9

Creating Procedures

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Objectives

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

- Distinguish anonymous PL/SQL blocks from named PL/SQL blocks (subprograms)
- Describe subprograms
- List the benefits of using subprograms
- List the different environments from which subprograms can be invoked

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Objectives

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

- Describe PL/SQL blocks and subprograms
- Describe the uses of procedures
- Create procedures
- Differentiate between formal and actual parameters
- List the features of different parameter modes
- Create procedures with parameters
- Invoke a procedure
- Handle exceptions in procedures
- Remove a procedure

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Overview of Subprograms

A subprogram:

- Is a named PL/SQL block that can accept parameters and be invoked from a calling environment
- Is of two types:
  - A procedure that performs an action
  - A function that computes a value
- Is based on standard PL/SQL block structure
- Provides modularity, reusability, extensibility, and maintainability
- Provides easy maintenance, improved data security and integrity, improved performance, and improved code clarity

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Block Structure for Anonymous PL/SQL Blocks

```
DECLARE      (optional)
             Declare PL/SQL objects to be used
             within this block
BEGIN        (mandatory)
             Define the executable statements
EXCEPTION    (optional)
             Define the actions that take place if
             an error or exception arises
END;         (mandatory)
```

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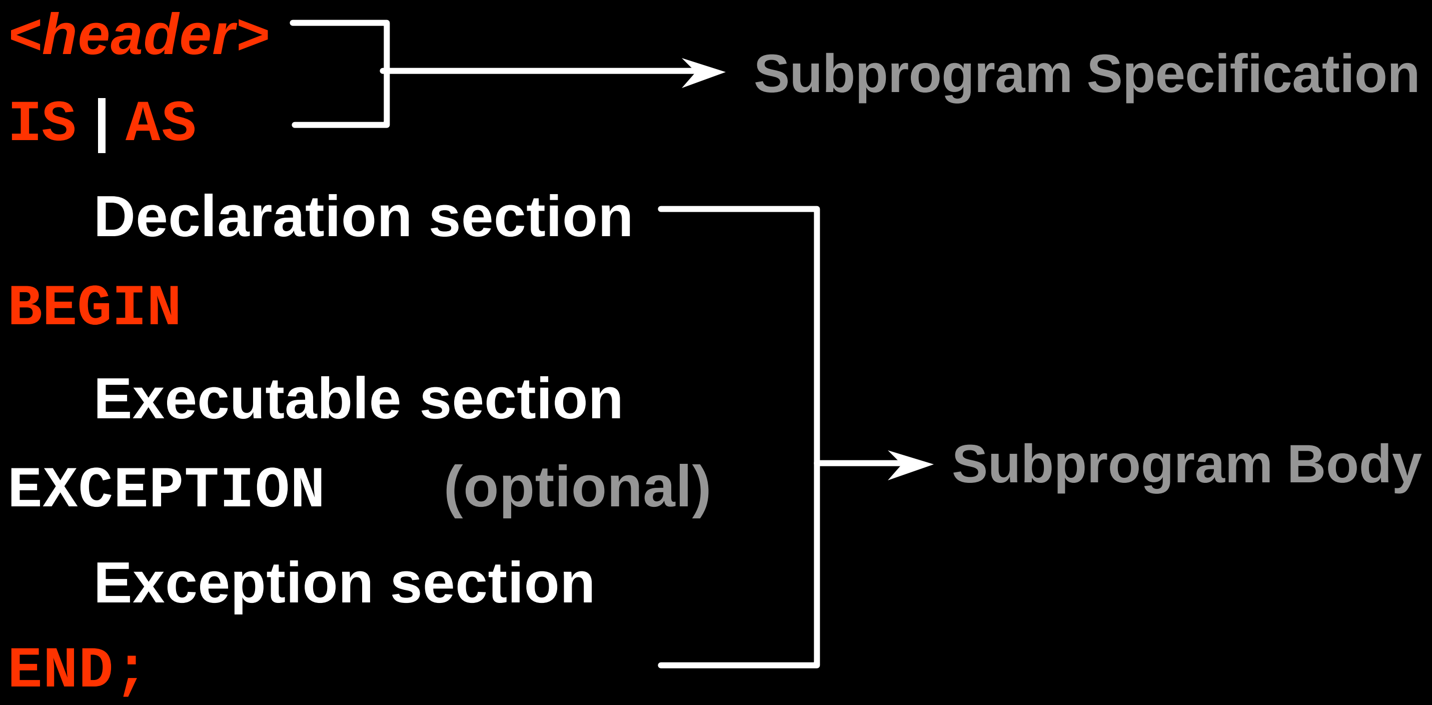
Block Structure for PL/SQL Subprograms



```
<header>
IS | AS
    Declaration section
BEGIN
    Executable section
EXCEPTION      (optional)
    Exception section
END;
```

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Benefits of Subprograms

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

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What Is a Procedure?

- A procedure is a type of subprogram that performs an action.
- A procedure can be stored in the database, as a schema object, for repeated execution.

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Syntax for Creating Procedures

```
CREATE [OR REPLACE] PROCEDURE procedure_name
 [(parameter1 [mode1] datatype1,
  parameter2 [mode2] datatype2,
  . . .)]
IS|AS
PL/SQL Block;
```

- The `REPLACE` option indicates that if the procedure exists, it will be dropped and replaced with the new version created by the statement.
- PL/SQL block starts with either `BEGIN` or the declaration of local variables and ends with either `END` or `END` *procedure_name.*

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Formal Versus Actual Parameters

- Formal parameters: variables declared in the parameter list of a subprogram specification

  Example:

```
CREATE PROCEDURE raise_sal(p_id NUMBER, p_amount NUMBER)
...
END raise_sal;
```

- Actual parameters: variables or expressions referenced in the parameter list of a subprogram call

  Example:

```
raise_sal(v_id, 2000)
```

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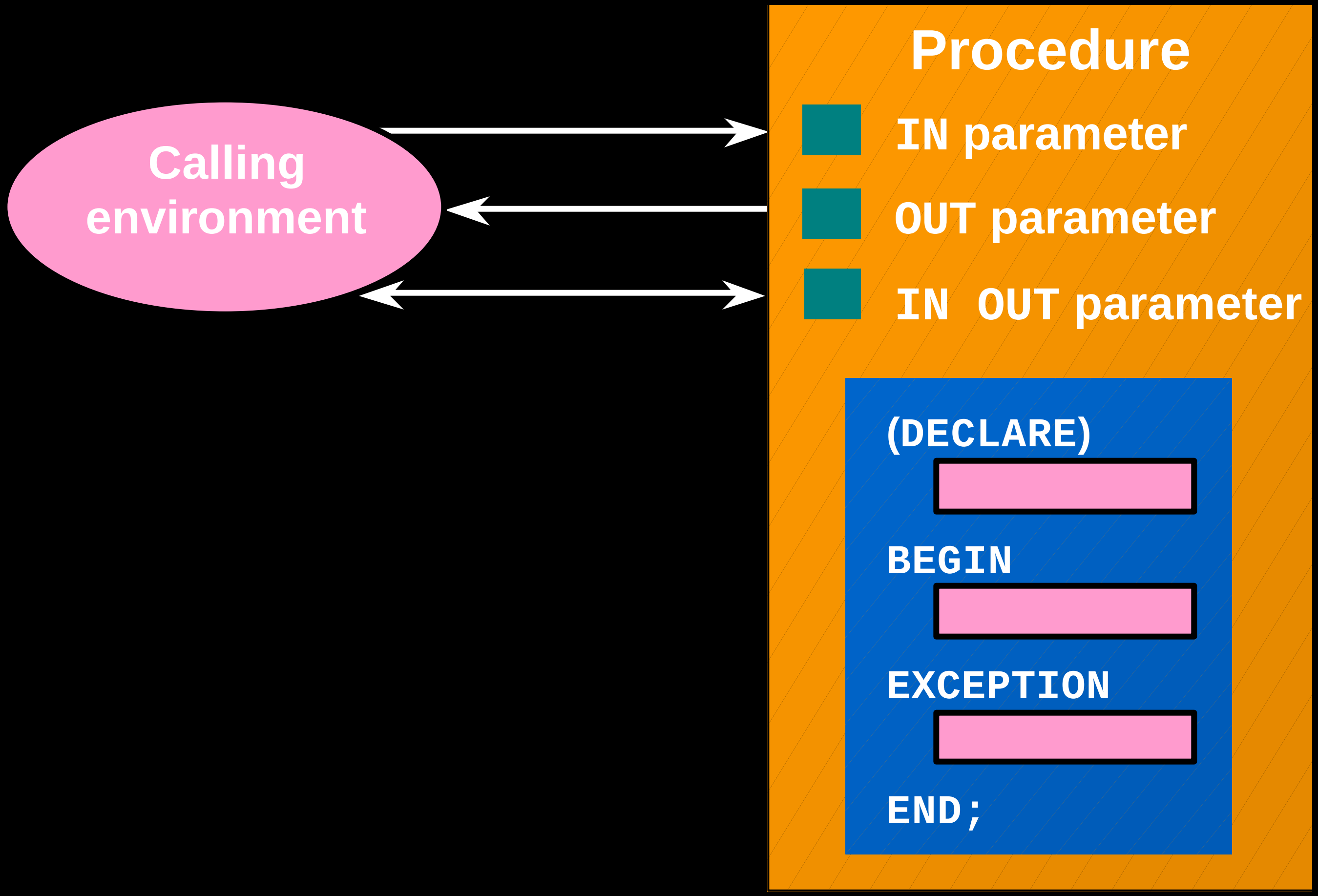
Procedural Parameter Modes



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Creating Procedures with Parameters

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

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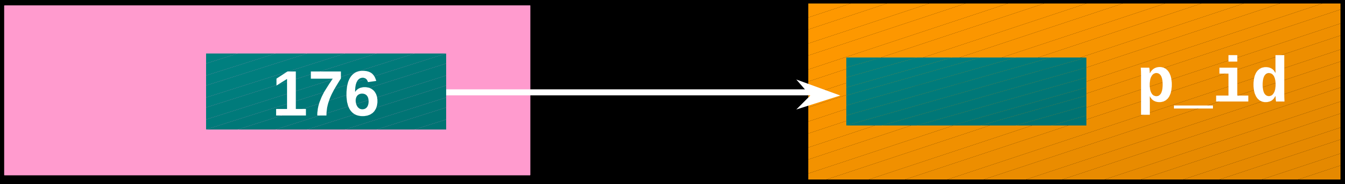
IN Parameters: Example



```
CREATE OR REPLACE PROCEDURE raise_salary
  (p_id IN employees.employee_id%TYPE)
IS
BEGIN
  UPDATE employees
  SET    salary = salary * 1.10
  WHERE  employee_id = p_id;
END raise_salary;
/
```

```
Procedure created.
```

