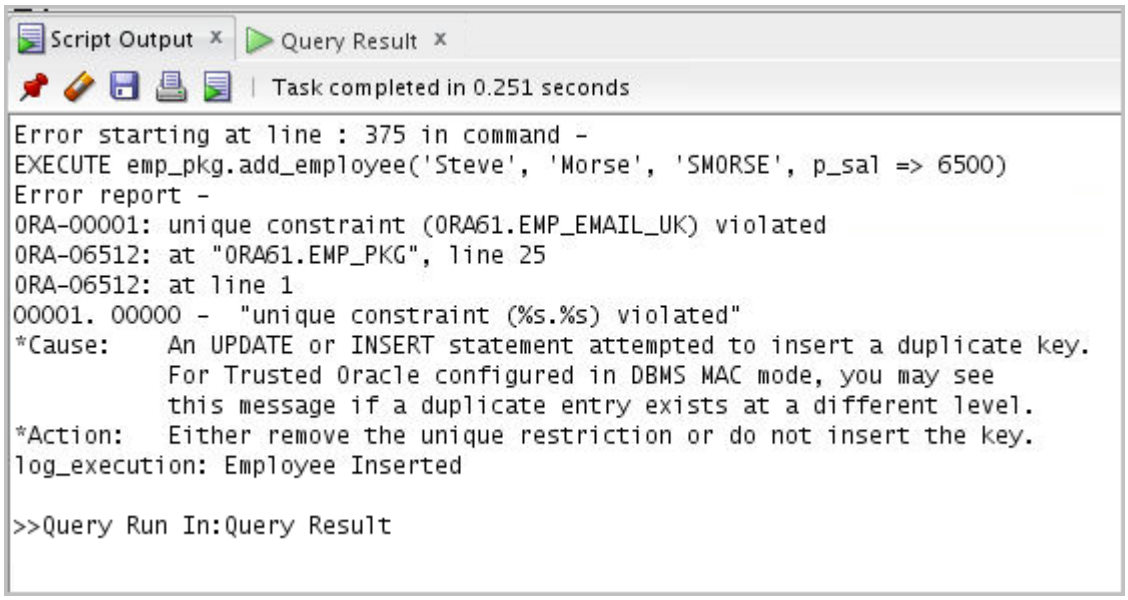
```
CREATE TRIGGER employee_initjobs_trg
BEFORE INSERT OR UPDATE OF job_id, salary ON employees
CALL jobs_pkg.initialize
/
```



c. Test the trigger by adding employee Steve Morse again. Confirm the inserted record in the `EMPLOYEES` table by displaying the employee ID, first and last names, salary, job ID, and department ID.

```
EXECUTE emp_pkg.add_employee('Steve', 'Morse', 'SMORSE', p_sal
=> 6500)
/
SELECT employee_id, first_name, last_name, salary, job_id,
department_id
FROM employees
WHERE last_name = 'Morse';
```

Uncomment and select the code under Task 3_c. Click the Run Script (F5) icon on the SQL Worksheet toolbar to run the script. The code and the results are shown below.



Practices for Lesson 11: Design Considerations for the PL/SQL Code

Chapter 11

Practices for Lesson 11: Overview

Overview

In this practice, you create a package that performs a bulk fetch of employees in a specified department. The data is stored in a PL/SQL table in the package. You also provide a procedure to display the contents of the table. In addition, you create the `add_employee` procedure that inserts new employees. The procedure uses a local autonomous subprogram to write a log record each time the `add_employee` procedure is called, whether it successfully adds a record or not.

Note:

1. Before starting this practice, execute `/home/oracle/labs/plpu/code_ex/cleanup_scripts/cleanup_11.sql` script.
2. If you missed a step in a practice, please run the appropriate solution script for that practice step before proceeding to the next step or the next practice.

Practice 11-1: Using Bulk Binding and Autonomous Transactions

Overview

In this practice, you create a package that performs a bulk fetch of employees in a specified department. The data is stored in a PL/SQL table in the package. You also provide a procedure to display the contents of the table. In addition, you create the `add_employee` procedure that inserts new employees. The procedure uses a local autonomous subprogram to write a log record each time the `add_employee` procedure is called, whether it successfully adds a record or not.

Note: Execute `cleanup_11.sql script` from `/home/oracle/labs/plpu/code_ex/cleanup_scripts/` before performing the following tasks.

Task

1. Update the `EMP_PKG` package with a new procedure to query employees in a specified department.
   a. In the package specification:
      1) Declare a `get_employees` procedure with a parameter called `dept_id`, which is based on the `employees.department_id` column type
      2) Define a nested PL/SQL type as a `TABLE OF EMPLOYEES%ROWTYPE`
   b. In the package body:
      1) Define a private variable called `emp_table` based on the type defined in the specification to hold employee records
      2) Implement the `get_employees` procedure to bulk fetch the data into the table
   c. Create a new procedure in the specification and body, called `show_employees`, which does not take arguments. The procedure displays the contents of the private PL/SQL table variable (if any data exists). Use the `print_employee` procedure that you created in an earlier practice. To view the results, click the Enable DBMS Output icon on the DBMS Output tab in SQL Developer, if you have not already done so.
   d. Enable `SERVEROUTPUT`. Invoke the `emp_pkg.get_employees` procedure for department `30`, and then invoke `emp_pkg.show_employees`. Repeat this for department `60`.
2. Your manager wants to keep a log whenever the `add_employee` procedure in the package is invoked to insert a new employee into the `EMPLOYEES` table.
   a. First, load and execute the code under Task 2_a from the `/home/oracle/labs/plpu/solns/sol_11.sql` script to create a log table called `LOG_NEWEMP`, and a sequence called `log_newemp_seq`.
   b. In the `EMP_PKG` package body, modify the `add_employee` procedure, which performs the actual `INSERT` operation. Add a local procedure called `audit_newemp` as follows:
      1) The `audit_newemp` procedure must use an autonomous transaction to insert a log record into the `LOG_NEWEMP` table.
      2) Store the `USER`, the current time, and the new employee name in the log table row.
      3) Use `log_newemp_seq` to set the `entry_id` column.

      Note: Remember to perform a `COMMIT` operation in a procedure with an autonomous transaction.

c. Modify the `add_employee` procedure to invoke `audit_newemp` before it performs the insert operation.

d. Invoke the `add_employee` procedure for these new employees: `Max Smart` in department 20 and `Clark Kent` in department 10. What happens?

e. Query the two `EMPLOYEES` records added, and the records in the `LOG_NEWEMP` table. How many log records are present?

f. Execute a `ROLLBACK` statement to undo the insert operations that have not been committed. Use the same queries from step 2 e. as follows:

   1) Use the first query to check whether the employee rows for `Smart` and `Kent` have been removed.

   2) Use the second query to check the log records in the `LOG_NEWEMP` table. How many log records are present? Why?

Solution 11-1: Using Bulk Binding and Autonomous Transactions

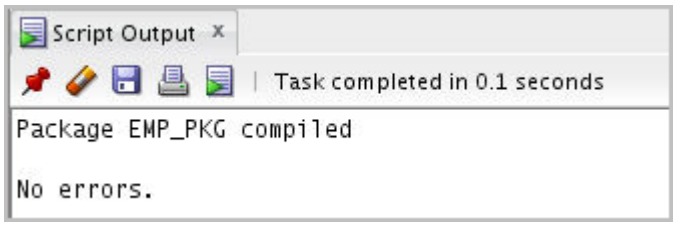
In this practice, you create a package that performs a bulk fetch of employees in a specified department. The data is stored in a PL/SQL table in the package. You also provide a procedure to display the contents of the table. In addition, you create the `add_employee` procedure that inserts new employees. The procedure uses a local autonomous subprogram to write a log record each time the `add_employee` procedure is called, whether it successfully adds a record or not.

1. Update the `EMP_PKG` package with a new procedure to query employees in a specified department.
   a. In the package specification:
      1) Declare a `get_employees` procedure with a parameter called `dept_id`, which is based on the `employees.department_id` column type
      2) Define a nested PL/SQL type as a `TABLE OF EMPLOYEES%ROWTYPE`

      Open the /`home/oracle/labs/plpu/solns/sol_11.sql` script. Uncomment and select the code under Task 1_a. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the specification. The code and the results are displayed as follows. The newly added code is highlighted in bold letters in the code box below.

```
CREATE OR REPLACE PACKAGE emp_pkg IS

  TYPE emp_tab_type IS TABLE OF employees%ROWTYPE;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30);

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE);

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE);
```

```
  FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype;

  PROCEDURE get_employees(p_dept_id
employees.department_id%type);

  PROCEDURE init_departments;

  PROCEDURE print_employee(p_rec_emp employees%rowtype);

END emp_pkg;
/
SHOW ERRORS
```



b. In the package body:

1) Define a private variable called `emp_table` based on the type defined in the specification to hold employee records
2) Implement the `get_employees` procedure to bulk fetch the data into the table

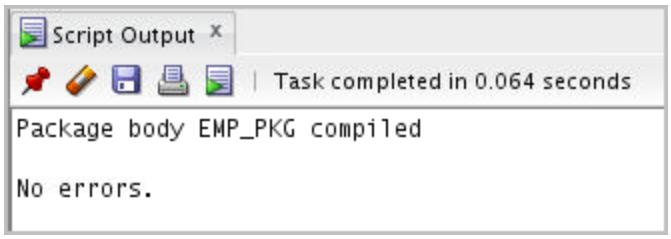
Uncomment and select the code under Task 1_b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the package body. The code and the results are shown below. The newly added code is highlighted in bold letters in the code box below.

```
CREATE OR REPLACE PACKAGE BODY emp_pkg IS
  TYPE boolean_tab_type IS TABLE OF BOOLEAN
     INDEX BY BINARY_INTEGER;
  valid_departments boolean_tab_type;
  emp_table         emp_tab_type;


FUNCTION valid_deptid(p_deptid IN
departments.department_id%TYPE) RETURN BOOLEAN IS
    v_dummy PLS_INTEGER;
  BEGIN
```

```
    RETURN valid_departments.exists(p_deptid);
  EXCEPTION
    WHEN NO_DATA_FOUND THEN
    RETURN FALSE;
END valid_deptid;


  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30) IS
  BEGIN
    IF valid_deptid(p_deptid) THEN

      INSERT INTO employees(employee_id, first_name, last_name,
email,
        job_id, manager_id, hire_date, salary, commission_pct,
department_id)
      VALUES (employees_seq.NEXTVAL, p_first_name, p_last_name,
p_email,
        p_job, p_mgr, TRUNC(SYSDATE), p_sal, p_comm, p_deptid);
    ELSE
      RAISE_APPLICATION_ERROR (-20204, 'Invalid department ID.
Try again.');
    END IF;
  END add_employee;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE) IS
    p_email employees.email%type;
  BEGIN
    p_email := UPPER(SUBSTR(p_first_name, 1,
1)||SUBSTR(p_last_name, 1, 7));
    add_employee(p_first_name, p_last_name, p_email, p_deptid =>
p_deptid);
  END;
```

```
  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE) IS
  BEGIN
    SELECT salary, job_id
    INTO p_sal, p_job
    FROM employees
    WHERE employee_id = p_empid;
  END get_employee;

FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE employee_id = p_emp_id;
    RETURN rec_emp;
  END;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype IS

rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE last_name = p_family_name;
    RETURN rec_emp;
END;

-- New get_employees procedure.

PROCEDURE get_employees(p_dept_id employees.department_id%type)
IS
  BEGIN
    SELECT * BULK COLLECT INTO emp_table
    FROM EMPLOYEES
    WHERE department_id = p_dept_id;
  END;

PROCEDURE init_departments IS
```

```
  BEGIN
    FOR rec IN (SELECT department_id FROM departments)
    LOOP
      valid_departments(rec.department_id) := TRUE;
    END LOOP;
  END;

PROCEDURE print_employee(p_rec_emp employees%rowtype) IS
  BEGIN
    DBMS_OUTPUT.PUT_LINE(p_rec_emp.department_id ||' '||
                         p_rec_emp.employee_id||' '||
                         p_rec_emp.first_name||' '||
                         p_rec_emp.last_name||' '||
                         p_rec_emp.job_id||' '||
                         p_rec_emp.salary);
  END;

BEGIN
  init_departments;

END emp_pkg;
/
SHOW ERRORS
```



c. Create a new procedure in the specification and body, called `show_employees`, which does not take arguments. The procedure displays the contents of the private PL/SQL table variable (if any data exists). Use the `print_employee` procedure that you created in an earlier practice. To view the results, click the Enable DBMS Output icon in the DBMS Output tab in SQL Developer, if you have not already done so.

Uncomment and select the code under Task 1_c. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to re-create and compile the package with the new procedure. The code and the results are shown below.

```
-- Package SPECIFICATION

CREATE OR REPLACE PACKAGE emp_pkg IS
  TYPE emp_tab_type IS TABLE OF employees%ROWTYPE;
```

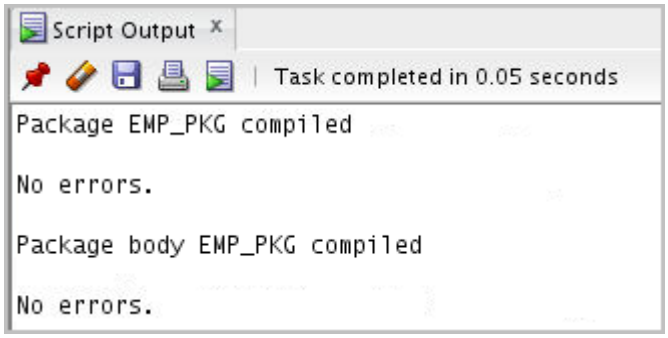
```
  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30);

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE);

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE);

  FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype;

  PROCEDURE get_employees(p_dept_id
employees.department_id%type);

  PROCEDURE init_departments;

  PROCEDURE print_employee(p_rec_emp employees%rowtype);

  PROCEDURE show_employees;

END emp_pkg;
/
SHOW ERRORS

-- Package BODY

CREATE OR REPLACE PACKAGE BODY emp_pkg IS
```

```
  TYPE boolean_tab_type IS TABLE OF BOOLEAN
     INDEX BY BINARY_INTEGER;

  valid_departments boolean_tab_type;
  emp_table         emp_tab_type;
  FUNCTION valid_deptid(p_deptid IN
   departments.department_id%TYPE)
    RETURN BOOLEAN;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30) IS
  BEGIN
    IF valid_deptid(p_deptid) THEN
      INSERT INTO employees(employee_id, first_name, last_name,
email,
        job_id, manager_id, hire_date, salary, commission_pct,
department_id)
      VALUES (employees_seq.NEXTVAL, p_first_name, p_last_name,
p_email,
        p_job, p_mgr, TRUNC(SYSDATE), p_sal, p_comm, p_deptid);
    ELSE
      RAISE_APPLICATION_ERROR (-20204, 'Invalid department ID.
Try again.');
    END IF;
  END add_employee;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE) IS
    p_email employees.email%type;
  BEGIN
    p_email := UPPER(SUBSTR(p_first_name, 1,
1)||SUBSTR(p_last_name, 1, 7));
    add_employee(p_first_name, p_last_name, p_email, p_deptid =>
p_deptid);
  END;
```

```
  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE) IS
  BEGIN
    SELECT salary, job_id
    INTO p_sal, p_job
    FROM employees
    WHERE employee_id = p_empid;
  END get_employee;

  FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE employee_id = p_emp_id;
    RETURN rec_emp;
  END;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE last_name = p_family_name;
    RETURN rec_emp;
  END;

  PROCEDURE get_employees(p_dept_id
employees.department_id%type) IS
  BEGIN
    SELECT * BULK COLLECT INTO emp_table
    FROM EMPLOYEES
    WHERE department_id = p_dept_id;
  END;

  PROCEDURE init_departments IS
  BEGIN
    FOR rec IN (SELECT department_id FROM departments)
```

```
    LOOP
      valid_departments(rec.department_id) := TRUE;
    END LOOP;
  END;

  PROCEDURE print_employee(p_rec_emp employees%rowtype) IS
  BEGIN
    DBMS_OUTPUT.PUT_LINE(p_rec_emp.department_id ||' '||
                         p_rec_emp.employee_id||' '||
                         p_rec_emp.first_name||' '||
                         p_rec_emp.last_name||' '||
                         p_rec_emp.job_id||' '||
                         p_rec_emp.salary);
  END;

  PROCEDURE show_employees IS
  BEGIN
    IF emp_table IS NOT NULL THEN
      DBMS_OUTPUT.PUT_LINE('Employees in Package table');
      FOR i IN 1 .. emp_table.COUNT
      LOOP
        print_employee(emp_table(i));
      END LOOP;
    END IF;
  END show_employees;

  FUNCTION valid_deptid(p_deptid IN
departments.department_id%TYPE)
   RETURN BOOLEAN IS
    v_dummy PLS_INTEGER;
  BEGIN
    RETURN valid_departments.exists(p_deptid);
  EXCEPTION
    WHEN NO_DATA_FOUND THEN
    RETURN FALSE;
END valid_deptid;


BEGIN
  init_departments;
END emp_pkg;

/
```

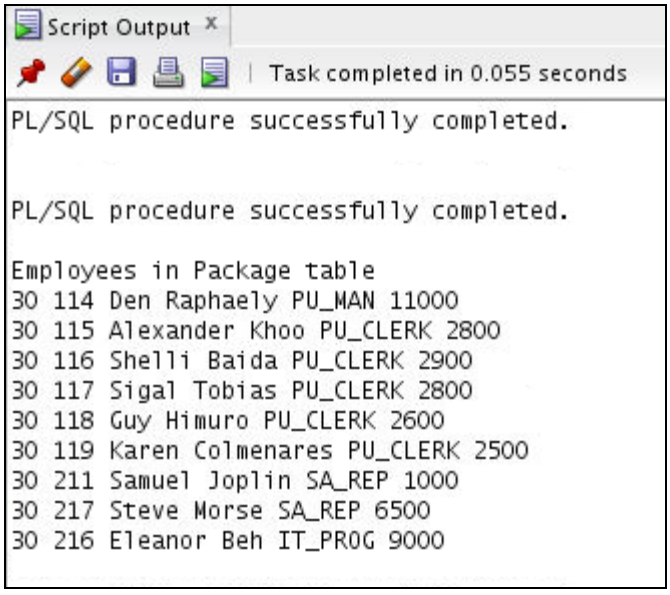
```
SHOW ERRORS
```



d. Enable `SERVEROUTPUT`. Invoke the `emp_pkg.get_employees` procedure for department `30`, and then invoke `emp_pkg.show_employees`. Repeat this for department `60`.

Uncomment and select the code under Task 1_d. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to invoke the package's procedures. The code and the results are shown below:

```
SET SERVEROUTPUT ON

EXECUTE emp_pkg.get_employees(30)
EXECUTE emp_pkg.show_employees

EXECUTE emp_pkg.get_employees(60)
EXECUTE emp_pkg.show_employees
```

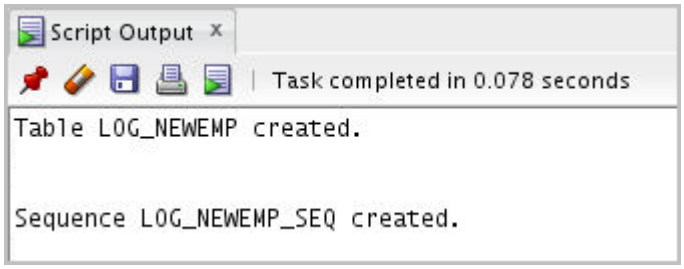


```
PL/SQL procedure successfully completed.


PL/SQL procedure successfully completed.

Employees in Package table
60 103 Alexander Hunold IT_PROG 9000
60 104 Bruce Ernst IT_PROG 6000
60 105 David Austin IT_PROG 5000
60 106 Valli Pataballa IT_PROG 5000
60 107 Diana Lorentz IT_PROG 5000
```

2. Your manager wants to keep a log whenever the `add_employee` procedure in the package is invoked to insert a new employee into the `EMPLOYEES` table.
   a. First, load and execute the code under Task 2_a from `/home/oracle/labs/plpu/solns/sol_11.sql` script to create a log table called `LOG_NEWEMP`, and a sequence called `log_newemp_seq`.

      Uncomment and select the code under Task 2_a. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
CREATE TABLE log_newemp (
  entry_id  NUMBER(6) CONSTRAINT log_newemp_pk PRIMARY KEY,
  user_id   VARCHAR2(30),
  log_time  DATE,
  name      VARCHAR2(60)
);

CREATE SEQUENCE log_newemp_seq;
```



   b. In the `EMP_PKG` package body, modify the `add_employee` procedure, which performs the actual `INSERT` operation. Add a local procedure called `audit_newemp` as follows:
      1) The `audit_newemp` procedure must use an autonomous transaction to insert a log record into the `LOG_NEWEMP` table.
      2) Store the `USER`, the current time, and the new employee name in the log table row.
      3) Use `log_newemp_seq` to set the `entry_id` column.

Note: Remember to perform a `COMMIT` operation in a procedure with an autonomous transaction.

Uncomment and select the code under Task 2_b. The newly added code is highlighted in bold letters in the following code box. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are displayed as follows:

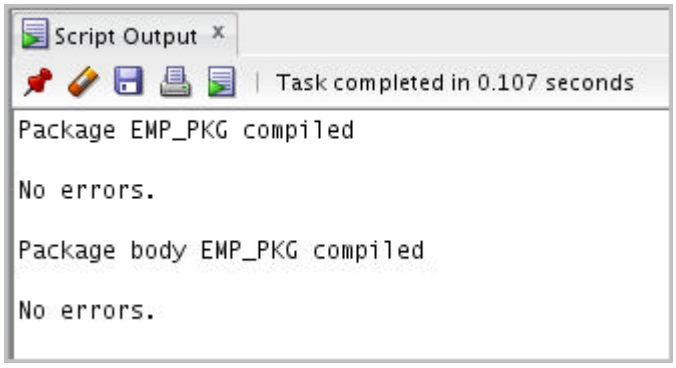
```
-- Package SPECIFICATION

CREATE OR REPLACE PACKAGE emp_pkg IS


  TYPE emp_tab_type IS TABLE OF employees%ROWTYPE;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30);

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE);

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE);

  FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype;

  PROCEDURE get_employees(p_dept_id
employees.department_id%type);
```

```
  PROCEDURE init_departments;

  PROCEDURE print_employee(p_rec_emp employees%rowtype);

  PROCEDURE show_employees;

END emp_pkg;
/
SHOW ERRORS

-- Package BODY

CREATE OR REPLACE PACKAGE BODY emp_pkg IS
  TYPE boolean_tab_type IS TABLE OF BOOLEAN
     INDEX BY BINARY_INTEGER;

  valid_departments boolean_tab_type;
  emp_table         emp_tab_type;

  FUNCTION valid_deptid(p_deptid IN
departments.department_id%TYPE)
    RETURN BOOLEAN;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30) IS

-- New local procedure

    PROCEDURE audit_newemp IS
      PRAGMA AUTONOMOUS_TRANSACTION;
      user_id VARCHAR2(30) := USER;
    BEGIN
      INSERT INTO log_newemp (entry_id, user_id, log_time,
                              name)
      VALUES (log_newemp_seq.NEXTVAL, user_id,
```

```
                sysdate,p_first_name||' '||p_last_name);
      COMMIT;
    END audit_newemp;

  BEGIN
  -- add_employee
    IF valid_deptid(p_deptid) THEN
      INSERT INTO employees(employee_id, first_name, last_name,
email,
        job_id, manager_id, hire_date, salary, commission_pct,
department_id)
      VALUES (employees_seq.NEXTVAL, p_first_name, p_last_name,
p_email,
        p_job, p_mgr, TRUNC(SYSDATE), p_sal, p_comm, p_deptid);
    ELSE
      RAISE_APPLICATION_ERROR (-20204, 'Invalid department ID.
Try again.');
    END IF;
  END add_employee;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE) IS
    p_email employees.email%type;
  BEGIN
    p_email := UPPER(SUBSTR(p_first_name, 1,
1)||SUBSTR(p_last_name, 1, 7));
    add_employee(p_first_name, p_last_name, p_email, p_deptid =>
p_deptid);
  END;

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE) IS
  BEGIN
    SELECT salary, job_id
    INTO p_sal, p_job
    FROM employees
    WHERE employee_id = p_empid;
  END get_employee;

  FUNCTION get_employee(p_emp_id employees.employee_id%type)
```

```
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE employee_id = p_emp_id;
    RETURN rec_emp;
  END;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE last_name = p_family_name;
    RETURN rec_emp;
  END;

-- New get_employees procedure.

