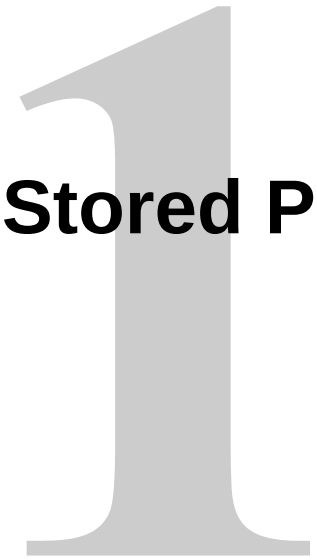


Creating Stored Procedures

Objectives

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

- Describe and create a procedure
- Create procedures with parameters
- Differentiate between formal and actual parameters
- Use different parameter-passing modes
- Invoke a procedure
- Handle exceptions in procedures
- Remove a procedure

What Is a Procedure?

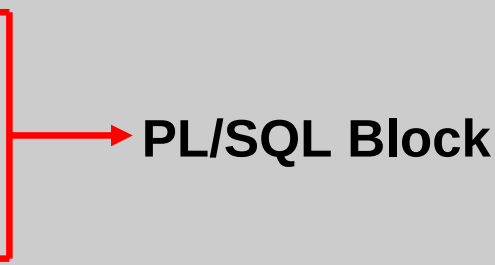
A procedure:

- Is a type of subprogram that performs an action
- Can be stored in the database as a schema object
- Promotes reusability and maintainability