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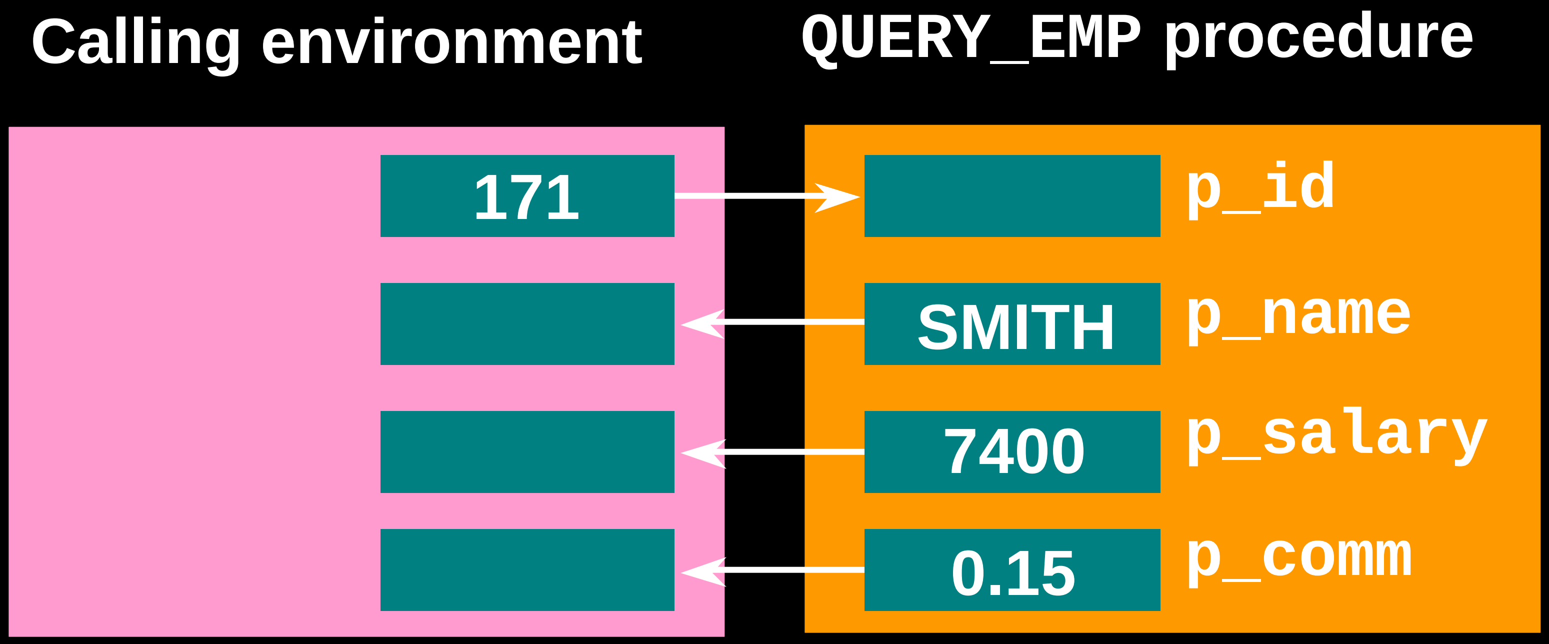
OUT Parameters: Example



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OUT Parameters: Example

emp_query.sql

```
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,
   p_comm     OUT  employees.commission_pct%TYPE)
IS
BEGIN
  SELECT   last_name, salary, commission_pct
   INTO    p_name, p_salary, p_comm
   FROM    employees
   WHERE   employee_id = p_id;
END query_emp;
/
```

```
Procedure created.
```

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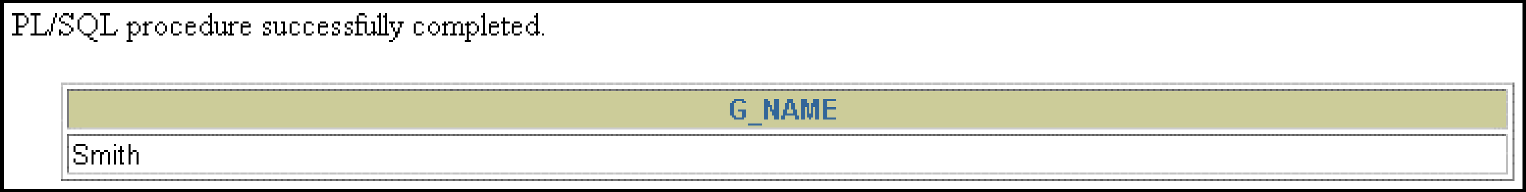
Viewing OUT Parameters

- Load and run the `emp_query.sql` script file to create the `QUERY_EMP` procedure.
- Declare host variables, execute the `QUERY_EMP` procedure, and print the value of the global `G_NAME` variable.

```
VARIABLE g_name     VARCHAR2(25)
VARIABLE g_sal      NUMBER
VARIABLE g_comm     NUMBER

EXECUTE query_emp(171, :g_name, :g_sal, :g_comm)

PRINT g_name
```



```
PL/SQL procedure successfully completed.

G_NAME
Smith
```

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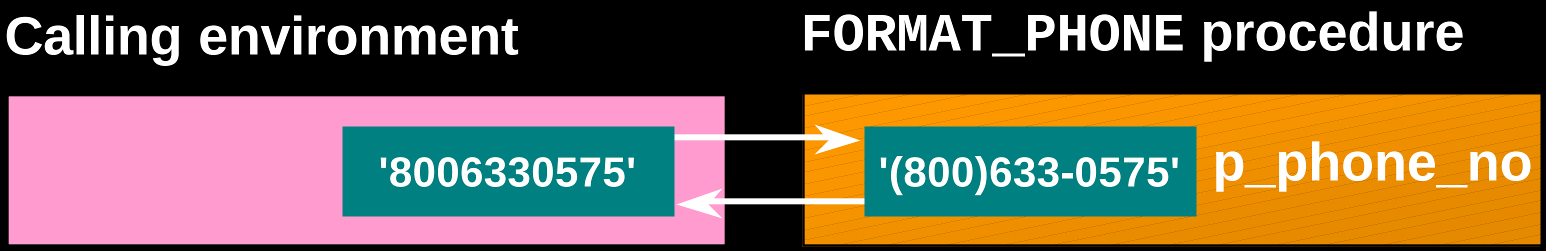
IN OUT Parameters



```
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;
/
```

```
Procedure created.
```

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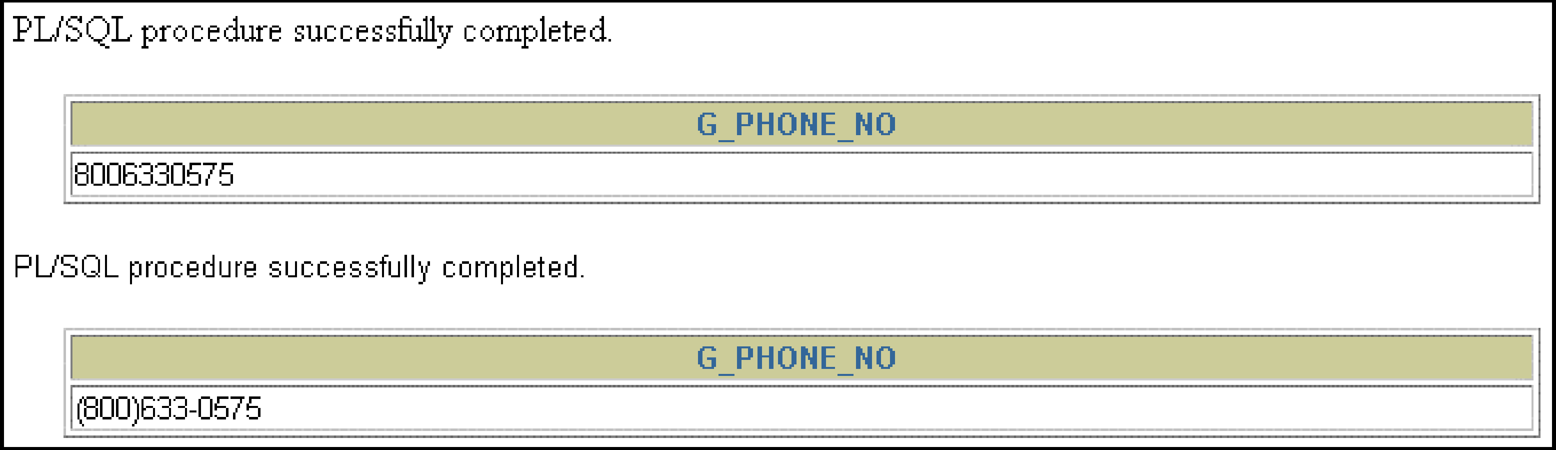
Viewing IN OUT Parameters

```
VARIABLE g_phone_no VARCHAR2(15)
BEGIN
  :g_phone_no := '8006330575';
END;
/
PRINT g_phone_no
EXECUTE format_phone (:g_phone_no)
PRINT g_phone_no
```



```
PL/SQL procedure successfully completed.

      G_PHONE_NO
8006330575

PL/SQL procedure successfully completed.

      G_PHONE_NO
(800)633-0575
```

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Methods for Passing Parameters

- Positional: List actual parameters in the same order as formal parameters.
- Named: List actual parameters in arbitrary order by associating each with its corresponding formal parameter.
- Combination: List some of the actual parameters as positional and some as named.

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DEFAULT Option for Parameters

```
CREATE OR REPLACE PROCEDURE add_dept
  (p_name  IN departments.department_name%TYPE
                              DEFAULT 'unknown',
   p_loc   IN 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;
/
```

```
Procedure created.
```