  PROCEDURE get_employees(p_dept_id
employees.department_id%type) IS
  BEGIN
    SELECT * BULK COLLECT INTO emp_table
    FROM EMPLOYEES
    WHERE department_id = p_dept_id;
  END;

  PROCEDURE init_departments IS
  BEGIN
    FOR rec IN (SELECT department_id FROM departments)
    LOOP
      valid_departments(rec.department_id) := TRUE;
    END LOOP;
  END;

  PROCEDURE print_employee(p_rec_emp employees%rowtype) IS
  BEGIN
    DBMS_OUTPUT.PUT_LINE(p_rec_emp.department_id ||' '||
                         p_rec_emp.employee_id||' '||
                         p_rec_emp.first_name||' '||
                         p_rec_emp.last_name||' '||
```

```
                          p_rec_emp.job_id||' '||
                          p_rec_emp.salary);
  END;

  PROCEDURE show_employees IS
  BEGIN
    IF emp_table IS NOT NULL THEN
      DBMS_OUTPUT.PUT_LINE('Employees in Package table');
      FOR i IN 1 .. emp_table.COUNT
      LOOP
        print_employee(emp_table(i));
      END LOOP;
    END IF;
  END show_employees;

  FUNCTION valid_deptid(p_deptid IN
departments.department_id%TYPE)
   RETURN BOOLEAN IS
    v_dummy PLS_INTEGER;
  BEGIN
    RETURN valid_departments.exists(p_deptid);
  EXCEPTION
    WHEN NO_DATA_FOUND THEN
    RETURN FALSE;
END valid_deptid;


BEGIN
  init_departments;
END emp_pkg;
/
SHOW ERRORS
```



c. Modify the `add_employee` procedure to invoke `audit_newemp` before it performs the insert operation.

Uncomment and select the code under Task 2_c. The newly added code is highlighted in bold letters in the following code box. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

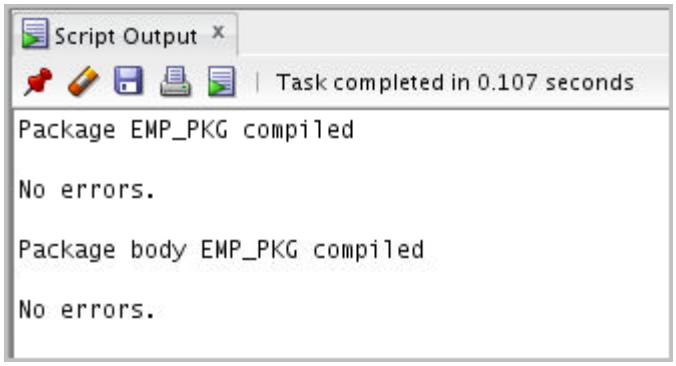
```
-- Package SPECIFICATION

CREATE OR REPLACE PACKAGE emp_pkg IS


  TYPE emp_tab_type IS TABLE OF employees%ROWTYPE;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30);

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE);

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE);

  FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype;

  PROCEDURE get_employees(p_dept_id
employees.department_id%type);
```

```
  PROCEDURE init_departments;

  PROCEDURE print_employee(p_rec_emp employees%rowtype);

  PROCEDURE show_employees;

END emp_pkg;
/
SHOW ERRORS

-- Package BODY

CREATE OR REPLACE PACKAGE BODY emp_pkg IS
  TYPE boolean_tab_type IS TABLE OF BOOLEAN
     INDEX BY BINARY_INTEGER;

  valid_departments boolean_tab_type;
  emp_table         emp_tab_type;

  FUNCTION valid_deptid(p_deptid IN
departments.department_id%TYPE)
    RETURN BOOLEAN;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_email employees.email%TYPE,
    p_job employees.job_id%TYPE DEFAULT 'SA_REP',
    p_mgr employees.manager_id%TYPE DEFAULT 145,
    p_sal employees.salary%TYPE DEFAULT 1000,
    p_comm employees.commission_pct%TYPE DEFAULT 0,
    p_deptid employees.department_id%TYPE DEFAULT 30) IS

    PROCEDURE audit_newemp IS
      PRAGMA AUTONOMOUS_TRANSACTION;
      user_id VARCHAR2(30) := USER;
    BEGIN
      INSERT INTO log_newemp (entry_id, user_id, log_time, name)
      VALUES (log_newemp_seq.NEXTVAL, user_id,
sysdate,p_first_name||' '||p_last_name);
      COMMIT;
    END audit_newemp;
```

```
  BEGIN -- add_employee
    IF valid_deptid(p_deptid) THEN
      audit_newemp;
      INSERT INTO employees(employee_id, first_name, last_name,
email,
        job_id, manager_id, hire_date, salary, commission_pct,
department_id)
      VALUES (employees_seq.NEXTVAL, p_first_name, p_last_name,
p_email,
        p_job, p_mgr, TRUNC(SYSDATE), p_sal, p_comm, p_deptid);
    ELSE
      RAISE_APPLICATION_ERROR (-20204, 'Invalid department ID.
Try again.');
    END IF;
  END add_employee;

  PROCEDURE add_employee(
    p_first_name employees.first_name%TYPE,
    p_last_name employees.last_name%TYPE,
    p_deptid employees.department_id%TYPE) IS
    p_email employees.email%type;
  BEGIN
    p_email := UPPER(SUBSTR(p_first_name, 1,
1)||SUBSTR(p_last_name, 1, 7));
    add_employee(p_first_name, p_last_name, p_email, p_deptid =>
p_deptid);
  END;

  PROCEDURE get_employee(
    p_empid IN employees.employee_id%TYPE,
    p_sal OUT employees.salary%TYPE,
    p_job OUT employees.job_id%TYPE) IS
  BEGIN
    SELECT salary, job_id
    INTO p_sal, p_job
    FROM employees
    WHERE employee_id = p_empid;
  END get_employee;

  FUNCTION get_employee(p_emp_id employees.employee_id%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
```

```
    FROM employees
    WHERE employee_id = p_emp_id;
    RETURN rec_emp;
  END;

  FUNCTION get_employee(p_family_name employees.last_name%type)
    return employees%rowtype IS
    rec_emp employees%rowtype;
  BEGIN
    SELECT * INTO rec_emp
    FROM employees
    WHERE last_name = p_family_name;
    RETURN rec_emp;

END;

  PROCEDURE get_employees(p_dept_id
employees.department_id%type) IS
  BEGIN
    SELECT * BULK COLLECT INTO emp_table
    FROM EMPLOYEES
    WHERE department_id = p_dept_id;
  END;

  PROCEDURE init_departments IS
  BEGIN
    FOR rec IN (SELECT department_id FROM departments)
    LOOP
      valid_departments(rec.department_id) := TRUE;
    END LOOP;
  END;

  PROCEDURE print_employee(p_rec_emp employees%rowtype) IS
  BEGIN
    DBMS_OUTPUT.PUT_LINE(p_rec_emp.department_id ||' '||
                         p_rec_emp.employee_id||' '||
                         p_rec_emp.first_name||' '||
                         p_rec_emp.last_name||' '||
                         p_rec_emp.job_id||' '||
                         p_rec_emp.salary);
  END;

  PROCEDURE show_employees IS
```

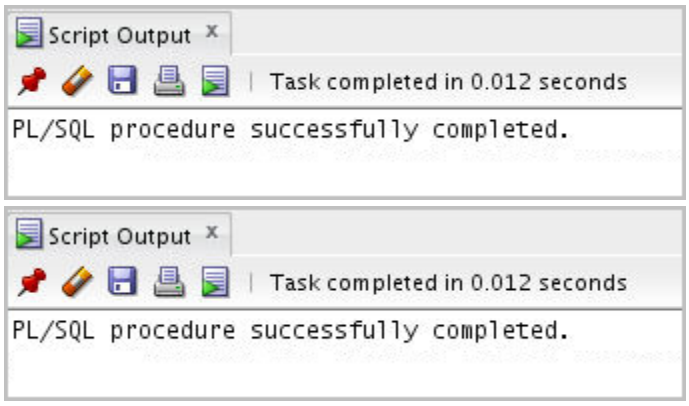
```
  BEGIN
    IF emp_table IS NOT NULL THEN
      DBMS_OUTPUT.PUT_LINE('Employees in Package table');
      FOR i IN 1 .. emp_table.COUNT
      LOOP
        print_employee(emp_table(i));
      END LOOP;
    END IF;
  END show_employees;

  FUNCTION valid_deptid(p_deptid IN
departments.department_id%TYPE)
   RETURN BOOLEAN IS
    v_dummy PLS_INTEGER;
  BEGIN
    RETURN valid_departments.exists(p_deptid);
  EXCEPTION
    WHEN NO_DATA_FOUND THEN

    RETURN FALSE;
END valid_deptid;
BEGIN
  init_departments;
END emp_pkg;
/
SHOW ERRORS
```



d. Invoke the `add_employee` procedure for these new employees: `Max Smart` in department 20 and `Clark Kent` in department 10. What happens?

Uncomment and select the code under Task 2_d. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are as follows.

```
EXECUTE emp_pkg.add_employee('Max', 'Smart', 20)
EXECUTE emp_pkg.add_employee('Clark', 'Kent', 10)
```

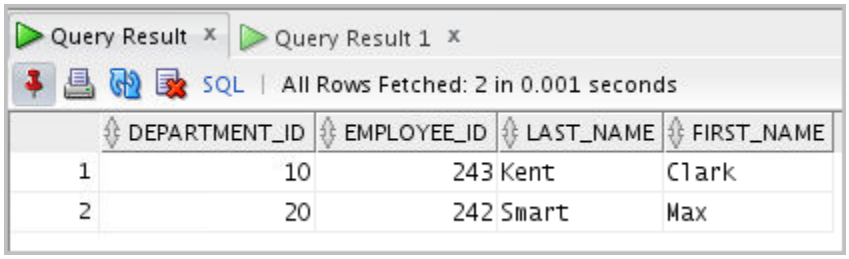


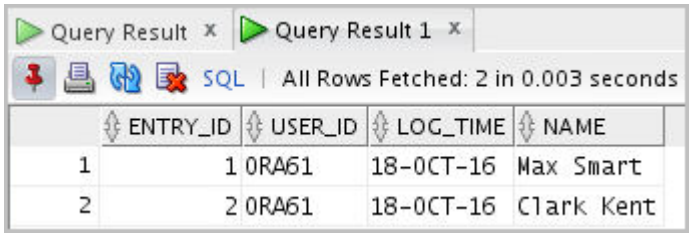
Both insert statements complete successfully. The log table has two log records as shown in the next step.

e. Query the two `EMPLOYEES` records added, and the records in the `LOG_NEWEMP` table. How many log records are present?

Uncomment and select the code under Task 2_e. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are displayed as follows:

```
select department_id, employee_id, last_name, first_name
from employees
where last_name in ('Kent', 'Smart');

select * from log_newemp;
```



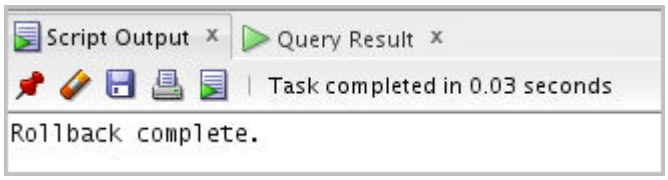


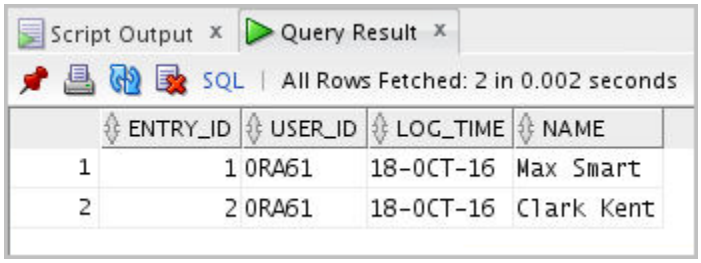
There are two log records, one for `Smart` and another for `Kent`.

f. Execute a `ROLLBACK` statement to undo the insert operations that have not been committed. Use the same queries from step 2 e. as follows:

1) Use the first query to check whether the employee rows for `Smart` and `Kent` have been removed.
2) Use the second query to check the log records in the `LOG_NEWEMP` table. How many log records are present? Why?

```
ROLLBACK;
select * from log_newemp;
```





The two employee records are removed (rolled back). The two log records remain in the log table because they were inserted using an autonomous transaction, which is unaffected by the rollback performed in the main transaction.

Practices for Lesson 12: Turning the PL/SQL Compiler

Chapter 12

Practices for Lesson 12: Overview

Overview

In this practice, you display the compiler initialization parameters. You then enable native compilation for your session and compile a procedure. You then suppress all compiler-warning categories and then restore the original session-warning settings. Finally, you identify the categories for some compiler-warning message numbers.

Note:

1. Before starting this practice, execute `/home/oracle/labs/plpu/code_ex/cleanup_scripts/cleanup_12.sql` script.
2. If you missed a step in a practice, please run the appropriate solution script for that practice step before proceeding to the next step or the next practice.

Practice 12-1: Using the PL/SQL Compiler Parameters and Warnings

Overview

In this practice, you display the compiler initialization parameters. You then enable native compilation for your session and compile a procedure. You then suppress all compiler-warning categories and then restore the original session-warning settings. Finally, you identify the categories for some compiler-warning message numbers.

Note: Execute `cleanup_12.sql script` from `/home/oracle/labs/plpu/code_ex/cleanup_scripts/` before performing the following tasks.

Task

1. Display the following information about compiler-initialization parameters by using the `USER_PLSQL_OBJECT_SETTINGS` data dictionary view. Note the settings for the `ADD_DEPARTMENT` object.
   Note: Click the Execute Statement icon (or press F9) to display the results on the Results tab.
   a. Object name
   b. Object type
   c. The object's compilation mode
   d. The compilation optimization level
2. Alter the `PLSQL_CODE_TYPE` parameter to enable native compilation for your session, and compile `ADD_DEPARTMENT`
   a. Execute the `ALTER SESSION` command to enable native compilation for the session.
   b. Compile the `ADD_DEPARTMENT` procedure.
   c. Rerun the code under Task 1 in `sol_12` script. Note the `PLSQL_CODE_TYPE` parameter.
   d. Switch compilation to use interpreted compilation mode as follows:
3. Use the Tools > Preferences>Database > PL/SQL Compiler Options region to disable all compiler warnings categories.
4. Edit, examine, and execute the `lab_12_04.sql` script to create the `UNREACHABLE_CODE` procedure. Click the Run Script icon (or press F5) to create the procedure. Use the procedure name in the Navigation tree to compile the procedure.
5. What are the compiler warnings that are displayed in the Compiler – Log tab, if any?
6. Enable all compiler-warning messages for this session using the Preferences window.
7. Recompile the `UNREACHABLE_CODE` procedure using the Object Navigation tree. What compiler warnings are displayed, if any?
8. Use the `USER_ERRORS` data dictionary view to display the compiler-warning messages details as follows.
9. Create a script named `warning_msgs` that uses the `EXECUTE DBMS_OUTPUT` and the `DBMS_WARNING` packages to identify the categories for the following compiler-warning message numbers: 5050, 6075, and 7100. Enable `SERVEROUTPUT` before running the script.

Solution 12-1: Using the PL/SQL Compiler Parameters and Warnings

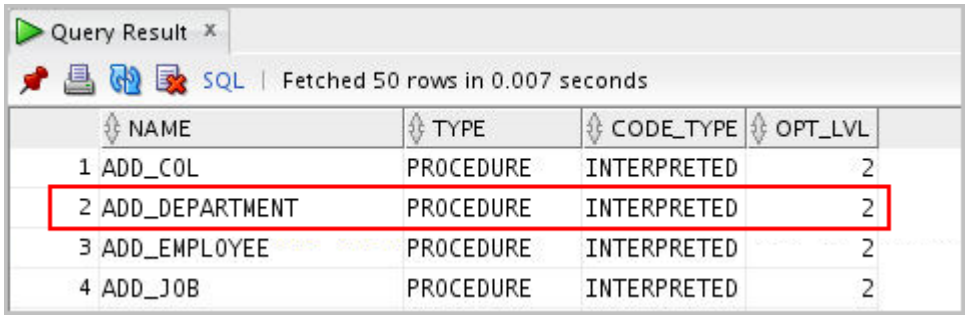
In this practice, you display the compiler initialization parameters. You then enable native compilation for your session and compile a procedure. You then suppress all compiler-warning categories and then restore the original session-warning settings. Finally, you identify the categories for some compiler-warning message numbers.

```
-- If you have dropped the EMP_PKG or ADD_DEPARTMENT procedure in the
clean up scripts
--Uncomment the code below and execute the following code of
ADD_DEPARTMENT
/*

CREATE SEQUENCE  DEPARTMENTS_SEQ
MINVALUE 1
MAXVALUE 9990
INCREMENT BY 10 START WITH 100 ;
/

create or replace PROCEDURE add_department(
    p_name VARCHAR2, p_mgr NUMBER, p_loc NUMBER) IS

BEGIN
  INSERT INTO departments (department_id,
    department_name, manager_id, location_id)
  VALUES (DEPARTMENTS_SEQ.NEXTVAL, p_name, p_mgr, p_loc);
  DBMS_OUTPUT.PUT_LINE('Added Dept: '|| p_name);

EXCEPTION
 WHEN OTHERS THEN
  DBMS_OUTPUT.PUT_LINE('Err: adding dept: '|| p_name);
END;
/
*/
```

1. Display the following information about compiler-initialization parameters by using the `USER_PLSQL_OBJECT_SETTINGS` data dictionary view. Note the settings for the `ADD_DEPARTMENT` object.
   Note: Click the Execute Statement icon (or press F9) to display the results in the Results tab.
   a. Object name
   b. Object type
   c. The object's compilation mode
   d. The compilation optimization level

Uncomment and select the code under Task 1. Click the Execute Statement icon (or press F9) on the SQL Worksheet toolbar to run the query. The code and a sample of the results are shown below.

```
SELECT name, type,plsql_code_type as code_type,
plsql_optimize_level as opt_lvl
FROM   user_plsql_object_settings;
```



	NAME	TYPE	CODE_TYPE	OPT_LVL
1	ADD_COL	PROCEDURE	INTERPRETED	2
2	ADD_DEPARTMENT	PROCEDURE	INTERPRETED	2
3	ADD_EMPLOYEE	PROCEDURE	INTERPRETED	2
4	ADD_JOB	PROCEDURE	INTERPRETED	2

. . .

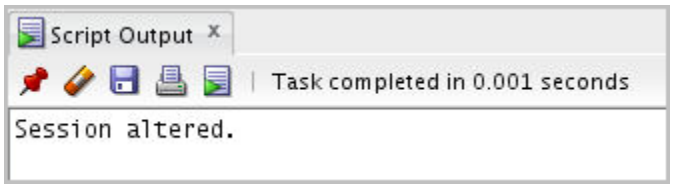
Note: In this step, our focus is on the `ADD_DEPARTMENT` procedure. Please ignore the difference in screenshot, if any.

2. Alter the `PLSQL_CODE_TYPE` parameter to enable native compilation for your session, and compile `ADD_DEPARTMENT`.

   a. Execute the `ALTER SESSION` command to enable native compilation for the session.

   Uncomment and select the code under Task 2_a. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the query. The code and the results are shown below.

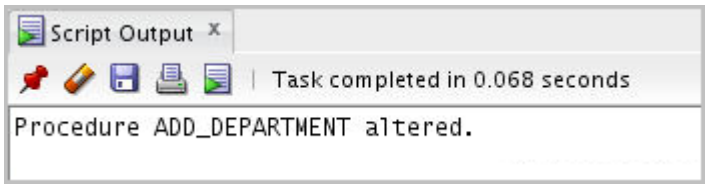
   ```
   ALTER SESSION SET PLSQL_CODE_TYPE = 'NATIVE';
   ```

   b. Compile the `ADD_DEPARTMENT` procedure.

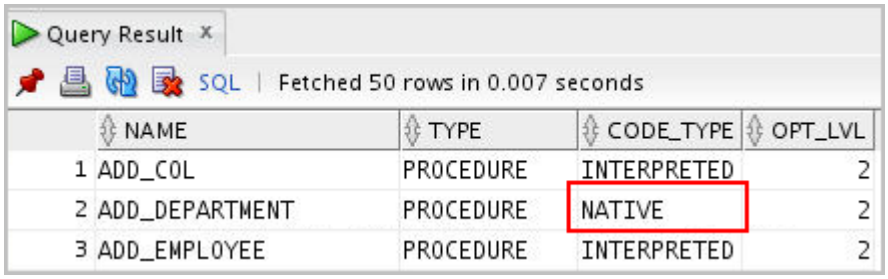
   Uncomment and select the code under Task 2_b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the query. The code and the results are shown below.

   ```
   ALTER PROCEDURE add_department COMPILE;
   ```

   c. Rerun the code under Task 1 from `sol_12.sql` script by clicking the Execute Statement icon (or pressing F9) on the SQL Worksheet. Note the `PLSQL_CODE_TYPE` parameter.

```
SELECT name, type, plsql_code_type as code_type,
plsql_optimize_level as opt_lvl
FROM   user_plsql_object_settings;
```

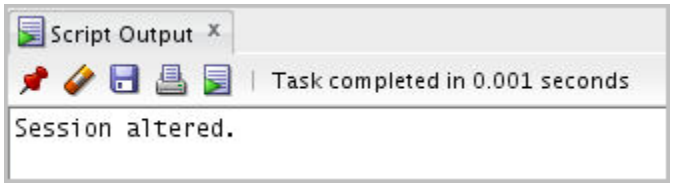


	NAME	TYPE	CODE_TYPE	OPT_LVL
1	ADD_COL	PROCEDURE	INTERPRETED	2
2	ADD_DEPARTMENT	PROCEDURE	NATIVE	2
3	ADD_EMPLOYEE	PROCEDURE	INTERPRETED	2

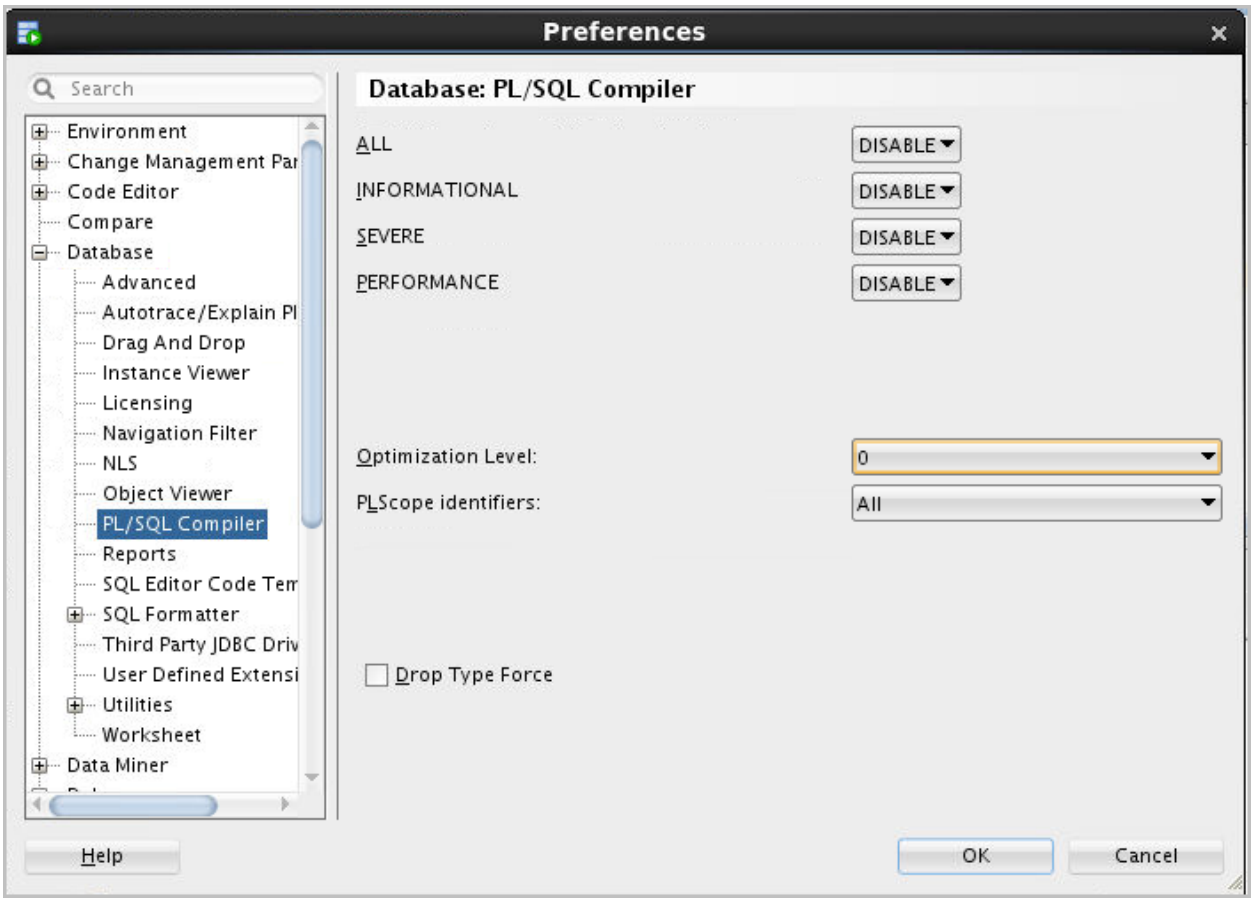
...

d. Switch compilation to use interpreted compilation mode as follows:

```
ALTER SESSION SET PLSQL_CODE_TYPE = 'INTERPRETED';
```



3. Use the Tools > Preferences >Database> PL/SQL Compiler Options region to disable all compiler warnings categories.

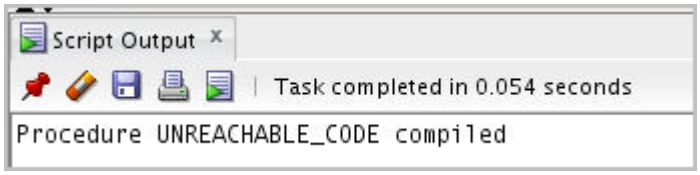


Select DISABLE for all four PL/SQL compiler warnings categories, and then click OK.

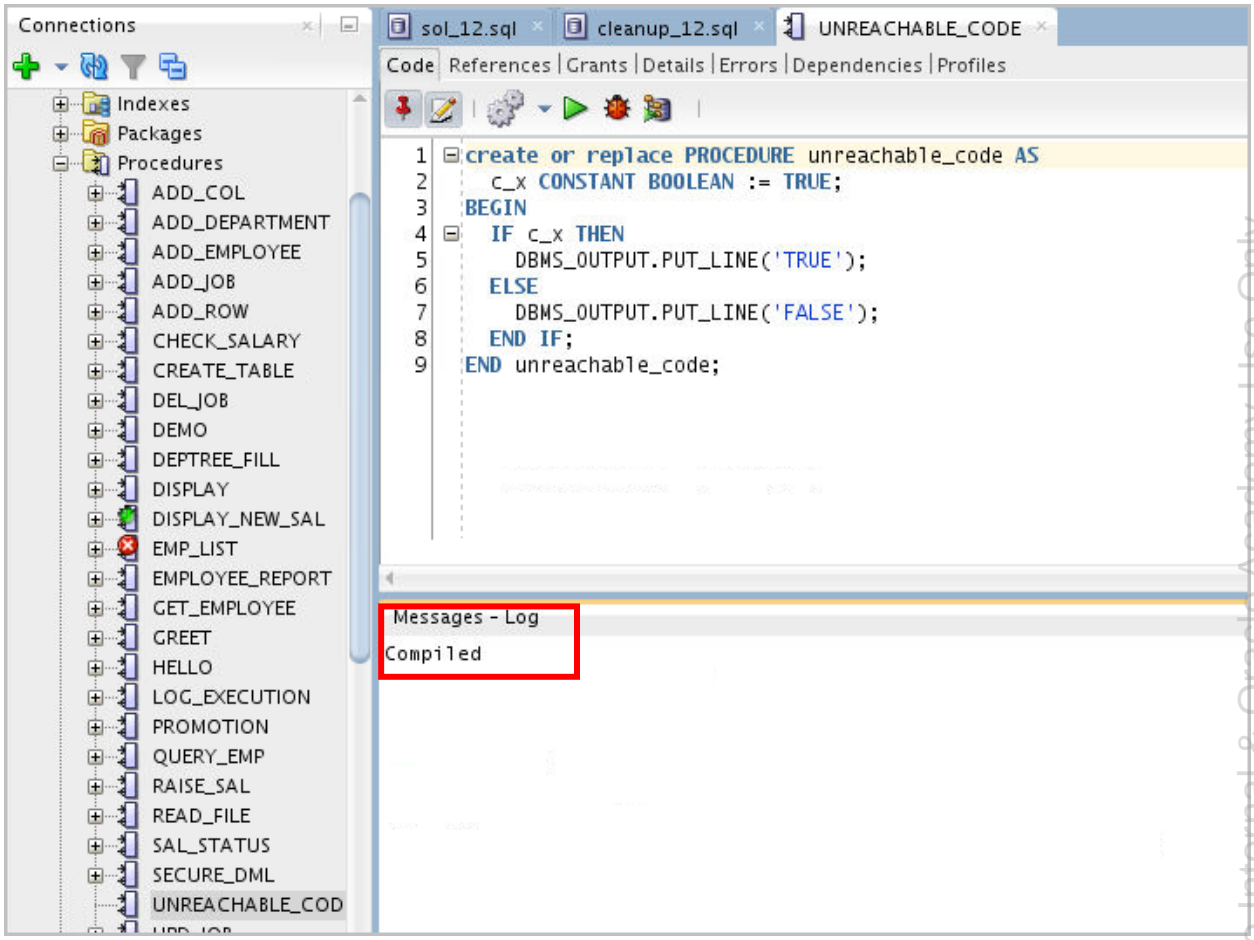
4. Edit, examine, and execute the `lab_12_04.sql` script to create the `UNREACHABLE_CODE` procedure. Click the Run Script icon (or press F5) to create and compile the procedure.

Uncomment and select the code under Task 4. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the query. The code and the results are shown below.