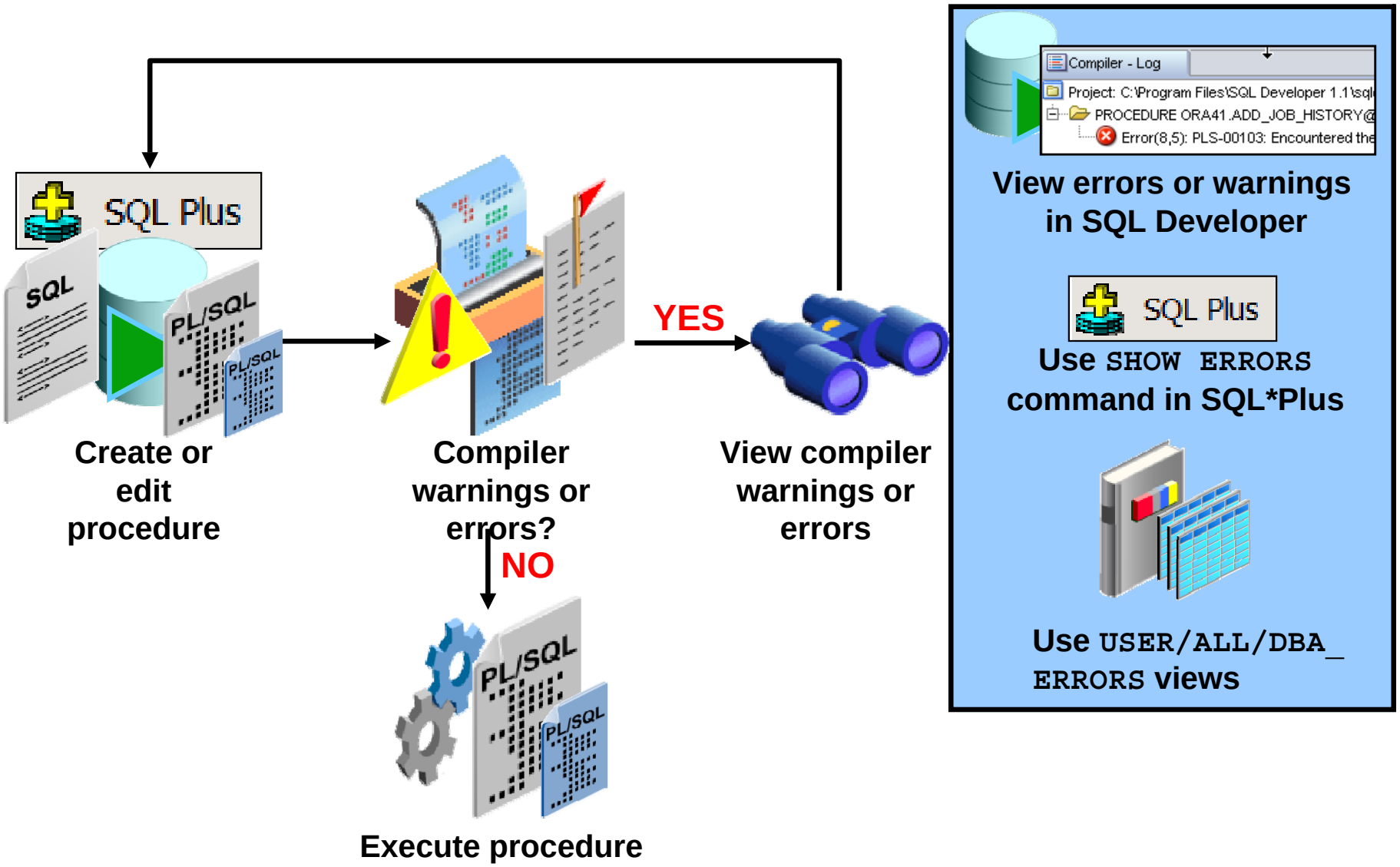
Syntax for Creating Procedures

- Use `CREATE PROCEDURE` followed by the name, optional parameters, and keyword `IS` or `AS`.
- Add the `OR REPLACE` option to overwrite an existing procedure.
- Write a PL/SQL block containing local variables, a `BEGIN` statement, and an `END` statement (or `END procedure_name`).

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



Developing Procedures



What Are Parameters?

Parameters:

- 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 (the default) provides values for a subprogram to process.
  - An `OUT` parameter returns a value to the caller.
  - An `IN OUT` parameter 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

  Example:

```
CREATE PROCEDURE raise_sal(id NUMBER,sal NUMBER) IS
BEGIN ...
END raise_sal;
```

- Actual parameters: Literal values, variables, and expressions used in the parameter list of the called subprogram

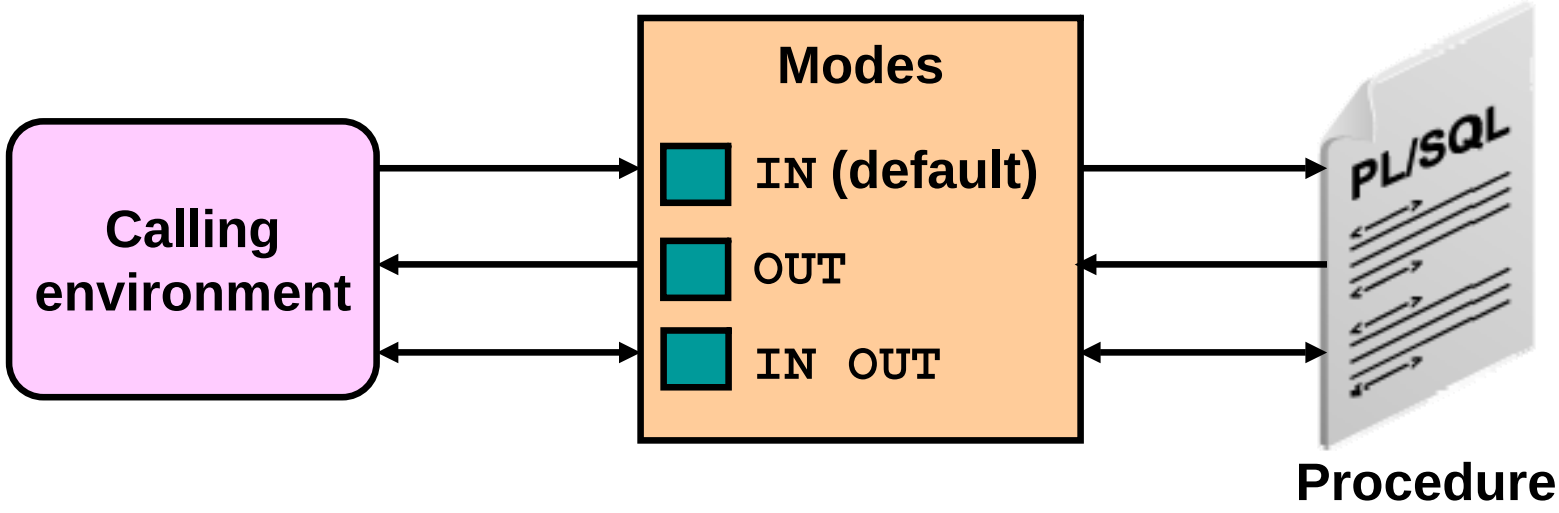
  Example:

```
emp_id := 100;
raise_sal(emp_id, 2000)
```

