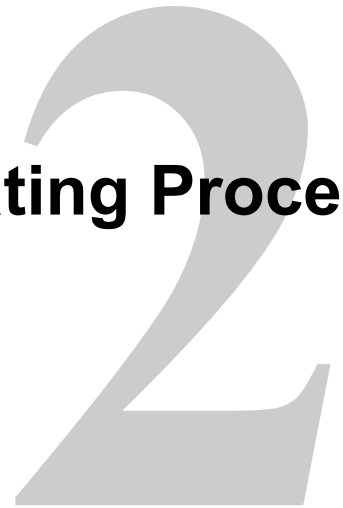


# Creating Procedures

# Objectives

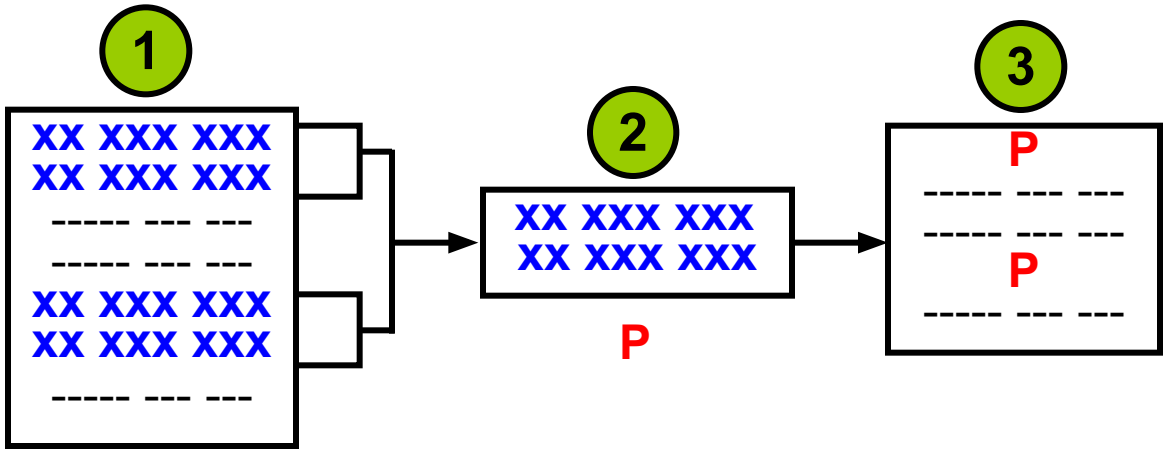
After completing this lesson, you should be able to do the following:

- Identify the benefits of modularized and layered subprogram design
- Create and call procedures
- Use formal and actual parameters
- Use positional, named, or mixed notation for passing parameters
- Identify the available parameter-passing modes
- Handle exceptions in procedures
- Remove a procedure
- Display the procedures' information

# Lesson Agenda

- Using a modularized and layered subprogram design and identifying the benefits of subprograms
- Working with procedures:
  - Creating and calling procedures
  - Identifying the available parameter-passing modes
  - Using formal and actual parameters
  - Using positional, named, or mixed notation
- Handling exceptions in procedures, removing a procedure, and displaying the procedures' information

# Creating a Modularized Subprogram Design




Modularize code into subprograms.

1. Locate code sequences repeated more than once.
2. Create subprogram P containing the repeated code
3. Modify original code to invoke the new subprogram.

# Creating a Layered Subprogram Design

Create subprogram layers for your application.

- Data access subprogram layer with SQL logic
- Business logic subprogram layer, which may or may not use the data access layer

# Modularizing Development with PL/SQL Blocks

- PL/SQL is a block-structured language. The PL/SQL code block helps modularize code by using:
  - Anonymous blocks
  - Procedures and functions
  - Packages
  - Database triggers
- The benefits of using modular program constructs are:
  - Easy maintenance
  - Improved data security and integrity
  - Improved performance
  - Improved code clarity

# Anonymous Blocks: Overview

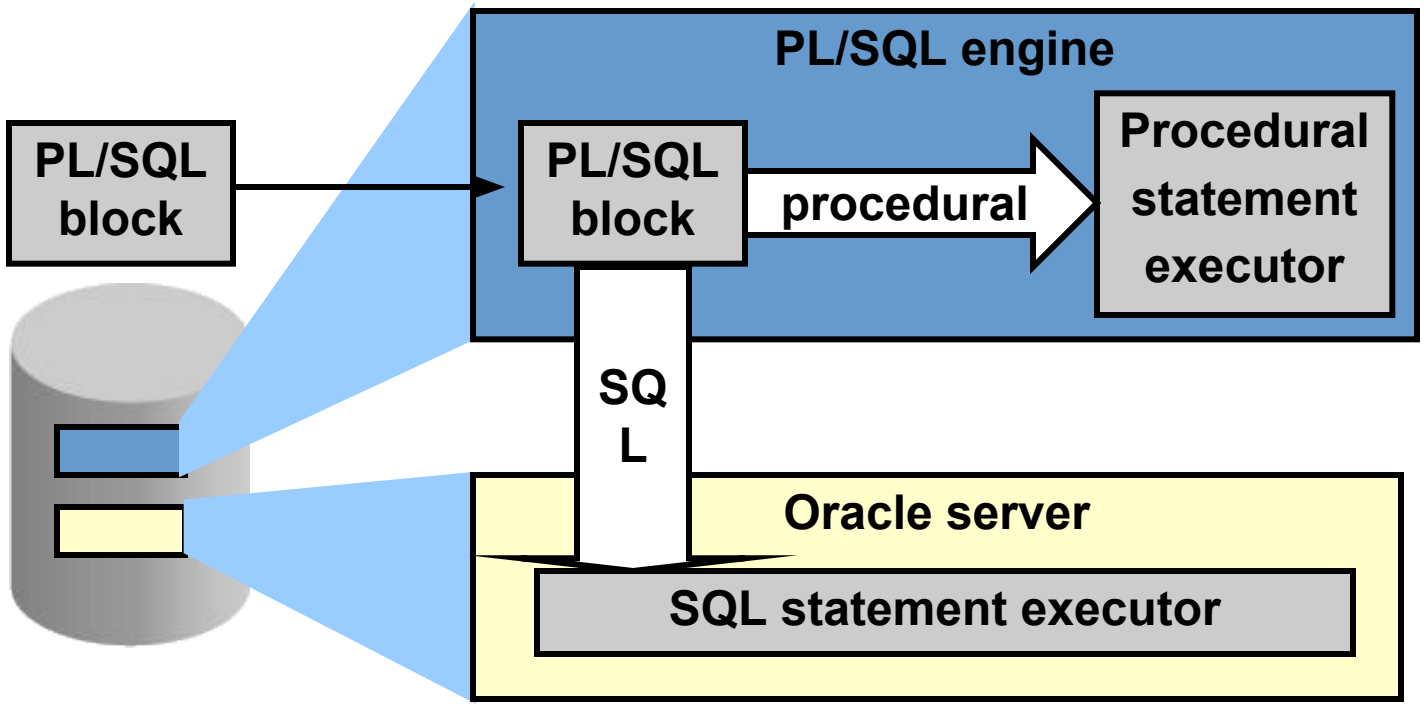
Anonymous blocks:

- Form the basic PL/SQL block structure
- Initiate PL/SQL processing tasks from applications
- Can be nested within the executable section of any PL/SQL block

```
[DECLARE      -- Declaration Section (Optional)
  variable declarations; ... ]
BEGIN         -- Executable Section (Mandatory)
  SQL or PL/SQL statements;
[EXCEPTION    -- Exception Section (Optional)
  WHEN exception THEN statements; ]
END;          -- End of Block (Mandatory)
```

