4

Using More Package Concepts

Objectives

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

- Overload package procedures and functions
- Use forward declarations
- Create an initialization block in a package body
- Manage persistent package data states for the life of a session
- Use PL/SQL tables and records in packages
- Wrap source code stored in the data dictionary so that it is not readable

Overloading Subprograms

The overloading feature in PL/SQL:

- Enables you to create two or more subprograms with the same name
- Requires that the subprogram's formal parameters differ in number, order, or data type family
- Enables you to build flexible ways for invoking subprograms with different data
- Provides a way to extend functionality without loss of existing code

Note: Overloading can be done with local subprograms, package subprograms, and type methods, but not with stand-alone subprograms.

Overloading: Example

```
CREATE OR REPLACE PACKAGE dept_pkg IS
  PROCEDURE add_department(deptno NUMBER,
   name VARCHAR2 := 'unknown', loc NUMBER := 1700);
  PROCEDURE add_department(
   name VARCHAR2 := 'unknown', loc NUMBER := 1700);
END dept_pkg;
/
```

Overloading: Example

```
CREATE OR REPLACE PACKAGE BODY dept_pkg  IS
  PROCEDURE add_department (deptno NUMBER,
   name VARCHAR2:='unknown', loc NUMBER:=1700) IS
  BEGIN
    INSERT INTO departments(department_id,
      department_name, location_id)
    VALUES  (deptno, name, loc);
  END add_department;

  PROCEDURE add_department (
    name VARCHAR2:='unknown', loc NUMBER:=1700) IS
  BEGIN
    INSERT INTO departments (department_id,
      department_name, location_id)
    VALUES (departments_seq.NEXTVAL, name, loc);
  END add_department;
 END dept_pkg;
/
```

Overloading and the STANDARD Package

- A package named STANDARD defines the PL/SQL environment and built-in functions.
- Most built-in functions are overloaded. An example is the TO_CHAR function:

```
FUNCTION TO_CHAR (p1 DATE) RETURN VARCHAR2;
FUNCTION TO_CHAR (p2 NUMBER) RETURN VARCHAR2;
FUNCTION TO_CHAR (p1 DATE, P2 VARCHAR2) RETURN
VARCHAR2;
FUNCTION TO_CHAR (p1 NUMBER, P2 VARCHAR2) RETURN
VARCHAR2;
```

- A PL/SQL subprogram with the same name as a built-in subprogram overrides the standard declaration in the local context, unless you qualify the built-in subprogram with its package name.