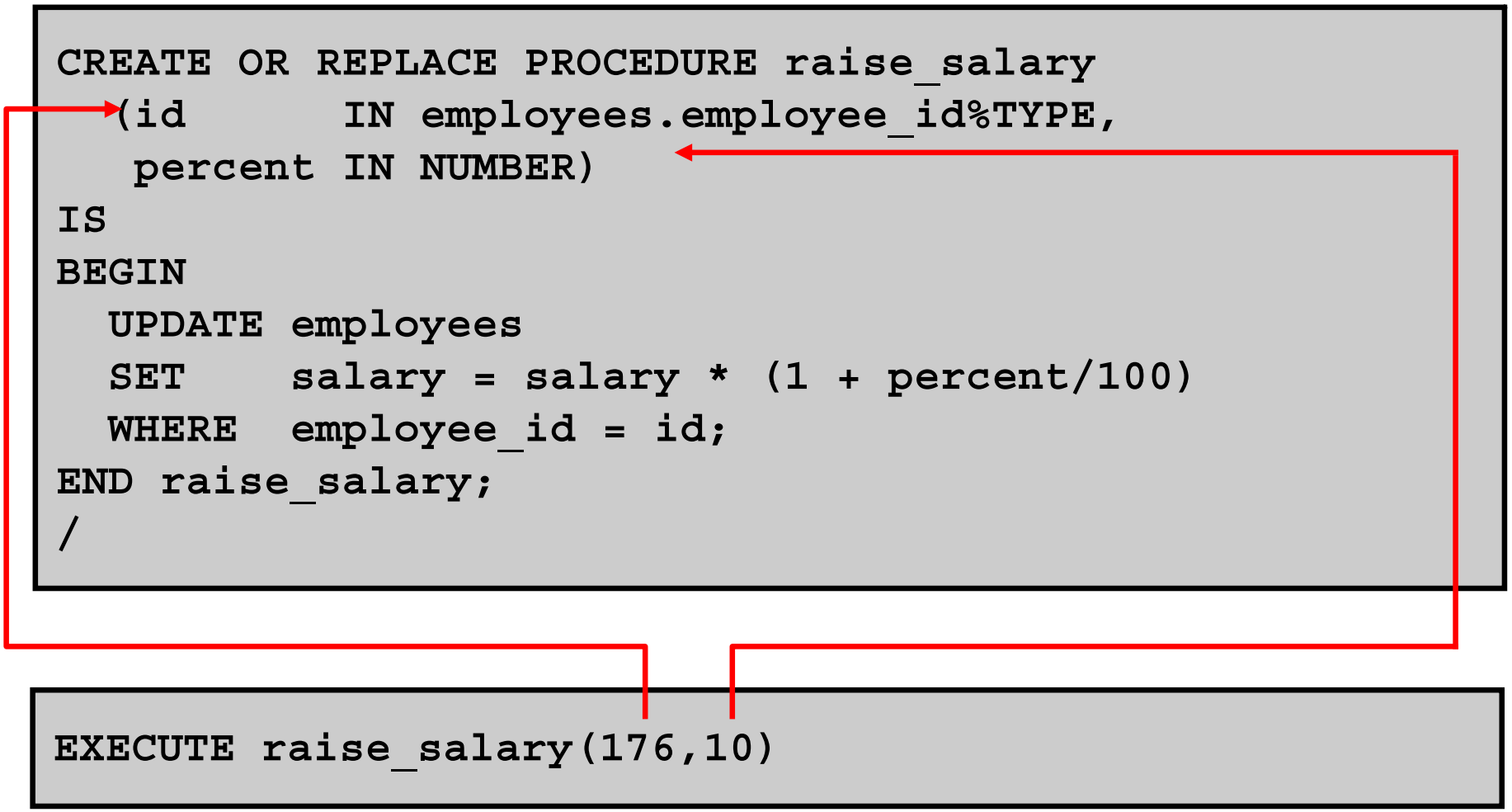
Procedural Parameter Modes

- 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 procedure(param [mode] datatype)
...