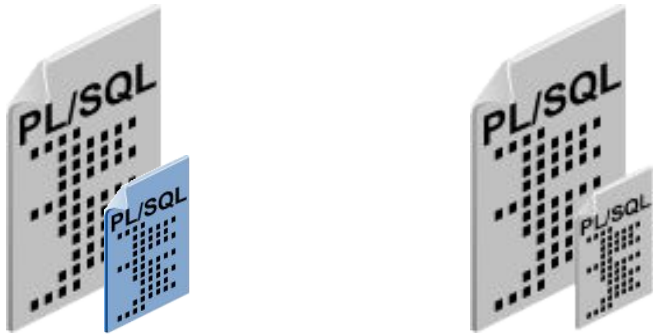
# PL/SQL Execution Environment

The PL/SQL run-time architecture:

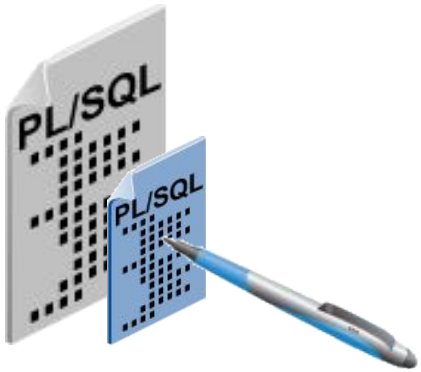


# What Are PL/SQL Subprograms?

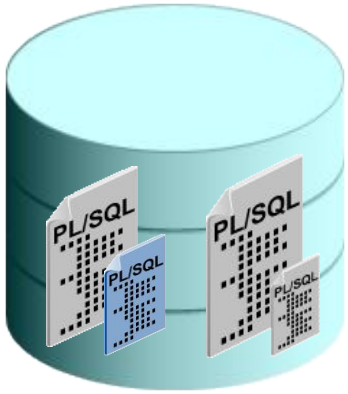
- A PL/SQL subprogram is a named PL/SQL block that can be called with a set of parameters.
- You can declare and define a subprogram within either a PL/SQL block or another subprogram.
- A subprogram consists of a specification and a body.
- A subprogram can be a procedure or a function.
- Typically, you use a procedure to perform an action and a function to compute and return a value.



# The Benefits of Using PL/SQL Subprograms




Easy maintenance




Subprograms:
Stored procedures
and functions

Improved data security
and integrity


Improved code clarity

Improved performance

# Differences Between Anonymous Blocks and Subprograms

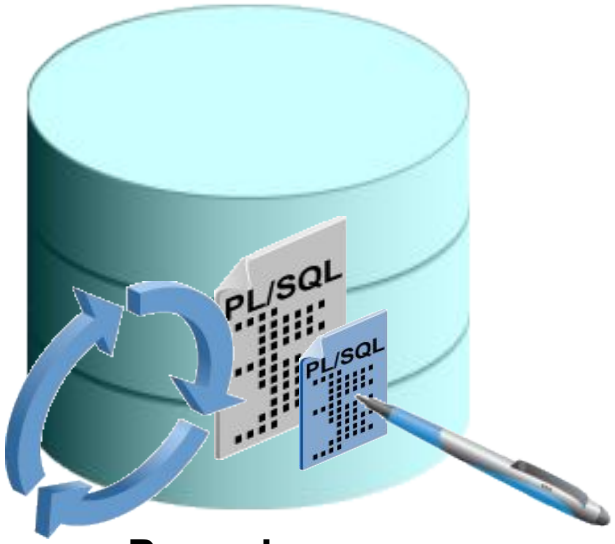
| Anonymous Blocks | Subprograms |
|---|---|
| Unnamed PL/SQL blocks | Named PL/SQL blocks |
| Compiled every time | Compiled only once |
| Not stored in the database | Stored in the database |
| Cannot be invoked by other applications | Named and, therefore, can be invoked by other applications |
| Do not return values | Subprograms called functions must return values. |
| Cannot take parameters | Can take parameters |

# Lesson Agenda

- Using a modularized and layered subprogram design and identifying the benefits of subprograms
- Working with procedures:
  - Creating and calling procedures
  - Identifying the available parameter-passing modes
  - Using formal and actual parameters
  - Using positional, named, or mixed notation
- Handling exceptions in procedures, removing a procedure, and displaying the procedures' information

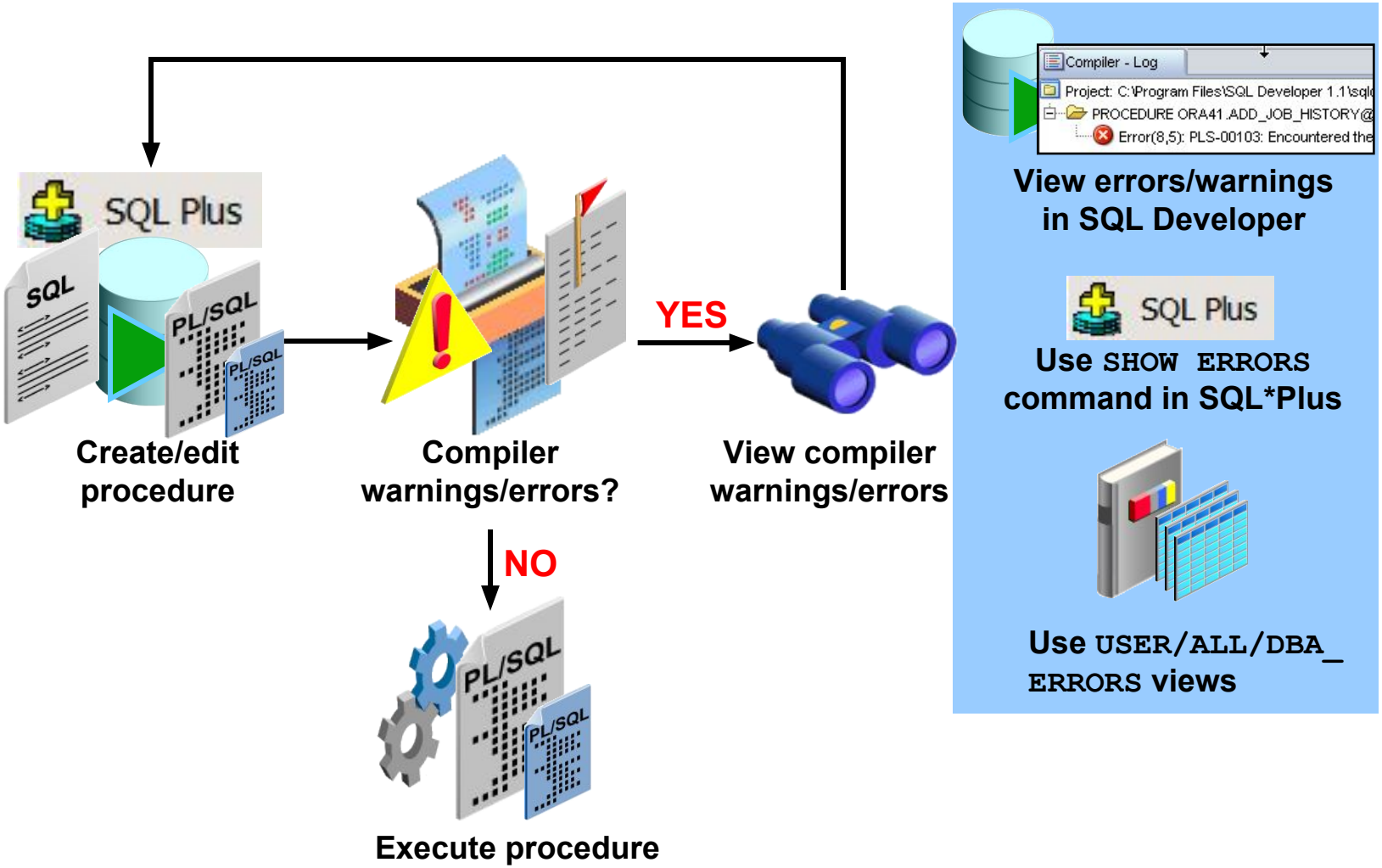
# What Are Procedures?