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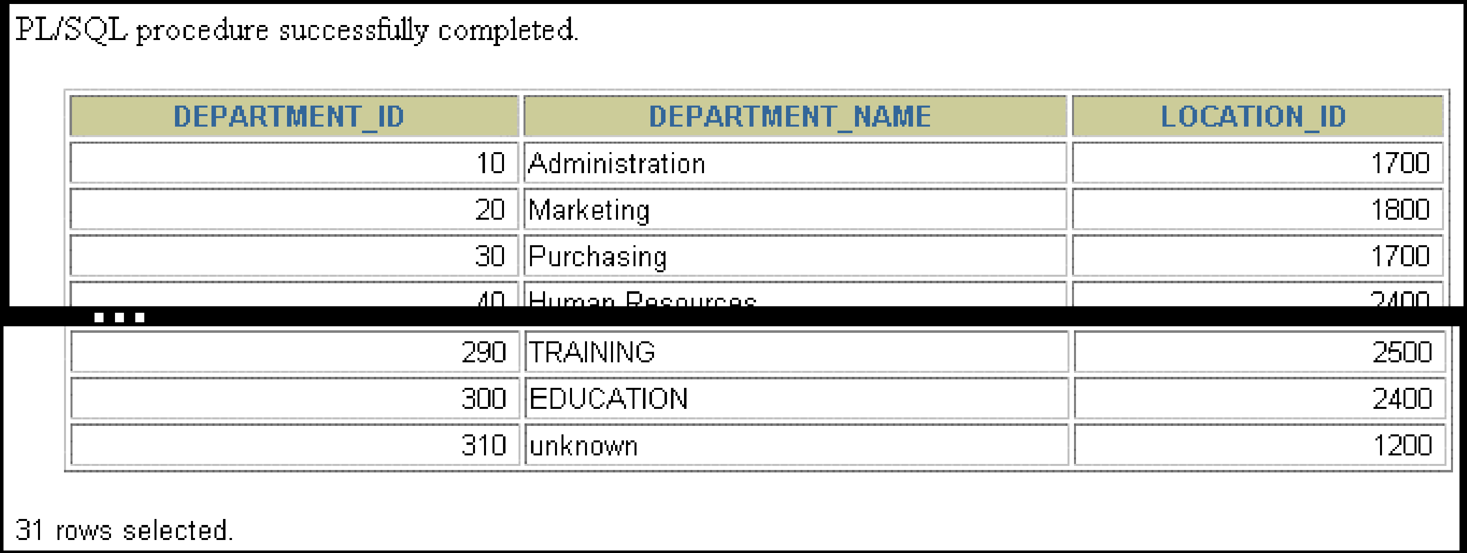
Examples of Passing Parameters

```
BEGIN
  add_dept;
  add_dept ('TRAINING', 2500);
  add_dept ( p_loc => 2400, p_name =>'EDUCATION');
  add_dept ( p_loc => 1200) ;
END;
/
SELECT department_id, department_name, location_id
FROM departments;
```



```
PL/SQL procedure successfully completed.

DEPARTMENT_ID  DEPARTMENT_NAME   LOCATION_ID
           10  Administration           1700
           20  Marketing                1800
           30  Purchasing               1700
           40  Human Resources          2400
...
          290  TRAINING                 2500
          300  EDUCATION                2400
          310  unknown                  1200

31 rows selected.
```

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Declaring Subprograms

leave_emp2.sql

```
CREATE OR REPLACE PROCEDURE leave_emp2
  (p_id  IN  employees.employee_id%TYPE)
IS
  PROCEDURE log_exec
  IS
  BEGIN
    INSERT INTO log_table (user_id, log_date)
    VALUES (USER, SYSDATE);
  END log_exec;
BEGIN
  DELETE FROM employees
  WHERE employee_id = p_id;
  log_exec;
END leave_emp2;
/
```

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Invoking a Procedure from an Anonymous PL/SQL Block

```
DECLARE
  v_id NUMBER := 163;
BEGIN
  raise_salary(v_id);    --invoke procedure
  COMMIT;
...
END;
```

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Invoking a Procedure from Another Procedure

process_emps.sql

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

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Removing Procedures

Drop a procedure stored in the database.

Syntax:

```
DROP PROCEDURE procedure_name
```

Example:

```
DROP PROCEDURE raise_salary;
```

```
Procedure dropped.
```

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Summary

In this lesson, you should have learned that:

- A procedure is a subprogram that performs an action.
- You create procedures by using the `CREATE PROCEDURE` command.
- You can compile and save a procedure in the database.
- Parameters are used to pass data from the calling environment to the procedure.
- There are three parameter modes: `IN`, `OUT`, and `IN OUT`.

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Summary

- Local subprograms are programs that are defined within the declaration section of another program.
- Procedures can be invoked from any tool or language that supports PL/SQL.
- You should be aware of the effect of handled and unhandled exceptions on transactions and calling procedures.
- You can remove procedures from the database by using the `DROP PROCEDURE` command.
- Procedures can serve as building blocks for an application.

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10

Creating Functions

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Objectives

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

- Describe the uses of functions
- Create stored functions
- Invoke a function
- Remove a function
- Differentiate between a procedure and a function

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Overview of Stored Functions

- A function is a named PL/SQL block that returns a value.
- A function can be stored in the database as a schema object for repeated execution.
- A function is called as part of an expression.

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Syntax for Creating Functions

```
CREATE [OR REPLACE] FUNCTION function_name
 [(parameter1 [mode1] datatype1,
  parameter2 [mode2] datatype2,
  . . .)]
RETURN datatype
IS|AS
PL/SQL Block;
```

The PL/SQL block must have at least one RETURN statement.

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Creating a Stored Function by Using *i*SQL*Plus

1. Enter the text of the `CREATE FUNCTION` statement in an editor and save it as a SQL script file.
2. Run the script file to store the source code and compile the function.
3. Use `SHOW ERRORS` to see compilation errors.
4. When successfully compiled, invoke the function.

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Creating a Stored Function by Using *i*SQL*Plus: Example

get_salary.sql

```
CREATE OR REPLACE FUNCTION get_sal
      (p_id  IN employees.employee_id%TYPE)
      RETURN NUMBER
IS
      v_salary employees.salary%TYPE :=0;
BEGIN
      SELECT salary
      INTO   v_salary
      FROM   employees
      WHERE  employee_id = p_id;
     RETURN v_salary;
END get_sal;
/
```

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Executing Functions

- Invoke a function as part of a PL/SQL expression.
- Create a variable to hold the returned value.
- Execute the function. The variable will be populated by the value returned through a `RETURN` statement.

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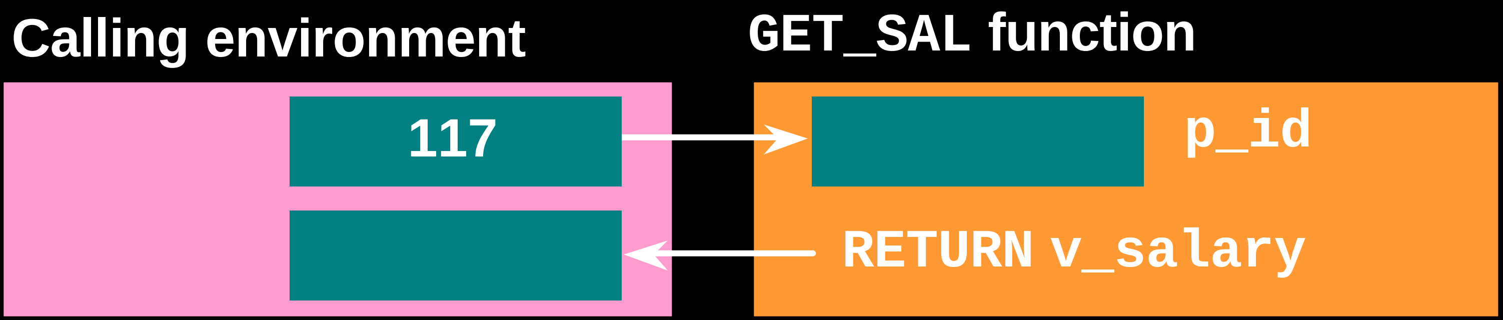
Executing Functions: Example



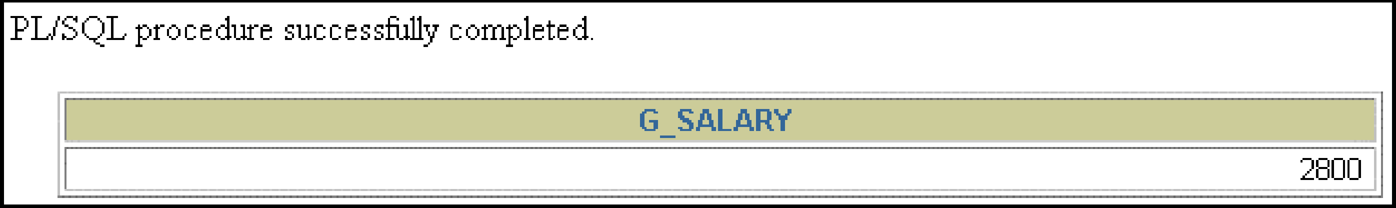
1. Load and run the `get_salary.sql` file to create the function

```
VARIABLE g_salary NUMBER

EXECUTE :g_salary := get_sal(117)

PRINT g_salary
```

Steps marked 2, 3 and 4 point to the three lines above.



```
PL/SQL procedure successfully completed.

G_SALARY
    2800
```

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Advantages of User-Defined Functions in SQL Expressions

- Extend SQL where activities are too complex, too awkward, or unavailable with SQL
- Can increase efficiency when used in the `WHERE` clause to filter data, as opposed to filtering the data in the application
- Can manipulate character strings

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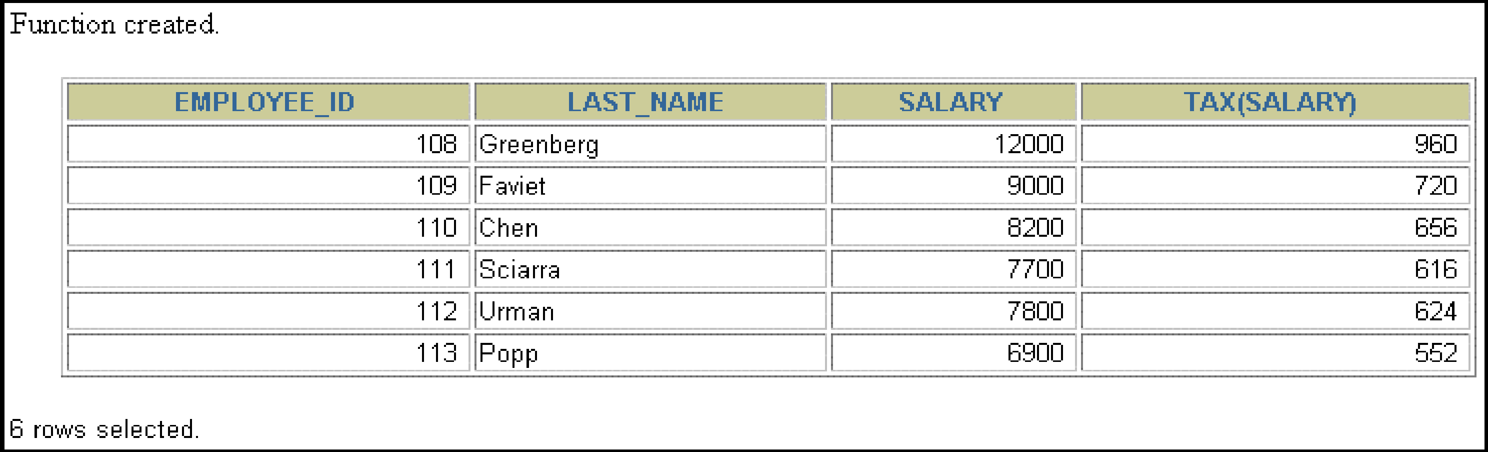
Invoking Functions in SQL Expressions: Example

```
CREATE OR REPLACE FUNCTION tax(p_value IN NUMBER)
 RETURN NUMBER IS
BEGIN
   RETURN (p_value * 0.08);
END tax;
/
SELECT employee_id, last_name, salary, tax(salary)
FROM   employees
WHERE  department_id = 100;
```



Function created.