```
CREATE OR REPLACE PROCEDURE unreachable_code AS
  c_x CONSTANT BOOLEAN := TRUE;
BEGIN
  IF c_x THEN
    DBMS_OUTPUT.PUT_LINE('TRUE');
  ELSE
    DBMS_OUTPUT.PUT_LINE('FALSE');
  END IF;
END unreachable_code;
/
```



To view any compiler warning errors, right-click the procedure's name in the Procedures node in the Navigation tree, and then click Compile.

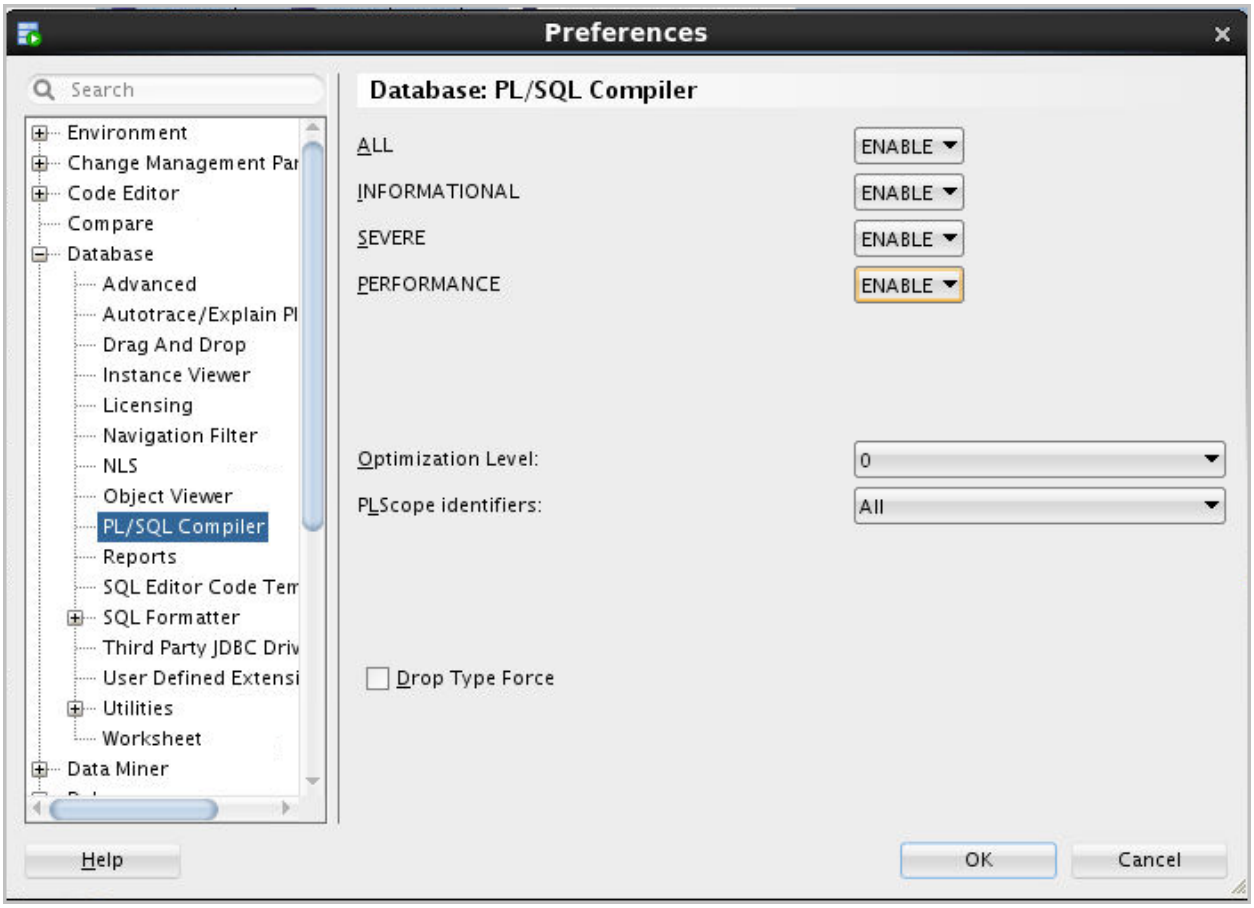


Note

- If the procedure is not displayed in the Navigation tree, click the Refresh icon on the Connections tab.
- Make sure your Messages – Log tab is displayed (select View > Log from the menu bar).

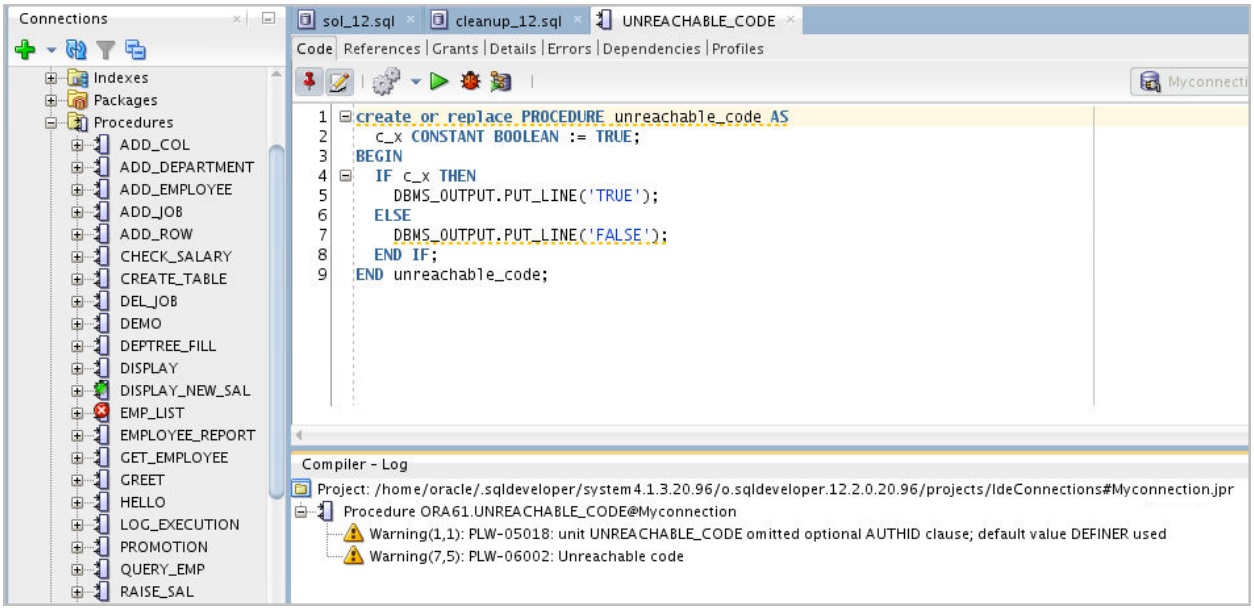
5. What are the compiler warnings that are displayed in the Compiler – Log tab, if any?
   Note that the message on the Messages – Log tab is "Compiled" without any warning messages because you disabled the compiler warnings in step 3.

6. Enable all compiler-warning messages for this session using the Preferences window.
   Select ENABLE for all four PL/SQL compiler warnings and then click OK.



7. Recompile the `UNREACHABLE_CODE` procedure using the Object Navigation tree. What compiler warnings are displayed, if any?

   Right-click the procedure's name in the Object Navigation tree and select Compile. Note the messages displayed in the Compiler – Log tab.

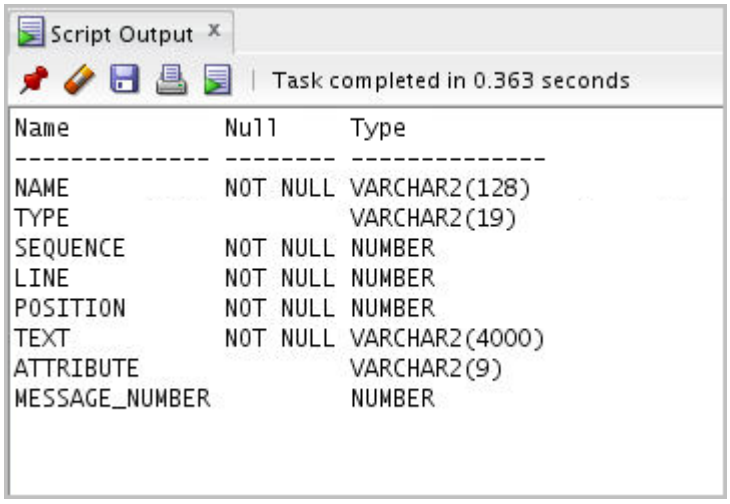


Note: If you get the following two warnings in SQL Developer, it is expected in some versions of SQL Developer. If you do get the following warnings, it is because your version of SQL Developer still uses the Oracle 11*g* database deprecated `PLSQL_DEBUG` parameter.

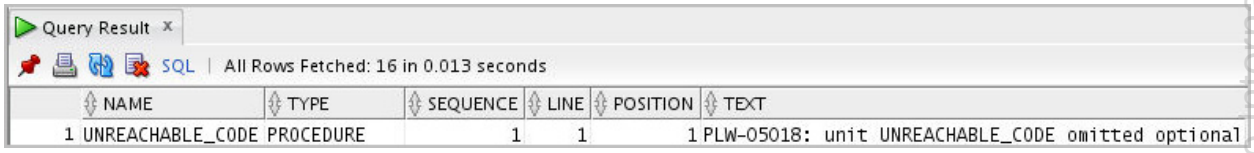
```
Warning(1):PLW-06015:parameter PLSQL_DEBUG is deprecated ; use
PLSQL_OPTIMIZE_LEVEL=1

Warning(1):PLW-06013:deprecated parameter PLSQL_DEBUG forces
PLSQL_OPTIMIZE_LEVEL<=1
```

8. Use the `USER_ERRORS` data dictionary view to display the compiler-warning messages details as follows.

```
DESCRIBE user_errors
```




```
SELECT *
FROM user_errors;
```



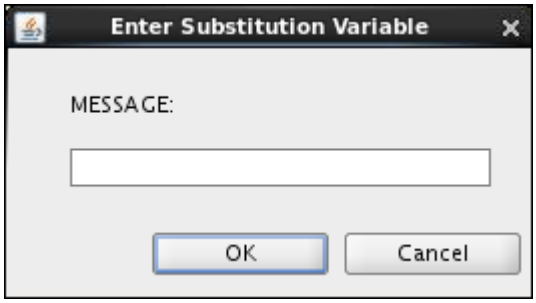
...

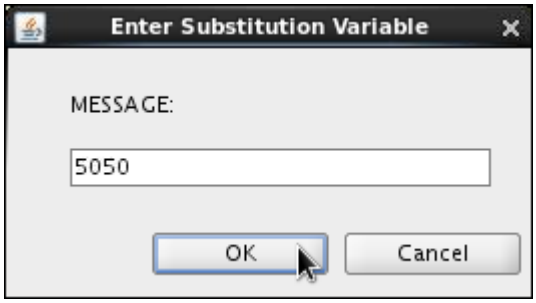
Note: The output was displayed on the Results tab because we used the F9 key to execute the `SELECT` statement. The results of the `SELECT` statement might be different depending on the amount of errors you had in your session.

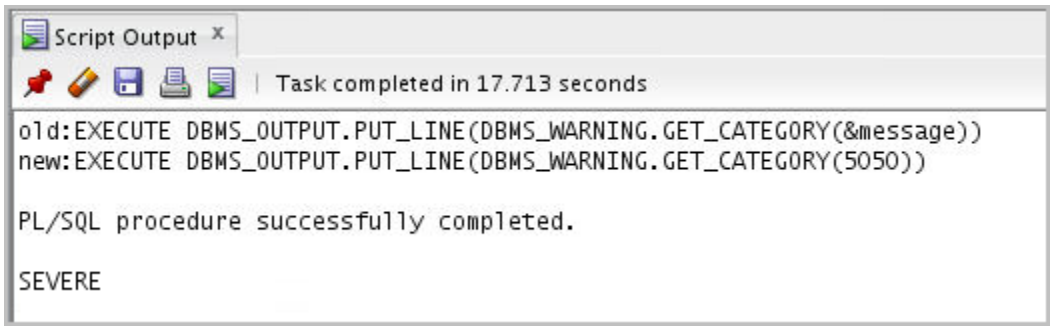
9. Create a script named `warning_msgs` that uses the `EXECUTE DBMS_OUTPUT` and the `DBMS_WARNING` packages to identify the categories for the following compiler-warning message numbers: 5050, 6075, and 7100. Enable `SERVEROUTPUT` before running the script.

Uncomment and select the code under Task 9. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the query. The code and the results are shown below.

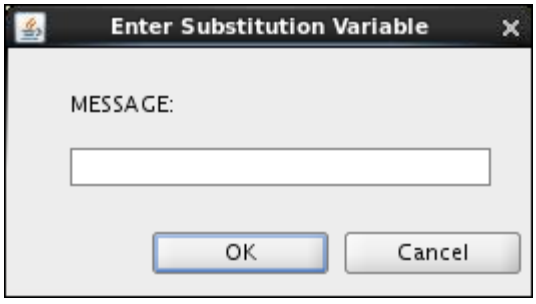
```
EXECUTE
DBMS_OUTPUT.PUT_LINE(DBMS_WARNING.GET_CATEGORY(&message));
```

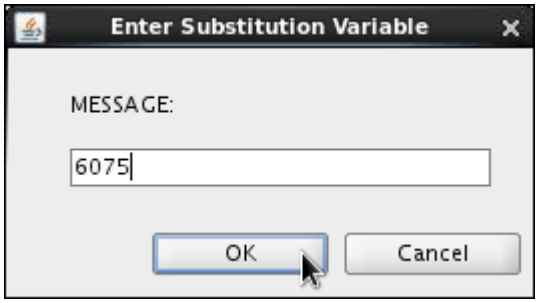


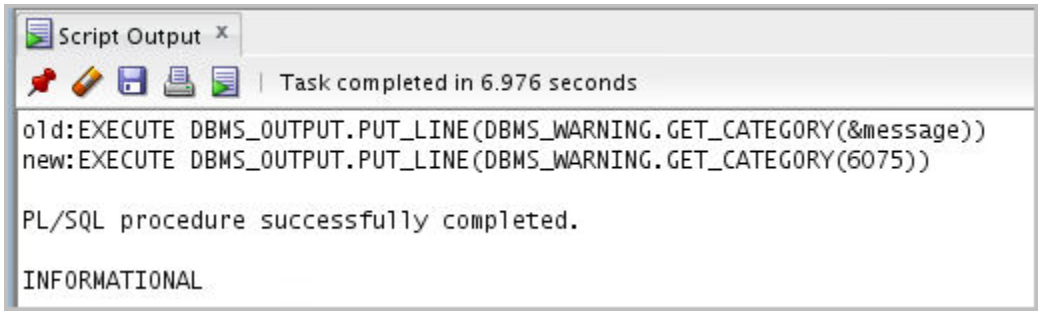




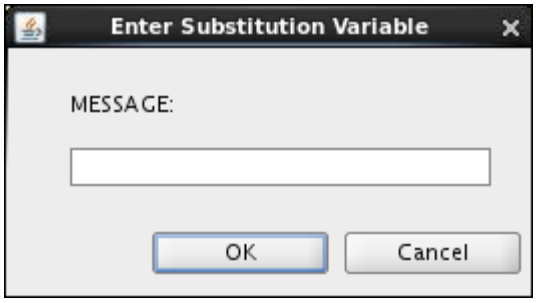

```
EXECUTE
DBMS_OUTPUT.PUT_LINE(DBMS_WARNING.GET_CATEGORY(&message));
```

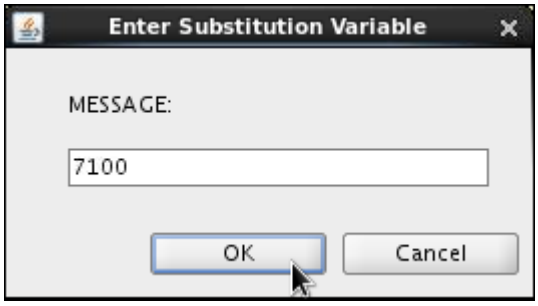


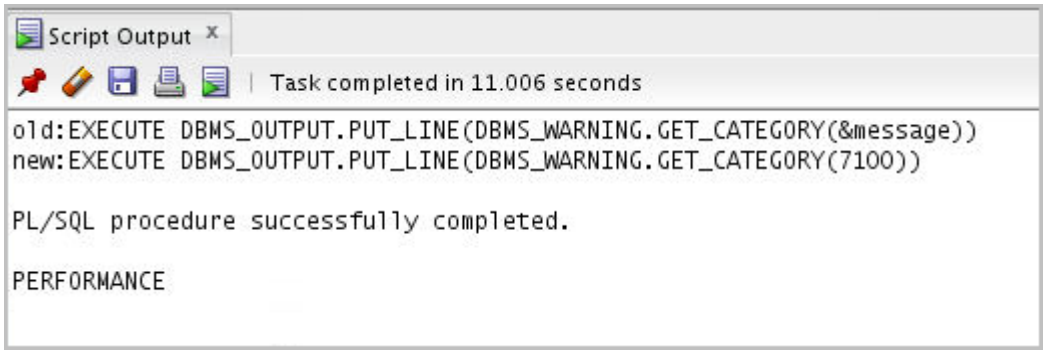





```
EXECUTE
DBMS_OUTPUT.PUT_LINE(DBMS_WARNING.GET_CATEGORY(&message));
```







Practices for Lesson 13: Managing Dependencies

Chapter 13

Practices for Lesson 13: Overview

Overview

In this practice, you use the `DEPTREE_FILL` procedure and the `IDEPTREE` view to investigate dependencies in your schema. In addition, you recompile invalid procedures, functions, packages, and views.

Note:

1. Before starting this practice, execute `/home/oracle/labs/plpu/code_ex/cleanup_scripts/cleanup_13.sql` script.
2. If you missed a step in a practice, please run the appropriate solution script for that practice step before proceeding to the next step or the next practice.

Practice 13-1: Managing Dependencies in Your Schema

Overview

In this practice, you use the DEPTREE_FILL procedure and the IDEPTREE view to investigate dependencies in your schema. In addition, you recompile invalid procedures, functions, packages, and views.

Note: Execute cleanup_13.sql script from /home/oracle/labs/plpu/code_ex/cleanup_scripts/ before performing the following tasks.

Task

1. Create a tree structure showing all dependencies involving your add_employee procedure and your valid_deptid function.

   Note: Create add_employee procedure and valid_deptid function from Practice 3 of lesson titled "Creating Functions and Debugging Subprograms" before performing the tasks.

   a. Load and execute the utldtree.sql script, which is located in the /home/oracle/labs/plpu/labs directory.

      Note: The view sys.deptree will not be created if you are not a sys user. If you are not a sys user deptree view is the alternative and that will be created.

   b. Execute the deptree_fill procedure for the add_employee procedure.

   c. Query the IDEPTREE view to see your results.

   d. Execute the deptree_fill procedure for the valid_deptid function.

   e. Query the IDEPTREE view to see your results.

If you have time, complete the following exercise:

2. Dynamically validate invalid objects.

   a. Make a copy of your EMPLOYEES table, called EMPS.

   b. Alter your EMPLOYEES table and add the column TOTSAL with data type NUMBER(9,2).

   c. Create and save a query to display the name, type, and status of all invalid objects.

   d. In the compile_pkg (created in Practice 8 of the lesson titled "Using Dynamic SQL"), add a procedure called recompile that recompiles all invalid procedures, functions, and packages in your schema. Use Native Dynamic SQL to alter the invalid object type and compile it.

   e. Execute the compile_pkg.recompile procedure.

   f. Run the script file that you created in step 3 c. to check the value of the STATUS column. Do you still have objects with an INVALID status?

Solution 13-1: Managing Dependencies in Your Schema

In this practice, you use the DEPTREE_FILL procedure and the IDEPTREE view to investigate dependencies in your schema. In addition, you recompile invalid procedures, functions, packages, and views.

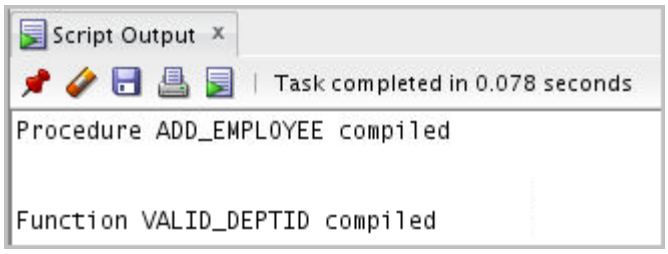
1. a.

   Create a tree structure showing all dependencies involving your add_employee procedure and your valid_deptid function.

   Note: add_employee and valid_deptid were created in the Practice 3 of lesson titled "Creating Functions." Execute the following code to create the add_employee procedure and valid_deptid function.

```
CREATE OR REPLACE PROCEDURE add_employee(
   p_first_name employees.first_name%TYPE,
   p_last_name  employees.last_name%TYPE,
   p_email      employees.email%TYPE,
   p_job        employees.job_id%TYPE         DEFAULT 'SA_REP',
   p_mgr        employees.manager_id%TYPE     DEFAULT 145,
   p_sal        employees.salary%TYPE         DEFAULT 1000,
   p_comm       employees.commission_pct%TYPE DEFAULT 0,
   p_deptid     employees.department_id%TYPE  DEFAULT 30) IS
BEGIN
 IF valid_deptid(p_deptid) THEN
   INSERT INTO employees(employee_id, first_name, last_name,
   email,
     job_id, manager_id, hire_date, salary, commission_pct,
   department_id)
   VALUES (employees_seq.NEXTVAL, p_first_name, p_last_name,
   p_email,
     p_job, p_mgr, TRUNC(SYSDATE), p_sal, p_comm, p_deptid);
 ELSE
   RAISE_APPLICATION_ERROR (-20204, 'Invalid department ID. Try
   again.');
 END IF;
END add_employee;
/
CREATE OR REPLACE FUNCTION valid_deptid(
  p_deptid IN departments.department_id%TYPE)
  RETURN BOOLEAN IS
  v_dummy  PLS_INTEGER;

BEGIN
  SELECT  1
```

```
  INTO     v_dummy
  FROM     departments
  WHERE    department_id = p_deptid;
  RETURN   TRUE;
EXCEPTION
  WHEN NO_DATA_FOUND THEN
    RETURN FALSE;
END valid_deptid;
/
```



Load and execute the `utldtree.sql` script, which is located in the `/home/oracle/labs/plpu/labs` directory.

Open the `/home/oracle/labs/plpu/solns/utldtree.sql` script. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

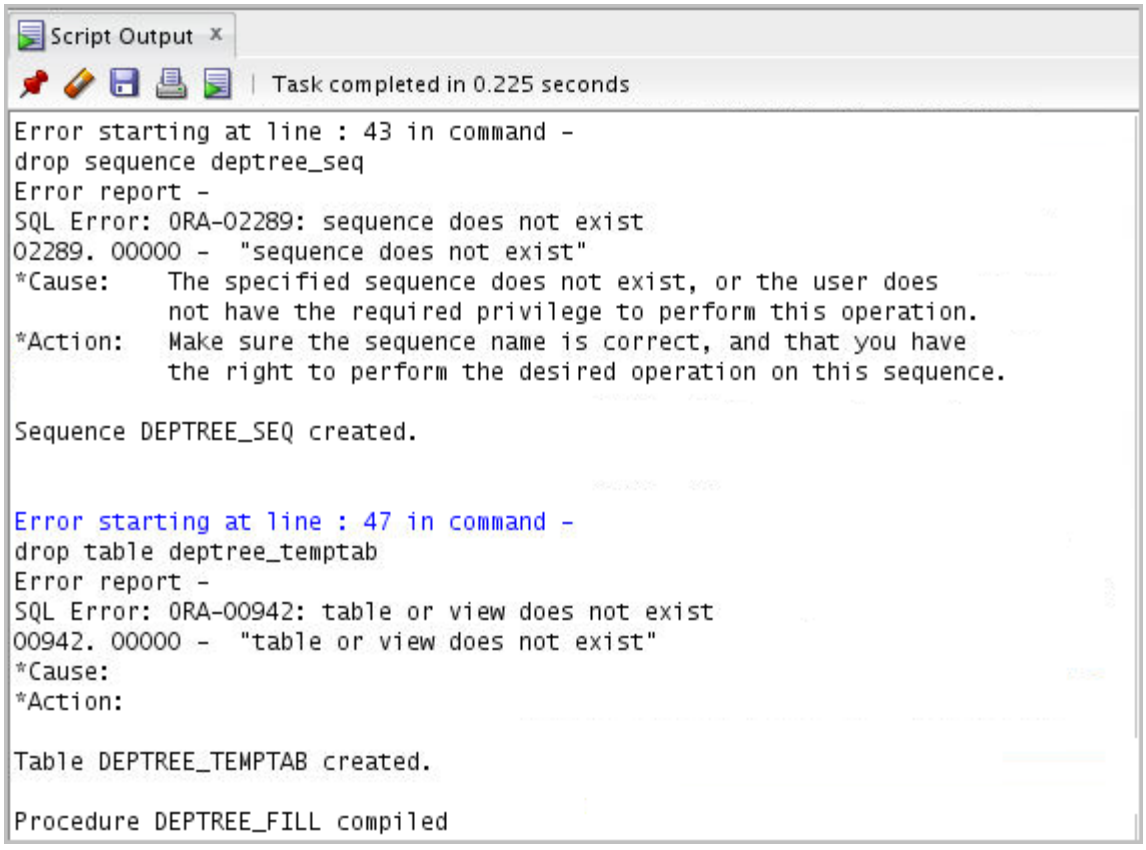
```
Rem
Rem $Header: utldtree.sql,v 3.2 2012/11/21 16:24:44 RKOOI Stab $
Rem
Rem  Copyright (c) 1991 by Oracle Corporation
Rem   NAME
Rem   deptree.sql - Show objects recursively dependent on
Rem   given object
Rem   DESCRIPTION
Rem   This procedure, view and temp table will allow you to see
Rem   all objects that are (recursively) dependent on the given
Rem   object.
Rem   Note: you will only see objects for which you have
Rem   permission.
Rem   Examples:
Rem   execute deptree_fill('procedure', 'scott', 'billing');
Rem   select * from deptree order by seq#;
Rem
Rem   execute deptree_fill('table', 'scott', 'emp');
Rem   select * from deptree order by seq#;
Rem
```

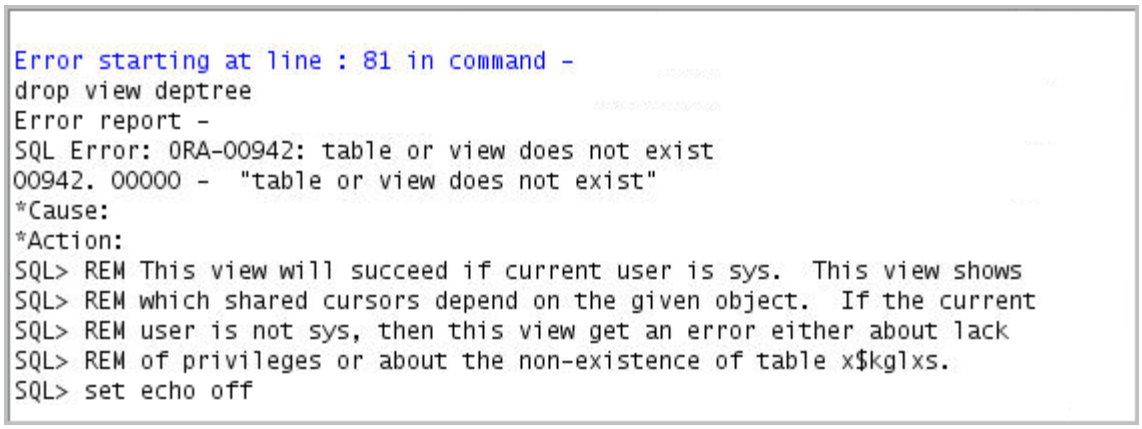
```
Rem   execute deptree_fill('package body', 'scott',
Rem   'accts_payable');
Rem   select * from deptree order by seq#;
Rem
Rem   A prettier way to display this information than
Rem   select * from deptree order by seq#;
Rem is
Rem   select * from ideptree;
Rem   This shows the dependency relationship via indenting.
Rem   Notice that no order by clause is needed with ideptree.
Rem   RETURNS
Rem
Rem   NOTES
Rem   Run this script once for each schema that needs this
Rem   utility.
Rem   MODIFIED   (MM/DD/YY)
Rem   rkooi      10/26/92 -  owner -> schema for SQL2
Rem   glumpkin   10/20/92 -  Renamed from DEPTREE.SQL
Rem   rkooi      09/02/92 -  change ORU errors
Rem   rkooi      06/10/92 -  add rae errors
Rem   rkooi      01/13/92 -  update for sys vs. regular user
Rem   rkooi      01/10/92 -  fix ideptree
Rem   rkooi      01/10/92 -  Better formatting, add ideptree
view
Rem   rkooi      12/02/91 -  deal with cursors
Rem   rkooi      10/19/91 -  Creation

DROP SEQUENCE deptree_seq
/
CREATE SEQUENCE deptree_seq cache 200
-- cache 200 to make sequence faster

/
DROP TABLE deptree_temptab
/
CREATE TABLE deptree_temptab
(
  object_id            number,
  referenced_object_id number,
  nest_level           number,
  seq#                 number
)
/
```

```
CREATE OR REPLACE PROCEDURE deptree_fill (type char, schema
char, name char) IS
  obj_id number;
BEGIN
  DELETE FROM deptree_temptab;
  COMMITT;
  SELECT object_id INTO obj_id FROM all_objects
    WHERE owner = upper(deptree_fill.schema)

AND   object_name  = upper(deptree_fill.name)
    AND   object_type  = upper(deptree_fill.type);
  INSERT INTO deptree_temptab
    VALUES(obj_id, 0, 0, 0);
  INSERT INTO deptree_temptab
    SELECT object_id, referenced_object_id,
        level, deptree_seq.nextval
      FROM public_dependency
      CONNECT BY PRIOR object_id = referenced_object_id
      START WITH referenced_object_id = deptree_fill.obj_id;
EXCEPTION
  WHEN no_data_found then
    raise_application_error(-20000, 'ORU-10013: ' ||
      type || ' ' || schema || '.' || name || ' was not
found.');
END;
/

DROP VIEW deptree
/

SET ECHO ON

REM This view will succeed if current user is sys. This view
REM shows which shared cursors depend on the given object. If
REM the current user is not sys, then this view get an error
REM either about lack of privileges or about the non-existence
of REM table x$kglxs.