- Are a type of subprogram that perform an action
- Can be stored in the database as a schema object
- Promote reusability and maintainability




**Procedures**

# Creating Procedures: Overview



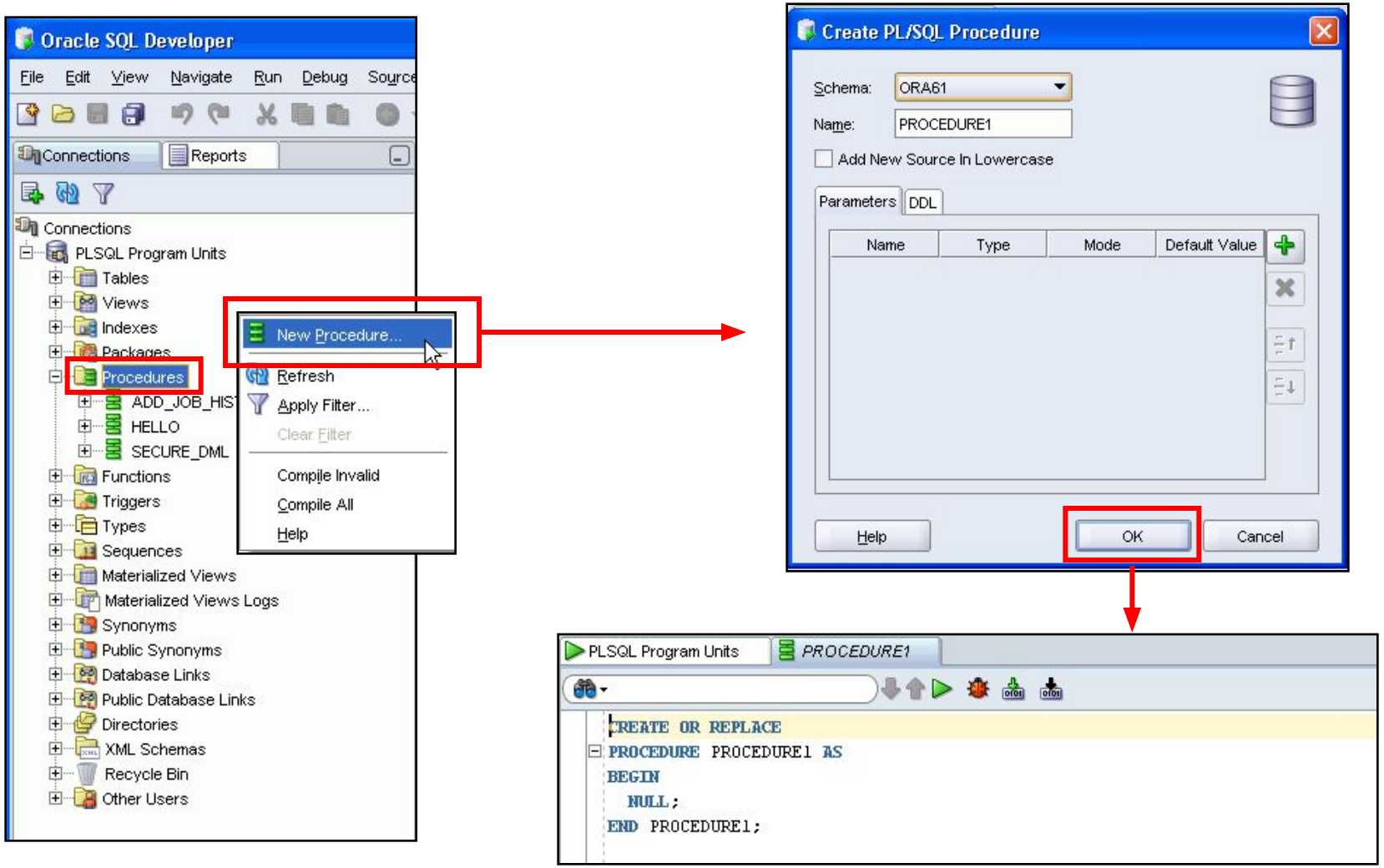
# Creating Procedures with the SQL `CREATE OR REPLACE` Statement

- Use the `CREATE` clause to create a stand-alone procedure that is stored in the Oracle database.
- Use the `OR REPLACE` option to overwrite an existing procedure.

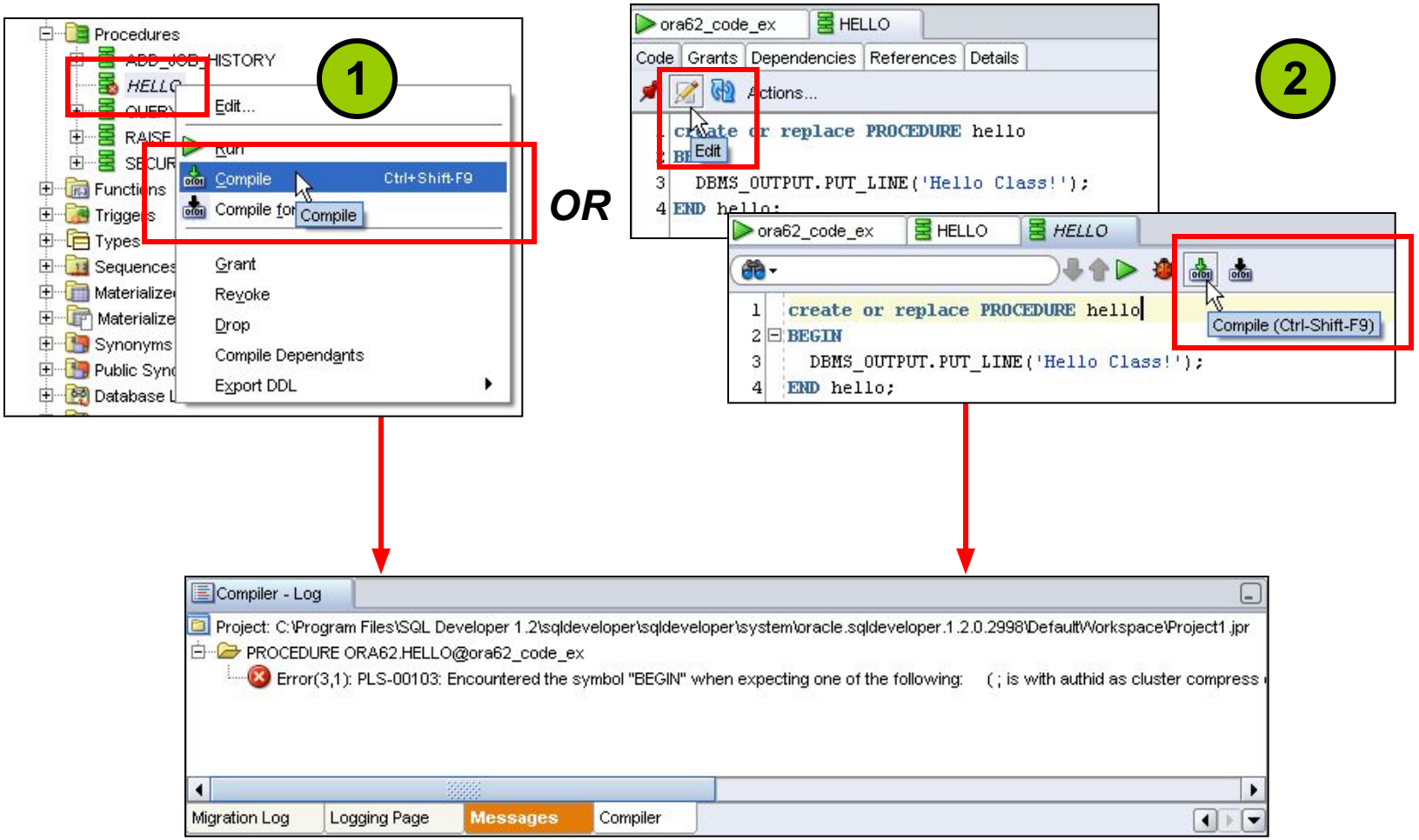
```
CREATE [OR REPLACE] PROCEDURE procedure_name
 [(parameter1 [mode] datatype1,
   parameter2 [mode] datatype2, ...)]
IS|AS
  [local_variable_declarations; ...]
BEGIN
      -- actions;
END [procedure_name];
```