EMPLOYEE_ID	LAST_NAME	SALARY	TAX(SALARY)
108	Greenberg	12000	960
109	Faviet	9000	720
110	Chen	8200	656
111	Sciarra	7700	616
112	Urman	7800	624
113	Popp	6900	552

6 rows selected.

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Restrictions on Calling Functions from SQL Expressions

To be callable from SQL expressions, a user-defined function must:

- Be a stored function
- Accept only `IN` parameters
- Accept only valid SQL data types, not PL/SQL specific types, as parameters
- Return data types that are valid SQL data types, not PL/SQL specific types

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Restrictions on Calling Functions from SQL Expressions

- Functions called from SQL expressions cannot contain DML statements.
- Functions called from UPDATE/DELETE statements on a table T cannot contain DML on the same table T.
- Functions called from an UPDATE or a DELETE statement on a table T cannot query the same table.
- Functions called from SQL statements cannot contain statements that end the transactions.
- Calls to subprograms that break the previous restriction are not allowed in the function.

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Restrictions on Calling from SQL

```
CREATE OR REPLACE FUNCTION dml_call_sql (p_sal NUMBER)
   RETURN NUMBER IS
BEGIN
   INSERT INTO employees(employee_id, last_name, email,
                         hire_date, job_id, salary)
         VALUES(1, 'employee 1', 'emp1@company.com',
                    SYSDATE, 'SA_MAN', 1000);
   RETURN (p_sal + 100);
END;
/
```

```
Function created.
```

```
UPDATE employees SET salary = dml_call_sql(2000)
 WHERE employee_id = 170;
```

```
UPDATE employees SET salary = dml_call_sql(2000)
                              *
ERROR at line 1:
ORA-04091: table PLSQL.EMPLOYEES is mutating, trigger/function may not see it
ORA-06512: at "PLSQL.DML_CALL_SQL", line 4
```

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Removing Functions

Drop a stored function.

Syntax:

```
DROP FUNCTION function_name
```

Example:

```
DROP FUNCTION get_sal;
```

```
Function dropped.
```

- All the privileges granted on a function are revoked when the function is dropped.
- The `CREATE OR REPLACE` syntax is equivalent to dropping a function and recreating it. Privileges granted on the function remain the same when this syntax is used.

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Comparing Procedures and Functions

Procedures	Functions
Execute as a PL/SQL statement	Invoke as part of an expression
Do not contain RETURN clause in the header	Must contain a RETURN clause in the header
Can return none, one, or many values	Must return a single value
Can contain a RETURN statement	Must contain at least one RETURN statement

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Summary

In this lesson, you should have learned that:

- A function is a named PL/SQL block that must return a value.
- A function is created by using the `CREATE FUNCTION` syntax.
- A function is invoked as part of an expression.
- A function stored in the database can be called in SQL statements.
- A function can be removed from the database by using the `DROP  FUNCTION` syntax.
- Generally, you use a procedure to perform an action and a function to compute a value.

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11

Managing Subprograms

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Objectives

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

- Contrast system privileges with object privileges
- Contrast invokers rights with definers rights
- Identify views in the data dictionary to manage stored objects
- Describe how to debug subprograms by using the `DBMS_OUTPUT` package

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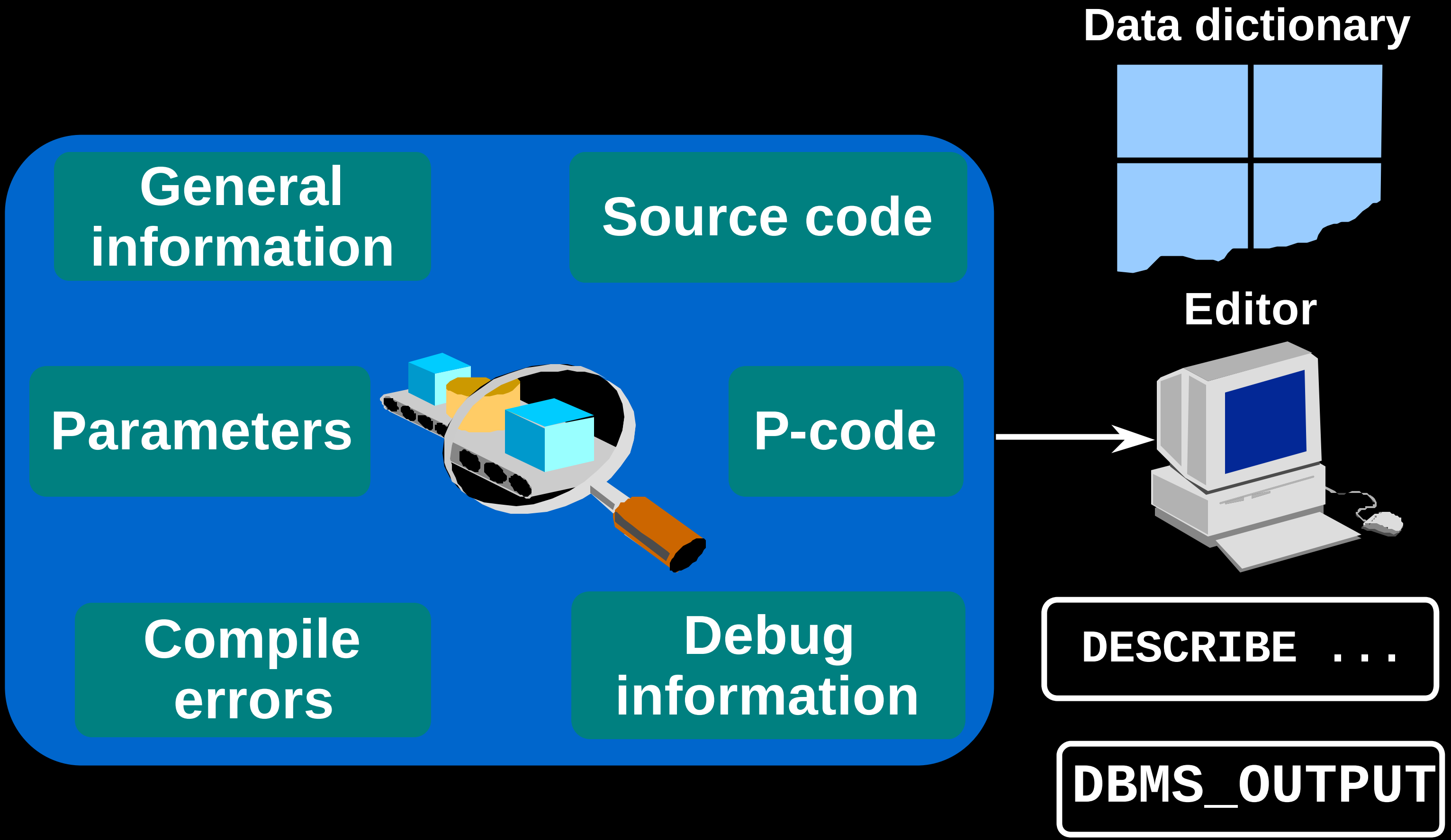
Managing Stored PL/SQL Objects



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USER_OBJECTS

Column	Column Description
OBJECT_NAME	Name of the object
OBJECT_ID	Internal identifier for the object
OBJECT_TYPE	Type of object, for example, TABLE, PROCEDURE, FUNCTION, PACKAGE, PACKAGE BODY, TRIGGER
CREATED	Date when the object was created
LAST_DDL_TIME	Date when the object was last modified
TIMESTAMP	Date and time when the object was last recompiled
STATUS	VALID or INVALID

*Abridged column list

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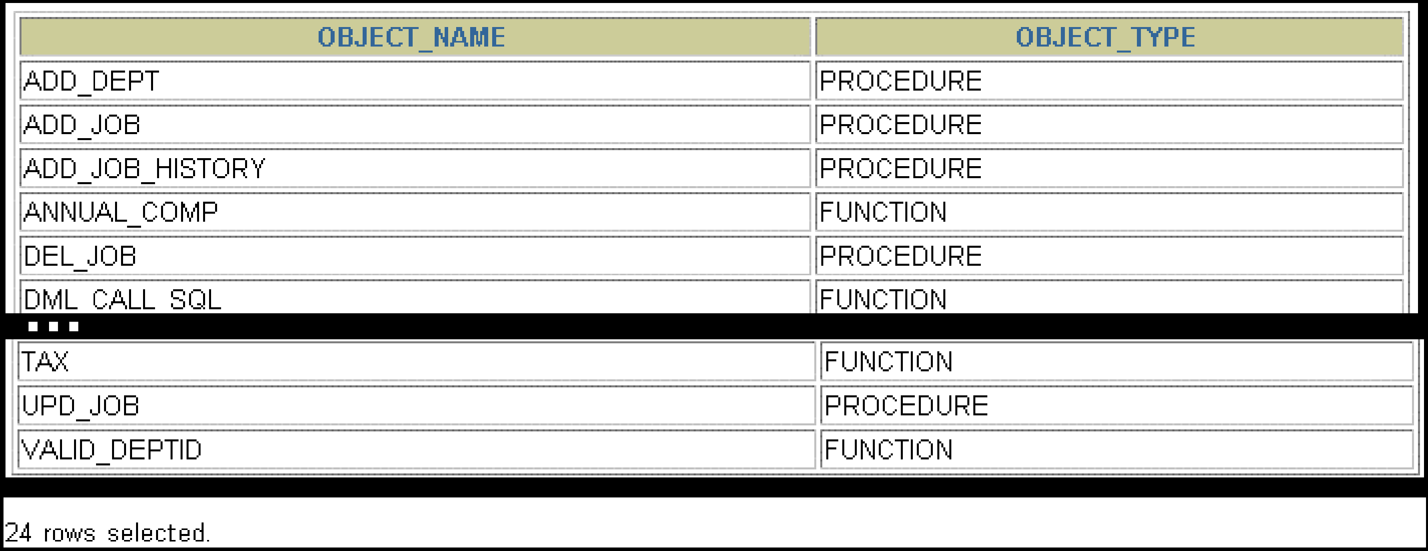
List All Procedures and Functions

```
SELECT object_name, object_type
FROM  user_objects
WHERE object_type in ('PROCEDURE','FUNCTION')
ORDER BY object_name;
```



OBJECT_NAME	OBJECT_TYPE
ADD_DEPT	PROCEDURE
ADD_JOB	PROCEDURE
ADD_JOB_HISTORY	PROCEDURE
ANNUAL_COMP	FUNCTION
DEL_JOB	PROCEDURE
DML_CALL_SQL	FUNCTION
…	
TAX	FUNCTION
UPD_JOB	PROCEDURE
VALID_DEPTID	FUNCTION

```
24 rows selected.
```

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USER_SOURCE Data Dictionary View

Column	Column Description
`NAME`	Name of the object
`TYPE`	Type of object, for example, `PROCEDURE`, `FUNCTION`, `PACKAGE`, `PACKAGE BODY`
`LINE`	Line number of the source code
`TEXT`	Text of the source code line

