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Database Programming with PL/SQL

10-1
Creating Packages

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Objectives

This lesson covers the following objectives:

- Describe the reasons for using a package
- Describe the two components of a package: specification and body
- Create packages containing related variables, cursors, constants, exceptions, procedures, and functions
- Create a PL/SQL block that invokes a package construct

Purpose

- You have already learned how to create and use stored procedures and functions.
- Suppose you want to create several procedures and/or functions that are related to each other.
- It might be helpful to group them together or in some way identify their relationship to each other.
- Oracle provides a way to do just that.

Purpose

- You can create and manage all the related subprograms as a single database object called a package.
- In this lesson, you learn what a package is and what its components are.
- You will also learn to create and use packages.

What Are PL/SQL Packages?

- PL/SQL packages are containers that enable you to group together related PL/SQL subprograms, variables, cursors, and exceptions.
- For example, a Human Resources package can contain hiring and firing procedures, commission and bonus functions, and tax-exemption variables.

Components of a PL/SQL Package

A package consists of two parts stored separately in the database:

- **Package specification:** The interface to your applications.
  - It must be created first.
  - It declares the constructs (procedures, functions, variables, and so on) that are visible to the calling environment.
- **Package body:** This contains the executable code of the subprograms that were declared in the package specification.
  - It can also contain its own variable declarations.