SET ECHO OFF
CREATE VIEW sys.deptree
  (nested_level, type, schema, name, seq#)
AS
```

```
  SELECT d.nest_level, o.object_type, o.owner, o.object_name,
d.seq#
  FROM deptree_temptab d, dba_objects o
  WHERE d.object_id = o.object_id (+)
UNION ALL
  SELECT d.nest_level+1, 'CURSOR', '<shared>',
'"'||c.kglnaobj||'"', d.seq#+.5
  FROM deptree_temptab d, x$kgldp k, x$kglob g, obj$ o, user$ u,
x$kglob c,
      x$kglxs a
    WHERE d.object_id = o.obj#
    AND   o.name = g.kglnaobj
    AND   o.owner# = u.user#
    AND   u.name = g.kglnaown
    AND   g.kglhdadr = k.kglrfhdl
    AND   k.kglhdadr = a.kglhdadr   -- make sure it is not a
transitive
    AND   k.kgldepno = a.kglxsdep   -- reference, but a direct
one
    AND   k.kglhdadr = c.kglhdadr
    AND   c.kglhdnsp = 0 -- a cursor
/

SET ECHO ON

REM This view will succeed if current user is not sys. This view
REM does *not* show which shared cursors depend on the given
REM object.
REM If the current user is sys then this view will get an error
REM indicating that the view already exists (since prior view
REM create will have succeeded).

SET ECHO OFF
CREATE VIEW deptree
  (nested_level, type, schema, name, seq#)
AS
  select d.nest_level, o.object_type, o.owner, o.object_name,
d.seq#
  FROM deptree_temptab d, all_objects o
  WHERE d.object_id = o.object_id (+)
/
DROP VIEW ideptree
/
CREATE VIEW ideptree (dependencies)
```

```
AS
  SELECT lpad(' ',3*(max(nested_level))) || max(nvl(type, '<no
permission>')
    || ' ' || schema || decode(type, NULL, '', '.') || name)
  FROM deptree
  GROUP BY seq# /* So user can omit sort-by when selecting from
ideptree */
/
```





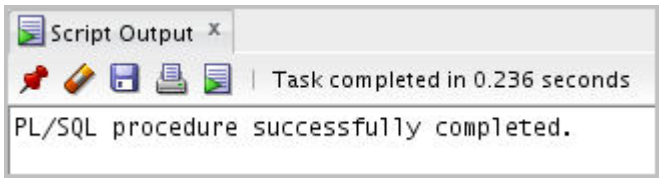
```
Error starting at line : 92 in command -
create view sys.deptree
  (nested_level, type, schema, name, seq#)
as
  select d.nest_level, o.object_type, o.owner, o.object_name, d.seq#
  from deptree_temptab d, dba_objects o
  where d.object_id = o.object_id (+)
union all
  select d.nest_level+1, 'CURSOR', '<shared>', '"'||c.kglnaobj||'"', d.seq#+.5
  from deptree_temptab d, x$kgldp k, x$kglob g, obj$ o, user$ u, x$kglob c,
      x$kglxs a
    where d.object_id = o.obj#
    and   o.name = g.kglnaobj
    and   o.owner# = u.user#
    and   u.name = g.kglnaown
    and   g.kglhdadr = k.kglrfhdl
    and   k.kglhdadr = a.kglhdadr   /* make sure it is not a transitive */
    and   k.kgldepno = a.kglxsdep   /* reference, but a direct one */
    and   k.kglhdadr = c.kglhdadr
    and   c.kglhdnsp = 0 /* a cursor */
Error report -
SQL Error: ORA-00942: table or view does not exist
00942. 00000 -  "table or view does not exist"
*Cause:
*Action:
```

```
SQL> REM This view will succeed if current user is not sys.  This view
SQL> REM does *not* show which shared cursors depend on the given object.
SQL> REM If the current user is sys then this view will get an error
SQL> REM indicating that the view already exists (since prior view create
SQL> REM will have succeeded).
SQL> set echo off

View DEPTREE created.


Error starting at line : 130 in command -
drop view ideptree
Error report -
SQL Error: ORA-00942: table or view does not exist
00942. 00000 -  "table or view does not exist"
*Cause:
*Action:

View IDEPTREE created.
```

b. Execute the `deptree_fill` procedure for the `add_employee` procedure.

Open the `/home/oracle/labs/plpu/solns/sol_12.sql` script. Uncomment and select the code under task 1_b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
EXECUTE deptree_fill('PROCEDURE', USER, 'add_employee')
```



c. Query the `IDEPTREE` view to see your results.

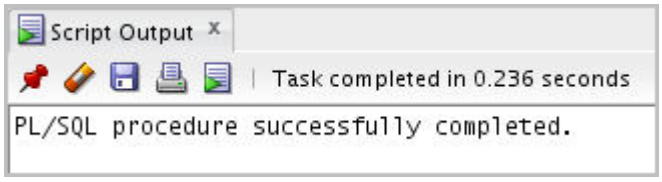
Uncomment and select the code under task 1_c. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
SELECT * FROM IDEPTREE;
```

d. Execute the `deptree_fill` procedure for the `valid_deptid` function.

Uncomment and select the code under task 1_d. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
EXECUTE deptree_fill('FUNCTION', USER, 'valid_deptid')
```



e. Query the `IDEPTREE` view to see your results.

Uncomment and select the code under task 1_e. Click the Execute Statement icon (or press F9) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

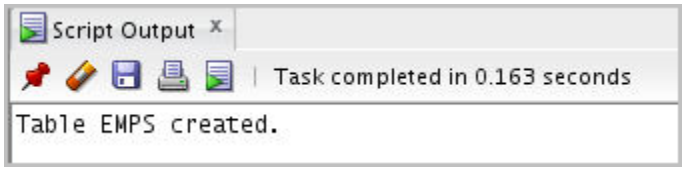
```
SELECT * FROM IDEPTREE;
```

If you have time, complete the following exercise:

2. Dynamically validate invalid objects.
   a. Make a copy of your `EMPLOYEES` table, called `EMPS`.

      Uncomment and select the code under task 2_a. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
CREATE TABLE emps AS
  SELECT * FROM employees;
```

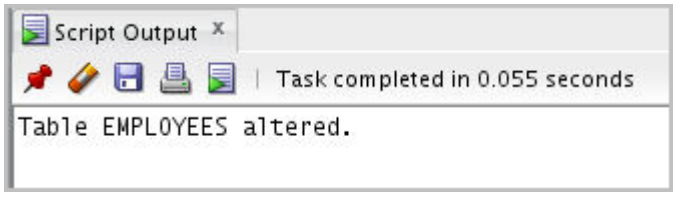


      Note: Please ignore the error message, if any while executing the `CREATE` statement.

   b. Alter your `EMPLOYEES` table and add the column `TOTSAL` with data type `NUMBER(9,2)`.

      Uncomment and select the code under task 2_b. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
ALTER TABLE employees
  ADD (totsal NUMBER(9,2));
```



   c. Create and save a query to display the name, type, and status of all invalid objects.

      Uncomment and select the code under task 2_c. Click the Execute Statement icon (or press F9) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
SELECT object_name, object_type, status
FROM USER_OBJECTS
WHERE status = 'INVALID';
```

	OBJECT_NAME	OBJECT_TYPE	STATUS
1	SECURE_EMPLOYEES	TRIGGER	INVALID
2	FORWARD_PKG	PACKAGE BODY	INVALID
3	LOG_EMPLOYEE	TRIGGER	INVALID
4	GET_EMPLOYEE	PROCEDURE	INVALID
5	DISPLAY	PROCEDURE	INVALID
6	RAISE_SAL	PROCEDURE	INVALID
7	DISPLAY_NEW_SAL	PROCEDURE	INVALID
8	QUERY_EMP	PROCEDURE	INVALID
9	EMP_MAILS	VIEW	INVALID

Note: Please ignore the difference in the screenshot.

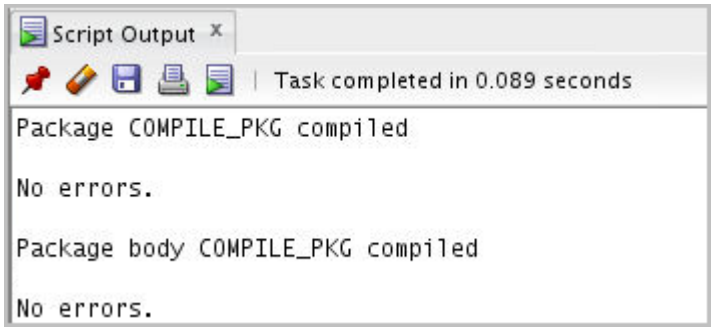
d. In the `compile_pkg` (created in Practice 8 of the lesson titled “Using Dynamic SQL”), add a procedure called `recompile` that recompiles all invalid procedures, functions, and packages in your schema. Use Native Dynamic SQL to alter the invalid object type and compile it.

```
   CREATE OR REPLACE PACKAGE compile_pkg IS
  PROCEDURE make(name VARCHAR2);
  PROCEDURE recompile;
END compile_pkg;
/
SHOW ERRORS

CREATE OR REPLACE PACKAGE BODY compile_pkg IS

  PROCEDURE execute(stmt VARCHAR2) IS
  BEGIN
    DBMS_OUTPUT.PUT_LINE(stmt);
    EXECUTE IMMEDIATE stmt;
  END;

  FUNCTION get_type(name VARCHAR2) RETURN VARCHAR2 IS
    proc_type VARCHAR2(30) := NULL;
  BEGIN
     -- The ROWNUM = 1 is added to the condition
     -- to ensure only one row is returned if the
     -- name represents a PACKAGE, which may also
     -- have a PACKAGE BODY. In this case, we can
```

```
   -- only compile the complete package, but not
   -- the specification or body as separate
   -- components.
SELECT object_type INTO proc_type
FROM user_objects
WHERE object_name = UPPER(name)
 AND ROWNUM = 1;
  RETURN proc_type;
EXCEPTION
  WHEN NO_DATA_FOUND THEN
    RETURN NULL;
END;

PROCEDURE make(name VARCHAR2) IS
  stmt       VARCHAR2(100);
  proc_type  VARCHAR2(30) := get_type(name);
BEGIN
  IF proc_type IS NOT NULL THEN
    stmt := 'ALTER '|| proc_type ||' '|| name ||' COMPILE';

execute(stmt);
  ELSE
    RAISE_APPLICATION_ERROR(-20001,
       'Subprogram '''|| name ||''' does not exist');
  END IF;
END make;

PROCEDURE recompile IS
  stmt VARCHAR2(200);
  obj_name user_objects.object_name%type;
  obj_type user_objects.object_type%type;
BEGIN
  FOR objrec IN (SELECT object_name, object_type
                 FROM user_objects
                 WHERE status = 'INVALID'
                 AND object_type <> 'PACKAGE BODY')
  LOOP
    stmt := 'ALTER '|| objrec.object_type ||' '||
                 objrec.object_name ||' COMPILE';
    execute(stmt);
  END LOOP;
END recompile;
```

```
END compile_pkg;
/
```

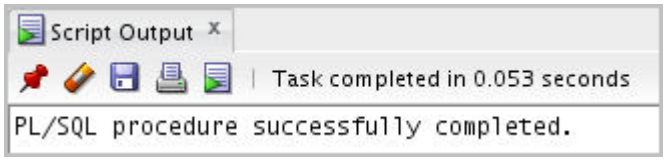
SHOW ERRORS



e. Execute the `compile_pkg.recompile` procedure.

Uncomment and select the code under task 2_e. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
EXECUTE compile_pkg.recompile
```

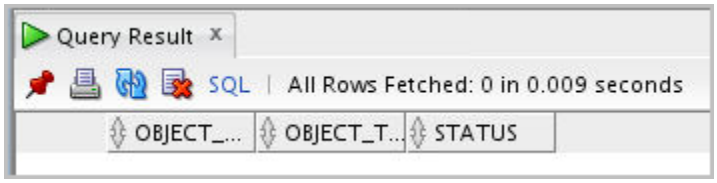


Note: If you come across an error message in the screenshot, please ignore. The procedure would have been compiled.

f. Run the script file that you created in step 2_c to check the value of the `STATUS` column. Do you still have objects with an `INVALID` status?

Uncomment and select the code under task 2_f. Click the Execute Statement icon (or press F9) on the SQL Worksheet toolbar to run the script. The code and the results are shown below.

```
SELECT object_name, object_type, status
FROM USER_OBJECTS
WHERE status = 'INVALID';
```



Note: Compare this output to the output in step 2(c). You see that all the objects from the previous screenshot are now valid.

Additional Practices 1

Chapter 14

Additional Practices 1: Overview

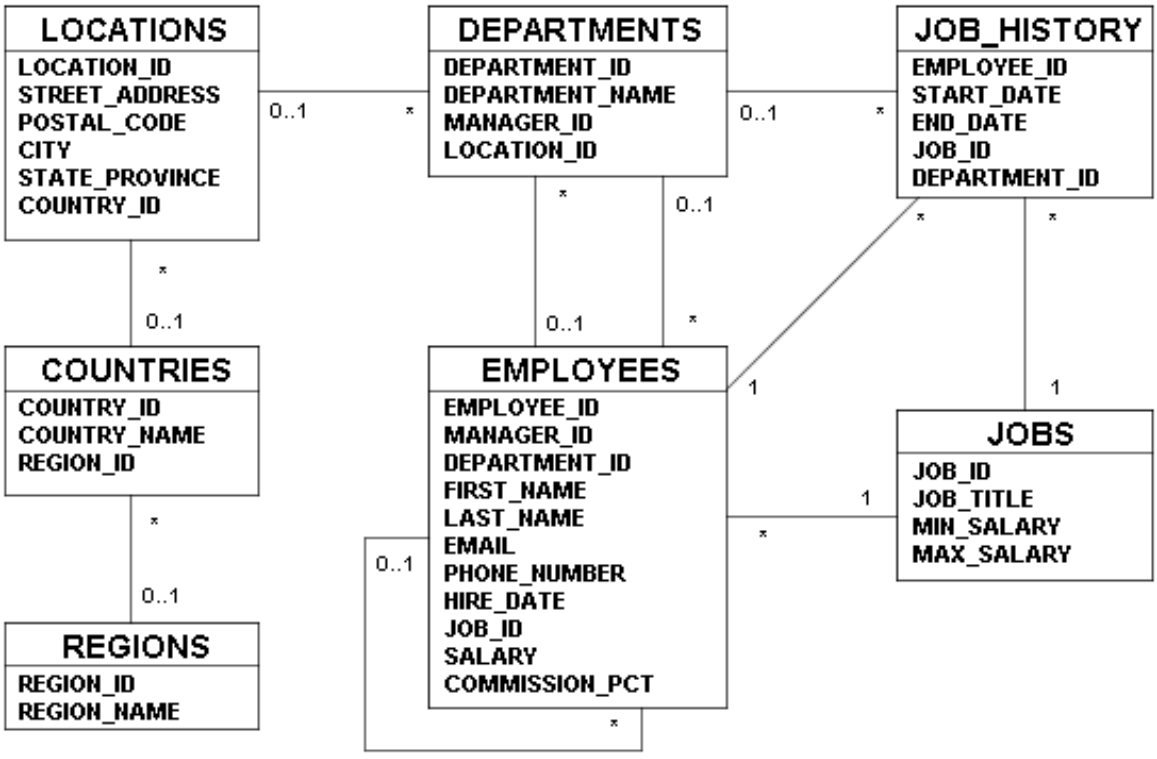
Overview

The additional practices are provided as a supplement to the course *Oracle Database: Develop PL/SQL Program Units*. In these practices, you apply the concepts that you learned in the course. The additional practices comprise two lessons.

Lesson 1 provides supplemental exercises to create stored procedures, functions, packages, and triggers, and to use the Oracle-supplied packages with SQL Developer or SQL*Plus as the development environment. The tables used in this portion of the additional practice include `EMPLOYEES`, `JOBS`, `JOB_HISTORY`, and `DEPARTMENTS`.

An entity relationship diagram is provided at the start of each practice. Each entity relationship diagram displays the table entities and their relationships. More detailed definitions of the tables and the data contained in them is provided in the appendix titled “Additional Practices: Table Descriptions and Data.”

The Human Resources (HR) Schema Entity Relationship Diagram



Practice 1-1: Creating a New SQL Developer Database Connection

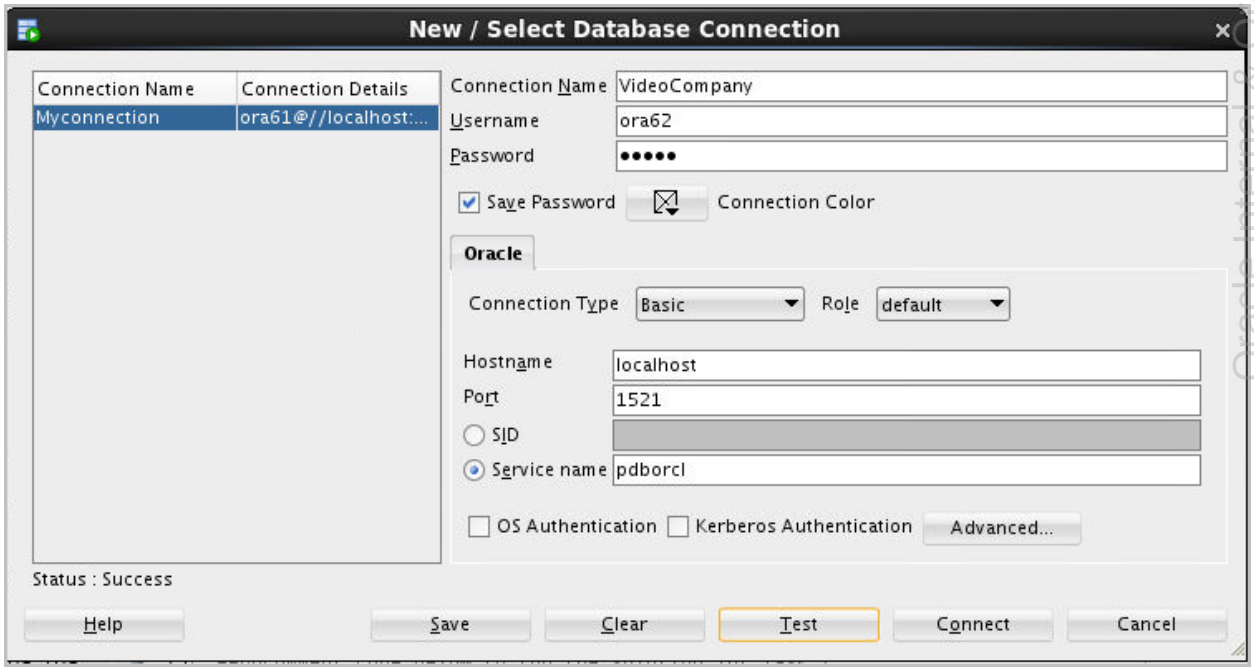
Overview

In this practice, you start SQL Developer using your connection information and create a new database connection.

Start up SQL Developer using the user ID and password that are provided to you by the instructor such as `ora62`.

Task

1. Start up SQL Developer using the user ID and password that are provided to you by the instructor such as `ora62`.
2. Create a database connection using the following information:
   a. Connection Name: `VideoCompany`
   b. Username: `ora62`
   c. Password: `Enter the password from the Course Practice Environment: Security Credentials document`
   d. Select the Save Password check box.
   e. Hostname: Enter the host name for your PC or alternatively mention localhost
   f. Port: 1521
   g. Service name: `pdborcl`
3. Test the new connection. If the Status shows as Success, connect to the database using this new connection:
   a. Click the Test button in the New/Select Database Connection window. If the status shows as Success, click the Connect button.



Solution 1-1: Creating a New SQL Developer Database Connection

In this practice, you start SQL Developer using your connection information and create a new database connection.

1. Start up SQL Developer using the user ID and password that are provided to you by the instructor, such as `ora62`.

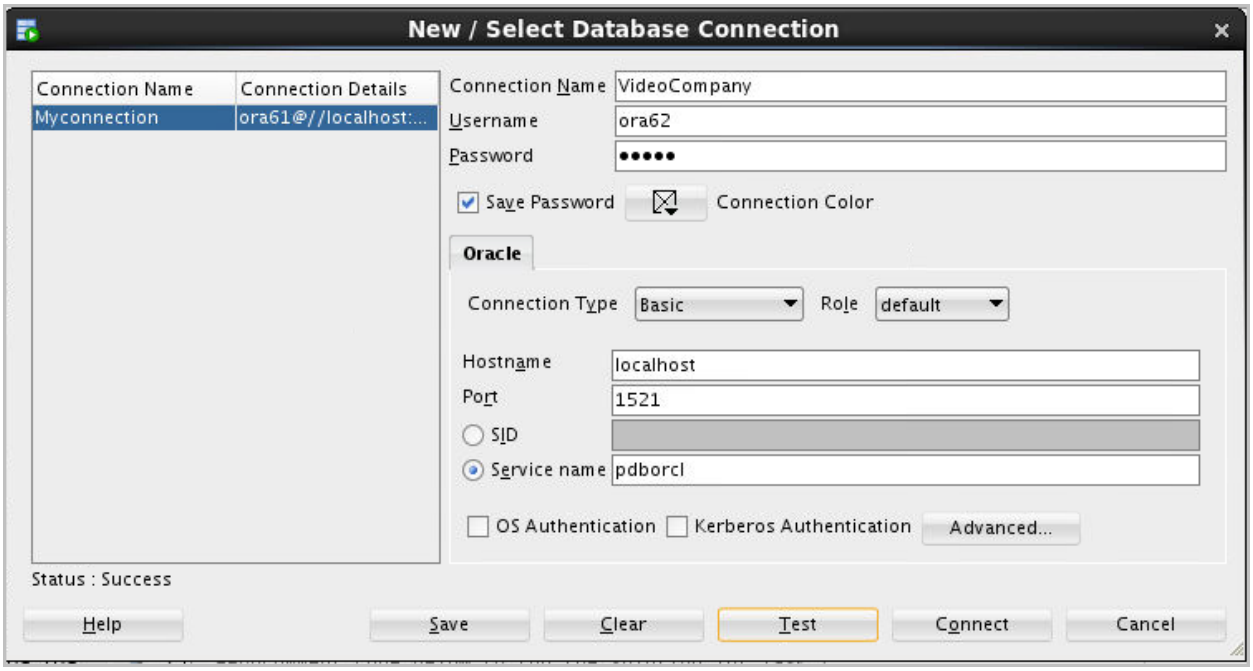
   Click the SQL Developer icon on your desktop.

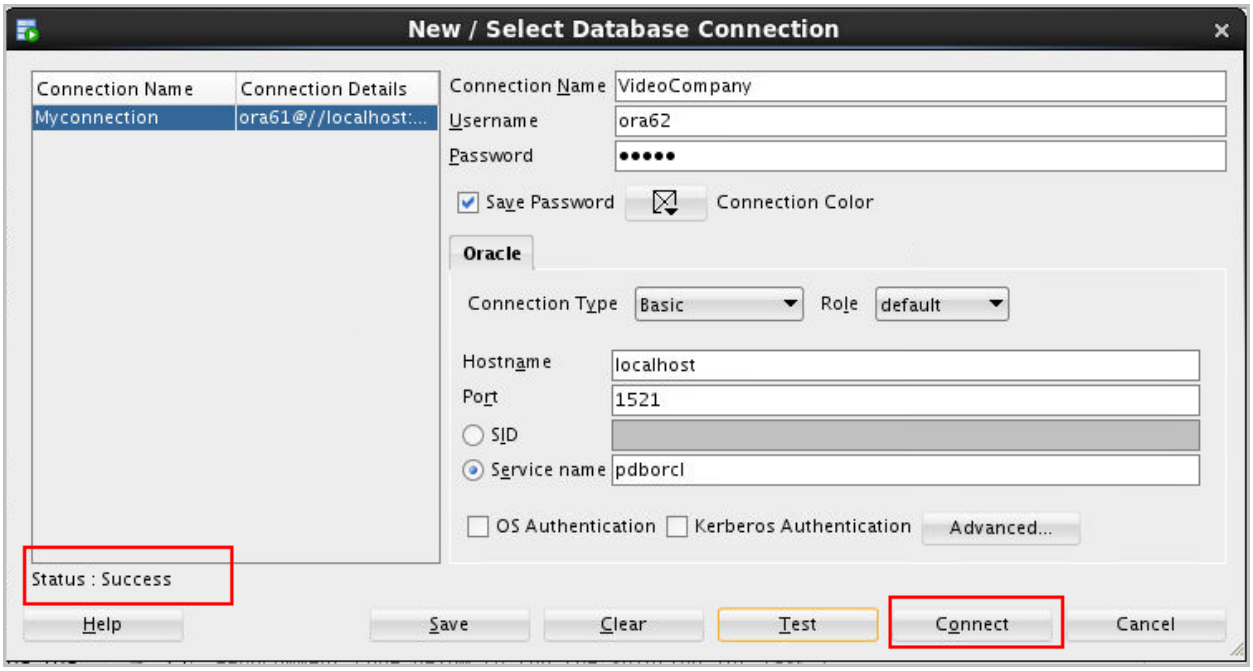
2. Create a database connection using the following information:
   a. Connection Name: `VideoCompany`
   b. Username: `ora62`
   c. Password: `ora62`
   d. Hostname: Enter the host name for your PC or let the default `localhost` remain.
   e. Port: 1521
   f. Service Name: `pdborcl`

   Right-click the Connections icon on the Connections tabbed page, and then select the New Connection option from the shortcut menu. The New/Select Database Connection window is displayed. Use the preceding information provided to create the new database connection.

Note: To display the properties of the newly created connection, right-click the connection name, and then select Properties from the shortcut menu. Substitute the username, password, host name, and service name with the appropriate information as provided by your instructor. The following is a sample of the newly created database connection for student `ora62`:



3. Test the new connection. If the status shows as Success, connect to the database using this new connection:
   a. Click the Test button in the New/Select Database Connection window. If the status shows as Success, click the Connect button.



Practice 1-2: Adding a New Job to the JOBS Table

Overview

In this practice, you create a subprogram to add a new job into the JOBS table.

Tasks

1. Create a stored procedure called NEW_JOB to enter a new order into the JOBS table. The procedure should accept three parameters. The first and second parameters supply a job ID and a job title. The third parameter supplies the minimum salary. Use the maximum salary for the new job as twice the minimum salary supplied for the job ID.
2. Enable SERVEROUTPUT, and then invoke the procedure to add a new job with job ID 'SY_ANAL', job title 'System Analyst', and minimum salary of 6000.
3. Check whether a row was added and note the new job ID for use in the next exercise. Commit the changes.

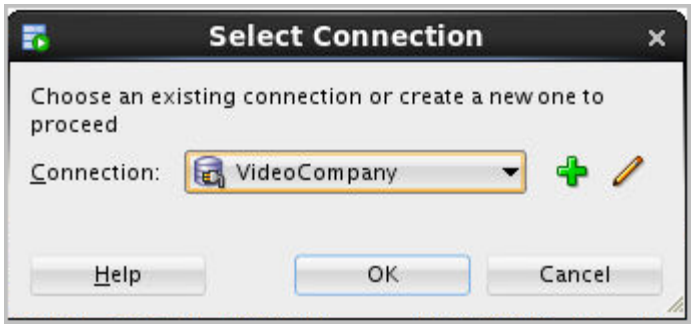
Solution 1-2: Adding a New Job to the JOBS Table

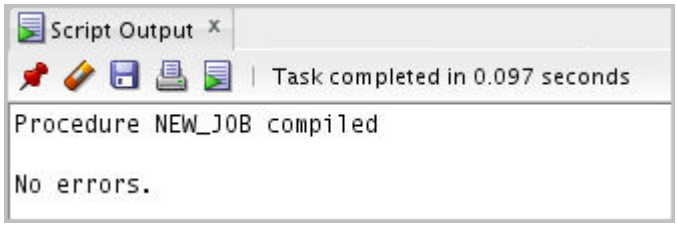
In this practice, you create a subprogram to add a new job into the JOBS table.