PL/SQL block

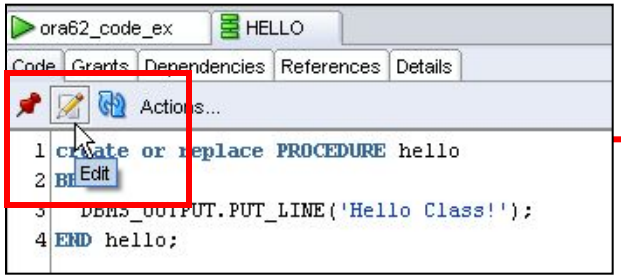
# Creating Procedures Using SQL Developer



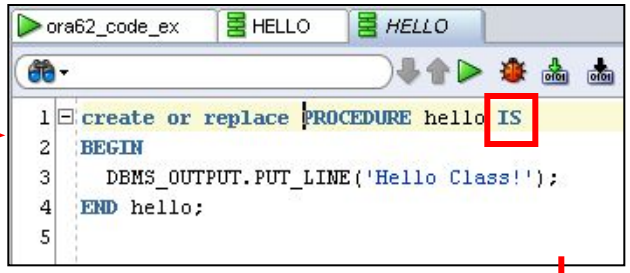
# Compiling Procedures and Displaying Compilation Errors in SQL Developer



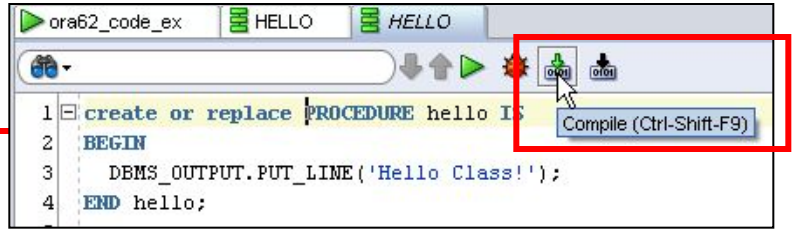
# Correcting Compilation Errors in SQL Developer



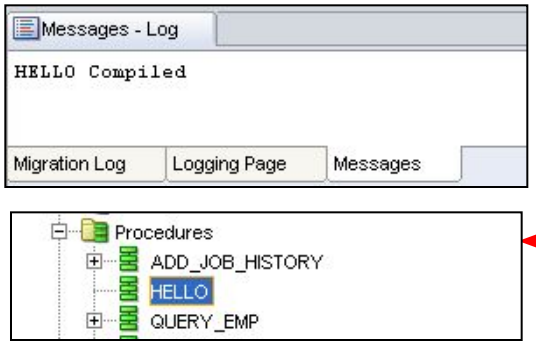

Edit procedure




Correct error




Recompile procedure




Recompilation successful

# Naming Conventions of PL/SQL Structures Used in This Course

| PL/SQL Structure | Convention | Example |
|---|---|---|
| Variable | v_*variable_name* | v_rate |
| Constant | c_*constant_name* | c_rate |
| Subprogram parameter | p_*parameter_name* | p_id |
| Bind (host) variable | b_*bind_name* | b_salary |
| Cursor | cur_*cursor_name* | cur_emp |
| Record | rec_*record_name* | rec_emp |
| Type | *type_name_type* | ename_table_type |
| Exception | e_*exception_name* | e_products_invalid |
| File handle | f_*file_handle_name* | f_file |

# What Are Parameters and Parameter Modes?

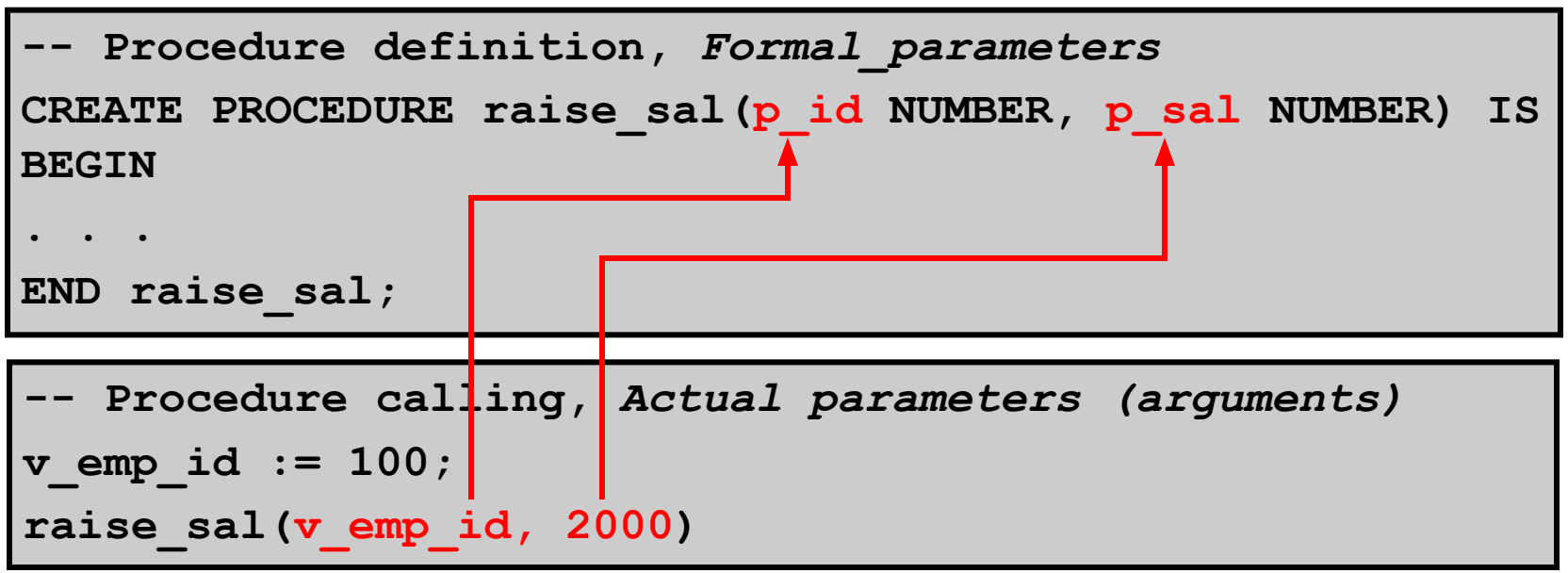
- Are declared after the subprogram name in the PL/SQL header
- Pass or communicate data between the caller and the subprogram
- Are used like local variables but are dependent on their parameter-passing mode:
  - An `IN` parameter mode (the default) provides values for a subprogram to process
  - An `OUT` parameter mode returns a value to the caller
  - An `IN OUT` parameter mode supplies an input value, which may be returned (output) as a modified value

# Formal and Actual Parameters

- Formal parameters: Local variables declared in the parameter list of a subprogram specification
- Actual parameters (or arguments): Literal values, variables, and expressions used in the parameter list of the calling subprogram

```
-- Procedure definition, Formal_parameters
CREATE PROCEDURE raise_sal(p_id NUMBER, p_sal NUMBER) IS
BEGIN
. . .
END raise_sal;
```