```



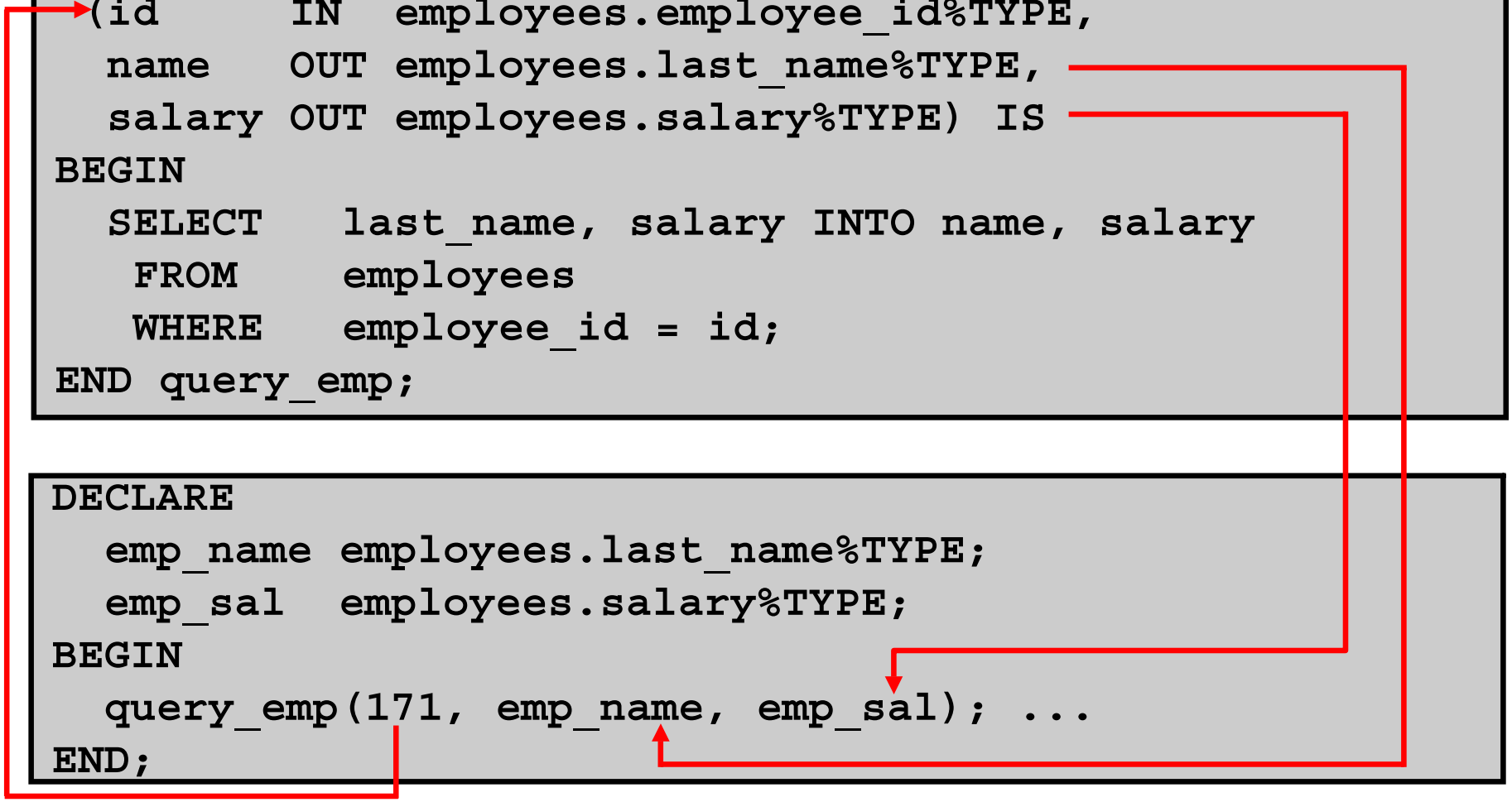
Using IN Parameters: Example



Using OUT Parameters: Example

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