Package specification

Package body

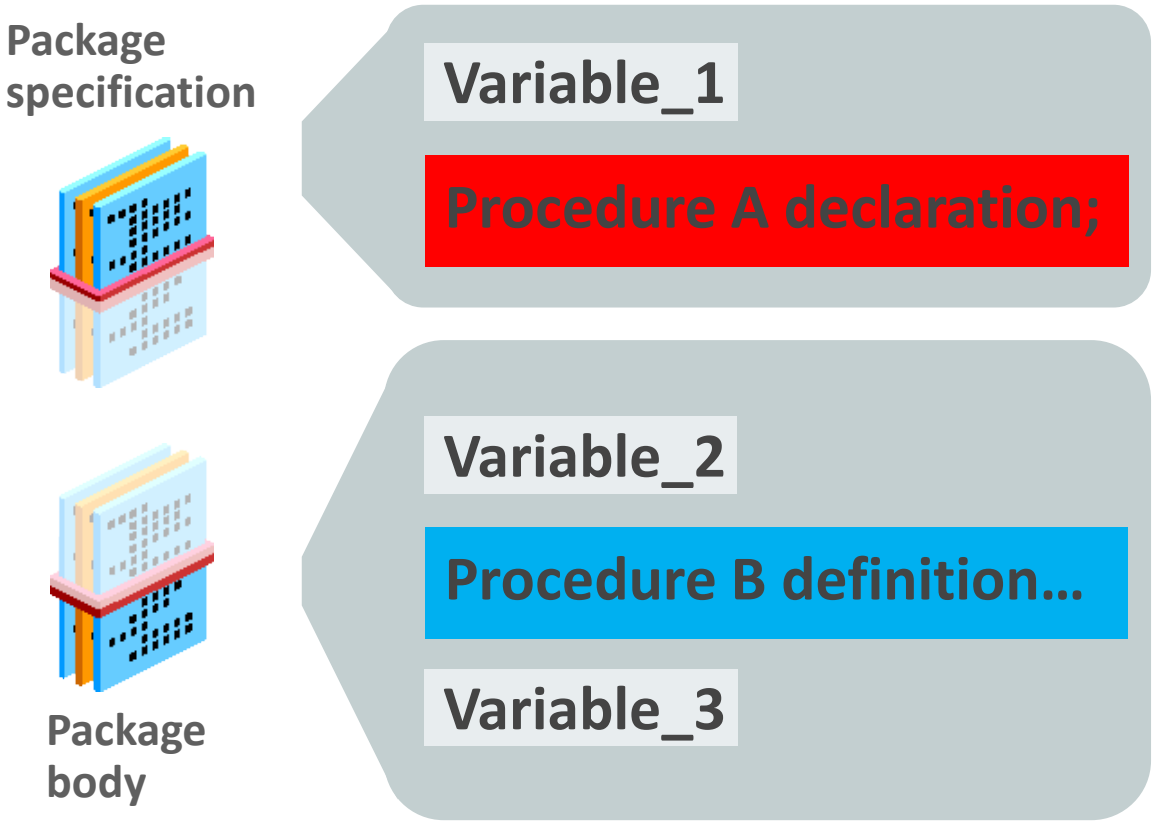
Components of a PL/SQL Package

- The detailed package body code is invisible to the calling environment, which can see only the specification.
- If changes to the code are needed, the body can be edited and recompiled without having to edit or recompile the specification.
- This two-part structure is an example of a modular programming principle called encapsulation.

Package specification

Package body

Components of a PL/SQL Package



Syntax for Creating the Package Specification

- To create packages, you declare all public constructs within the package specification.

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

- The OR REPLACE option drops and re-creates the package specification.

Syntax for Creating the Package Specification

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

- *package_name*: Specifies a name for the package that must be unique among objects within the owning schema.
- Including the package name after the END keyword is optional.

Syntax for Creating the Package Specification

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

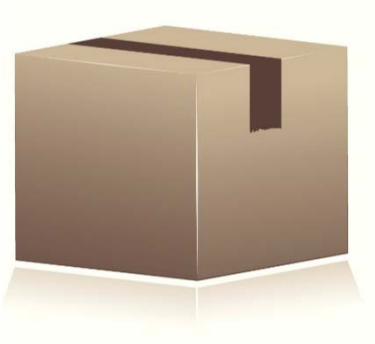
- *public type and variable declarations*: Declares public variables, constants, cursors, exceptions, user-defined types, and subtypes.
- Variables declared in the package specification are initialized to NULL by default.
- *public subprogram specifications*: Declares the public procedures and/or functions in the package.

Creating the Package Specification

- "Public" means that the package construct (variable, procedure, function, and so on) can be seen and executed from outside the package.
- All constructs declared in the package specification are automatically public constructs.
- For all public procedures and functions, the package specification should contain the subprogram name and associated parameters terminated by a semicolon (not the actual code of the subprogram).

Creating the Package Specification

- The implementation (i.e., the detailed code) of a procedure or function that is declared in a package specification is done in the package body.
- The next two slides show code examples.



Example of Package Specification: check_emp_pkg

- G_MAX_LENGTH_OF_SERVICE is a constant declared and initialized in the specification.
- CHK_HIREDATE and CHK_DEPT_MGR are two public procedures declared in the specification.
- Their detailed code is written in the package body.

```
CREATE OR REPLACE PACKAGE check_emp_pkg
IS
  g_max_length_of_service CONSTANT NUMBER := 100;
  PROCEDURE chk_hiredate
    (p_date    IN   employees.hire_date%TYPE);
  PROCEDURE chk_dept_mgr
    (p_empid   IN   employees.employee_id%TYPE,
     p_mgr     IN   employees.manager_id%TYPE);
END check_emp_pkg;
```

Package Specification: A Second Example

Remember that a cursor is a type of variable.

```
CREATE OR REPLACE PACKAGE manage_jobs_pkg
IS
  g_todays_date       DATE := SYSDATE;
  CURSOR jobs_curs  IS
    SELECT employee_id, job_id FROM employees
      ORDER BY employee_id;
  PROCEDURE update_job
    (p_emp_id  IN   employees.employee_id%TYPE);
  PROCEDURE fetch_emps
    (p_job_id  IN   employees.job_id%TYPE,
     p_emp_id  OUT  employees.employee_id%TYPE);
END manage_jobs_pkg;
```

Syntax for Creating the Package Body

- Create a package body to contain the detailed code for all the subprograms declared in the specification.