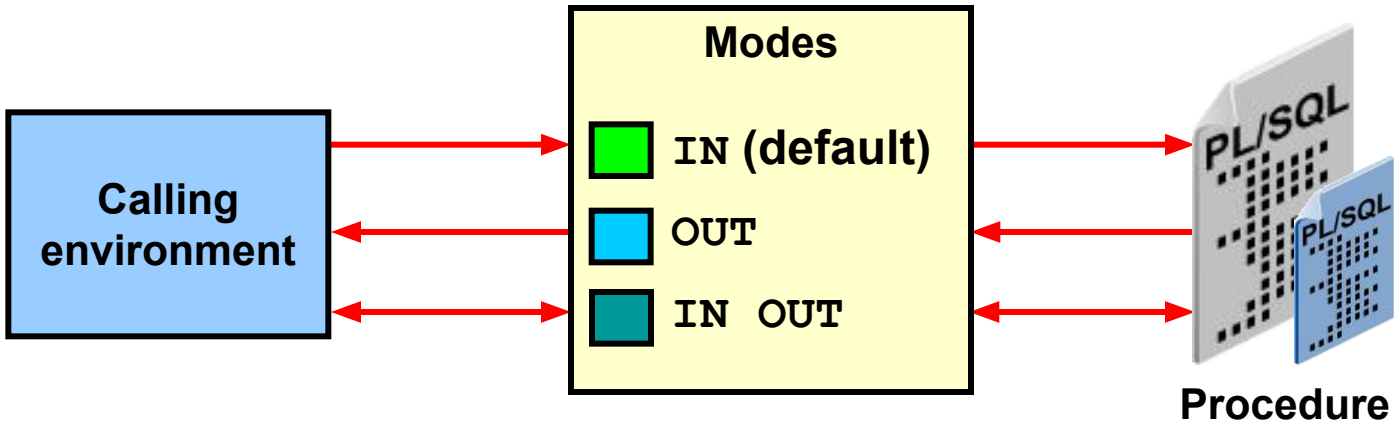
```
-- Procedure calling, Actual parameters (arguments)
v_emp_id := 100;
raise_sal(v_emp_id, 2000)
```



# Procedural Parameter Modes

- Parameter modes are specified in the formal parameter declaration, after the parameter name and before its data type.
- The `IN` mode is the default if no mode is specified.

```
CREATE PROCEDURE proc_name(param_name [mode] datatype)
...
```

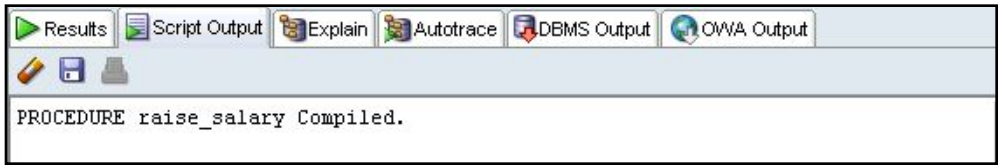


# Comparing the Parameter Modes

| IN | OUT | IN OUT |
|---|---|---|
| Default mode | Must be specified | Must be specified |
| Value is passed into subprogram | Returned to calling environment | Passed into subprogram; returned to calling environment |
| Formal parameter acts as a constant | Uninitialized variable | Initialized variable |
| Actual parameter can be a literal, expression, constant, or initialized variable | Must be a variable | Must be a variable |
| Can be assigned a default value | Cannot be assigned a default value | Cannot be assigned a default value |

# Using the IN Parameter Mode: Example

```
CREATE OR REPLACE PROCEDURE raise_salary
 (p_id       IN employees.employee_id%TYPE,
  p_percent  IN NUMBER)
 IS
 BEGIN
  UPDATE employees
  SET    salary = salary * (1 + p_percent/100)
  WHERE  employee_id = p_id;
 END raise_salary;
 /
```




```
EXECUTE raise_salary(176, 10)
```

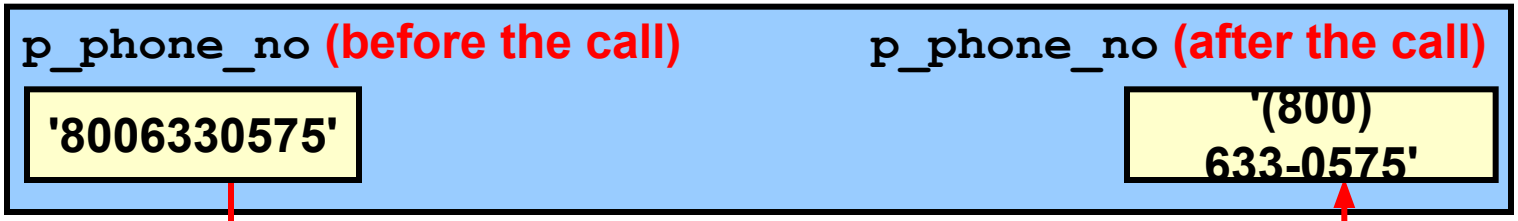
# Using the OUT Parameter Mode: Example

```
CREATE OR REPLACE PROCEDURE query_emp
 (p_id      IN  employees.employee_id%TYPE,
  p_name    OUT employees.last_name%TYPE,
  p_salary OUT employees.salary%TYPE) IS
BEGIN
  SELECT  last_name, salary INTO p_name, p_salary
  FROM    employees
  WHERE   employee_id = p_id;
END query_emp;
/
```

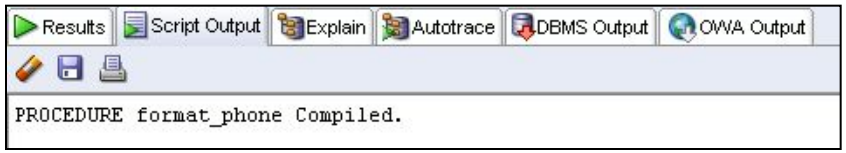
```
DECLARE
  v_emp_name employees.last_name%TYPE;
  v_emp_sal  employees.salary%TYPE;
BEGIN
  query_emp(171, v_emp_name, v_emp_sal);
  DBMS_OUTPUT.PUT_LINE(v_emp_name||' earns '||
    to_char(v_emp_sal, '$999,999.00'));
END;/
```

# Using the IN OUT Parameter Mode: Example

**Calling environment**




```
CREATE OR REPLACE PROCEDURE format_phone
   (p_phone_no IN OUT VARCHAR2) IS
BEGIN
  p_phone_no := '('   || SUBSTR(p_phone_no,1,3) ||
                ') '  || SUBSTR(p_phone_no,4,3) ||
                '-'   || SUBSTR(p_phone_no,7);
END format_phone;
/
```



# Viewing the OUT Parameters: Using the DBMS_OUTPUT.PUT_LINE Subroutine

Use PL/SQL variables that are printed with calls to the `DBMS_OUTPUT.PUT_LINE` procedure.

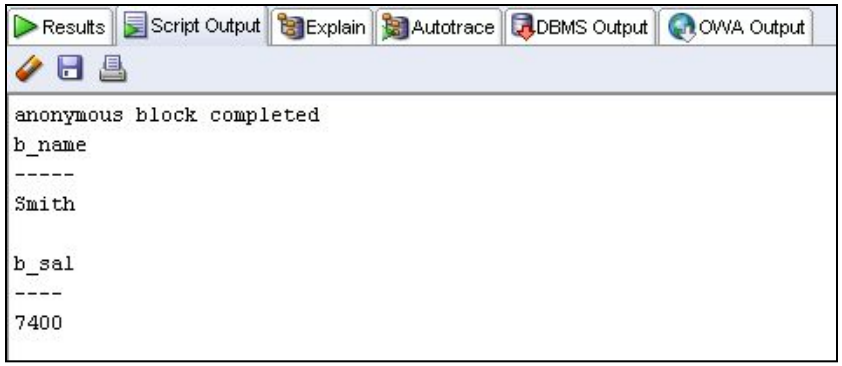
```
SET SERVEROUTPUT ON

DECLARE
  v_emp_name employees.last_name%TYPE;
  v_emp_sal  employees.salary%TYPE;
BEGIN
  query_emp(171, v_emp_name, v_emp_sal);
  DBMS_OUTPUT.PUT_LINE('Name: ' || v_emp_name);
  DBMS_OUTPUT.PUT_LINE('Salary: ' || v_emp_sal);
END;
```

```
anonymous block completed
Name: Smith
Salary: 7400
```

# Viewing OUT Parameters: Using SQL*Plus Host Variables

1. Use SQL*Plus host variables.
2. Execute QUERY_EMP using host variables.
3. Print the host variables.

```
VARIABLE b_name  VARCHAR2(25)
VARIABLE b_sal       NUMBER
EXECUTE query_emp(171, :b_name, :b_sal)
PRINT b_name b_sal
```