1. Create a stored procedure called NEW_JOB to enter a new order into the JOBS table. The procedure should accept three parameters. The first and second parameters supply a job ID and a job title. The third parameter supplies the minimum salary. Use the maximum salary for the new job as twice the minimum salary supplied for the job ID.

   Open the /home/oracle/labs/plpu/solns/sol_ap1.sql script. Uncomment and select the code under Task 1 of Additional Practice 1-2. Click the Run Script icon (or press F5) on the SQL Worksheet toolbar to create and compile the procedure. Make sure that you have selected the new VideoCompany connection. The code, connection prompt, and the results are displayed as follows:

```
CREATE OR REPLACE PROCEDURE new_job(
  p_jobid  IN jobs.job_id%TYPE,
  p_title  IN jobs.job_title%TYPE,
  v_minsal IN jobs.min_salary%TYPE) IS
  v_maxsal  jobs.max_salary%TYPE := 2 * v_minsal;
BEGIN
  INSERT INTO jobs(job_id, job_title, min_salary, max_salary)
  VALUES (p_jobid, p_title, v_minsal, v_maxsal);
  DBMS_OUTPUT.PUT_LINE ('New row added to JOBS table:');
  DBMS_OUTPUT.PUT_LINE (p_jobid || '  ' || p_title ||' '||
                        v_minsal || '  ' || v_maxsal);
END new_job;
/
SHOW ERRORS
```

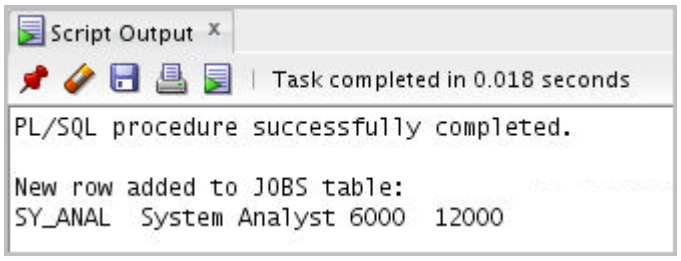




2. Enable SERVEROUTPUT, and then invoke the procedure to add a new job with job ID 'SY_ANAL', job title '`System Analyst`', and minimum salary of 6000.

   Uncomment and select the code under Task 2 of Additional Practice 1-2. When prompted to select a connection, select the new `VideoCompany` connection. The code and the results are displayed as follows:

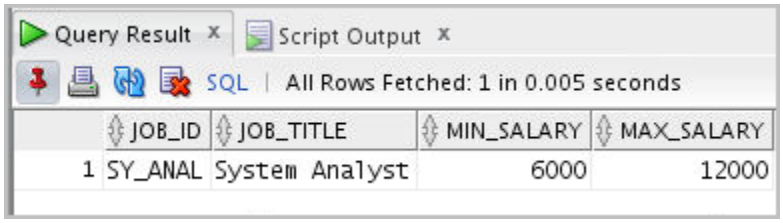
```
SET SERVEROUTPUT ON

EXECUTE new_job ('SY_ANAL', 'System Analyst', 6000)
```

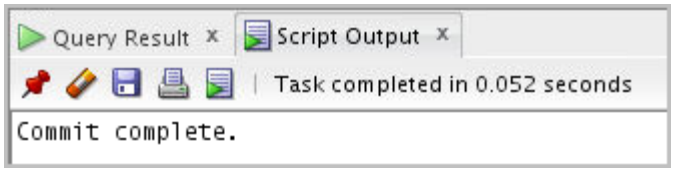


3. Check whether a row was added and note the new job ID for use in the next exercise. Commit the changes.

   Run Uncomment and select the code under Task 3 of Additional Practice 1-2. The code and the results are displayed as follows:

```
SELECT *
FROM   jobs
WHERE  job_id = 'SY_ANAL';
COMMIT;
```





Practice 1-3: Adding a New Row to the JOB_HISTORY Table

Overview

In this Additional Practice, you add a new row to the JOB_HISTORY table for an existing employee.

Tasks

1. Create a stored procedure called ADD_JOB_HIST to add a new row into the JOB_HISTORY table for an employee who is changing his job to the new job ID ('SY_ANAL') that you created in Task 2 of Practice 1-2.
   a. The procedure should provide two parameters, one for the employee ID who is changing the job, and the second for the new job ID.
   b. Read the employee ID from the EMPLOYEES table and insert it into the JOB_HISTORY table.
   c. Make the hire date of this employee as start date and today's date as end date for this row in the JOB_HISTORY table.
   d. Change the hire date of this employee in the EMPLOYEES table to today's date.
   e. Update the job ID of this employee to the job ID passed as parameter (use the 'SY_ANAL' job ID) and salary equal to the minimum salary for that job ID + 500.
   Note: Include exception handling to handle an attempt to insert a nonexistent employee.
2. Disable all triggers on the EMPLOYEES, JOBS, and JOB_HISTORY tables before invoking the ADD_JOB_HIST procedure.
3. Enable SERVEROUTPUT, and then execute the procedure with employee ID 106 and job ID 'SY_ANAL' as parameters.
4. Query the JOB_HISTORY and EMPLOYEES tables to view your changes for employee 106, and then commit the changes.
5. Re-enable the triggers on the EMPLOYEES, JOBS, and JOB_HISTORY tables.

Solution 1-3: Adding a New Row to the JOB_HISTORY Table

In this Additional Practice, you add a new row to the JOB_HISTORY table for an existing employee.

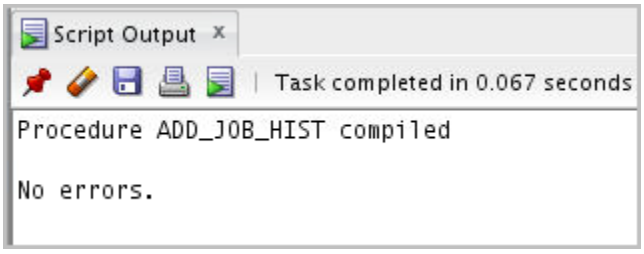
1. Create a stored procedure called ADD_JOB_HIST to add a new row into the JOB_HISTORY table for an employee who is changing his job to the new job ID ('SY_ANAL') that you created in exercise 2.
   a. The procedure should provide two parameters, one for the employee ID who is changing the job, and the second for the new job ID.
   b. Read the employee ID from the EMPLOYEES table and insert it into the JOB_HISTORY table.
   c. Make the hire date of this employee as start date and today's date as end date for this row in the JOB_HISTORY table.
   d. Change the hire date of this employee in the EMPLOYEES table to today's date.
   e. Update the job ID of this employee to the job ID passed as parameter (use the 'SY_ANAL' job ID) and salary equal to the minimum salary for that job ID + 500.

      Note: Include exception handling to handle an attempt to insert a nonexistent employee.

      Uncomment and select the code under Task 1 of Additional Practice 1-3. The code and the results are displayed as follows:

```
CREATE OR REPLACE PROCEDURE add_job_hist(
  p_emp_id    IN employees.employee_id%TYPE,
  p_new_jobid IN jobs.job_id%TYPE) IS
BEGIN
  INSERT INTO job_history
    SELECT employee_id, hire_date, SYSDATE, job_id,
department_id
    FROM   employees
    WHERE  employee_id = p_emp_id;
  UPDATE employees
    SET  hire_date = SYSDATE,
         job_id = p_new_jobid,
         salary = (SELECT min_salary + 500
                   FROM   jobs
                   WHERE  job_id = p_new_jobid)
   WHERE employee_id = p_emp_id;
  DBMS_OUTPUT.PUT_LINE ('Added employee ' || p_emp_id ||
                        ' details to the JOB_HISTORY table');
  DBMS_OUTPUT.PUT_LINE ('Updated current job of employee ' ||
                        p_emp_id|| ' to '|| p_new_jobid);
```

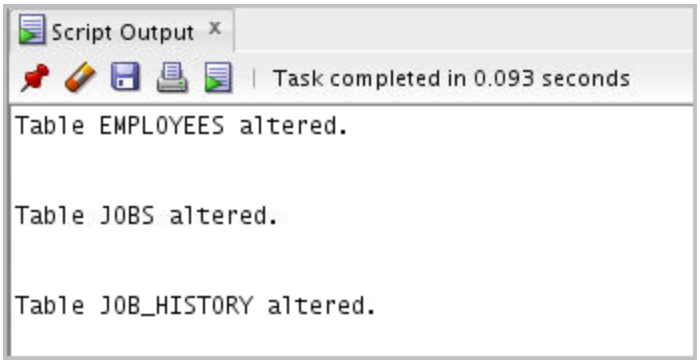
```
EXCEPTION
  WHEN NO_DATA_FOUND THEN
    RAISE_APPLICATION_ERROR (-20001, 'Employee does not
exist!');
END add_job_hist;
/
SHOW ERRORS
```



2. Disable all triggers on the EMPLOYEES, JOBS, and JOB_HISTORY tables before invoking the ADD_JOB_HIST procedure.

   Uncomment and select the code under Task 2 of Additional Practice 1-3. The code and the results are displayed as follows:

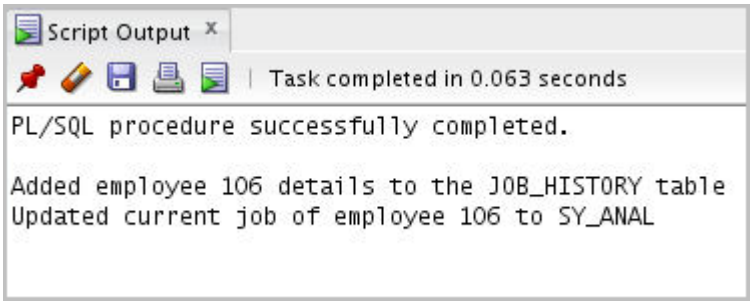
```
ALTER TABLE employees DISABLE ALL TRIGGERS;
ALTER TABLE jobs DISABLE ALL TRIGGERS;
ALTER TABLE job_history DISABLE ALL TRIGGERS;
```



3. Enable SERVEROUTPUT, and then execute the procedure with employee ID 106 and job ID 'SY_ANAL' as parameters.

Uncomment and select the code under Task 3 of Additional Practice 1-3. The code and the results are displayed as follows:

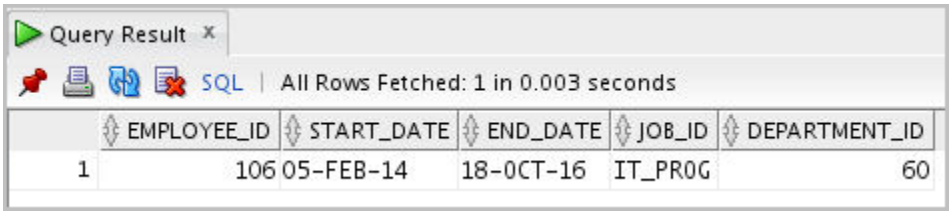
```
SET SERVEROUTPUT ON

EXECUTE add_job_hist(106, 'SY_ANAL')
```

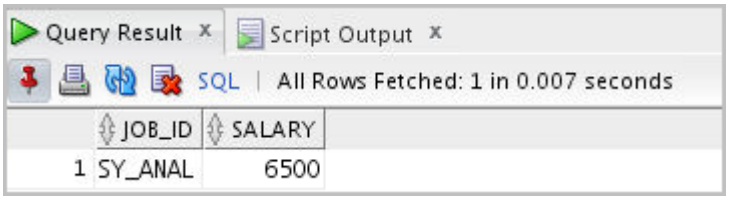


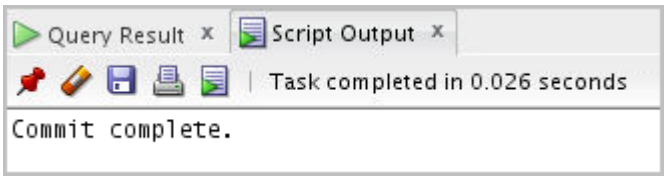
4. Query the JOB_HISTORY and EMPLOYEES tables to view your changes for employee 106, and then commit the changes.

Uncomment and select the code under Task 4 of Additional Practice 1-3. The code and the results are displayed as follows:

```
SELECT *  FROM  job_history
WHERE  employee_id = 106;

SELECT job_id, salary FROM employees
WHERE  employee_id = 106;

COMMIT;
```



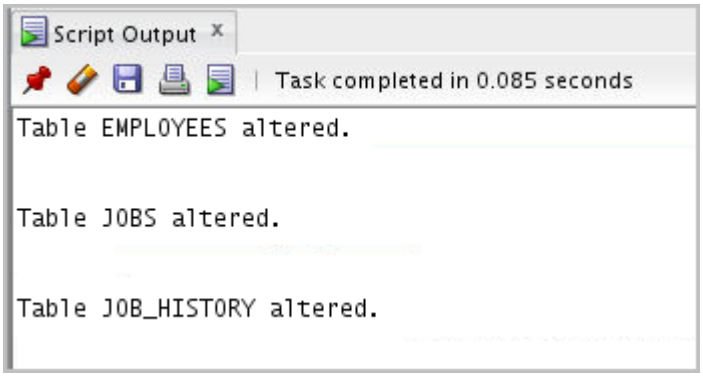




5. Re-enable the triggers on the EMPLOYEES, JOBS and JOB_HISTORY tables.

Uncomment and select the code under Task 5 of Additional Practice 1-3. The code and the results are displayed as follows:

```
ALTER TABLE employees ENABLE ALL TRIGGERS;
ALTER TABLE jobs ENABLE ALL TRIGGERS;
ALTER TABLE job_history ENABLE ALL TRIGGERS;
```



Practice 1-4: Updating the Minimum and Maximum Salaries for a Job

Overview

In this Additional Practice, you create a program to update the minimum and maximum salaries for a job in the JOBS table.

Tasks

1. Create a stored procedure called UPD_JOBSAL to update the minimum and maximum salaries for a specific job ID in the JOBS table. The procedure should provide three parameters: the job ID, a new minimum salary, and a new maximum salary. Add exception handling to account for an invalid job ID in the JOBS table. Raise an exception if the maximum salary supplied is less than the minimum salary, and provide a message that will be displayed if the row in the JOBS table is locked.

   Hint: The resource locked/busy error number is –54.
2. Enable SERVEROUTPUT, and then execute the UPD_JOBSAL procedure by using a job ID of 'SY_ANAL', a minimum salary of 7000 and a maximum salary of 140.

   Note: This should generate an exception message.
3. Disable triggers on the EMPLOYEES and JOBS tables.
4. Execute the UPD_JOBSAL procedure using a job ID of 'SY_ANAL', a minimum salary of 7000, and a maximum salary of 14000.
5. Query the JOBS table to view your changes, and then commit the changes.
6. Enable the triggers on the EMPLOYEES and JOBS tables.

Solution 1-4: Updating the Minimum and Maximum Salaries for a Job

In this Additional Practice, you create a program to update the minimum and maximum salaries for a job in the JOBS table.

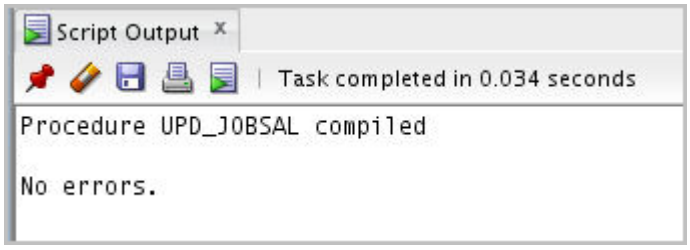
1. Create a stored procedure called UPD_JOBSAL to update the minimum and maximum salaries for a specific job ID in the JOBS table. The procedure should provide three parameters: the job ID, a new minimum salary, and a new maximum salary. Add exception handling to account for an invalid job ID in the JOBS table. Raise an exception if the maximum salary supplied is less than the minimum salary, and provide a message that will be displayed if the row in the JOBS table is locked.

   Hint: The resource locked/busy error number is –54.

   Uncomment and select the code under Task 1 of Additional Practice 1-4. The code and the results are displayed as follows:

```
CREATE OR REPLACE PROCEDURE upd_jobsal(
  p_jobid       IN jobs.job_id%type,
  p_new_minsal  IN jobs.min_salary%type,
  p_new_maxsal  IN jobs.max_salary%type) IS
  v_dummy            PLS_INTEGER;
  e_resource_busy  EXCEPTION;
  e_sal_error        EXCEPTION;
  PRAGMA           EXCEPTION_INIT (e_resource_busy , -54);
BEGIN
  IF (p_new_maxsal < p_new_minsal) THEN
    RAISE e_sal_error;
  END IF;
  SELECT 1 INTO v_dummy
    FROM jobs
    WHERE job_id = p_jobid
    FOR UPDATE OF min_salary NOWAIT;
  UPDATE jobs
    SET min_salary =  p_new_minsal,
        max_salary =  p_new_maxsal
    WHERE job_id  = p_jobid;
EXCEPTION
  WHEN e_resource_busy THEN
    RAISE_APPLICATION_ERROR (-20001,
      'Job information is currently locked, try later.');
  WHEN NO_DATA_FOUND THEN
    RAISE_APPLICATION_ERROR(-20001, 'This job ID does not
exist');
```

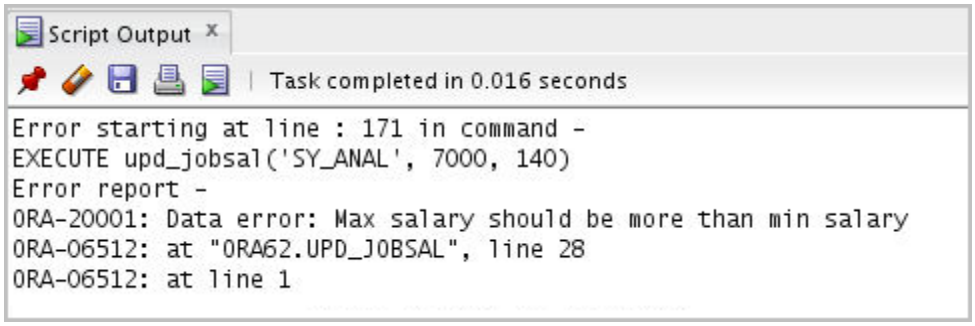
```
  WHEN e_sal_error THEN
    RAISE_APPLICATION_ERROR(-20001,
     'Data error: Max salary should be more than min salary');
END upd_jobsal;
/
SHOW ERRORS
```



2. Enable SERVEROUTPUT, and then execute the UPD_JOBSAL procedure by using a job ID of 'SY_ANAL', a minimum salary of 7000 and a maximum salary of 140.
   Note: This should generate an exception message.

   Uncomment and select the code under Task 2 of Additional Practice 1-4. The code and the results are displayed as follows:

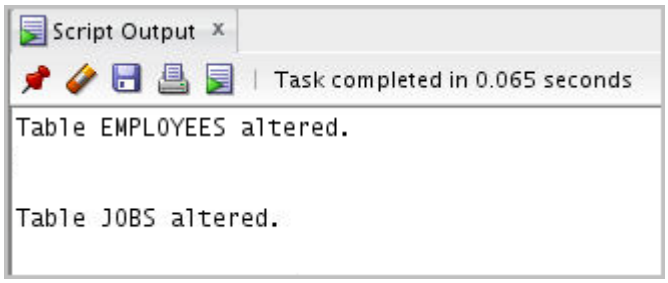
```
SET SERVEROUTPUT ON

EXECUTE upd_jobsal('SY_ANAL', 7000, 140)
```



3. Disable triggers on the EMPLOYEES and JOBS tables.

Uncomment and select the code under Task 3 of Additional Practice 1-4. The code and the results are displayed as follows:

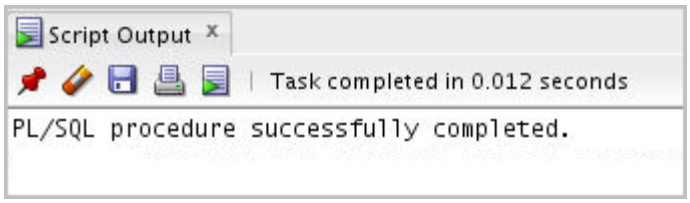
```
ALTER TABLE employees DISABLE ALL TRIGGERS;
ALTER TABLE jobs DISABLE ALL TRIGGERS;
```



4. Execute the UPD_JOBSAL procedure using a job ID of 'SY_ANAL', a minimum salary of 7000, and a maximum salary of 14000.

Uncomment and select the code under Task 4 of Additional Practice 1-4. The code and the results are displayed as follows:

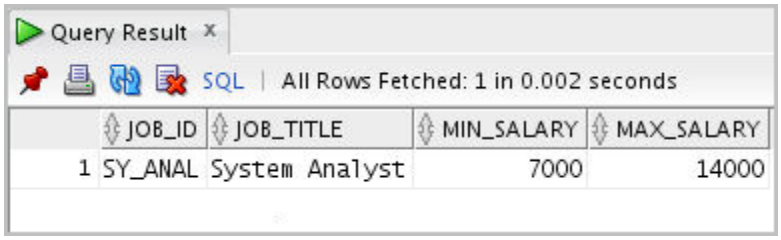
```
EXECUTE upd_jobsal('SY_ANAL', 7000, 14000)
```



5. Query the JOBS table to view your changes, and then commit the changes.

Uncomment and select the code under Task 5 of Additional Practice 1-4. The code and the results are displayed as follows:

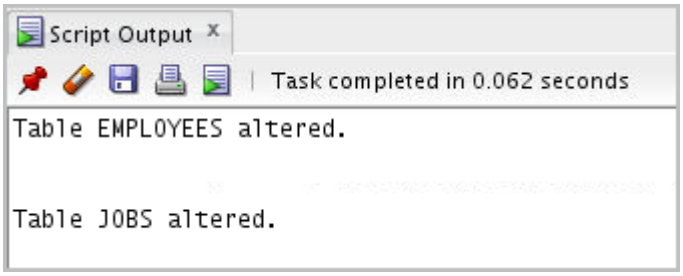
```
SELECT *
FROM  jobs
WHERE job_id = 'SY_ANAL';
```



6. Enable the triggers on the EMPLOYEES and JOBS tables.

Uncomment and select the code under Task 6 of Additional Practice 1-4. The code and the results are displayed as follows:

```
ALTER TABLE employees ENABLE ALL TRIGGERS;
ALTER TABLE jobs ENABLE ALL TRIGGERS;
```



Practice 1-5: Monitoring Employees Salaries

Overview

In this Additional Practice, you create a procedure to monitor whether employees have exceeded their average salaries for their job type.

Tasks

1. Disable the SECURE_EMPLOYEES trigger.
2. In the EMPLOYEES table, add an EXCEED_AVGSAL column to store up to three characters and a default value of NO. Use a check constraint to allow the values YES or NO.
3. Create a stored procedure called CHECK_AVGSAL that checks whether each employee's salary exceeds the average salary for the JOB_ID.
   a. The average salary for a job is calculated from the information in the JOBS table.
   b. If the employee's salary exceeds the average for his or her job, then update the EXCEED_AVGSAL column in the EMPLOYEES table to a value of YES; otherwise, set the value to NO.
   c. Use a cursor to select the employee's rows using the FOR UPDATE option in the query.
   d. Add exception handling to account for a record being locked.
      Hint: The resource locked/busy error number is –54.
   e. Write and use a local function called GET_JOB_AVGSAL to determine the average salary for a job ID specified as a parameter.
4. Execute the CHECK_AVGSAL procedure. To view the results of your modifications, write a query to display the employee's ID, job, the average salary for the job, the employee's salary and the exceed_avgsal indicator column for employees whose salaries exceed the average for their job, and finally commit the changes.

   Note: These exercises can be used for extra practice when discussing how to create functions.

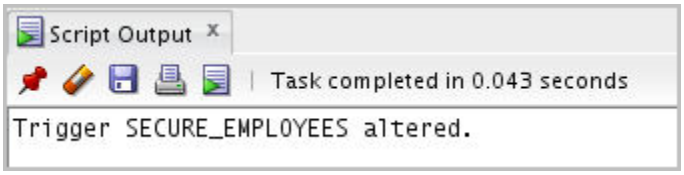
Solution 1-5: Monitoring Employees Salaries

In this practice, you create a procedure to monitor whether employees have exceeded their average salaries for their job type.

1. Disable the SECURE_EMPLOYEES trigger.

   Uncomment and select the code under Task 1 of Additional Practice 1-5. The code and the results are displayed as follows:

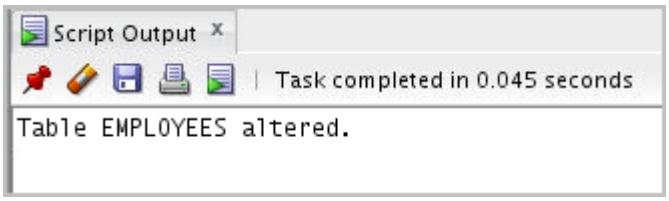
```
ALTER TRIGGER secure_employees DISABLE;
```



2. In the EMPLOYEES table, add an EXCEED_AVGSAL column to store up to three characters and a default value of NO. Use a check constraint to allow the values YES or NO.

   Uncomment and select the code under Task 2 of Additional Practice 1-5. The code and the results are displayed as follows:

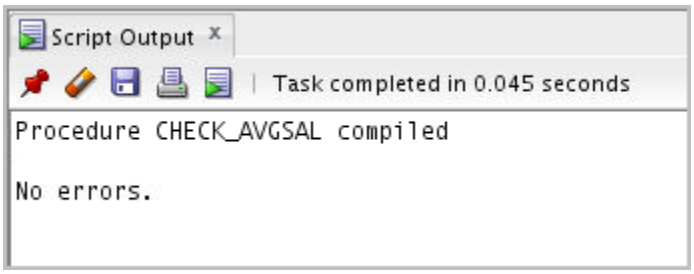
```
ALTER TABLE employees ADD (exceed_avgsal VARCHAR2(3) DEFAULT
'NO'
    CONSTRAINT employees_exceed_avgsal_ck
    CHECK (exceed_avgsal IN ('YES', 'NO')));
```



3. Create a stored procedure called CHECK_AVGSAL that checks whether each employee's salary exceeds the average salary for the JOB_ID.
   a. The average salary for a job is calculated from the information in the JOBS table.
   b. If the employee's salary exceeds the average for his or her job, then update the EXCEED_AVGSAL column in the EMPLOYEES table to a value of YES; otherwise, set the value to NO.
   c. Use a cursor to select the employee's rows using the FOR UPDATE option in the query.
   d. Add exception handling to account for a record being locked.
      Hint: The resource locked/busy error number is –54.
   e. Write and use a local function called GET_JOB_AVGSAL to determine the average salary for a job ID specified as a parameter.

Uncomment and select the code under Task 3 of Additional Practice 1-5. The code and the results are displayed as follows::

```
CREATE OR REPLACE PROCEDURE check_avgsal IS
  emp_exceed_avgsal_type employees.exceed_avgsal%type;
  CURSOR  c_emp_csr IS
    SELECT  employee_id, job_id, salary
    FROM employees
    FOR UPDATE;
  e_resource_busy  EXCEPTION;
  PRAGMA EXCEPTION_INIT(e_resource_busy, -54);
  FUNCTION get_job_avgsal (jobid VARCHAR2) RETURN NUMBER IS
    avg_sal employees.salary%type;
  BEGIN
    SELECT (max_salary + min_salary)/2 INTO avg_sal
    FROM jobs
    WHERE job_id = jobid;
    RETURN avg_sal;
  END;

BEGIN
  FOR emprec IN c_emp_csr
  LOOP
    emp_exceed_avgsal_type := 'NO';
    IF emprec.salary >= get_job_avgsal(emprec.job_id) THEN
      emp_exceed_avgsal_type := 'YES';
    END IF;
    UPDATE employees
      SET exceed_avgsal = emp_exceed_avgsal_type
      WHERE CURRENT OF c_emp_csr;
  END LOOP;
EXCEPTION
  WHEN e_resource_busy THEN
    ROLLBACK;
    RAISE_APPLICATION_ERROR (-20001, 'Record is busy, try
later.');
END check_avgsal;
/
SHOW ERRORS
```

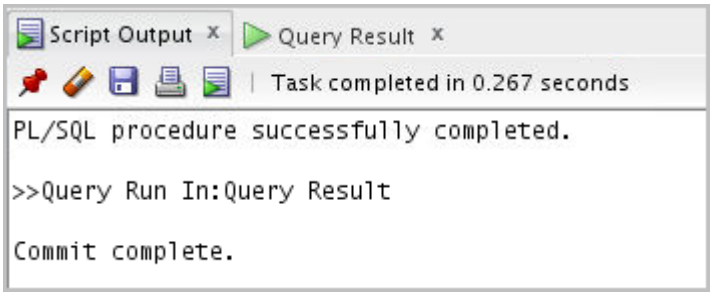


4. Execute the CHECK_AVGSAL procedure. To view the results of your modifications, write a query to display the employee's ID, job, the average salary for the job, the employee's salary and the exceed_avgsal indicator column for employees whose salaries exceed the average for their job, and finally commit the changes.