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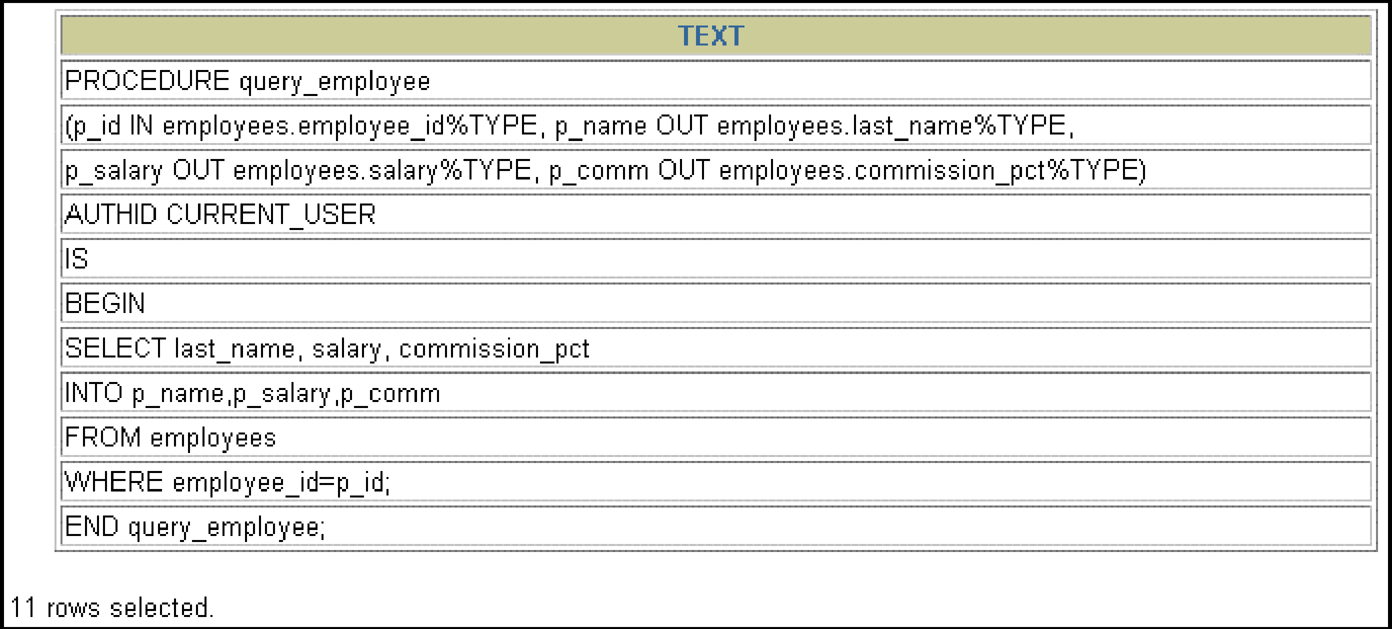
List the Code of Procedures and Functions

```
SELECT  text
FROM  user_source
WHERE  name = 'QUERY_EMPLOYEE'
ORDER BY  line;
```



TEXT
PROCEDURE query_employee
(p_id IN employees.employee_id%TYPE, p_name OUT employees.last_name%TYPE,
p_salary OUT employees.salary%TYPE, p_comm OUT employees.commission_pct%TYPE)
AUTHID CURRENT_USER
IS
BEGIN
SELECT last_name, salary, commission_pct
INTO p_name,p_salary,p_comm
FROM employees
WHERE employee_id=p_id;
END query_employee;

11 rows selected.

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USER_ERRORS

Column	Column Description
`NAME`	Name of the object
`TYPE`	Type of object, for example, `PROCEDURE`, `FUNCTION`, `PACKAGE`, `PACKAGE BODY`, `TRIGGER`
`SEQUENCE`	Sequence number, for ordering
`LINE`	Line number of the source code at which the error occurs
`POSITION`	Position in the line at which the error occurs
`TEXT`	Text of the error message

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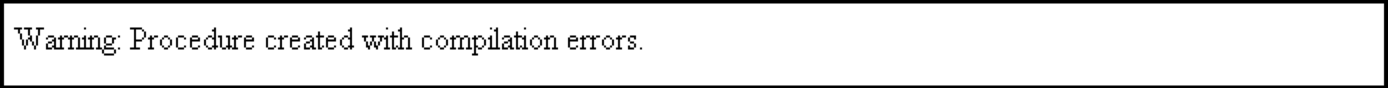
Detecting Compilation Errors: Example

```
CREATE OR REPLACE PROCEDURE log_execution
IS
BEGIN
INPUT INTO log_table (user_id, log_date)
                                         -- wrong
VALUES (USER, SYSDATE);
END;
/
```



```
Warning: Procedure created with compilation errors.
```

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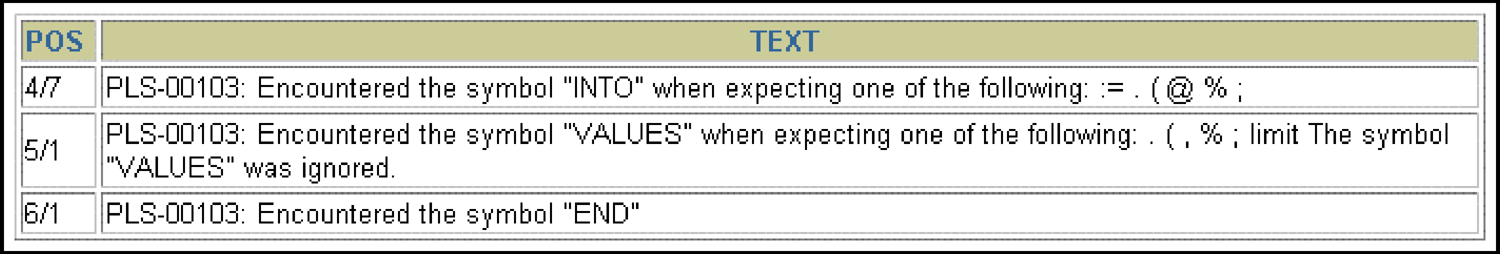
List Compilation Errors by Using USER_ERRORS

```
SELECT line || '/' || position POS, text
FROM   user_errors
WHERE  name = 'LOG_EXECUTION'
ORDER BY line;
```



POS	TEXT
4/7	PLS-00103: Encountered the symbol "INTO" when expecting one of the following: := . (@ % ;
5/1	PLS-00103: Encountered the symbol "VALUES" when expecting one of the following: . (, % ; limit The symbol "VALUES" was ignored.
6/1	PLS-00103: Encountered the symbol "END"

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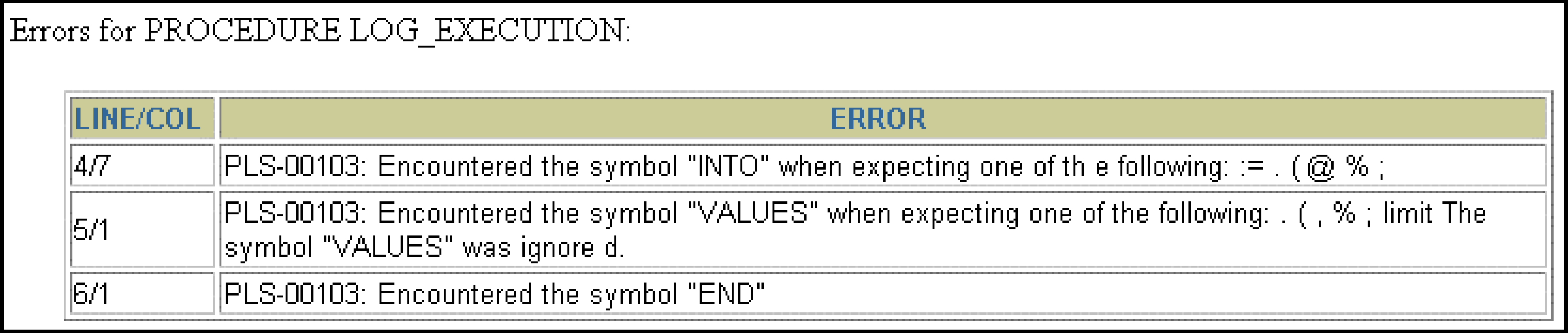
List Compilation Errors by Using `SHOW ERRORS`

```
SHOW ERRORS PROCEDURE log_execution
```



Errors for PROCEDURE LOG_EXECUTION:

LINE/COL	ERROR
4/7	PLS-00103: Encountered the symbol "INTO" when expecting one of th e following: := . (@ % ;
5/1	PLS-00103: Encountered the symbol "VALUES" when expecting one of the following: . (, % ; limit The symbol "VALUES" was ignore d.
6/1	PLS-00103: Encountered the symbol "END"

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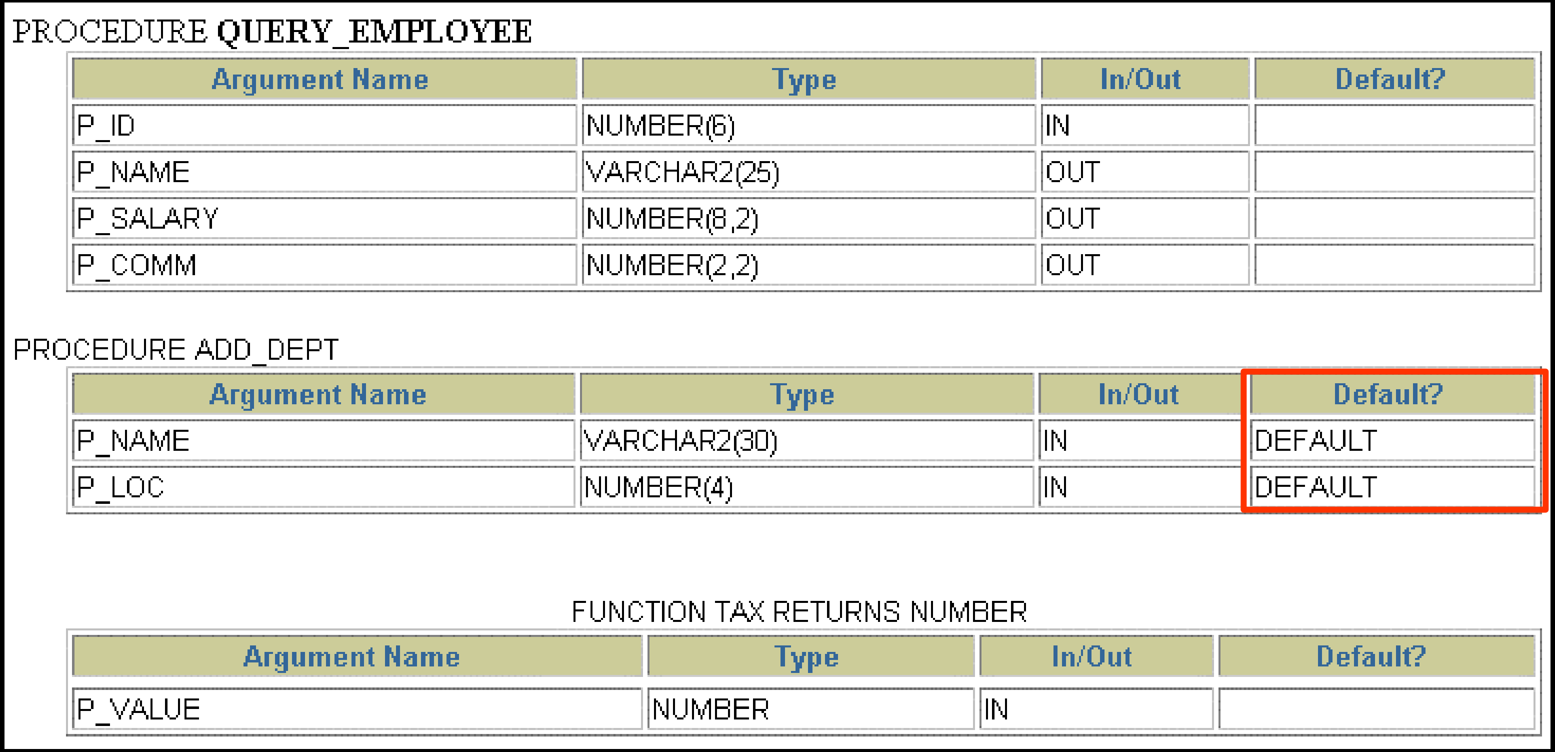
DESCRIBE in *i*SQL*Plus

```
DESCRIBE query_employee
DESCRIBE add_dept
DESCRIBE tax
```