# Available Notations for Passing Actual Parameters

When calling a subprogram, you can write the actual parameters using the following notations:

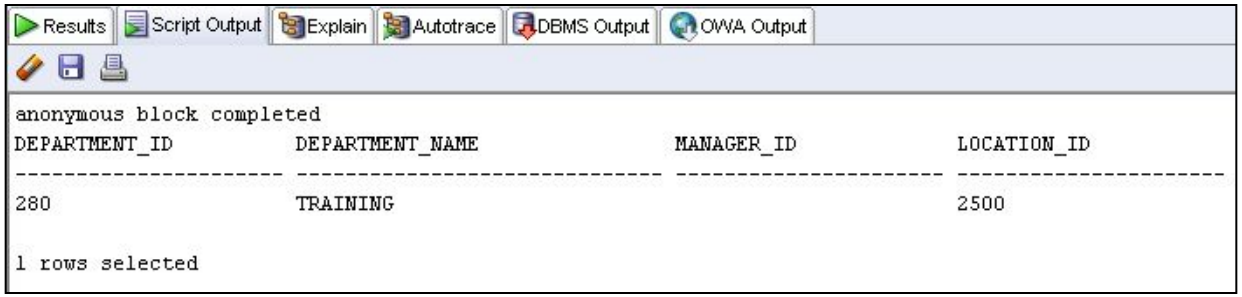
- Positional:
  - Lists the actual parameters in the same order as the formal parameters
- Named:
  - Lists the actual parameters in arbitrary order and uses the association operator (=>) to associate a named formal parameter with its actual parameter
- Mixed:
  - Lists some of the actual parameters as positional and some as named

# Passing Actual Parameters: Creating the add_dept Procedure

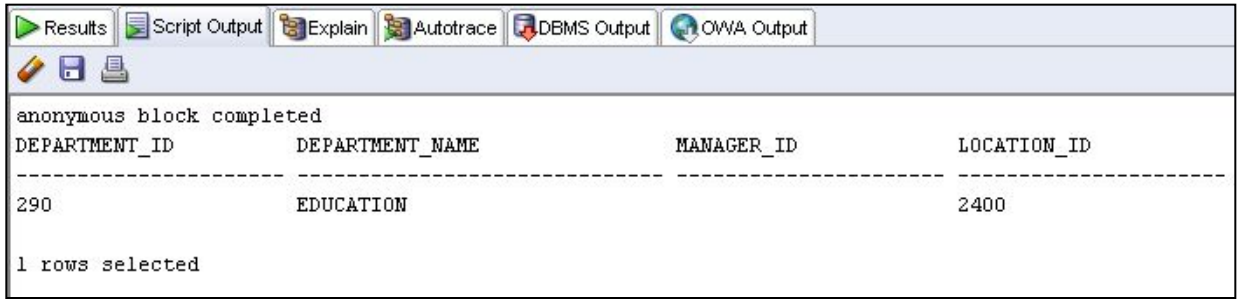
```
CREATE OR REPLACE PROCEDURE add_dept(
  p_name IN departments.department_name%TYPE,
  p_loc  IN departments.location_id%TYPE) IS
BEGIN
  INSERT INTO departments(department_id,
              department_name, location_id)
  VALUES (departments_seq.NEXTVAL, p_name , p_loc );
END add_dept;
/
```

# Passing Actual Parameters: Examples

```
-- Passing parameters using the positional notation.
EXECUTE add_dept ('TRAINING', 2500)
```




```
-- Passing parameters using the named notation.
EXECUTE add_dept (p_loc=>2400, p_name=>'EDUCATION')
```



# Using the DEFAULT Option for the Parameters

- Defines default values for parameters.
- Provides flexibility by combining the positional and named parameter-passing syntax.

```
CREATE OR REPLACE PROCEDURE add_dept(
 p_name departments.department_name%TYPE:='Unknown',
 p_loc  departments.location_id%TYPE DEFAULT 1700)
IS
BEGIN
  INSERT INTO departments (department_id,
    department_name, location_id)
  VALUES (departments_seq.NEXTVAL, p_name, p_loc);
END add_dept;
```

```
EXECUTE add_dept
EXECUTE add_dept ('ADVERTISING', p_loc => 1200)
EXECUTE add_dept (p_loc => 1200)
```

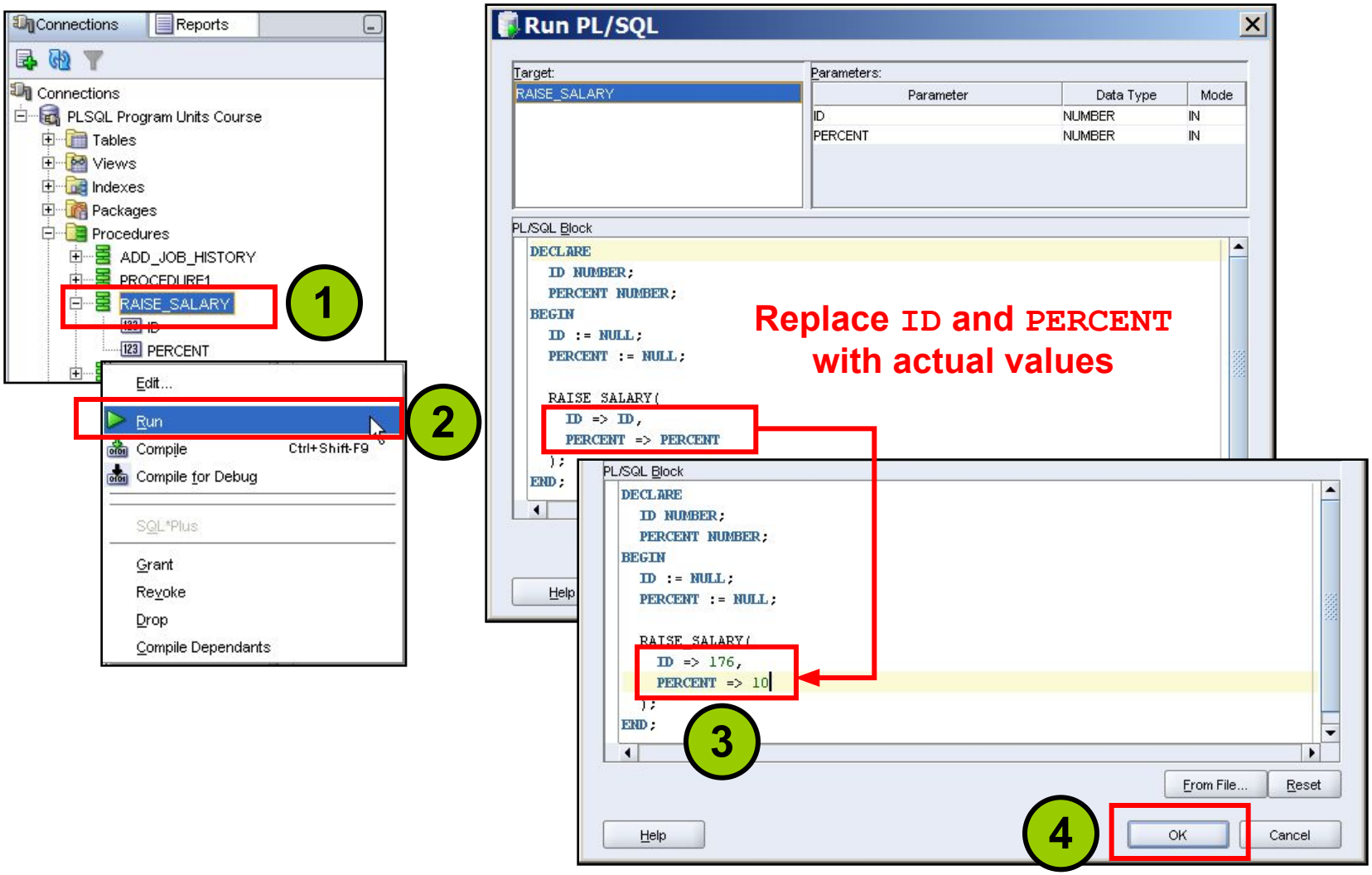
# Calling Procedures

You can call procedures using anonymous blocks, another procedure, or packages.

```
CREATE OR REPLACE PROCEDURE process_employees
IS
   CURSOR cur_emp_cursor IS
      SELECT employee_id
      FROM   employees;
BEGIN
   FOR emp_rec IN cur_emp_cursor
   LOOP
     raise_salary(emp_rec.employee_id, 10);
   END LOOP;
   COMMIT;
END process_employees;
/
```

```
PROCEDURE process_employees Compiled.
```