   Note: These exercises can be used for extra practice when discussing how to create functions.

   Uncomment and select the code under Task 4 of Additional Practice 1-5. The code and the results are displayed as follows:

```
EXECUTE check_avgsal

SELECT e.employee_id, e.job_id, (j.max_salary-j.min_salary/2)
job_avgsal,
       e.salary, e.exceed_avgsal avg_exceeded
FROM   employees e, jobs j
WHERE  e.job_id = j.job_id
and e.exceed_avgsal = 'YES';

COMMIT;
```



Script Output | Query Result

SQL | All Rows Fetched: 27 in 0.006 seconds

	EMPLOYEE_ID	JOB_ID	JOB_AVGSAL	SALARY	AVG_EXCEEDED
1	109	FI_ACCOUNT	6900	9000	YES
2	110	FI_ACCOUNT	6900	8200	YES
3	111	FI_ACCOUNT	6900	7700	YES
4	112	FI_ACCOUNT	6900	7800	YES
5	113	FI_ACCOUNT	6900	6900	YES
6	206	AC_ACCOUNT	6900	8300	YES
7	150	SA_REP	9008	10000	YES
8	151	SA_REP	9008	9500	YES
9	156	SA_REP	9008	10000	YES
10	157	SA_REP	9008	9500	YES
11	162	SA_REP	9008	10500	YES
12	163	SA_REP	9008	9500	YES
13	168	SA_REP	9008	11500	YES
14	169	SA_REP	9008	10000	YES
15	170	SA_REP	9008	9600	YES
16	174	SA_REP	9008	11000	YES
17	120	ST_MAN	5750	8000	YES
18	121	ST_MAN	5750	8200	YES
19	122	ST_MAN	5750	7900	YES
20	137	ST_CLERK	3996	3600	YES
21	184	SH_CLERK	4250	4200	YES
22	185	SH_CLERK	4250	4100	YES
23	192	SH_CLERK	4250	4000	YES
24	103	IT_PROG	8000	9000	YES
25	201	MK_MAN	10500	13000	YES
26	203	HR_REP	7000	6500	YES
27	204	PR_REP	8250	10000	YES

Practice 1-6: Retrieving the Total Number of Years of Service for an Employee

Overview

In this practice, you create a subprogram to retrieve the number of years of service for a specific employee.

Tasks

1. Create a stored function called `GET_YEARS_SERVICE` to retrieve the total number of years of service for a specific employee. The function should accept the employee ID as a parameter and return the number of years of service. Add error handling to account for an invalid employee ID.
2. Invoke the `GET_YEARS_SERVICE` function in a call to `DBMS_OUTPUT.PUT_LINE` for an employee with ID 999.
3. Display the number of years of service for employee 106 with `DBMS_OUTPUT.PUT_LINE` invoking the `GET_YEARS_SERVICE` function. Make sure that you enable `SERVEROUTPUT`.
4. Query the `JOB_HISTORY` and `EMPLOYEES` tables for the specified employee to verify that the modifications are accurate. The values represented in the results on this page may differ from those that you get when you run these queries.

Solution 1-6: Retrieving the Total Number of Years of Service for an Employee

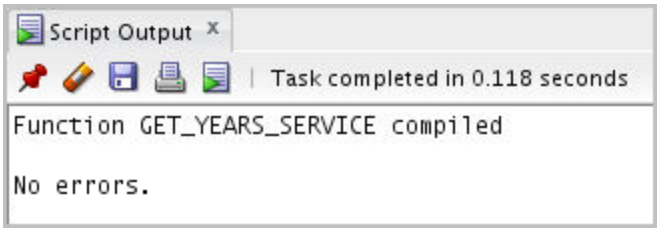
In this practice, you create a subprogram to retrieve the number of years of service for a specific employee.

1. Create a stored function called GET_YEARS_SERVICE to retrieve the total number of years of service for a specific employee. The function should accept the employee ID as a parameter and return the number of years of service. Add error handling to account for an invalid employee ID.

   Uncomment and select the code under Task 1 of Additional Practice 1-6. The code and the results are displayed as follows:

```
CREATE OR REPLACE FUNCTION get_years_service(
  p_emp_empid_type IN employees.employee_id%TYPE) RETURN NUMBER
IS
  CURSOR c_jobh_csr IS
    SELECT MONTHS_BETWEEN(end_date, start_date)/12
v_years_in_job
    FROM   job_history
    WHERE  employee_id = p_emp_empid_type;
  v_years_service NUMBER(2) := 0;
  v_years_in_job  NUMBER(2) := 0;
BEGIN
  FOR jobh_rec IN c_jobh_csr
  LOOP
    EXIT WHEN c_jobh_csr%NOTFOUND;
    v_years_service := v_years_service +
jobh_rec.v_years_in_job;
  END LOOP;
  SELECT MONTHS_BETWEEN(SYSDATE, hire_date)/12 INTO
v_years_in_job
  FROM   employees
  WHERE  employee_id = p_emp_empid_type;
  v_years_service := v_years_service + v_years_in_job;
  RETURN ROUND(v_years_service);
EXCEPTION
  WHEN NO_DATA_FOUND THEN
    RAISE_APPLICATION_ERROR(-20348,
      'Employee with ID '|| p_emp_empid_type ||' does not
exist.');
    RETURN NULL;
END get_years_service;
```

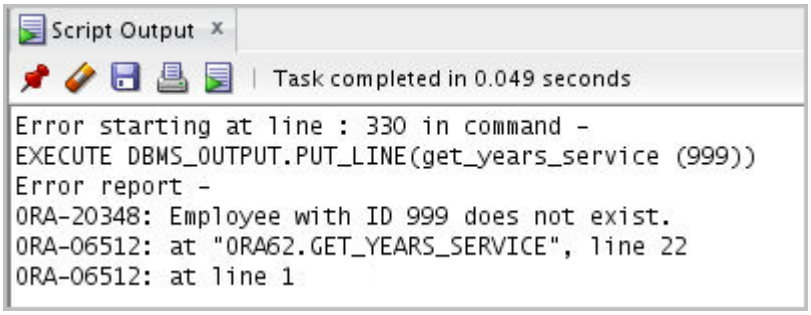
```
/
SHOW ERRORS
```



2. Invoke the GET_YEARS_SERVICE function in a call to DBMS_OUTPUT.PUT_LINE for an employee with ID 999.

   Uncomment and select the code under Task 2 of Additional Practice 1-6. The code and the results are displayed as follows:

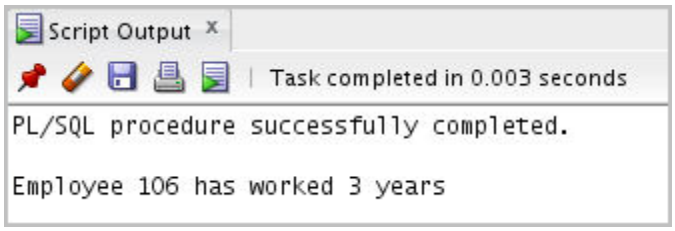
```
SET SERVEROUTPUT ON
EXECUTE DBMS_OUTPUT.PUT_LINE(get_years_service (999))
```



3. Display the number of years of service for employee 106 with DBMS_OUTPUT.PUT_LINE invoking the GET_YEARS_SERVICE function. Make sure that you enable SERVEROUTPUT.

   Uncomment and select the code under Task 3 of Additional Practice 1-6. The code and the results are displayed as follows:

```
SET SERVEROUTPUT ON

BEGIN
  DBMS_OUTPUT.PUT_LINE (
    'Employee 106 has worked ' || get_years_service(106) || '
years');
END;
/
```



4. Query the JOB_HISTORY and EMPLOYEES tables for the specified employee to verify that the modifications are accurate. The values represented in the results on this page may differ from those you get when you run these queries.

Uncomment and select the code under Task 4 of Additional Practice 1-6. The code and the results are displayed as follows:

```
SELECT employee_id, job_id,
       MONTHS_BETWEEN(end_date, start_date)/12 duration
FROM   job_history;

SELECT job_id, MONTHS_BETWEEN(SYSDATE, hire_date)/12 duration
FROM   employees
WHERE  employee_id = 106;
```

Query Result | Query Result 1

SQL | All Rows Fetched: 11 in 0.003 seconds

	EMPLOYEE_ID	JOB_ID	DURATION
1	102	IT_PROG	5.529569892473118279569892473118279569 89
2	101	AC_ACCOUNT	7.099462365591397849462365591397849462 37
3	101	AC_MGR	3.381720430107526881720430107526881720 43
4	201	MK_REP	3.838709677419354838709677419354838709 68
5	114	ST_CLERK	1.768817204301075268817204301075268817 2
6	122	ST_CLERK	0.997311827956989247311827956989247311 8283
7	200	AD_ASST	13.75
8	176	SA_REP	0.768817204301075268817204301075268817 2042
9	176	SA_MAN	0.997311827956989247311827956989247311 8283
10	200	AC_ACCOUNT	4.497311827956989247311827956989247311 83
11	106	IT_PROG	2.704137855933890880127439267224213460 77

Query Result | Query Result 1

SQL | All Rows Fetched: 1 in 0.001 seconds

	JOB_ID	DURATION
1	SY_ANAL	0

Practice 1-7: Retrieving the Total Number of Different Jobs for an Employee

Overview

In this practice, you create a program to retrieve the number of different jobs that an employee worked on during his or her service.

Tasks

1. Create a stored function called `GET_JOB_COUNT` to retrieve the total number of different jobs on which an employee worked.
   a. The function should accept the employee ID in a parameter, and return the number of different jobs that the employee worked on until now, including the present job.
   b. Add exception handling to account for an invalid employee ID.
      Hint: Use the distinct job IDs from the `JOB_HISTORY` table, and exclude the current job ID, if it is one of the job IDs on which the employee has already worked.
   c. Write a `UNION` of two queries and count the rows retrieved into a PL/SQL table.
   d. Use a `FETCH` with `BULK COLLECT INTO` to obtain the unique jobs for the employee.
2. Invoke the function for the employee with the ID of 176. Make sure that you enable `SERVEROUTPUT`.

   Note: These exercises can be used for extra practice when discussing how to create packages.

Solution 1-7: Retrieving the Total Number of Different Jobs for an Employee

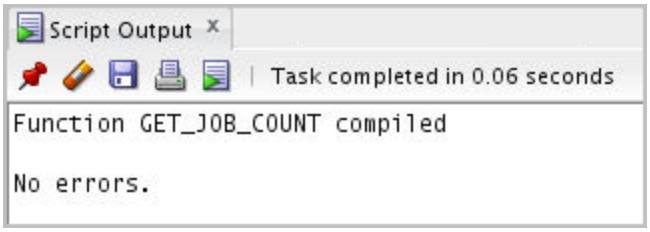
In this practice, you create a program to retrieve the number of different jobs that an employee worked on during his or her service.

1. Create a stored function called `GET_JOB_COUNT` to retrieve the total number of different jobs on which an employee worked.
   a. The function should accept the employee ID in a parameter, and return the number of different jobs that the employee worked on until now, including the present job.
   b. Add exception handling to account for an invalid employee ID.
   Hint: Use the distinct job IDs from the `JOB_HISTORY` table, and exclude the current job ID if it is one of the job IDs on which the employee has already worked.
   c. Write a `UNION` of two queries and count the rows retrieved into a PL/SQL table.
   d. Use a `FETCH` with `BULK COLLECT INTO` to obtain the unique jobs for the employee.

   Uncomment and select the code under Task 1 of Additional Practice 1-7. The code and the results are displayed as follows:

```
CREATE OR REPLACE FUNCTION get_job_count(
  p_emp_empid_type IN employees.employee_id%TYPE) RETURN NUMBER
IS
  TYPE jobs_table_type IS TABLE OF jobs.job_id%type;
  v_jobtab jobs_table_type;
  CURSOR c_empjob_csr IS
    SELECT job_id
    FROM job_history
    WHERE employee_id = p_emp_empid_type
      UNION
    SELECT job_id
    FROM employees
    WHERE employee_id = p_emp_empid_type;
BEGIN
  OPEN c_empjob_csr;
  FETCH c_empjob_csr BULK COLLECT INTO v_jobtab;
  CLOSE c_empjob_csr;
  IF v_jobtab.count = 0 THEN
     RAISE NO_DATA_FOUND;
  ELSE
     RETURN v_jobtab.count;
  END IF;
EXCEPTION
  WHEN NO_DATA_FOUND THEN
```

```
    RAISE_APPLICATION_ERROR(-20348,
      'Employee with ID '|| p_emp_empid_type ||' does not
exist!');
    RETURN NULL;
END get_job_count;
/
SHOW ERRORS
```

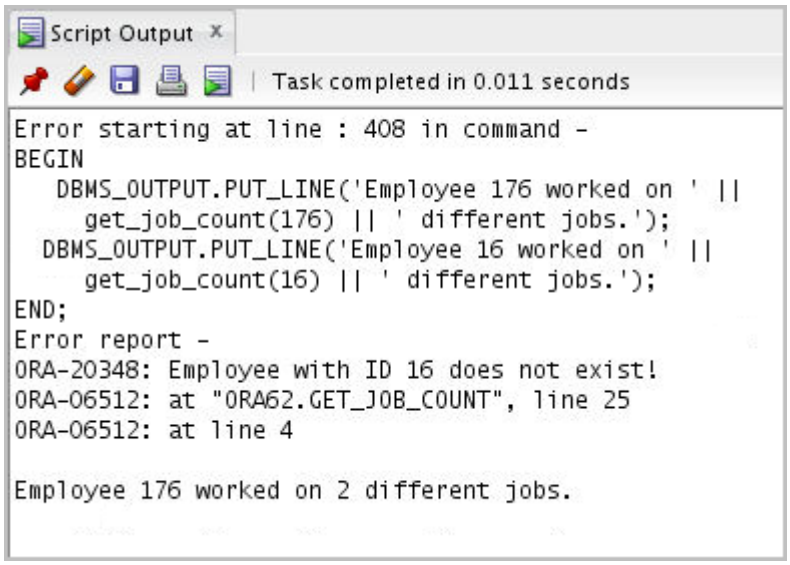


2. Invoke the function for the employee with the ID of 176. Make sure that you enable SERVEROUTPUT.

   Note: These exercises can be used for extra practice when discussing how to create packages.

   Uncomment and select the code under Task 2 of Additional Practice 1-7. The code and the results are displayed as follows:

```
SET SERVEROUTPUT ON

BEGIN
  DBMS_OUTPUT.PUT_LINE('Employee 176 worked on ' ||
     get_job_count(176) || ' different jobs.');
  DBMS_OUTPUT.PUT_LINE('Employee 16 worked on ' ||
     get_job_count(16) || ' different jobs.');

END;
/
```



Practice 1-8: Creating a New Package that Contains the Newly Created Procedures and Functions

Overview

In this practice, you create a package called EMPJOB_PKG that contains your NEW_JOB, ADD_JOB_HIST, UPD_JOBSAL procedures, as well as your GET_YEARS_SERVICE and GET_JOB_COUNT functions.

Tasks

1. Create the package specification with all the subprogram constructs as public. Move any subprogram local-defined types into the package specification.
2. Create the package body with the subprogram implementation; remember to remove, from the subprogram implementations, any types that you moved into the package specification.
3. Invoke your EMPJOB_PKG.NEW_JOB procedure to create a new job with the ID PR_MAN, the job title Public Relations Manager, and the salary 6250. Make sure that you enable SERVEROUTPUT.
4. Invoke your EMPJOB_PKG.ADD_JOB_HIST procedure to modify the job of employee ID 110 to job ID PR_MAN.

   Note: You need to disable the UPDATE_JOB_HISTORY trigger before you execute the ADD_JOB_HIST procedure, and re-enable the trigger after you have executed the procedure.
5. Query the JOBS, JOB_HISTORY, and EMPLOYEES tables to verify the results.

   Note: These exercises can be used for extra practice when discussing how to create database triggers.

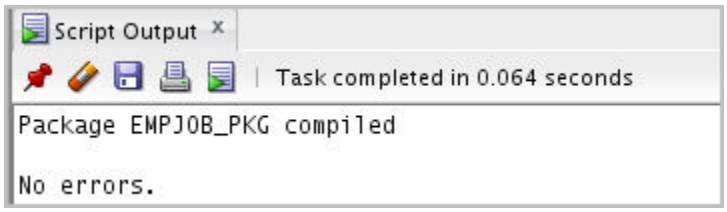
Solution 1-8: Creating a New Package that Contains the Newly Created Procedures and Functions

In this practice, you create a package called EMPJOB_PKG that contains your NEW_JOB, ADD_JOB_HIST, UPD_JOBSAL procedures, as well as your GET_YEARS_SERVICE and GET_JOB_COUNT functions.

1. Create the package specification with all the subprogram constructs as public. Move any subprogram local-defined types into the package specification.

   Uncomment and select the code under Task 1 of Additional Practice 1-8. The code and the results are displayed as follows:

```
CREATE OR REPLACE PACKAGE empjob_pkg IS
  TYPE jobs_table_type IS TABLE OF jobs.job_id%type;

  PROCEDURE add_job_hist(
     p_emp_id IN employees.employee_id%TYPE,
     p_new_jobid IN jobs.job_id%TYPE);

  FUNCTION get_job_count(
     p_emp_id IN employees.employee_id%TYPE) RETURN NUMBER;

  FUNCTION get_years_service(
     p_emp_id IN employees.employee_id%TYPE) RETURN NUMBER;

  PROCEDURE new_job(
    p_jobid IN jobs.job_id%TYPE,
    p_title IN jobs.job_title%TYPE,
    p_minsal IN jobs.min_salary%TYPE);

  PROCEDURE upd_jobsal(
    p_jobid IN jobs.job_id%type,
    p_new_minsal IN jobs.min_salary%type,
    p_new_maxsal IN jobs.max_salary%type);
END empjob_pkg;
/
SHOW ERRORS
```



2. Create the package body with the subprogram implementation; remember to remove from the subprogram implementations any types that you moved into the package specification.

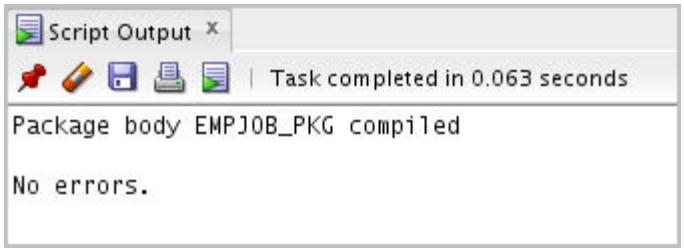
Uncomment and select the code under Task 2 of Additional Practice 1-8. The code and the results are displayed as follows:

```
CREATE OR REPLACE PACKAGE BODY empjob_pkg IS
  PROCEDURE add_job_hist(
    p_emp_id IN employees.employee_id%TYPE,
    p_new_jobid IN jobs.job_id%TYPE) IS
  BEGIN
    INSERT INTO job_history
      SELECT employee_id, hire_date, SYSDATE, job_id,
department_id
      FROM employees
      WHERE employee_id = p_emp_id;
    UPDATE employees
      SET hire_date = SYSDATE,
          job_id = p_new_jobid,
          salary = (SELECT min_salary + 500
                    FROM jobs
          WHERE job_id = p_new_jobid)
      WHERE employee_id = p_emp_id;
    DBMS_OUTPUT.PUT_LINE ('Added employee ' || p_emp_id ||
       ' details to the JOB_HISTORY table');
    DBMS_OUTPUT.PUT_LINE ('Updated current job of employee ' ||
       p_emp_id|| ' to '|| p_new_jobid);
  EXCEPTION
    WHEN NO_DATA_FOUND THEN
      RAISE_APPLICATION_ERROR (-20001, 'Employee does not
exist!');
  END add_job_hist;

  FUNCTION get_job_count(
    p_emp_id IN employees.employee_id%TYPE) RETURN NUMBER IS
    v_jobtab jobs_table_type;
    CURSOR c_empjob_csr IS
```

```
      SELECT job_id
      FROM job_history
      WHERE employee_id = p_emp_id
      UNION
      SELECT job_id
      FROM employees
      WHERE employee_id = p_emp_id;
  BEGIN
    OPEN c_empjob_csr;
    FETCH c_empjob_csr BULK COLLECT INTO v_jobtab;
    CLOSE c_empjob_csr;
    RETURN v_jobtab.count;
  EXCEPTION
    WHEN NO_DATA_FOUND THEN
      RAISE_APPLICATION_ERROR(-20348,
        'Employee with ID '|| p_emp_id ||' does not exist!');
      RETURN 0;
  END get_job_count;

  FUNCTION get_years_service(
    p_emp_id IN employees.employee_id%TYPE) RETURN NUMBER IS
    CURSOR c_jobh_csr IS
      SELECT MONTHS_BETWEEN(end_date, start_date)/12
v_years_in_job
      FROM job_history
      WHERE employee_id = p_emp_id;
    v_years_service NUMBER(2) := 0;
    v_years_in_job NUMBER(2) := 0;
  BEGIN
    FOR jobh_rec IN c_jobh_csr
    LOOP
      EXIT WHEN c_jobh_csr%NOTFOUND;
      v_years_service := v_years_service +
jobh_rec.v_years_in_job;
    END LOOP;
    SELECT MONTHS_BETWEEN(SYSDATE, hire_date)/12 INTO
v_years_in_job
    FROM employees
    WHERE employee_id = p_emp_id;
    v_years_service := v_years_service + v_years_in_job;
    RETURN ROUND(v_years_service);
  EXCEPTION
    WHEN NO_DATA_FOUND THEN
```

```
    RAISE_APPLICATION_ERROR(-20348,
      'Employee with ID '|| p_emp_id ||' does not exist.');
    RETURN 0;
END get_years_service;

PROCEDURE new_job(
  p_jobid IN jobs.job_id%TYPE,
  p_title IN jobs.job_title%TYPE,
  p_minsal IN jobs.min_salary%TYPE) IS
  v_maxsal jobs.max_salary%TYPE := 2 * p_minsal;
BEGIN
  INSERT INTO jobs(job_id, job_title, min_salary, max_salary)
  VALUES (p_jobid, p_title, p_minsal, v_maxsal);
  DBMS_OUTPUT.PUT_LINE ('New row added to JOBS table:');
  DBMS_OUTPUT.PUT_LINE (p_jobid || ' ' || p_title ||' '||
                        p_minsal || ' ' || v_maxsal);
END new_job;

PROCEDURE upd_jobsal(
  p_jobid IN jobs.job_id%type,
  p_new_minsal IN jobs.min_salary%type,
  p_new_maxsal IN jobs.max_salary%type) IS
  v_dummy PLS_INTEGER;
  e_resource_busy EXCEPTION;
  e_sal_error EXCEPTION;
  PRAGMA EXCEPTION_INIT (e_resource_busy , -54);
BEGIN
  IF (p_new_maxsal < p_new_minsal) THEN
    RAISE e_sal_error;
  END IF;
  SELECT 1 INTO v_dummy
  FROM jobs
  WHERE job_id = p_jobid
  FOR UPDATE OF min_salary NOWAIT;
  UPDATE jobs
    SET min_salary = p_new_minsal,
        max_salary = p_new_maxsal
  WHERE job_id = p_jobid;
EXCEPTION
  WHEN e_resource_busy THEN
    RAISE_APPLICATION_ERROR (-20001,
      'Job information is currently locked, try later.');
```

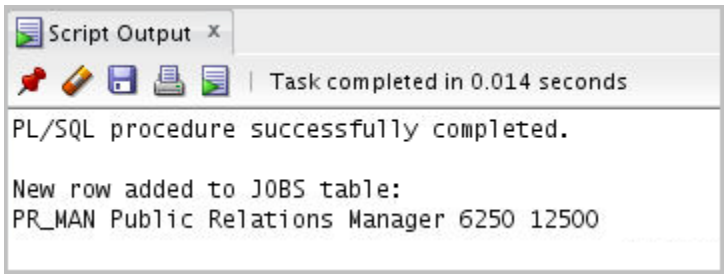
```
    WHEN NO_DATA_FOUND THEN
      RAISE_APPLICATION_ERROR(-20001, 'This job ID does not
exist');
    WHEN e_sal_error THEN
      RAISE_APPLICATION_ERROR(-20001,
        'Data error: Max salary should be more than min
salary');
  END upd_jobsal;
END empjob_pkg;
/
SHOW ERRORS
```



3. Invoke your EMPJOB_PKG.NEW_JOB procedure to create a new job with the ID PR_MAN, the job title Public Relations Manager, and the salary 6250. Make sure that you enable SERVEROUTPUT.

   Uncomment and select the code under Task 3 of Additional Practice 1-8. The code and the results are displayed as follows:

```
SET SERVEROUTPUT ON

EXECUTE empjob_pkg.new_job('PR_MAN', 'Public Relations Manager',
6250)
```

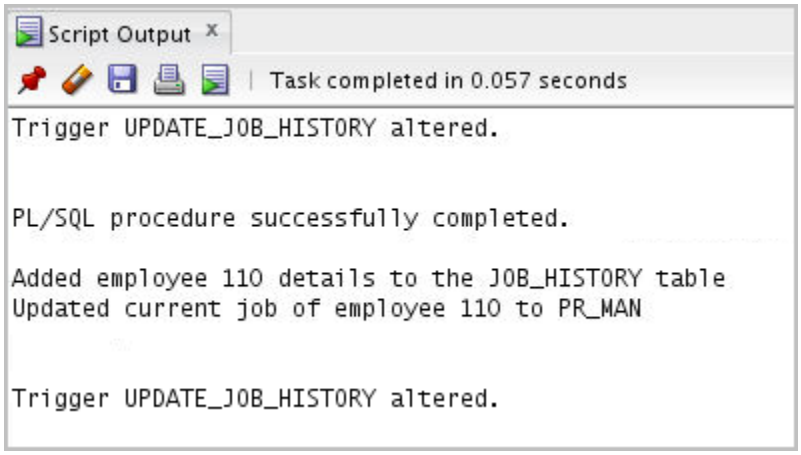


4. Invoke your EMPJOB_PKG.ADD_JOB_HIST procedure to modify the job of employee ID 110 to job ID PR_MAN.

   Note: You need to disable the UPDATE_JOB_HISTORY trigger before you execute the ADD_JOB_HIST procedure, and re-enable the trigger after you have executed the procedure.

Uncomment and select the code under Task 4 of Additional Practice 1-8. The code and the results are displayed as follows:

```
SET SERVEROUTPUT ON
ALTER TRIGGER update_job_history DISABLE;
EXECUTE empjob_pkg.add_job_hist(110, 'PR_MAN')
ALTER TRIGGER update_job_history ENABLE;
```

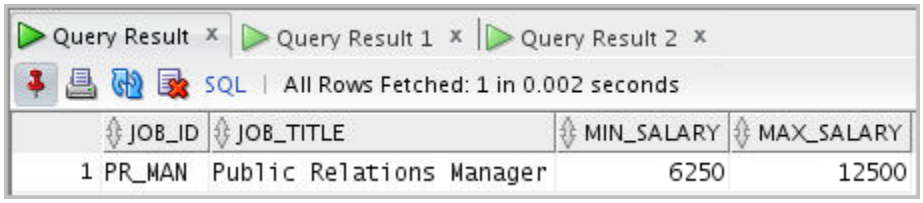


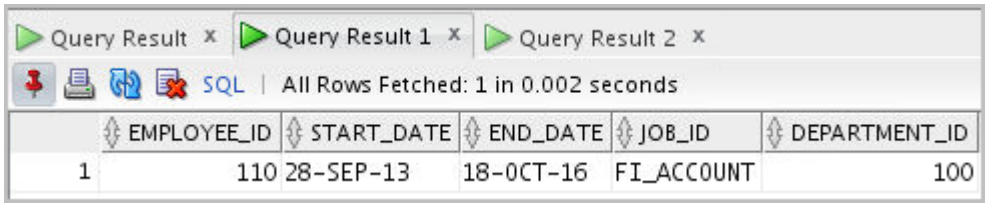
5. Query the JOBS, JOB_HISTORY, and EMPLOYEES tables to verify the results.