PROCEDURE QUERY_EMPLOYEE

Argument Name	Type	In/Out	Default?
P_ID	NUMBER(6)	IN	
P_NAME	VARCHAR2(25)	OUT	
P_SALARY	NUMBER(8,2)	OUT	
P_COMM	NUMBER(2,2)	OUT	

PROCEDURE ADD_DEPT

Argument Name	Type	In/Out	Default?
P_NAME	VARCHAR2(30)	IN	DEFAULT
P_LOC	NUMBER(4)	IN	DEFAULT

FUNCTION TAX RETURNS NUMBER

Argument Name	Type	In/Out	Default?
P_VALUE	NUMBER	IN	

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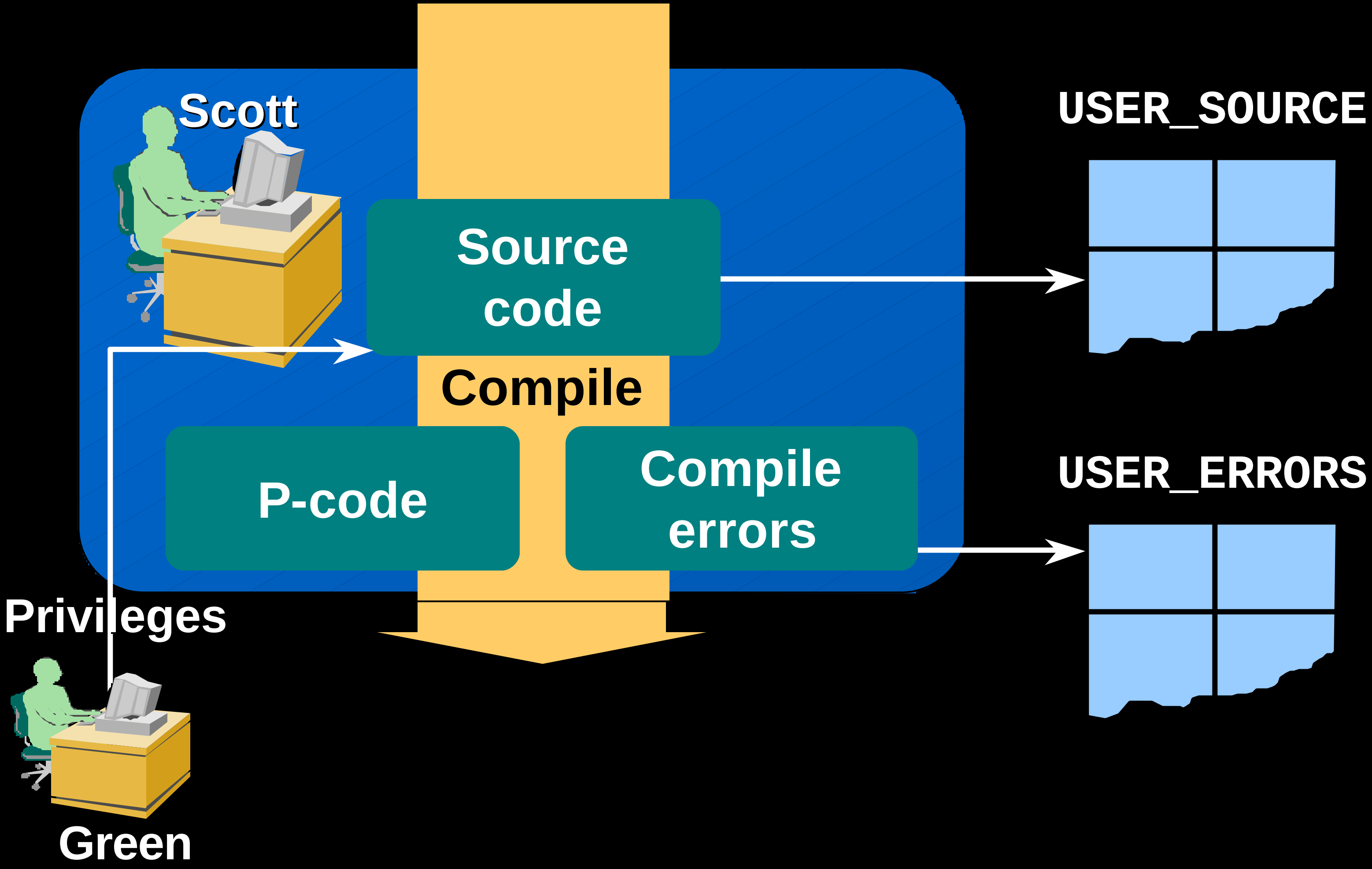
Summary



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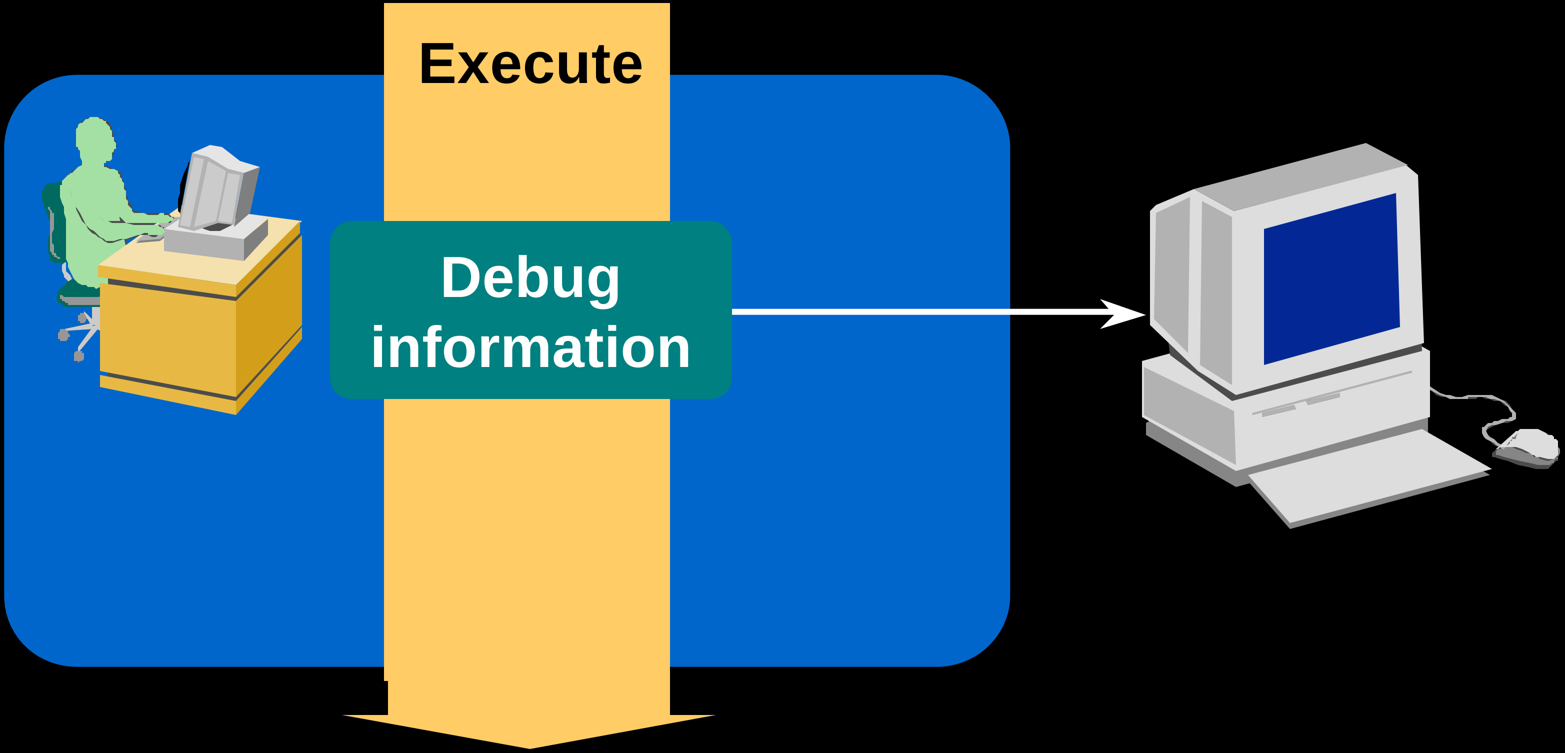
Summary



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Practice 11 Overview

This practice covers the following topics:

- Re-creating the source file for a procedure
- Re-creating the source file for a function

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12

Creating Packages

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Objectives

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

- Describe packages and list their possible components
- Create a package to group together related variables, cursors, constants, exceptions, procedures, and functions
- Designate a package construct as either public or private
- Invoke a package construct
- Describe a use for a bodiless package

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Overview of Packages

Packages:

- Group logically related PL/SQL types, items, and subprograms
- Consist of two parts:
  - Specification
  - Body
- Cannot be invoked, parameterized, or nested
- Allow the Oracle server to read multiple objects into memory at once