```
DECLARE
  emp_name employees.last_name%TYPE;
  emp_sal  employees.salary%TYPE;
BEGIN
  query_emp(171, emp_name, emp_sal); ...
END;
```



Viewing OUT Parameters

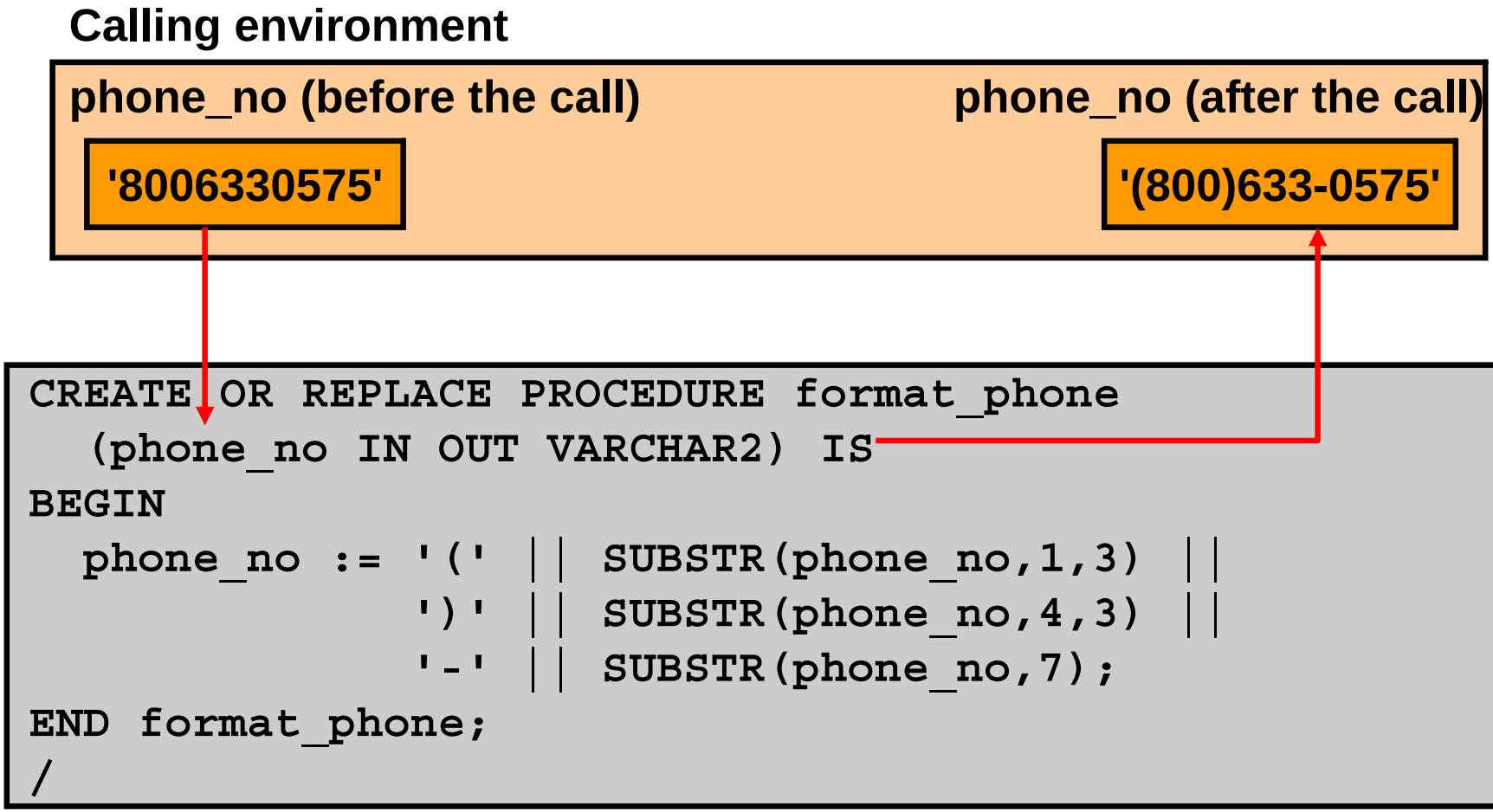
- Use PL/SQL variables that are printed with calls to the DBMS_OUTPUT.PUT_LINE procedure.