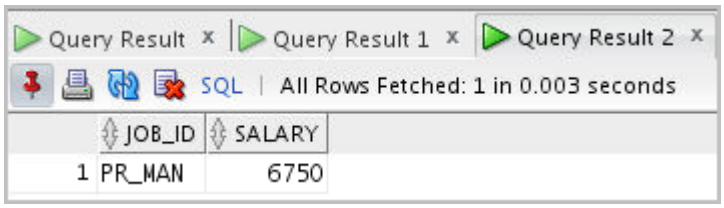
   Note: These exercises can be used for extra practice when discussing how to create database triggers.

Uncomment and select the code under Task 5 of Additional Practice 1-8. The code and the results are displayed as follows:

```
SELECT * FROM jobs WHERE job_id = 'PR_MAN';
SELECT * FROM job_history WHERE employee_id = 110;
SELECT job_id, salary FROM employees WHERE employee_id = 110;
```







Practice 1-9: Creating a Trigger to Ensure that the Employees' Salaries Are Within the Acceptable Range

Overview

In this practice, you create a trigger to ensure that the minimum and maximum salaries of a job are never modified such that the salary of an existing employee with that job ID is out of the new range specified for the job.

Tasks

1. Create a trigger called `CHECK_SAL_RANGE` that is fired before every row that is updated in the `MIN_SALARY` and `MAX_SALARY` columns in the `JOBS` table.
   a. For any minimum or maximum salary value that is changed, check whether the salary of any existing employee with that job ID in the `EMPLOYEES` table falls within the new range of salaries specified for this job ID.
   b. Include exception handling to cover a salary range change that affects the record of any existing employee.
2. Test the trigger using the `SY_ANAL` job, setting the new minimum salary to 5000, and the new maximum salary to 7000. Before you make the change, write a query to display the current salary range for the `SY_ANAL` job ID, and another query to display the employee ID, last name, and salary for the same job ID. After the update, query the change (if any) to the `JOBS` table for the specified job ID.
3. Using the `SY_ANAL` job, set the new minimum salary to 7,000, and the new maximum salary to 18000. Explain the results.

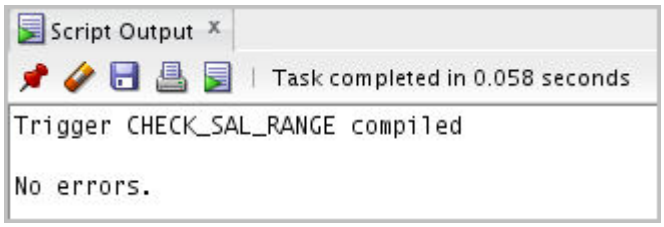
Solution 1-9: Creating a Trigger to Ensure that the Employees Salaries are Within the Acceptable Range

In this practice, you create a trigger to ensure that the minimum and maximum salaries of a job are never modified such that the salary of an existing employee with that job ID is out of the new range specified for the job.

1. Create a trigger called CHECK_SAL_RANGE that is fired before every row that is updated in the MIN_SALARY and MAX_SALARY columns in the JOBS table.
   a. For any minimum or maximum salary value that is changed, check whether the salary of any existing employee with that job ID in the EMPLOYEES table falls within the new range of salaries specified for this job ID.
   b. Include exception handling to cover a salary range change that affects the record of any existing employee.

      Uncomment and select the code under Task 1 of Additional Practice 1-9. The code and the results are displayed as follows:

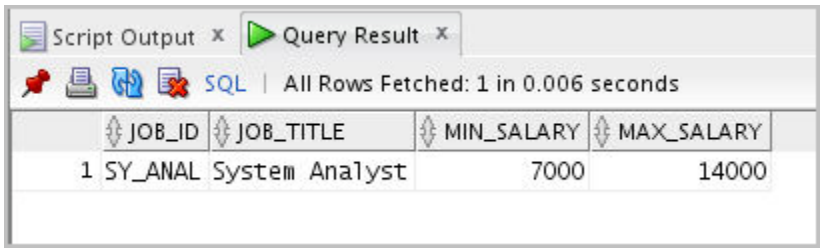
```
CREATE OR REPLACE TRIGGER check_sal_range
BEFORE UPDATE OF min_salary, max_salary ON jobs
FOR EACH ROW
DECLARE
  v_minsal employees.salary%TYPE;
  v_maxsal employees.salary%TYPE;
  e_invalid_salrange EXCEPTION;
BEGIN
  SELECT MIN(salary), MAX(salary) INTO v_minsal, v_maxsal
  FROM employees
  WHERE job_id = :NEW.job_id;
  IF (v_minsal < :NEW.min_salary) OR (v_maxsal >
:NEW.max_salary) THEN
    RAISE e_invalid_salrange;
  END IF;
EXCEPTION
  WHEN e_invalid_salrange THEN
    RAISE_APPLICATION_ERROR(-20550,
     'Employees exist whose salary is out of the specified
range. '||
     'Therefore the specified salary range cannot be updated.');
END check_sal_range;
/
SHOW ERRORS
```

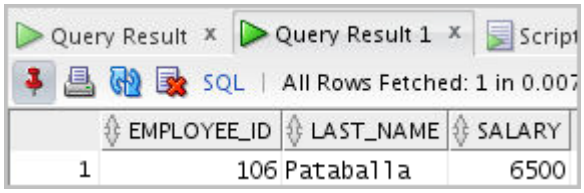


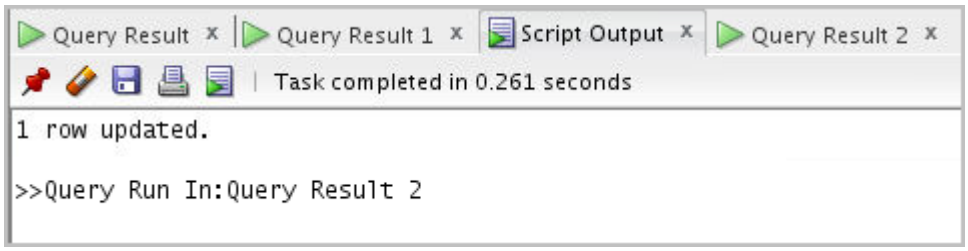
2. Test the trigger using the SY_ANAL job, setting the new minimum salary to 5000, and the new maximum salary to 7000. Before you make the change, write a query to display the current salary range for the SY_ANAL job ID, and another query to display the employee ID, last name, and salary for the same job ID. After the update, query the change (if any) to the JOBS table for the specified job ID.

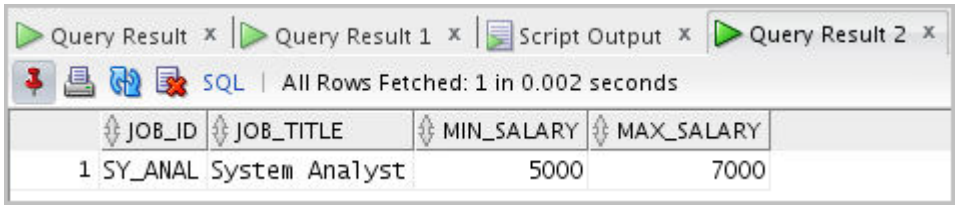
Uncomment and select the code under Task 2 of Additional Practice 1-9. The code and the results are displayed as follows:

```
SELECT * FROM jobs
WHERE job_id = 'SY_ANAL';

SELECT employee_id, last_name, salary
FROM  employees
WHERE job_id = 'SY_ANAL';

UPDATE jobs
  SET min_salary = 5000, max_salary = 7000
  WHERE job_id = 'SY_ANAL';

SELECT * FROM jobs
WHERE job_id = 'SY_ANAL';
```







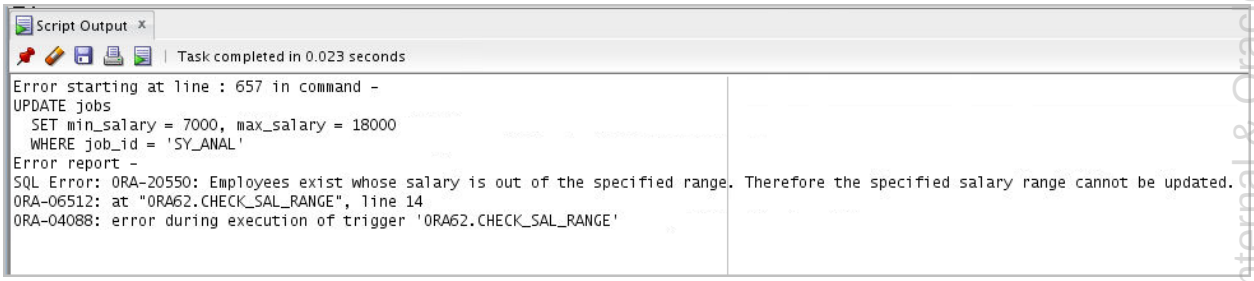


	JOB_ID	JOB_TITLE	MIN_SALARY	MAX_SALARY
1	SY_ANAL	System Analyst	5000	7000

3. Using the SY_ANAL job, set the new minimum salary to 7,000, and the new maximum salary to 18000. Explain the results.

Uncomment and select the code under Task 3 of Additional Practice 1-9. The code and the results are displayed as follows:

```
UPDATE jobs
  SET min_salary = 7000, max_salary = 18000
  WHERE job_id = 'SY_ANAL';
```



The update fails to change the salary range due to the functionality provided by the `CHECK_SAL_RANGE` trigger because employee 106 who has the `SY_ANAL` job ID has a salary of `6500`, which is less than the minimum salary for the new salary range specified in the `UPDATE` statement.

Additional Practices 2

Chapter 15

Additional Practices 2: Overview

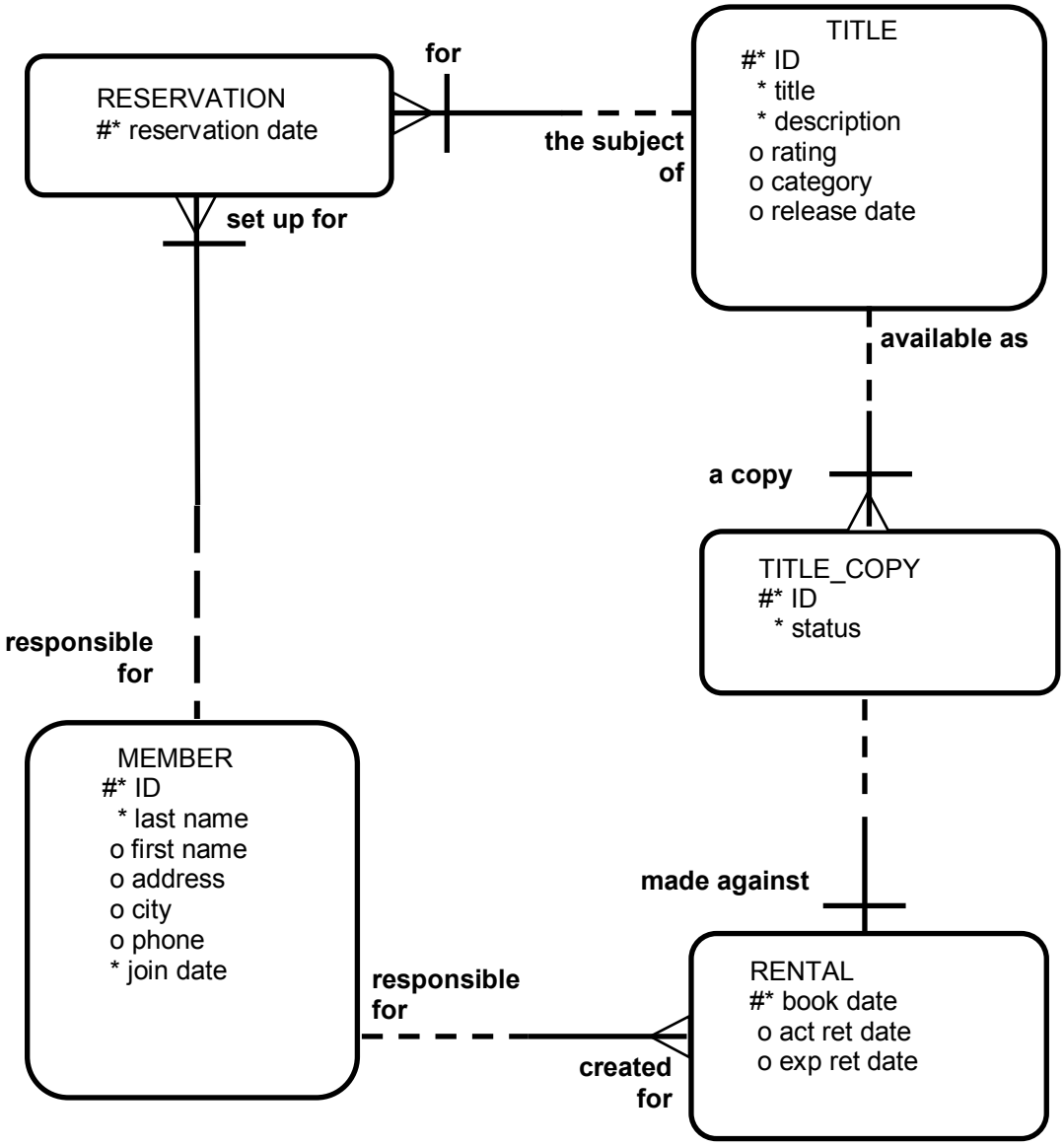
Overview

In this case study, you create a package named `VIDEO_PKG` that contains procedures and functions for a video store application. This application enables customers to become a member of the video store. Any member can rent movies, return rented movies, and reserve movies. Additionally, you create a trigger to ensure that any data in the video tables is modified only during business hours.

Create the package by using SQL*Plus and use the `DBMS_OUTPUT` Oracle-supplied package to display messages.

The video store database contains the following tables: `TITLE`, `TITLE_COPY`, `RENTAL`, `RESERVATION`, and `MEMBER`.

The video store database entity relationship diagram



Practice 2-1: Creating the VIDEO_PKG Package

Overview

In this practice, you create a package named VIDEO_PKG that contains procedures and functions for a video store application.

Task

1. Load and execute the /home/oracle/labs/plpu/labs/buildvid1.sql script to create all the required tables and sequences that are needed for this exercise.
2. Load and execute the /home/oracle/labs/plpu/labs/buildvid2.sql script to populate all the tables created through the buildvid1.sql script.
3. Create a package named VIDEO_PKG with the following procedures and functions:
   a. **NEW_MEMBER:** A public procedure that adds a new member to the MEMBER table. For the member ID number, use the sequence MEMBER_ID_SEQ; for the join date, use SYSDATE. Pass all other values to be inserted into a new row as parameters.
   b. **NEW_RENTAL:** An overloaded public function to record a new rental. Pass the title ID number for the video that a customer wants to rent, and either the customer's last name or his member ID number into the function. The function should return the due date for the video. Due dates are three days from the date the video is rented. If the status for a movie requested is listed as AVAILABLE in the TITLE_COPY table for one copy of this title, then update this TITLE_COPY table and set the status to RENTED. If there is no copy available, the function must return NULL. Then, insert a new record into the RENTAL table identifying the booked date as today's date, the copy ID number, the member ID number, the title ID number, and the expected return date. Be aware of multiple customers with the same last name. In this case, have the function return NULL, and display a list of the customers' names that match and their ID numbers.
   c. **RETURN_MOVIE:** A public procedure that updates the status of a video (available, rented, or damaged) and sets the return date. Pass the title ID, the copy ID, and the status to this procedure. Check whether there are reservations for that title and display a message if it is reserved. Update the RENTAL table and set the actual return date to today's date. Update the status in the TITLE_COPY table based on the status parameter passed into the procedure.
   d. **RESERVE_MOVIE:** A private procedure that executes only if all the video copies requested in the NEW_RENTAL procedure have a status of RENTED. Pass the member ID number and the title ID number to this procedure. Insert a new record into the RESERVATION table and record the reservation date, member ID number, and title ID number. Print a message indicating that a movie is reserved and its expected date of return.
   e. **EXCEPTION_HANDLER:** A private procedure that is called from the exception handler of the public programs. Pass the SQLCODE number to this procedure, and the name of the program (as a text string) where the error occurred. Use RAISE_APPLICATION_ERROR to raise a customized error. Start with a unique key violation (-1) and foreign key violation (-2292). Allow the exception handler to raise a generic error for any other errors.
4. Use the following scripts located in the /home/oracle/labs/plpu/soln directory to test your routines:
   a. Add two members using the code under Task 4_a from sol_ap2.sql script.

b. Add new video rentals using the code under Task 4_b from `sol_ap2.sql` script.

c. Return movies using the code under Task 4_c from `sol_ap2.sql` script.

5. The business hours for the video store are 8:00 AM through 10:00 PM, Sunday through Friday, and 8:00 AM through 12:00 PM on Saturday. To ensure that the tables can be modified only during these hours, create a stored procedure that is called by triggers on the tables.

   a. Create a stored procedure called `TIME_CHECK` that checks the current time against business hours. If the current time is not within business hours, use the `RAISE_APPLICATION_ERROR` procedure to give an appropriate message.

   b. Create a trigger on each of the five tables. Fire the trigger before data is inserted, updated, and deleted from the tables. Call your `TIME_CHECK` procedure from each of these triggers.

   c. Test your triggers.

      Note: In order for your trigger to fail, you may need to change the time to be outside the range of your current time in class. For example, while testing, you may want valid video hours in your trigger to be from 6:00 PM through 8:00 AM.

Solution 2-1: Creating the VIDEO_PKG Package

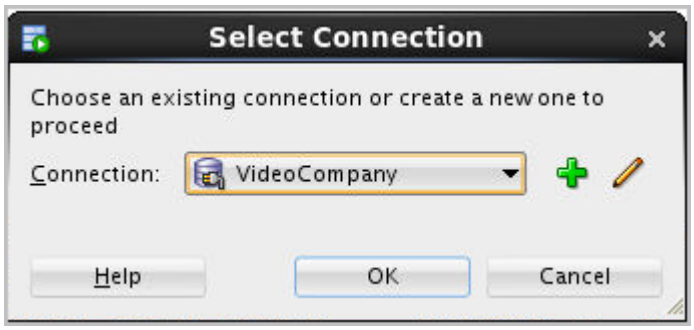
In this practice, you create a package named VIDEO_PKG that contains procedures and functions for a video store application.

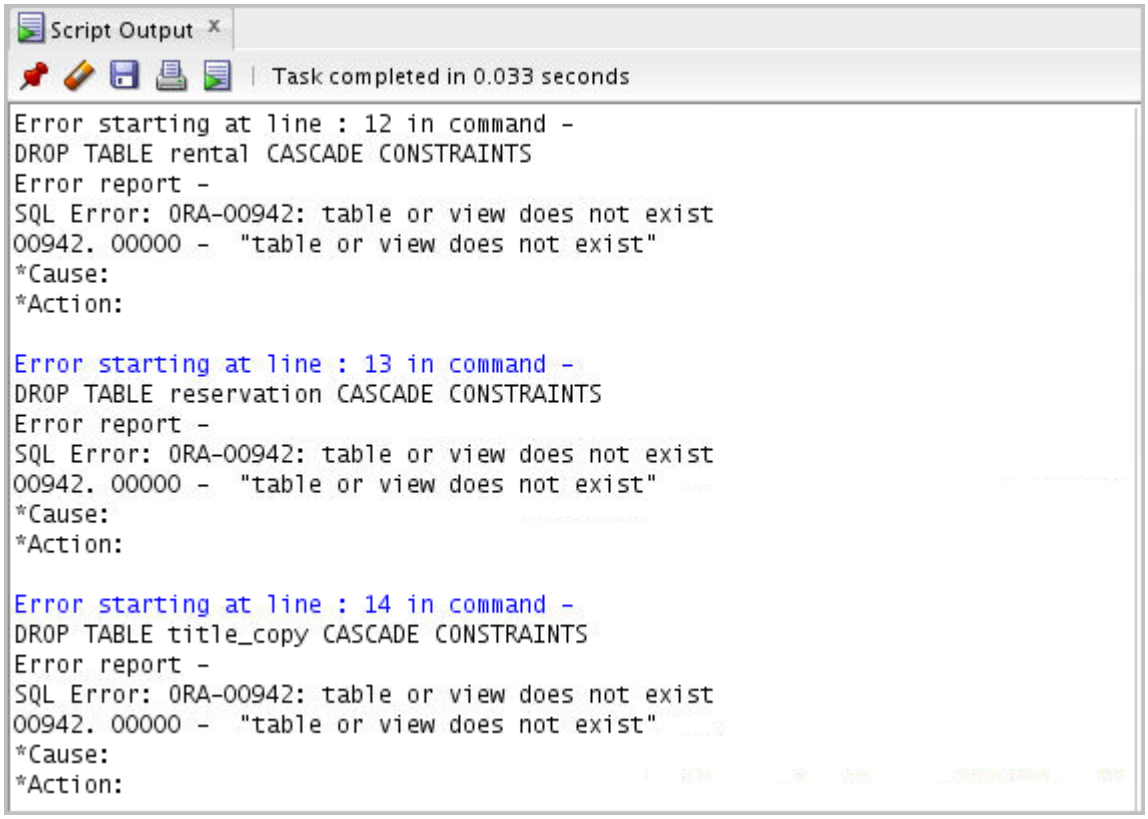
1. Load and execute the /home/oracle/labs/plpu/labs/buildvid1.sql script to create all the required tables and sequences that are needed for this exercise.
   Run the /home/oracle/labs/plpu/labs/buildvid1.sql script. The code, the connection prompt, and the results are displayed as follows:

```
SET ECHO OFF
/* Script to build the Video Application (Part 1 - buildvid1.sql)
   for the Oracle Introduction to Oracle with Procedure Builder
course.
   Created by: Debby Kramer Creation date: 12/10/95
   Last updated: 11/21/12
   Modified by Supriya Ananth on 21-NOV-2012
    For the course Oracle Database: PL/SQL Program Units
    This part of the script creates tables and sequences that are
used
    by Task 4 of the Additional Practices of the course.
*/

DROP TABLE rental CASCADE CONSTRAINTS;
DROP TABLE reservation CASCADE CONSTRAINTS;
DROP TABLE title_copy CASCADE CONSTRAINTS;
DROP TABLE title CASCADE CONSTRAINTS;
DROP TABLE member CASCADE CONSTRAINTS;

PROMPT Please wait while tables are created....

CREATE TABLE MEMBER
  (member_id  NUMBER (10)        CONSTRAINT member_id_pk PRIMARY
KEY
 , last_name  VARCHAR2(25)
    CONSTRAINT member_last_nn NOT NULL
 , first_name VARCHAR2(25)
 , address    VARCHAR2(100)
 , city       VARCHAR2(30)
 , phone      VARCHAR2(25)
 , join_date  DATE DEFAULT SYSDATE
    CONSTRAINT join_date_nn NOT NULL)
/

CREATE TABLE TITLE
  (title_id   NUMBER(10)
     CONSTRAINT title_id_pk PRIMARY KEY
 , title      VARCHAR2(60)
     CONSTRAINT title_nn NOT NULL
 , description VARCHAR2(400)
```

```
     CONSTRAINT title_desc_nn NOT NULL
 , rating      VARCHAR2(4)
     CONSTRAINT title_rating_ck CHECK (rating IN
('G','PG','R','NC17','NR'))
 , category     VARCHAR2(20) DEFAULT 'DRAMA'
     CONSTRAINT title_categ_ck CHECK (category IN
('DRAMA','COMEDY','ACTION',
'CHILD','SCIFI','DOCUMENTARY'))
 , release_date DATE)
/

CREATE TABLE TITLE_COPY
  (copy_id   NUMBER(10)
 , title_id  NUMBER(10)
    CONSTRAINT copy_title_id_fk
       REFERENCES title(title_id)
 , status    VARCHAR2(15)
     CONSTRAINT copy_status_nn NOT NULL
     CONSTRAINT copy_status_ck CHECK (status IN ('AVAILABLE',
'DESTROYED',
                                'RENTED', 'RESERVED'))
 , CONSTRAINT copy_title_id_pk  PRIMARY KEY(copy_id, title_id))
/

CREATE TABLE RENTAL
  (book_date DATE DEFAULT SYSDATE
 , copy_id   NUMBER(10)
 , member_id NUMBER(10)
    CONSTRAINT rental_mbr_id_fk REFERENCES member(member_id)
 , title_id  NUMBER(10)
 , act_ret_date DATE
 , exp_ret_date DATE DEFAULT SYSDATE+2
 , CONSTRAINT rental_copy_title_id_fk FOREIGN KEY (copy_id,
title_id)
              REFERENCES title_copy(copy_id,title_id)
 , CONSTRAINT rental_id_pk PRIMARY KEY(book_date, copy_id,
title_id, member_id))
/

CREATE TABLE RESERVATION
  (res_date  DATE
 , member_id NUMBER(10)
 , title_id  NUMBER(10)
 , CONSTRAINT res_id_pk PRIMARY KEY(res_date, member_id, title_id))
/

PROMPT Tables created.

DROP SEQUENCE title_id_seq;
DROP SEQUENCE member_id_seq;

PROMPT Creating Sequences...
```

```
CREATE SEQUENCE member_id_seq
  START WITH 100
  NOCACHE
/

CREATE SEQUENCE title_id_seq
  START WITH 91
  NOCACHE
/

PROMPT Sequences created.

PROMPT Run buildvid2.sql now to populate the above tables.
```





```
Error starting at line : 15 in command -
DROP TABLE title CASCADE CONSTRAINTS
Error report -
SQL Error: ORA-00942: table or view does not exist
00942. 00000 -  "table or view does not exist"
*Cause:
*Action:

Error starting at line : 16 in command -
DROP TABLE member CASCADE CONSTRAINTS
Error report -
SQL Error: ORA-00942: table or view does not exist
00942. 00000 -  "table or view does not exist"
*Cause:
*Action:
```

```
Please wait while tables are created....

Table MEMBER created.


Table TITLE created.

Table TITLE_COPY created.


Table RENTAL created.


Table RESERVATION created.

Tables created.

Sequence TITLE_ID_SEQ dropped.

Sequence MEMBER_ID_SEQ dropped.

Creating Sequences...

Sequence MEMBER_ID_SEQ created.
```

```
Sequence TITLE_ID_SEQ created.

Sequences created.
Run buildvid2.sql now to populate the above tables.
```

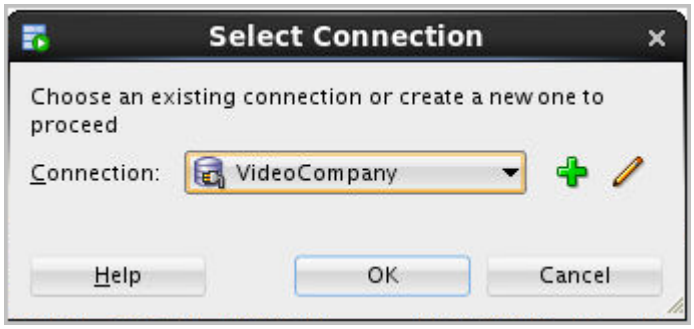
2. Load and execute the `/home/oracle/labs/plpu/labs/buildvid2.sql` script to populate all the tables created through the buildvid1.sql script.