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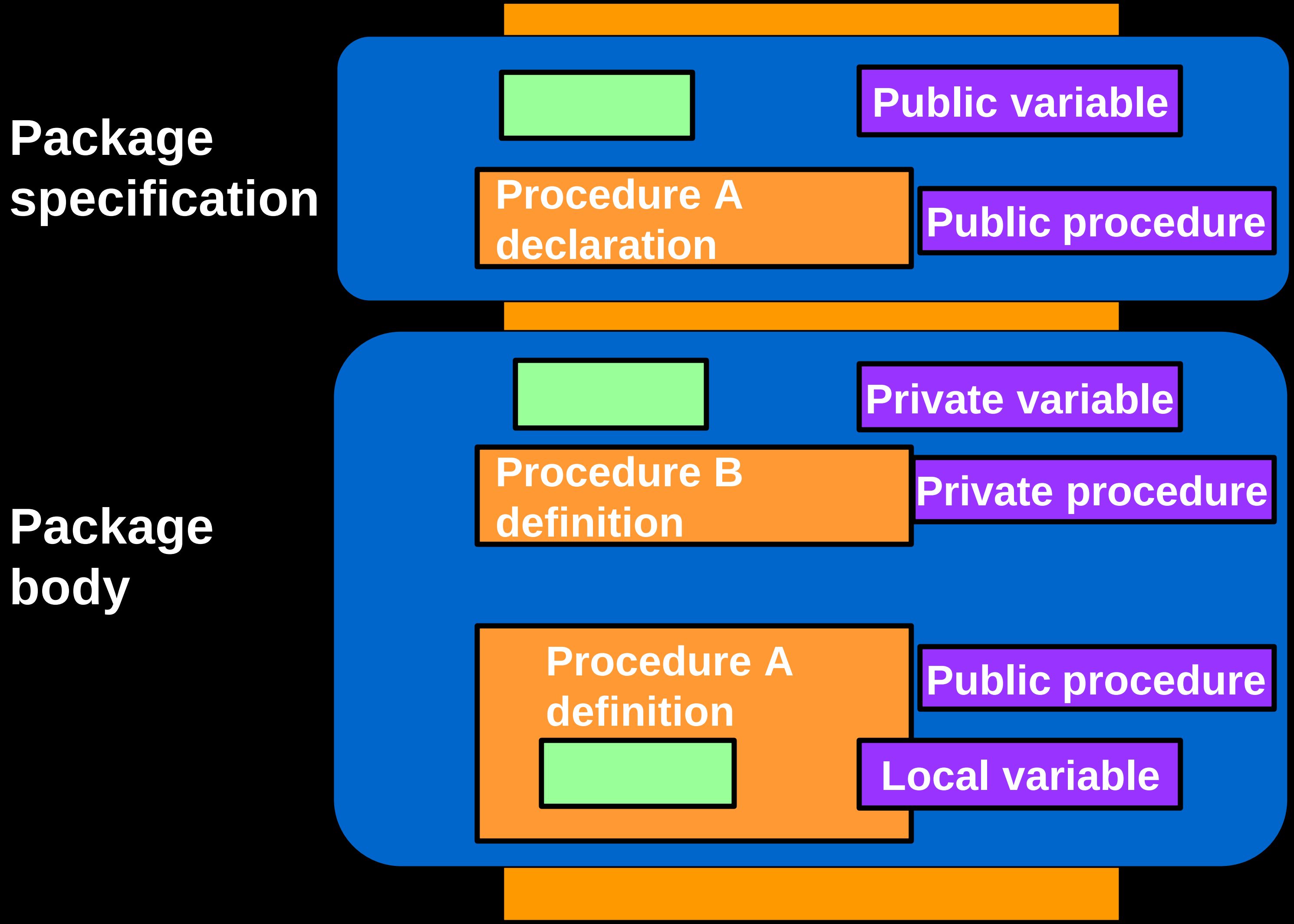
Components of a Package



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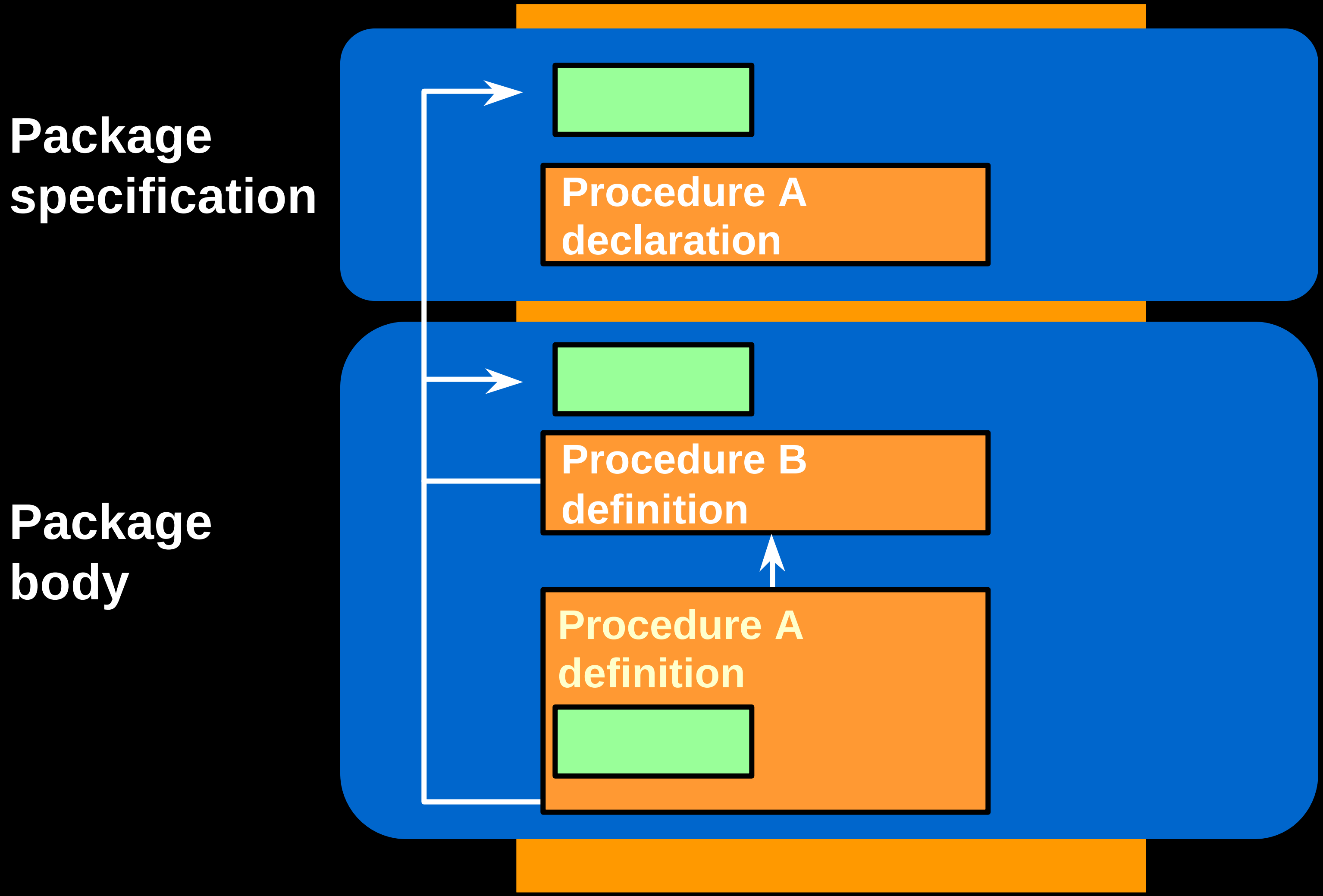
Referencing Package Objects



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Developing a Package

- Saving the text of the `CREATE PACKAGE` statement in two different SQL files facilitates later modifications to the package.
- A package specification can exist without a package body, but a package body cannot exist without a package specification.

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Creating the Package Specification

Syntax:

```
CREATE [OR REPLACE] PACKAGE package_name
IS|AS
    public type and item declarations
    subprogram specifications
END package_name;
```

- **The `REPLACE` option drops and recreates the package specification.**
- **Variables declared in the package specification are initialized to `NULL` by default.**
- **All the constructs declared in a package specification are visible to users who are granted privileges on the package.**

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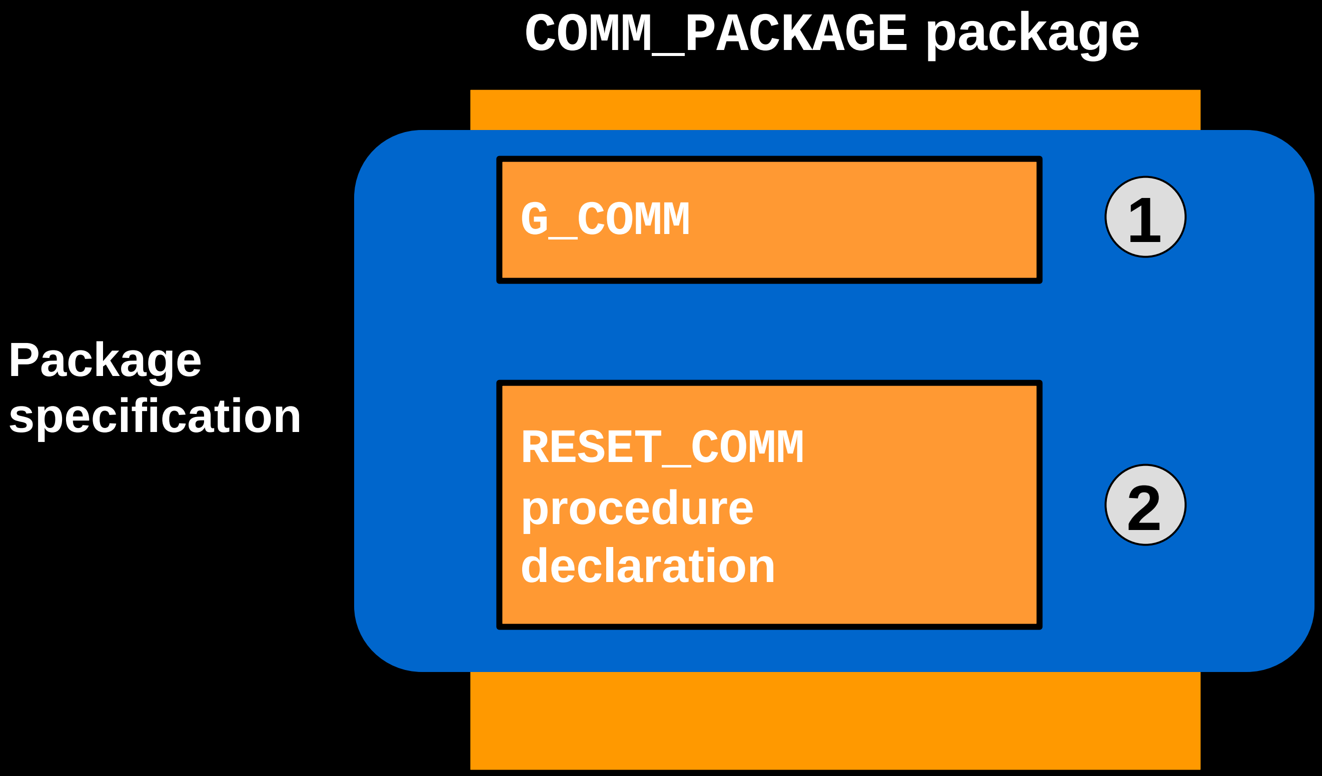
Declaring Public Constructs



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Creating a Package Specification: Example

```
CREATE OR REPLACE PACKAGE comm_package IS
  g_comm NUMBER := 0.10;  --initialized to 0.10
  PROCEDURE reset_comm
  (p_comm   IN  NUMBER);
END comm_package;
/
```

```
Package created.
```

- G_COMM is a global variable and is initialized to 0.10.
- RESET_COMM is a public procedure that is implemented in the package body.