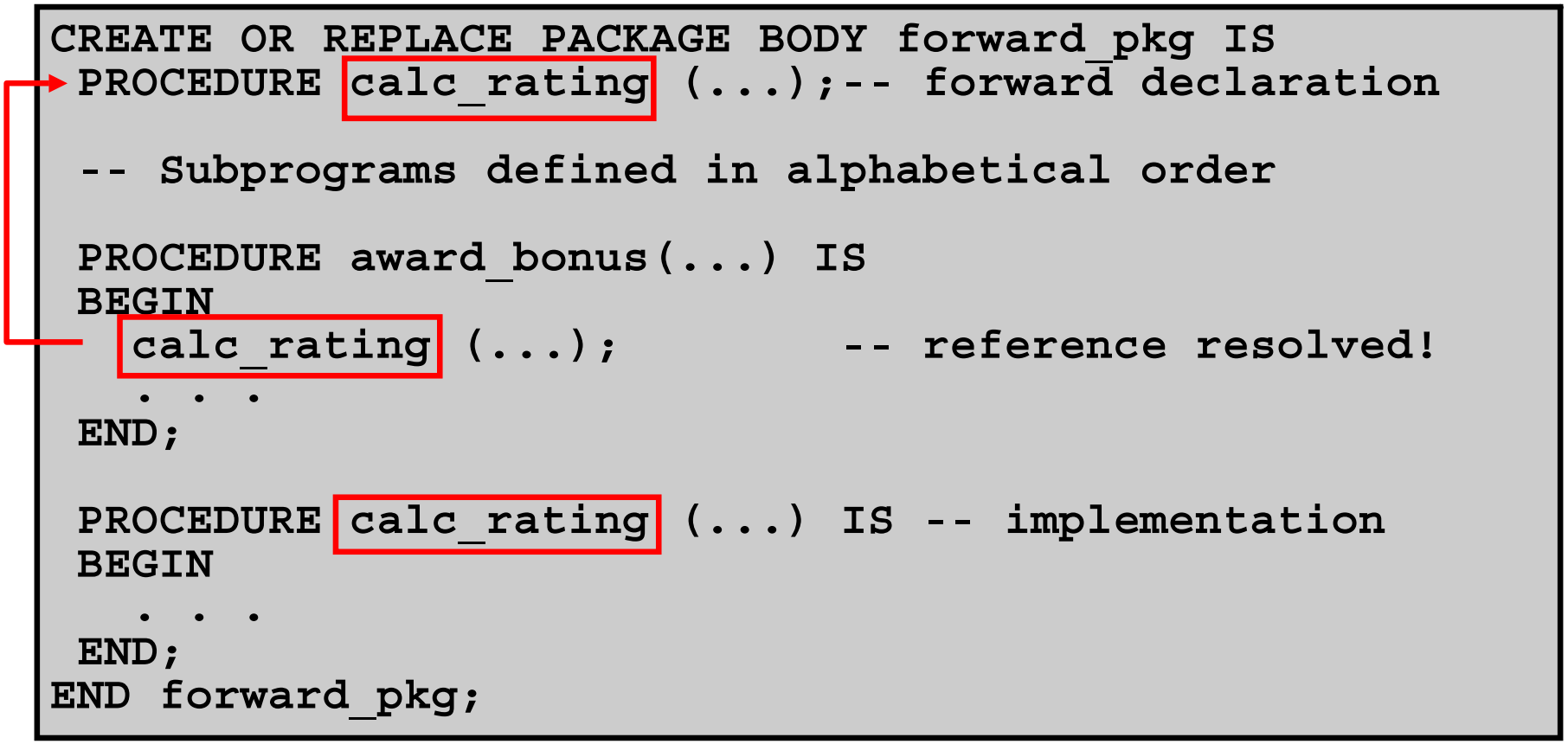
Using Forward Declarations

- Block-structured languages (such as PL/SQL) must declare identifiers before referencing them.
- Example of a referencing problem:

```
CREATE OR REPLACE PACKAGE BODY forward_pkg IS
  PROCEDURE award_bonus(. . .) IS
  BEGIN

    calc_rating (. . .);    --illegal reference

  END;

  PROCEDURE calc_rating (. . .) IS
  BEGIN
    ...
  END;
END forward_pkg;
/
```

Using Forward Declarations

In the package body, a forward declaration is a private subprogram specification terminated by a semicolon.



```
CREATE OR REPLACE PACKAGE BODY forward_pkg IS
 PROCEDURE calc_rating (...);-- forward declaration

 -- Subprograms defined in alphabetical order

 PROCEDURE award_bonus(...) IS
 BEGIN
   calc_rating (...);          -- reference resolved!
   . . .
 END;

 PROCEDURE calc_rating (...) IS -- implementation
 BEGIN
   . . .
 END;
END forward_pkg;
```

Package Initialization Block

The block at the end of the package body executes once and is used to initialize public and private package variables.

```
CREATE OR REPLACE PACKAGE taxes IS
  tax   NUMBER;
  ...   -- declare all public procedures/functions
END taxes;
/
CREATE OR REPLACE PACKAGE BODY taxes IS
  ... -- declare all private variables
  ... -- define public/private procedures/functions
 BEGIN
   SELECT   rate_value INTO tax
   FROM     tax_rates
   WHERE    rate_name = 'TAX';
END taxes;
/
```

Using Package Functions in SQL and Restrictions

- Package functions can be used in SQL statements.
- Functions called from:
  - A query or DML statement must not end the current transaction, create or roll back to a savepoint, or alter the system or session
  - A query or a parallelized DML statement cannot execute a DML statement or modify the database
  - A DML statement cannot read or modify the table being changed by that DML statement

Note: A function calling subprograms that break the preceding restrictions is not allowed.

Package Function in SQL: Example

```
CREATE OR REPLACE PACKAGE taxes_pkg IS
  FUNCTION tax (value IN NUMBER) RETURN NUMBER;
END taxes_pkg;
/
CREATE OR REPLACE PACKAGE BODY taxes_pkg IS
  FUNCTION tax (value IN NUMBER) RETURN NUMBER IS
    rate NUMBER := 0.08;
  BEGIN
    RETURN (value * rate);
  END tax;
END taxes_pkg;
/
```

```
SELECT taxes_pkg.tax(salary), salary, last_name
FROM   employees;
```

Persistent State of Packages

The collection of package variables and the values define the package state. The package state is:

- Initialized when the package is first loaded
- Persistent (by default) for the life of the session
  - Stored in the User Global Area (UGA)
  - Unique to each session
  - Subject to change when package subprograms are called or public variables are modified
- Not persistent for the session but persistent for the life of a subprogram call when using `PRAGMA SERIALLY_REUSABLE` in the package specification