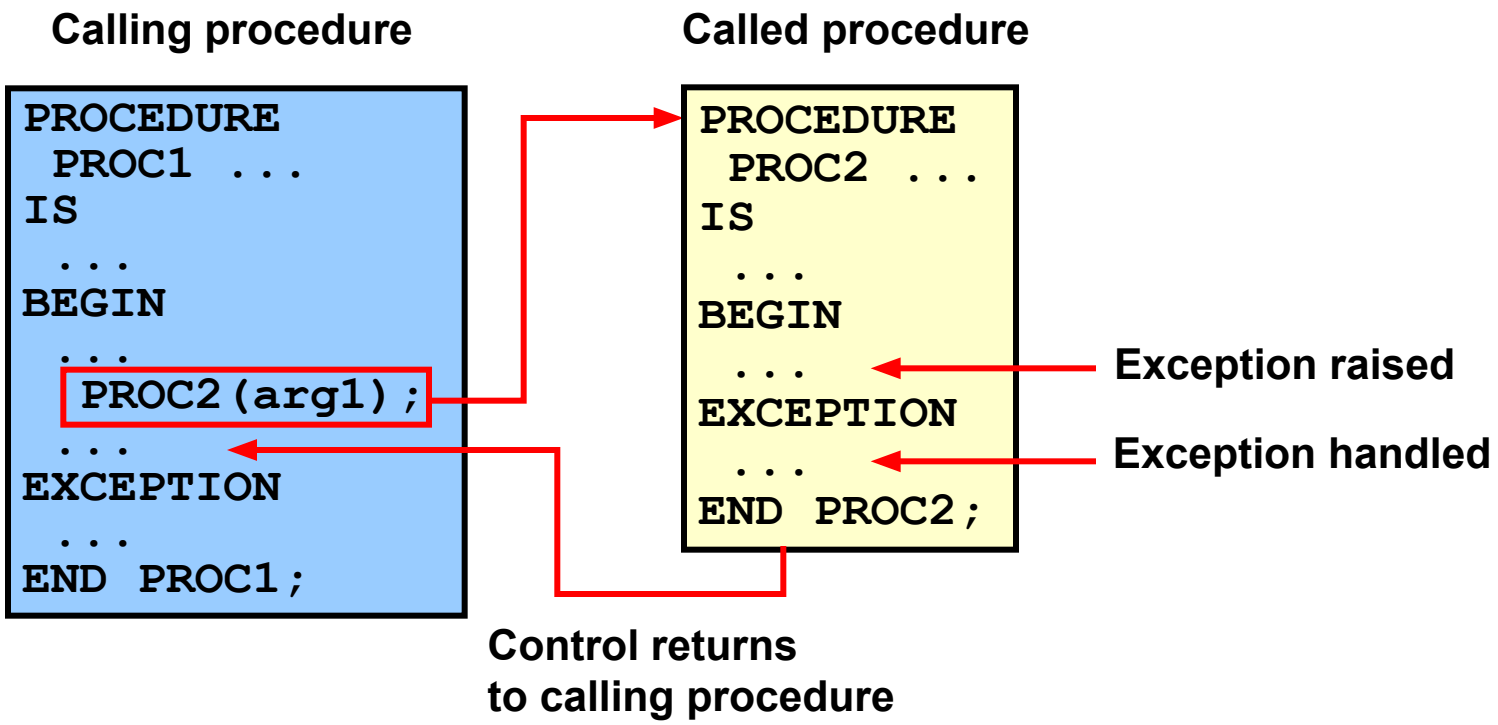
# Calling Procedures Using SQL Developer



# Lesson Agenda

- Using a modularized and layered subprogram design and identifying the benefits of subprograms
- Working with procedures:
  - Creating and calling procedures
  - Identifying the available parameter-passing modes
  - Using formal and actual parameters
  - Using positional, named, or mixed notation
- Handling exceptions in procedures, removing a procedure, and displaying the procedures' information

# Handled Exceptions

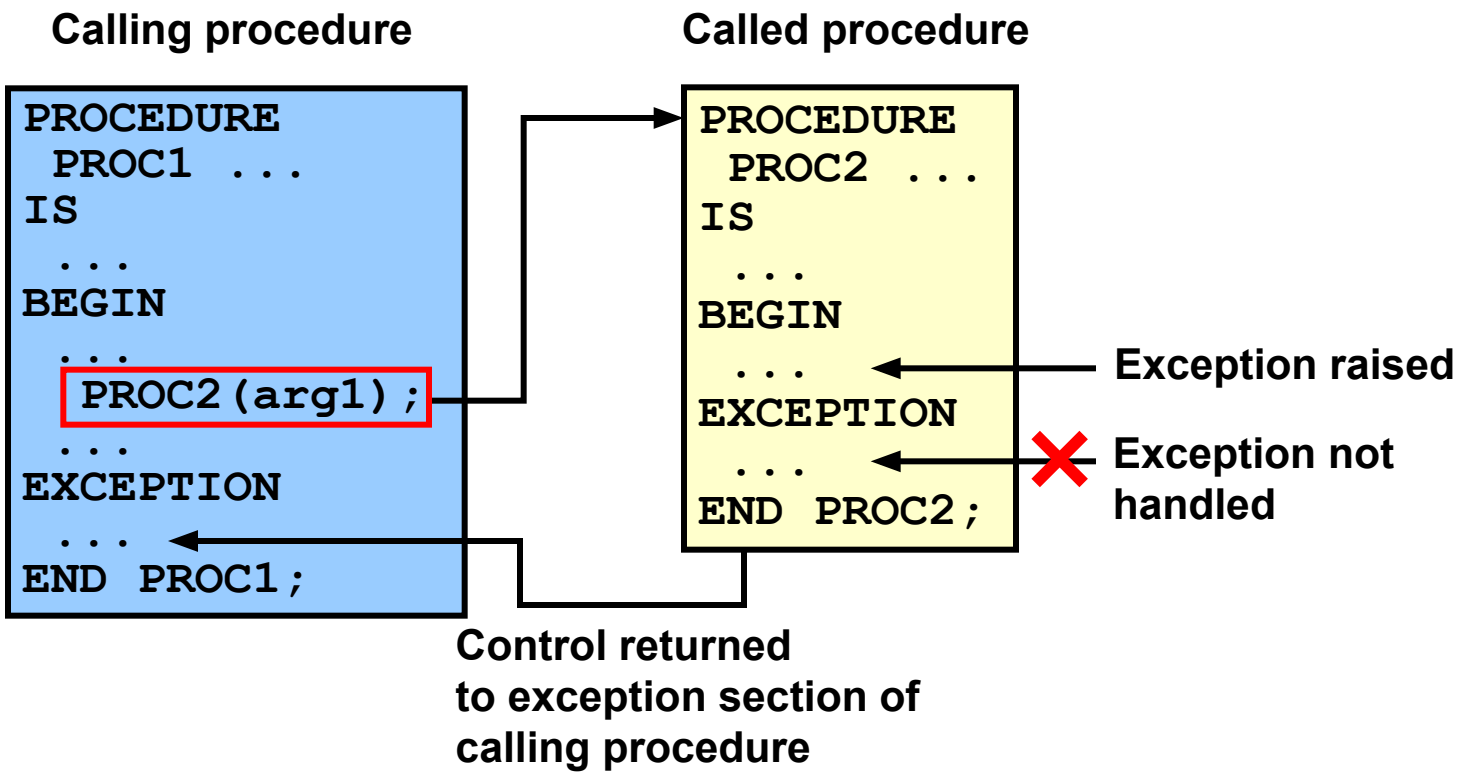


# Handled Exceptions: Example

```
CREATE 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;
```

```
CREATE PROCEDURE create_departments IS
BEGIN
  add_department('Media', 100, 1800);
  add_department('Editing', 99, 1800);
  add_department('Advertising', 101, 1800);
END;
```