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Creating the Package Body

Syntax:

```
CREATE [OR REPLACE] PACKAGE BODY package_name
IS|AS
    private type and item declarations
    subprogram bodies
END package_name;
```

- The REPLACE option drops and recreates the package body.
- Identifiers defined only in the package body are private constructs. These are not visible outside the package body.
- All private constructs must be declared before they are used in the public constructs.

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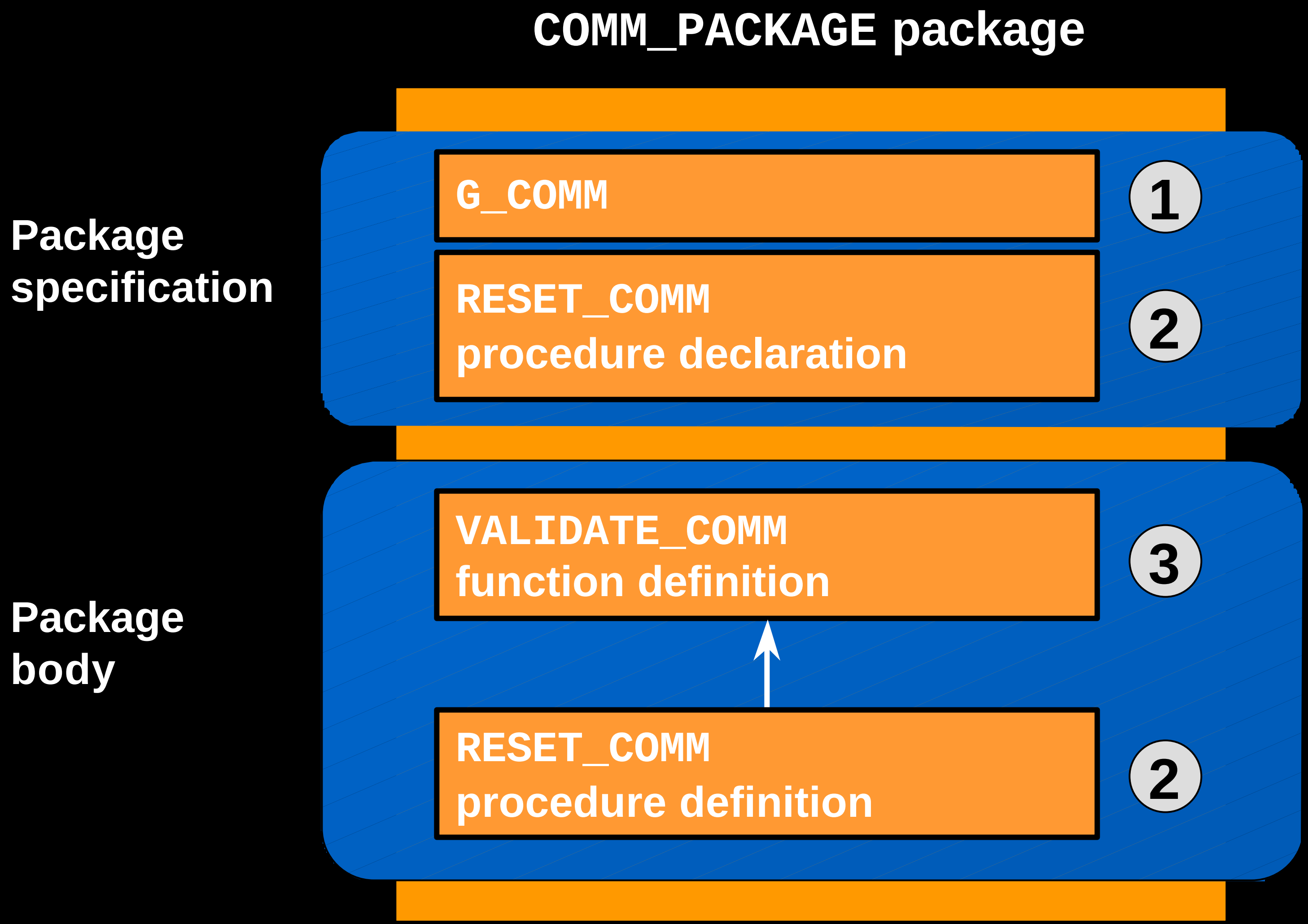
Public and Private Constructs


COMM_PACKAGE package
Package specification
G_COMM
1
RESET_COMM procedure declaration
2
Package body
VALIDATE_COMM function definition
3
RESET_COMM procedure definition
2

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Creating a Package Body: Example

comm_pack.sql

```
CREATE OR REPLACE PACKAGE BODY comm_package
IS
   FUNCTION  validate_comm (p_comm IN NUMBER)
    RETURN BOOLEAN
   IS
     v_max_comm    NUMBER;
   BEGIN
     SELECT    MAX(commission_pct)
      INTO     v_max_comm
      FROM     employees;
     IF   p_comm > v_max_comm THEN RETURN(FALSE);
     ELSE   RETURN(TRUE);
     END IF;
   END validate_comm;
...
```

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Creating a Package Body: Example

comm_pack.sql

```
  PROCEDURE  reset_comm (p_comm   IN  NUMBER)
  IS
  BEGIN
   IF  validate_comm(p_comm)
    THEN   g_comm:=p_comm;  --reset global variable
   ELSE
    RAISE_APPLICATION_ERROR(-20210,'Invalid commission');
   END IF;
  END reset_comm;
END comm_package;
/
```

```
Package body created.
```

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Invoking Package Constructs

Example 1: Invoke a function from a procedure within the same package.

```
CREATE OR REPLACE PACKAGE BODY comm_package IS
   . . .
 PROCEDURE reset_comm
  (p_comm   IN  NUMBER)
 IS
 BEGIN
  IF validate_comm(p_comm)
  THEN g_comm := p_comm;
  ELSE
    RAISE_APPLICATION_ERROR
         (-20210, 'Invalid commission');
  END IF;
 END reset_comm;
END comm_package;
```

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Invoking Package Constructs

Example 2: Invoke a package procedure from *i*SQL*Plus.

```
EXECUTE comm_package.reset_comm(0.15)
```

Example 3: Invoke a package procedure in a different schema.

```
EXECUTE scott.comm_package.reset_comm(0.15)
```

Example 4: Invoke a package procedure in a remote database.

```
EXECUTE comm_package.reset_comm@ny(0.15)
```

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Declaring a Bodiless Package

```
CREATE OR REPLACE PACKAGE global_consts IS
  mile_2_kilo    CONSTANT  NUMBER  :=  1.6093;
  kilo_2_mile    CONSTANT  NUMBER  :=  0.6214;
  yard_2_meter   CONSTANT  NUMBER  :=  0.9144;
  meter_2_yard   CONSTANT  NUMBER  :=  1.0936;
END global_consts;
/

EXECUTE DBMS_OUTPUT.PUT_LINE('20 miles = '||20*
    global_consts.mile_2_kilo||' km')
```

```
Package created.
20 miles = 32.186 km
PL/SQL procedure successfully completed.
```

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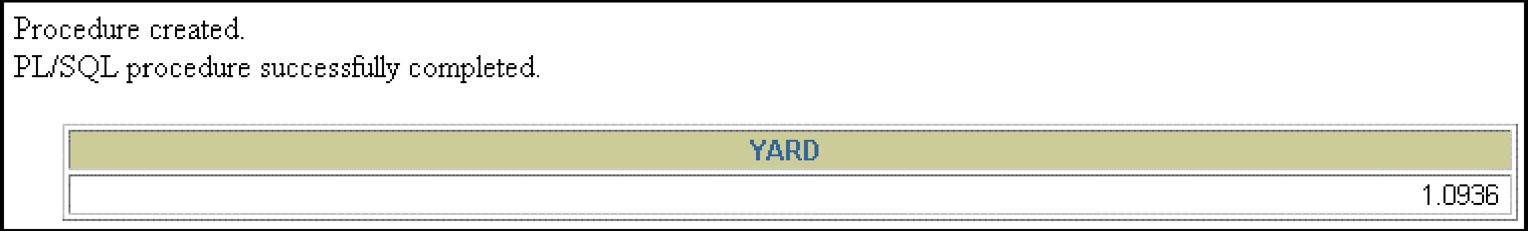
Referencing a Public Variable from a Stand-Alone Procedure

Example:

```
CREATE OR REPLACE PROCEDURE meter_to_yard
            (p_meter IN NUMBER, p_yard OUT NUMBER)
IS
BEGIN
  p_yard := p_meter * global_consts.meter_2_yard;
END meter_to_yard;
/
VARIABLE yard NUMBER
EXECUTE  meter_to_yard (1, :yard)
PRINT yard
```



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

YARD
1.0936

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Removing Packages

To remove the package specification and the body, use the following syntax:

```
DROP PACKAGE package_name;
```

To remove the package body, use the following syntax:

```
DROP PACKAGE BODY package_name;
```

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Guidelines for Developing Packages

- Construct packages for general use.
- Define the package specification before the body.
- The package specification should contain only those constructs that you want to be public.
- Place items in the declaration part of the package body when you must maintain them throughout a session or across transactions.
- Changes to the package specification require recompilation of each referencing subprogram.
- The package specification should contain as few constructs as possible.

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Advantages of Packages

- Modularity: Encapsulate related constructs.
- Easier application design: Code and compile specification and body separately.
- Hiding information:
  - Only the declarations in the package specification are visible and accessible to applications.
  - Private constructs in the package body are hidden and inaccessible.
  - All coding is hidden in the package body.

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Advantages of Packages

- Added functionality: Persistency of variables and cursors
- Better performance:
  - The entire package is loaded into memory when the package is first referenced.
  - There is only one copy in memory for all users.
  - The dependency hierarchy is simplified.
- Overloading: Multiple subprograms of the same name

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Summary

In this lesson, you should have learned how to:

- Improve organization, management, security, and performance by using packages
- Group related procedures and functions together in a package
- Change a package body without affecting a package specification
- Grant security access to the entire package

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Summary

In this lesson, you should have learned how to:

- Hide the source code from users
- Load the entire package into memory on the first call
- Reduce disk access for subsequent calls
- Provide identifiers for the user session

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Summary

Command	Task
`CREATE [OR REPLACE] PACKAGE`	Create (or modify) an existing package specification
`CREATE [OR REPLACE] PACKAGE BODY`	Create (or modify) an existing package body
`DROP PACKAGE`	Remove both the package specification and the package body
`DROP PACKAGE BODY`	Remove the package body only

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