```
SET SERVEROUTPUT ON
DECLARE
  emp_name employees.last_name%TYPE;
  emp_sal  employees.salary%TYPE;
BEGIN
  query_emp(171, emp_name, emp_sal);
  DBMS_OUTPUT.PUT_LINE('Name: ' || emp_name);
  DBMS_OUTPUT.PUT_LINE('Salary: ' || emp_sal);
END;
```

- Use SQL*Plus host variables, execute QUERY_EMP using host variables, and print the host variables.

```
VARIABLE name VARCHAR2(25)
VARIABLE sal  NUMBER
EXECUTE query_emp(171, :name, :sal)
PRINT name sal
```

Using IN OUT Parameters: Example



Syntax for Passing Parameters

- 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
- Combination:
  - Lists some of the actual parameters as positional and some as named

Parameter Passing: Examples

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

- Passing by positional notation:

```
EXECUTE add_dept ('TRAINING', 2500)
```

- Passing by named notation:

```
EXECUTE add_dept (loc=>2400, name=>'EDUCATION')
```

Using the DEFAULT Option for Parameters

- Defines default values for parameters:

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

- Provides flexibility by combining the positional and named parameter-passing syntax:

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

Summary of 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

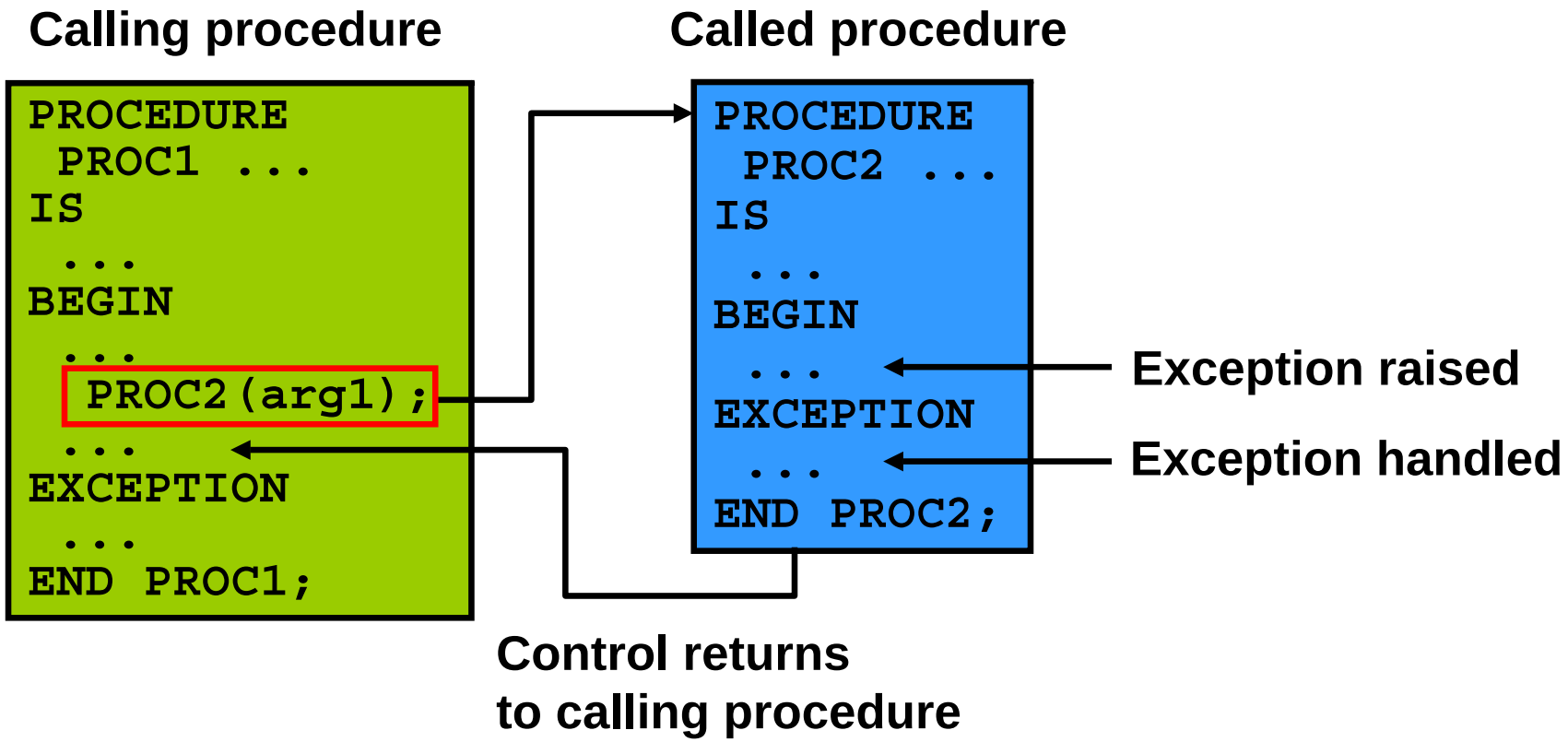
Invoking Procedures

You can invoke procedures by using:

- Anonymous blocks
- Another procedure, as in the following example:

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

Handled Exceptions

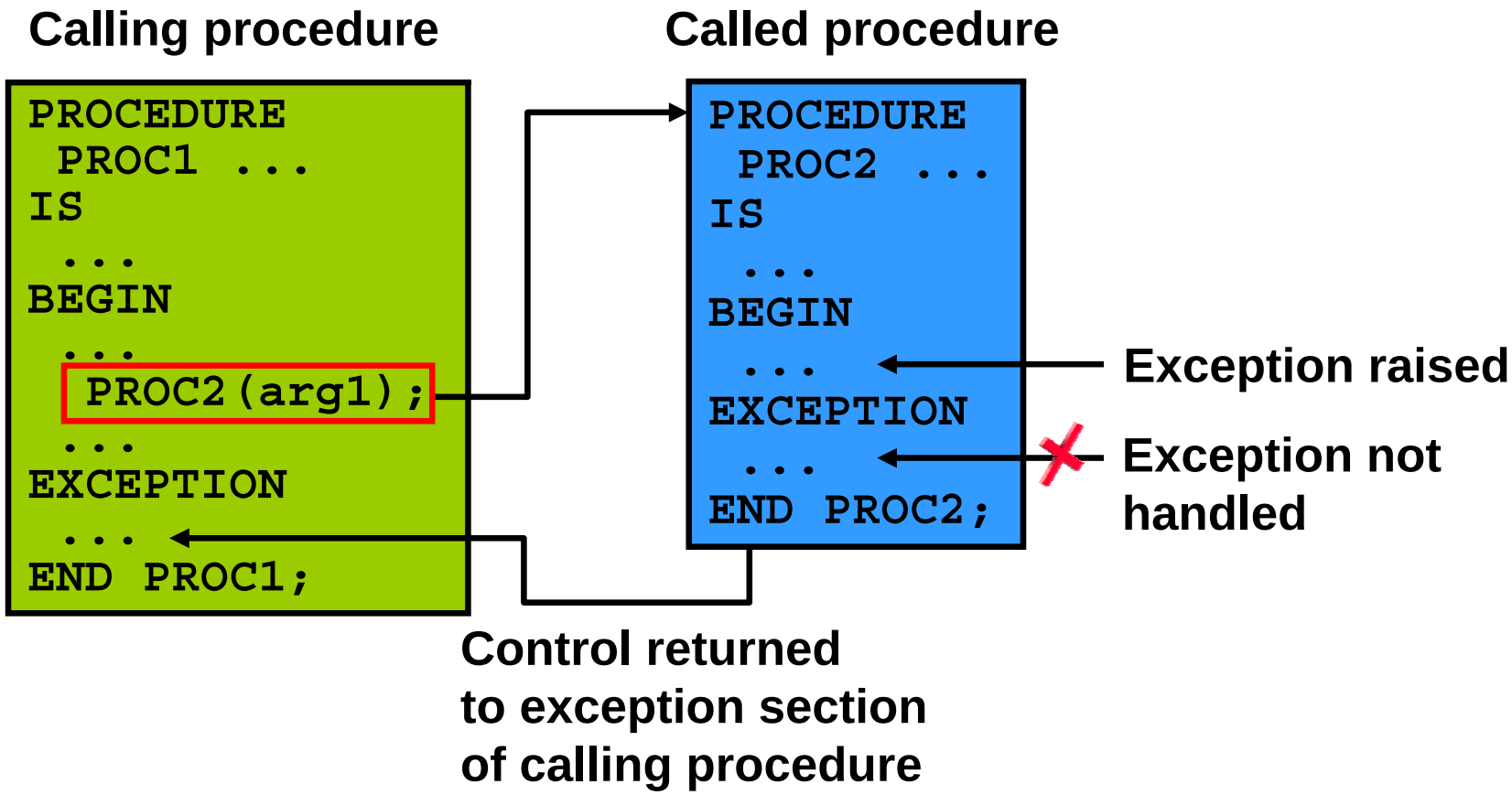


Handled Exceptions: Example