# Exceptions Not Handled



# Exceptions Not Handled: Example

```
SET SERVEROUTPUT ON
CREATE PROCEDURE add_department_noex(
    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);
 END;
```

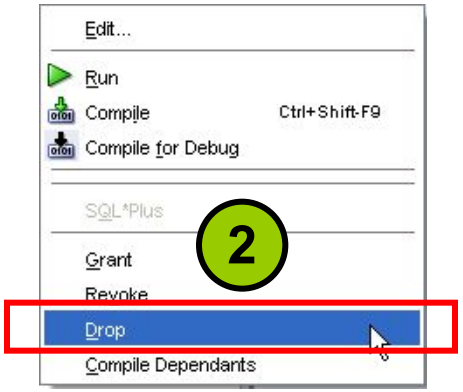
```
CREATE PROCEDURE create_departments_noex IS
BEGIN
  add_department_noex('Media', 100, 1800);
  add_department_noex('Editing', 99, 1800);
  add_department_noex('Advertising', 101, 1800);
END;
```

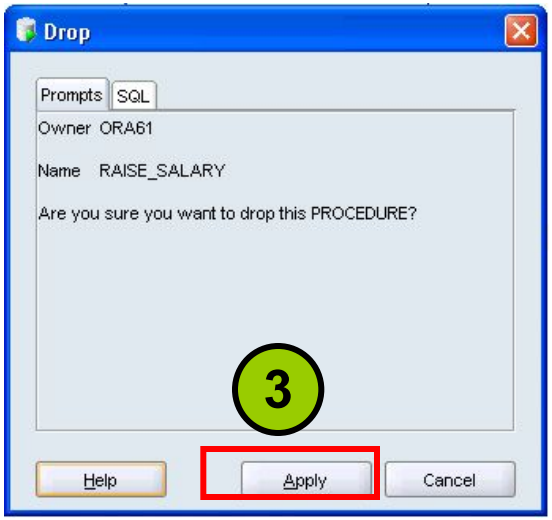
# Removing Procedures: Using the DROP SQL Statement or SQL Developer

- Using the DROP statement:

```
DROP PROCEDURE raise_salary;
```

- Using SQL Developer:

# Viewing Procedure Information Using the Data Dictionary Views

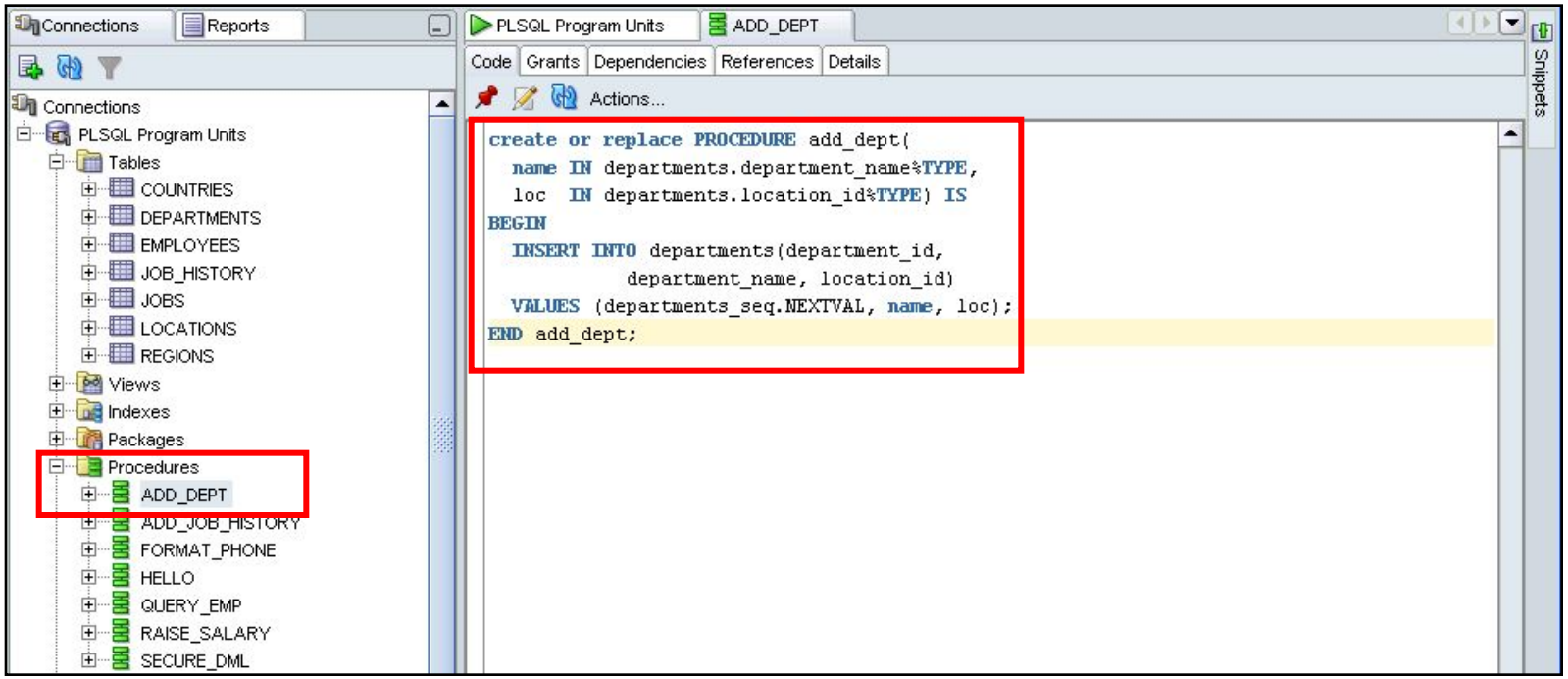
```
DESCRIBE user_source
```

```
DESCRIBE user_source
Name                           Null     Type
------------------------------ -------- ----------------------------------------
NAME                                    VARCHAR2(30)
TYPE                                    VARCHAR2(12)
LINE                                    NUMBER
TEXT                                    VARCHAR2(4000)

4 rows selected
```

```
SELECT text
FROM   user_source
WHERE  name = 'ADD_DEPT' AND type = 'PROCEDURE'
ORDER BY line;
```

| | TEXT |
|---|---|
| 1 | PROCEDURE add_dept( |
| 2 | p_name IN departments.department_name%TYPE, |
| 3 | p_loc IN departments.location_id%TYPE) IS |
| 4 | |
| 5 | BEGIN |
| 6 | INSERT INTO departments(department_id, department_name, location_id) |
| 7 | VALUES (departments_seq.NEXTVAL, p_name, p_loc); |
| 8 | END add_dept; |

# Viewing Procedure Information Using SQL Developer



# Quiz

Formal parameters are literal values, variables, and expressions used in the parameter list of the calling subprogram

1. True
2. False

# Summary

In this lesson, you should have learned how to:

- Identify the benefits of modularized and layered subprogram design
- Create and call procedures
- Use formal and actual parameters
- Use positional, named, or mixed notation for passing parameters
- Identify the available parameter-passing modes
- Handle exceptions in procedures
- Remove a procedure
- Display the procedures' information

# Practice 2 Overview: Creating, Compiling, and Calling Procedures

This practice covers the following topics:

- Creating stored procedures to:
  - Insert new rows into a table using the supplied parameter values
  - Update data in a table for rows that match the supplied parameter values
  - Delete rows from a table that match the supplied parameter values
  - Query a table and retrieve data based on supplied parameter values
- Handling exceptions in procedures
- Compiling and invoking procedures