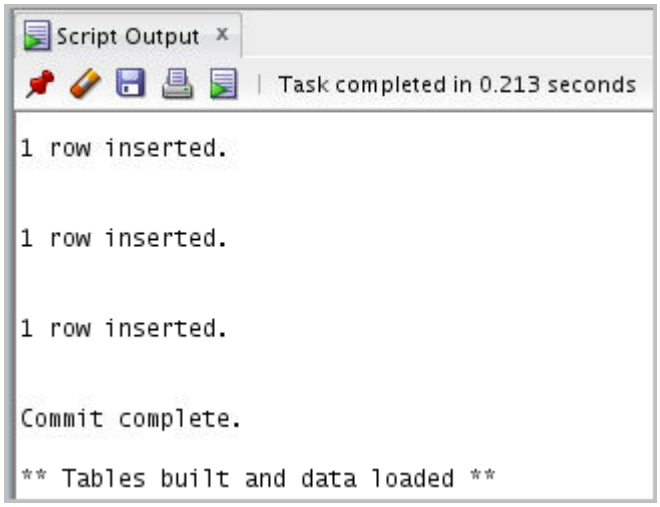
   Run the `/home/oracle/labs/plpu/labs/buildvid2.sql` script. The code, the connection prompt, and the results are displayed as follows:

```
/* Script to build the Video Application (Part 2 -
buildvid2.sql)
   This part of the script populates the tables that are created
using buildvid1.sql
   These are used by Part B of the Additional Practices of the
course.
   You should run the script buildvid1.sql before running this
script to create the above tables.
*/


INSERT INTO member VALUES  (member_id_seq.NEXTVAL, 'Velasquez',
'Carmen', '283 King Street', 'Seattle', '587-99-6666', '03-MAR-
90');
INSERT INTO member  VALUES   (member_id_seq.NEXTVAL, 'Ngao',
'LaDoris', '5 Modrany',  'Bratislava', '586-355-8882', '08-MAR-
90');
INSERT INTO member VALUES  (member_id_seq.NEXTVAL,'Nagayama',
'Midori', '68 Via Centrale', 'Sao Paolo', '254-852-5764', '17-
JUN-91');
INSERT INTO member VALUES  (member_id_seq.NEXTVAL,'Quick-To-
See','Mark', '6921 King Way', 'Lagos', '63-559-777', '07-APR-
90');
INSERT INTO member VALUES  (member_id_seq.NEXTVAL, 'Ropeburn',
'Audry', '86 Chu Street',  'Hong Kong', '41-559-87', '04-MAR-
90');
INSERT INTO member VALUES (member_id_seq.NEXTVAL, 'Urguhart',
'Molly', '3035 Laurier Blvd.',  'Quebec', '418-542-9988','18-
JAN-91');
INSERT INTO member VALUES (member_id_seq.NEXTVAL, 'Menchu',
'Roberta', 'Boulevard de Waterloo 41', 'Brussels', '322-504-
2228', '14-MAY-90');
INSERT INTO member VALUES (member_id_seq.NEXTVAL, 'Biri', 'Ben',
'398 High St.', 'Columbus', '614-455-9863', '07-APR-90');
INSERT INTO member VALUES (member_id_seq.NEXTVAL, 'Catchpole',
'Antoinette', '88 Alfred St.', 'Brisbane', '616-399-1411', '09-
FEB-92');


COMMIT;



INSERT INTO TITLE (title_id, title, description, rating,
category, release_date)
VALUES (TITLE_ID_SEQ.NEXTVAL, 'Willie and Christmas Too', 'All
of Willie''s friends made a Christmas list for Santa, but Willie
has yet to create his own wish list.', 'G', 'CHILD', '05-OCT-
95');
```

```
INSERT INTO TITLE (title_id, title, description, rating,
category, release_date)
VALUES (TITLE_ID_SEQ.NEXTVAL, 'Alien Again', 'Another
installment of science fiction history. Can the heroine save the
planet from the alien life form?', 'R', 'SCIFI',          '19-
MAY-95');
INSERT INTO TITLE (title_id, title, description, rating,
category, release_date)
VALUES (TITLE_ID_SEQ.NEXTVAL, 'The Glob', 'A meteor crashes near
a small American town and unleashes carivorous goo in this
classic.', 'NR', 'SCIFI', '12-AUG-95');
INSERT INTO TITLE (title_id, title, description, rating,
category, release_date)
VALUES (TITLE_ID_SEQ.NEXTVAL, 'My Day Off', 'With a little luck
and a lot of ingenuity, a teenager skips school for a day in New
York.', 'PG', 'COMEDY', '12-JUL-95');
INSERT INTO TITLE (title_id, title, description, rating,
category, release_date)
VALUES (TITLE_ID_SEQ.NEXTVAL, 'Miracles on Ice', 'A six-year-old
has doubts about Santa Claus. But she discovers that miracles
really do exist.', 'PG', 'DRAMA', '12-SEP-95');
INSERT INTO TITLE (title_id, title, description, rating,
category, release_date)
VALUES (TITLE_ID_SEQ.NEXTVAL,  'Soda Gang', 'After discovering a
cached of drugs, a young couple find themselves pitted against a
vicious gang.', 'NR', 'ACTION', '01-JUN-95');
INSERT INTO title (title_id, title, description, rating,
category, release_date)
VALUES (TITLE_ID_SEQ.NEXTVAL, 'Interstellar Wars', 'Futuristic
interstellar action movie. Can the rebels save the humans from
the evil Empire?', 'PG', 'SCIFI','07-JUL-77');


COMMIT;

INSERT INTO title_copy VALUES (1,92, 'AVAILABLE');
INSERT INTO title_copy VALUES (1,93, 'AVAILABLE');
INSERT INTO title_copy VALUES (2,93, 'RENTED');
INSERT INTO title_copy VALUES (1,94, 'AVAILABLE');
INSERT INTO title_copy VALUES (1,95, 'AVAILABLE');
INSERT INTO title_copy VALUES (2,95, 'AVAILABLE');
INSERT INTO title_copy VALUES (3,95, 'RENTED');
INSERT INTO title_copy VALUES (1,96, 'AVAILABLE');
INSERT INTO title_copy VALUES (1,97, 'AVAILABLE');
COMMIT;
```

```
INSERT INTO reservation VALUES (sysdate-1, 101, 93);
INSERT INTO reservation VALUES (sysdate-2, 106, 102);


COMMIT;

INSERT INTO rental VALUES (sysdate-1, 2, 101, 93, null,
sysdate+1);
INSERT INTO rental VALUES (sysdate-2, 3, 102, 95, null,
sysdate);
INSERT INTO rental VALUES (sysdate-4, 1, 106, 97, sysdate-2,
sysdate-2);
INSERT INTO rental VALUES (sysdate-3, 1, 101, 92, sysdate-2,
sysdate-1);

COMMIT;

PROMPT ** Tables built and data loaded **
```





3. Create a package named `VIDEO_PKG` with the following procedures and functions:

a. **NEW_MEMBER:** A public procedure that adds a new member to the MEMBER table. For the member ID number, use the sequence MEMBER_ID_SEQ; for the join date, use SYSDATE. Pass all other values to be inserted into a new row as parameters.

b. **NEW_RENTAL:** An overloaded public function to record a new rental. Pass the title ID number for the video that a customer wants to rent, and either the customer's last name or his member ID number into the function. The function should return the due date for the video. Due dates are three days from the date the video is rented. If the status for a movie requested is listed as AVAILABLE in the TITLE_COPY table for one copy of this title, then update this TITLE_COPY table and set the status to RENTED. If there is no copy available, the function must return NULL. Then, insert a new record into the RENTAL table identifying the booked date as today's date, the copy ID number, the member ID number, the title ID number, and the expected return date. Be aware of multiple customers with the same last name. In this case, have the function return NULL, and display a list of the customers' names that match and their ID numbers.

c. **RETURN_MOVIE:** A public procedure that updates the status of a video (available, rented, or damaged) and sets the return date. Pass the title ID, the copy ID, and the status to this procedure. Check whether there are reservations for that title and display a message if it is reserved. Update the RENTAL table and set the actual return date to today's date. Update the status in the TITLE_COPY table based on the status parameter passed into the procedure.

d. **RESERVE_MOVIE:** A private procedure that executes only if all the video copies requested in the NEW_RENTAL procedure have a status of RENTED. Pass the member ID number and the title ID number to this procedure. Insert a new record into the RESERVATION table and record the reservation date, member ID number, and title ID number. Print a message indicating that a movie is reserved and its expected date of return.

e. **EXCEPTION_HANDLER:** A private procedure that is called from the exception handler of the public programs. Pass the SQLCODE number to this procedure, and the name of the program (as a text string) where the error occurred. Use RAISE_APPLICATION_ERROR to raise a customized error. Start with a unique key violation (-1) and foreign key violation (-2292). Allow the exception handler to raise a generic error for any other errors.

Uncomment and run the code under Task 3 from /home/oracle/labs/plpu/solns/sol_ap2.sql script. The code, the connection prompt, and the results are displayed as follows:

VIDEO_PKG Package Specification

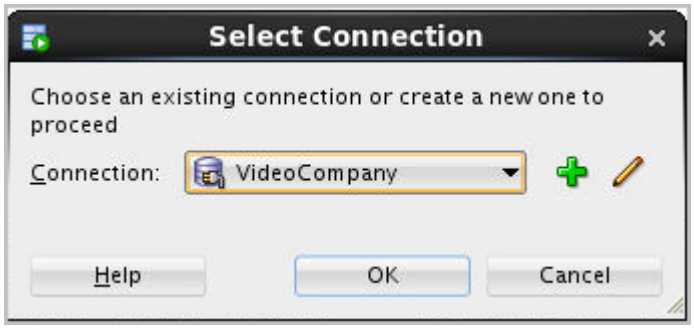
```
CREATE OR REPLACE PACKAGE video_pkg IS
  PROCEDURE new_member
    (p_lname       IN member.last_name%TYPE,
     p_fname       IN member.first_name%TYPE   DEFAULT NULL,
     p_address     IN member.address%TYPE      DEFAULT NULL,
     p_city        IN member.city%TYPE         DEFAULT NULL,
     p_phone       IN member.phone%TYPE        DEFAULT NULL);

  FUNCTION new_rental
```

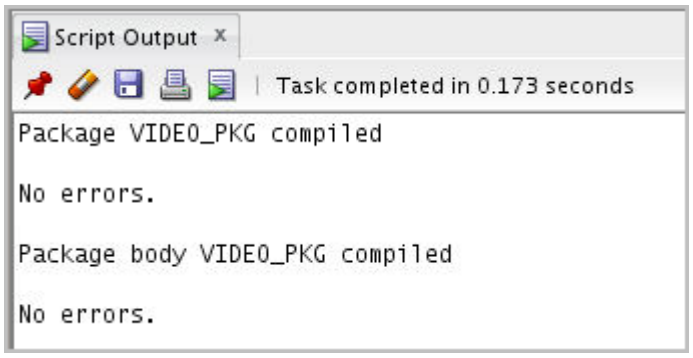
```
    (p_memberid   IN rental.member_id%TYPE,
     p_titleid    IN rental.title_id%TYPE)
    RETURN DATE;

  FUNCTION new_rental
    (p_membername IN member.last_name%TYPE,
     p_titleid    IN rental.title_id%TYPE)
    RETURN DATE;

  PROCEDURE return_movie
    (p_titleid    IN rental.title_id%TYPE,
     p_copyid     IN rental.copy_id%TYPE,
     p_sts        IN title_copy.status%TYPE);
END video_pkg;
/
SHOW ERRORS

CREATE OR REPLACE PACKAGE BODY video_pkg IS
  PROCEDURE exception_handler(errcode IN  NUMBER, p_context IN
VARCHAR2) IS
  BEGIN
    IF errcode = -1 THEN
      RAISE_APPLICATION_ERROR(-20001,
        'The number is assigned to this member is already in use,
'||
        'try again.');
    ELSIF errcode = -2291 THEN
      RAISE_APPLICATION_ERROR(-20002, p_context ||
        ' has attempted to use a foreign key value that is
invalid');
    ELSE
      RAISE_APPLICATION_ERROR(-20999, 'Unhandled error in ' ||
        p_context || '. Please contact your application '||
        'administrator with the following information: '
        || CHR(13) || SQLERRM);
    END IF;
  END exception_handler;

  PROCEDURE reserve_movie
    (p_memberid  IN  reservation.member_id%TYPE,
     p_titleid   IN  reservation.title_id%TYPE) IS
    CURSOR c_rented_csr IS
      SELECT exp_ret_date
        FROM rental
        WHERE title_id = p_titleid
        AND act_ret_date IS NULL;
  BEGIN
    INSERT INTO reservation (res_date, member_id, title_id)
    VALUES (SYSDATE, p_memberid, p_titleid);
    COMMIT;
    FOR rented_rec IN c_rented_csr LOOP
      DBMS_OUTPUT.PUT_LINE('Movie reserved. Expected back on: '
        || rented_rec.exp_ret_date);
```

```
      EXIT WHEN c_rented_csr%found;
    END LOOP;
  EXCEPTION
    WHEN OTHERS THEN
      exception_handler(SQLCODE, 'RESERVE_MOVIE');
  END reserve_movie;

PROCEDURE return_movie(
   p_titleid IN rental.title_id%TYPE,
   p_copyid IN rental.copy_id%TYPE,
   p_sts IN title_copy.status%TYPE) IS
   v_dummy VARCHAR2(1);
   CURSOR c_res_csr IS
      SELECT *
      FROM reservation
      WHERE title_id = p_titleid;
  BEGIN
    SELECT '' INTO v_dummy
      FROM title
      WHERE title_id = p_titleid;
    UPDATE rental
      SET act_ret_date = SYSDATE
      WHERE title_id = p_titleid
      AND copy_id = p_copyid AND act_ret_date IS NULL;
    UPDATE title_copy
      SET status = UPPER(p_sts)
      WHERE title_id = p_titleid AND copy_id = p_copyid;
    FOR res_rec IN c_res_csr LOOP
      IF c_res_csr%FOUND THEN
        DBMS_OUTPUT.PUT_LINE('Put this movie on hold -- '||
          'reserved by member #' || res_rec.member_id);
      END IF;
    END LOOP;
  EXCEPTION
    WHEN OTHERS THEN
      exception_handler(SQLCODE, 'RETURN_MOVIE');
  END return_movie;

  FUNCTION new_rental(
    p_memberid  IN  rental.member_id%TYPE,
    p_titleid   IN  rental.title_id%TYPE) RETURN DATE IS
    CURSOR c_copy_csr IS
      SELECT * FROM title_copy
      WHERE title_id = p_titleid
      FOR UPDATE;
    v_flag   BOOLEAN  := FALSE;
  BEGIN
    FOR copy_rec IN c_copy_csr LOOP
      IF copy_rec.status = 'AVAILABLE' THEN
        UPDATE title_copy
          SET status = 'RENTED'
          WHERE CURRENT OF c_copy_csr;
        INSERT INTO rental(book_date, copy_id, member_id,
```

```
                        title_id, exp_ret_date)
      VALUES (SYSDATE, copy_rec.copy_id, p_memberid,
                        p_titleid, SYSDATE + 3);
      v_flag := TRUE;
      EXIT;
    END IF;
  END LOOP;
  COMMIT;
  IF v_flag THEN
    RETURN (SYSDATE + 3);
  ELSE
    reserve_movie(p_memberid, p_titleid);
    RETURN NULL;
  END IF;
EXCEPTION
  WHEN OTHERS THEN
    exception_handler(SQLCODE, 'NEW_RENTAL');
    RETURN NULL;
END new_rental;

FUNCTION new_rental(
  p_membername IN member.last_name%TYPE,
  p_titleid    IN rental.title_id%TYPE) RETURN DATE IS
  CURSOR c_copy_csr IS
    SELECT * FROM title_copy
      WHERE title_id = p_titleid
      FOR UPDATE;
  v_flag  BOOLEAN  := FALSE;
  v_memberid  member.member_id%TYPE;
  CURSOR c_member_csr IS
    SELECT member_id, last_name, first_name
      FROM member
      WHERE LOWER(last_name) = LOWER(p_membername)
      ORDER BY last_name, first_name;
BEGIN
  SELECT member_id INTO v_memberid
    FROM member
    WHERE lower(last_name) = lower(p_membername);
  FOR copy_rec IN c_copy_csr LOOP
    IF copy_rec.status = 'AVAILABLE' THEN
      UPDATE title_copy
        SET status = 'RENTED'
        WHERE CURRENT OF c_copy_csr;
      INSERT INTO rental (book_date, copy_id, member_id,
                          title_id, exp_ret_date)
        VALUES (SYSDATE, copy_rec.copy_id, v_memberid,
                          p_titleid, SYSDATE + 3);
      v_flag := TRUE;
      EXIT;
    END IF;
  END LOOP;
  COMMIT;
  IF v_flag THEN
```

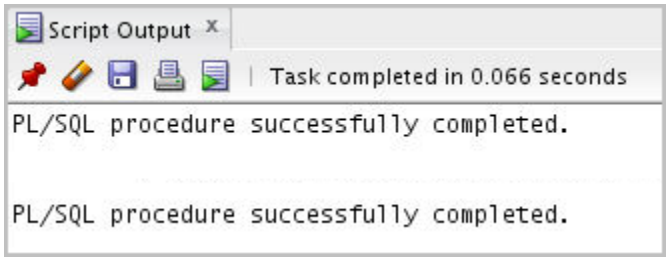
```
      RETURN(SYSDATE + 3);
    ELSE
      reserve_movie(v_memberid, p_titleid);
      RETURN NULL;
    END IF;
  EXCEPTION
    WHEN TOO_MANY_ROWS THEN
      DBMS_OUTPUT.PUT_LINE(
       'Warning! More than one member by this name.');
      FOR member_rec IN c_member_csr LOOP
        DBMS_OUTPUT.PUT_LINE(member_rec.member_id || CHR(9) ||
          member_rec.last_name || ', ' || member_rec.first_name);
      END LOOP;
      RETURN NULL;
    WHEN OTHERS THEN
      exception_handler(SQLCODE, 'NEW_RENTAL');
      RETURN NULL;
  END new_rental;

  PROCEDURE new_member(
    p_lname       IN member.last_name%TYPE,
    p_fname       IN member.first_name%TYPE   DEFAULT NULL,
    p_address     IN member.address%TYPE      DEFAULT NULL,
    p_city        IN member.city%TYPE         DEFAULT NULL,
    p_phone       IN member.phone%TYPE        DEFAULT NULL) IS
  BEGIN
    INSERT INTO member(member_id, last_name, first_name,
                       address, city, phone, join_date)
      VALUES(member_id_seq.NEXTVAL, p_lname, p_fname,
             p_address, p_city, p_phone, SYSDATE);
    COMMIT;
  EXCEPTION
    WHEN OTHERS THEN
      exception_handler(SQLCODE, 'NEW_MEMBER');
  END new_member;
END video_pkg;
/
SHOW ERRORS
```





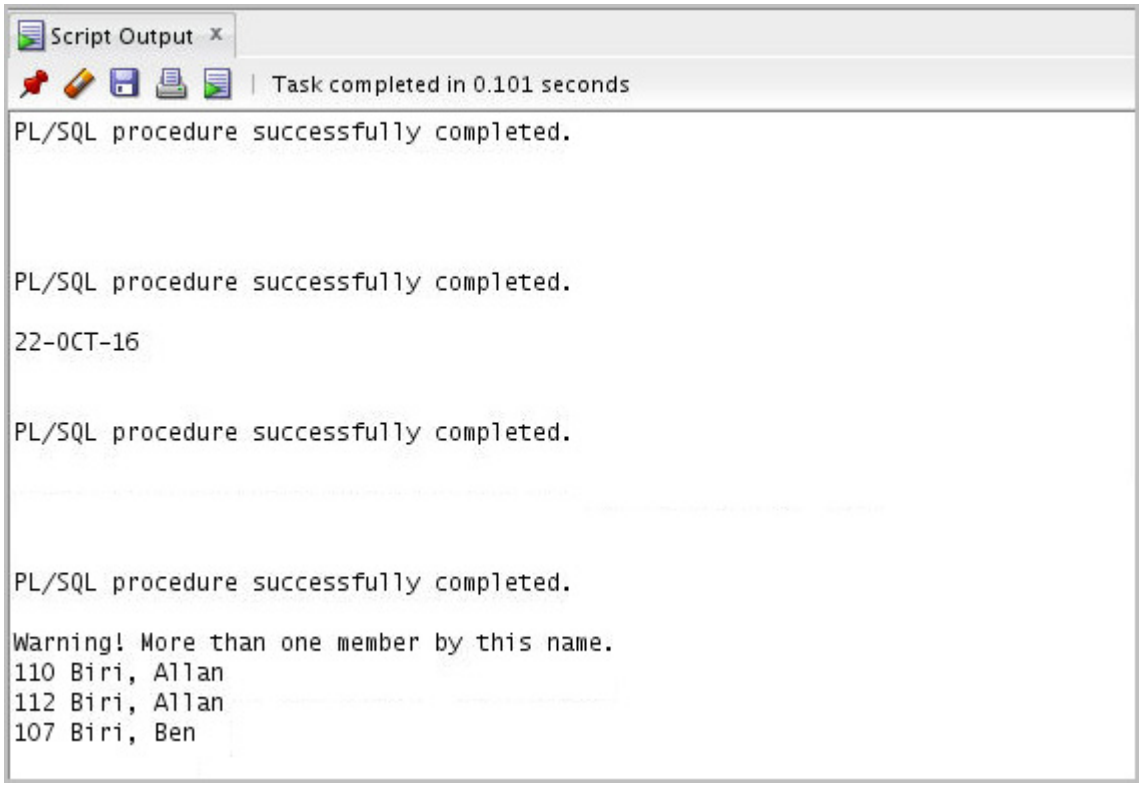
4. Use the following scripts located in the `/home/oracle/labs/plpu/soln` directory to test your routines. Make sure you enable `SERVEROUTPUT`:
   a. Add two members using the code under Task 4_a.
      Uncomment and run the code under Task 4_a. The code and the results are displayed as follows:

```
EXECUTE video_pkg.new_member('Haas', 'James', 'Chestnut Street',
'Boston', '617-123-4567')
EXECUTE  video_pkg.new_member('Biri', 'Allan',  'Hiawatha
Drive', 'New York', '516-123-4567')
```



   b. Add new video rentals using the code under Task 4_b.
      Uncomment and run the code under Task 4_b. The code and the results are displayed as follows:

```
SET SERVEROUTPUT ON

EXEC DBMS_OUTPUT.PUT_LINE(video_pkg.new_rental(110, 98))
EXEC DBMS_OUTPUT.PUT_LINE(video_pkg.new_rental(109, 93))
EXEC DBMS_OUTPUT.PUT_LINE(video_pkg.new_rental(107, 98))
EXEC DBMS_OUTPUT.PUT_LINE(video_pkg.new_rental('Biri', 97))
```



c. Return movies using the code under Task 4_c.

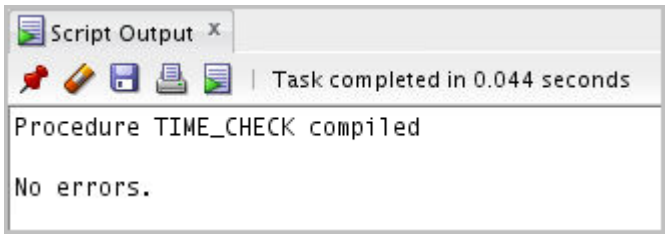
Uncomment and run the code under Task 4_c. The code and the results are displayed as follows:

```
SET SERVEROUTPUT ON

EXECUTE video_pkg.return_movie(92, 3, 'AVAILABLE')
EXECUTE video_pkg.return_movie(95, 3, 'AVAILABLE')
EXECUTE video_pkg.return_movie(93, 1, 'RENTED')
```

5. The business hours for the video store are 8:00 AM through 10:00 PM, Sunday through Friday, and 8:00 AM through 12:00 PM on Saturday. To ensure that the tables can be modified only during these hours, create a stored procedure that is called by triggers on the tables.
   a. Create a stored procedure called `TIME_CHECK` that checks the current time against business hours. If the current time is not within business hours, use the `RAISE_APPLICATION_ERROR` procedure to give an appropriate message.

      Uncomment and run the code under task 5_a. The code and the results are displayed as follows:

```
CREATE OR REPLACE PROCEDURE time_check IS
BEGIN
  IF ((TO_CHAR(SYSDATE,'D') BETWEEN 1 AND 6) AND
      (TO_DATE(TO_CHAR(SYSDATE, 'hh24:mi'), 'hh24:mi') NOT
BETWEEN
       TO_DATE('08:00', 'hh24:mi') AND TO_DATE('22:00',
'hh24:mi')))
       OR ((TO_CHAR(SYSDATE, 'D') = 7)
       AND  (TO_DATE(TO_CHAR(SYSDATE, 'hh24:mi'), 'hh24:mi') NOT
BETWEEN
       TO_DATE('08:00', 'hh24:mi') AND TO_DATE('24:00',
'hh24:mi'))) THEN
    RAISE_APPLICATION_ERROR(-20999,
       'Data changes restricted to office hours.');
  END IF;
END time_check;
/
SHOW ERRORS
```

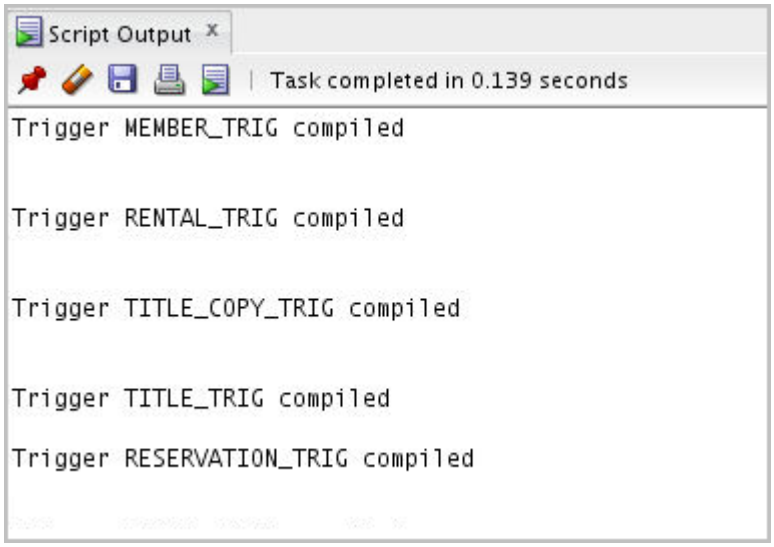


   b. Create a trigger on each of the five tables. Fire the trigger before data is inserted, updated, and deleted from the tables. Call your `TIME_CHECK` procedure from each of these triggers.

      Uncomment and run the code under Task 5_b. The code and the result are displayed as follows:

```
CREATE OR REPLACE TRIGGER member_trig
  BEFORE INSERT OR UPDATE OR DELETE ON member
```

```
CALL time_check
/

CREATE OR REPLACE TRIGGER rental_trig
  BEFORE INSERT OR UPDATE OR DELETE ON rental
CALL time_check
/

CREATE OR REPLACE TRIGGER title_copy_trig
  BEFORE INSERT OR UPDATE OR DELETE ON title_copy
CALL time_check
/

CREATE OR REPLACE TRIGGER title_trig
  BEFORE INSERT OR UPDATE OR DELETE ON title
CALL time_check
/
CREATE OR REPLACE TRIGGER reservation_trig
  BEFORE INSERT OR UPDATE OR DELETE ON reservation
CALL time_check
/
```



c. Test your triggers.

Note: In order for your trigger to fail, you may need to change the time to be outside the range of your current time in class. For example, while testing, you may want valid video hours in your trigger to be from 6:00 PM through 8:00 AM.

Uncomment and run the code under Task 5_c. The code and the result are displayed as follows:

```
-- First determine current timezone and time
SELECT SESSIONTIMEZONE,
       TO_CHAR(CURRENT_DATE, 'DD-MON-YYYY HH24:MI') CURR_DATE
FROM DUAL;

-- Change your time zone using [+|-]HH:MI format such that --
the current time returns a time between 6pm and 8am

ALTER SESSION SET TIME_ZONE='-07:00';

-- Add a new member (for a sample test)

EXECUTE  video_pkg.new_member('Elias', 'Elliane',  'Vine
Street', 'California', '789-123-4567')

BEGIN video_pkg.new_member('Elias', 'Elliane',  'Vine Street',
'California', '789-123-4567'); END;

-- Restore the original time zone for your session.
ALTER SESSION SET TIME_ZONE='-00:00';
```