Persistent State of Package Variables: Example

Time	Events	State for: -Scott- STD	MAX	-Jones- STD	MAX
9:00	Scott> EXECUTE comm_pkg.reset_comm(0.25)	0.10 0.25	0.4	-	0.4
9:30	Jones> INSERT INTO employees(last_name,commission_pct) VALUES('Madonna', 0.8);	0.25	0.4		0.8
9:35	Jones> EXECUTE comm_pkg.reset_comm (0.5)	0.25	0.4	0.1 0.5	0.8
10:00	Scott> EXECUTE comm_pkg.reset_comm(0.6) Err -20210 'Bad Commission'	0.25	0.4	0.5	0.8
11:00 11:01 12:00	Jones> ROLLBACK; EXIT ... EXEC comm_pkg.reset_comm(0.2)	0.25 0.25 0.25	0.4 0.4 0.4	0.5 - 0.2	0.4 0.4 0.4

Persistent State of a Package Cursor

```
CREATE OR REPLACE PACKAGE BODY curs_pkg IS
  CURSOR c IS SELECT employee_id FROM employees;
  PROCEDURE open IS
  BEGIN
    IF NOT c%ISOPEN THEN   OPEN c;  END IF;
  END open;
  FUNCTION next(n NUMBER := 1) RETURN BOOLEAN IS
    emp_id employees.employee_id%TYPE;
  BEGIN
    FOR count IN 1 .. n LOOP
      FETCH c INTO emp_id;
      EXIT WHEN c%NOTFOUND;
      DBMS_OUTPUT.PUT_LINE('Id: ' ||(emp_id));
    END LOOP;
    RETURN c%FOUND;
  END next;
  PROCEDURE close IS BEGIN
    IF c%ISOPEN THEN  CLOSE c;  END IF;
  END close;
END curs_pkg;
```

Executing CURS_PKG

```
SET SERVEROUTPUT ON
EXECUTE curs_pkg.open
DECLARE
  more BOOLEAN := curs_pkg.next(3);
BEGIN
  IF NOT more THEN
    curs_pkg.close;
  END IF;
END;
/
```

```
anonymous block completed
anonymous block completed
Id: 100
Id: 101
Id: 102

anonymous block completed
anonymous block completed
Id: 103
Id: 104
Id: 105
```

Using PL/SQL Tables of Records in Packages

```
CREATE OR REPLACE PACKAGE emp_pkg IS
  TYPE emp_table_type IS TABLE OF employees%ROWTYPE
     INDEX BY BINARY_INTEGER;
  PROCEDURE get_employees(emps OUT emp_table_type);
END emp_pkg;
/
```

```
CREATE OR REPLACE PACKAGE BODY emp_pkg IS
  PROCEDURE get_employees(emps OUT emp_table_type) IS
    i BINARY_INTEGER := 0;
  BEGIN
    FOR emp_record IN (SELECT * FROM employees)
    LOOP
      emps(i) := emp_record;
      i:= i+1;
    END LOOP;
  END get_employees;
END emp_pkg;
/
```

PL/SQL Wrapper

- The PL/SQL wrapper is a stand-alone utility that hides application internals by converting PL/SQL source code into portable object code.
- Wrapping has the following features:
  - Platform independence
  - Dynamic loading
  - Dynamic binding
  - Dependency checking
  - Normal importing and exporting when invoked

Running the Wrapper

The command-line syntax is:

```
WRAP INAME=input_file_name [ONAME=output_file_name]
```

- The `INAME` argument is required.
- The default extension for the input file is `.sql`, unless it is specified with the name.
- The `ONAME` argument is optional.
- The default extension for output file is `.plb`, unless specified with the `ONAME` argument.

Examples:

```
WRAP INAME=demo_04_hello.sql
WRAP INAME=demo_04_hello
WRAP INAME=demo_04_hello.sql ONAME=demo_04_hello.plb
```

Results of Wrapping

- Original PL/SQL source code in the input file:

```
CREATE PACKAGE banking IS
  min_bal := 100;
  no_funds EXCEPTION;
...
END banking;
/
```

- Wrapped code in the output file:

```
CREATE PACKAGE banking
wrapped

012abc463e ...

/
```

Guidelines for Wrapping

- You must wrap only the package body, not the package specification.
- The wrapper can detect syntactic errors but cannot detect semantic errors.
- The output file should not be edited. You maintain the original source code and wrap again as required.

Summary

In this lesson, you should have learned how to:

- Create and call overloaded subprograms
- Use forward declarations for subprograms
- Write package initialization blocks
- Maintain persistent package state
- Use the PL/SQL wrapper to wrap code

Practice 4: Overview

This practice covers the following topics:

- Using overloaded subprograms
- Creating a package initialization block
- Using a forward declaration
- Using the `WRAP` utility to prevent the source code from being deciphered by humans