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

- *package_name* specifies a name for the package body that must be the same as its package specification.
- Using the package name after the END keyword is optional.

Syntax for Creating the Package Body

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

- Private types and variables, and BEGIN initialization statements, are discussed in later lessons.
- *subprogram bodies* must contain the code of all the subprograms declared in the package specification (i.e., the public subprograms) and the code for all private subprograms.

Creating the Package Body

When creating a package body, do the following:

- Specify the OR REPLACE option to overwrite an existing package body.
- Define the subprograms in an appropriate order.
- The basic principle is that you must declare a variable or subprogram before it can be referenced by other components in the same package body.
- Every subprogram declared in the package specification must also be included in the package body.

Example of Package Body: check_emp_pkg

```
CREATE OR REPLACE PACKAGE BODY check_emp_pkg IS
 PROCEDURE chk_hiredate
   (p_date    IN   employees.hire_date%TYPE)
   IS BEGIN
     IF MONTHS_BETWEEN(SYSDATE, p_date) >
       g_max_length_of_service * 12 THEN
       RAISE_APPLICATION_ERROR(-20200, 'Invalid Hiredate');
     END IF;
 END chk_hiredate;
 PROCEDURE chk_dept_mgr
   (p_empid   IN   employees.employee_id%TYPE,
    p_mgr     IN   employees.manager_id%TYPE)
   IS BEGIN ...
 END chk_dept_mgr;
END check_emp_pkg;
```

Changing the Package Body Code

- Suppose now you want to make a change to the CHK_HIREDATE procedure, for example, to raise a different error message.
- You must edit and recompile the package body, but you do not need to recompile the specification.
- Remember, the specification can exist without the body (but the body cannot exist without the specification).
- Because the specification is not recompiled, you do not need to recompile any applications (or other PL/SQL subprograms) that are already invoking the package procedures.

Recompiling the Package Body: check_emp_pkg

```
CREATE OR REPLACE PACKAGE BODY check_emp_pkg IS
 PROCEDURE chk_hiredate
   (p_date    IN   employees.hire_date%TYPE)
   IS BEGIN
     IF MONTHS_BETWEEN(SYSDATE, p_date) >
       g_max_length_of_service * 12 THEN
       RAISE_APPLICATION_ERROR(-20201, 'Hiredate Too Old');
     END IF;
 END chk_hiredate;
 PROCEDURE chk_dept_mgr
   (p_empid   IN   employees.employee_id%TYPE,
    p_mgr     IN   employees.manager_id%TYPE)
   IS BEGIN ...
 END chk_dept_mgr;
END check_emp_pkg;
```

Describing a Package

- You can DESCRIBE a package in the same way as you can DESCRIBE a table or view:

```
DESCRIBE check_emp_pkg
```

Object Type PACKAGE Object CHECK_EMP_PKG

Package Name	Procedure	Argument	In Out	Datatype
CHECK_EMP_PKG	CHK_DEPT_MGR	P_EMPID	IN	NUMBER
		P_MGR	IN	NUMBER
	CHK_HIREDATE	P_DATE	IN	DATE

- You cannot DESCRIBE individual packaged subprograms, only the whole package.

Reasons for Using Packages

- Modularity: Related programs and variables can be grouped together.
- Hiding information: Only the declarations in the package specification are visible to invokers.
- Application developers do not need to know the details of the package body code.
- Easier maintenance: You can change and recompile the package body code without having to recompile the specification.
- Therefore, applications that already use the package do not need to be recompiled.

Terminology

Key terms used in this lesson included:

- Encapsulation
- OR REPLACE
- Package body
- Package specification
- PL/SQL packages

Summary

In this lesson, you should have learned how to:

- Describe the reasons for using a package
- Describe the two components of a package: specification and body
- Create packages containing related variables, cursors, constants, exceptions, procedures, and functions
- Create a PL/SQL block that invokes a package construct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