```
CREATE PROCEDURE add_department(
    name VARCHAR2, mgr NUMBER, loc NUMBER) IS
BEGIN
  INSERT INTO DEPARTMENTS (department_id,
    department_name, manager_id, location_id)
  VALUES (DEPARTMENTS_SEQ.NEXTVAL, name, mgr, loc);
  DBMS_OUTPUT.PUT_LINE('Added Dept: '||name);
EXCEPTION
 WHEN OTHERS THEN
  DBMS_OUTPUT.PUT_LINE('Err: adding dept: '||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(
    name VARCHAR2, mgr NUMBER, loc NUMBER) IS
BEGIN
  INSERT INTO DEPARTMENTS (department_id,
    department_name, manager_id, location_id)
  VALUES (DEPARTMENTS_SEQ.NEXTVAL, name, mgr, loc);
  DBMS_OUTPUT.PUT_LINE('Added Dept: '||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

You can remove a procedure that is stored in the database.

- Syntax:

```
DROP PROCEDURE procedure_name
```

- Example:

```
DROP PROCEDURE raise_salary;
```

Viewing Procedures in the Data Dictionary

Information for PL/SQL procedures is saved in the following data dictionary views:

- View source code in the `USER_SOURCE` table to view the subprograms that you own, or the `ALL_SOURCE` table for procedures that are owned by others who have granted you the `EXECUTE` privilege.

```
SELECT text
FROM   user_source
WHERE  name='ADD_DEPARTMENT' and type='PROCEDURE'
ORDER BY line;
```

- View the names of procedures in `USER_OBJECTS`.

```
SELECT object_name
FROM   user_objects
WHERE  object_type = 'PROCEDURE';
```

Benefits of Subprograms

- Easy maintenance
- Improved data security and integrity
- Improved performance
- Improved code clarity

Summary

In this lesson, you should have learned how to:

- Write a procedure to perform a task or an action
- Create, compile, and save procedures in the database by using the `CREATE PROCEDURE SQL` command
- Use parameters to pass data from the calling environment to the procedure by using three different parameter modes: `IN` (the default), `OUT`, and `IN OUT`
- Recognize the effect of handling and not handling exceptions on transactions and calling procedures

Summary

In this lesson, you should have learned how to:

- Remove procedures from the database by using the `DROP PROCEDURE` SQL command
- Modularize your application code by using procedures as building blocks

Practice 1: Overview

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