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Database Programming with PL/SQL

15-1
Using PL/SQL Initialization Parameters

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Objectives

This lesson covers the following objectives:

- Describe how PLSQL_CODE_TYPE can improve execution speed
- Describe how PLSQL_OPTIMIZE_LEVEL can improve execution speed
- Use USER_PLSQL_OBJECT_SETTINGS to see how a PL/SQL program was compiled

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Purpose

- In many programming environments, fast program execution is imperative.
- In an earlier lesson, you learned how coding techniques such as the `NOCOPY` hint and Bulk Binding can improve the execution speed of PL/SQL programs.
- Setting PL/SQL initialization parameters can help to make your PL/SQL programs run even faster.

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What are Initialization Parameters?

- *Initialization parameters* are used to change the way your database session interacts with the Oracle server.
- All initialization parameters have a name, a data type, and a default value.
- They can be used to adjust security, improve performance, and do many other things.
- Many of them have nothing to do with PL/SQL. In this lesson, you learn how to use two initialization parameters that change how your PL/SQL code is compiled.
- Do not confuse initialization parameters with the formal and actual parameters that we pass to subprograms.

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Two PL/SQL Initialization Parameters

- The names of these initialization parameters are:
  - PLSQL_CODE_TYPE
  - PLSQL_OPTIMIZE_LEVEL
- PLSQL_CODE_TYPE is a VARCHAR2 with possible values INTERPRETED (the default value) and NATIVE.
- PLSQL_OPTIMIZE_LEVEL is a NUMBER with possible values 0, 1, 2 (the default), and 3.

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Changing the Value of a Parameter

- You can change any initialization parameter's value by executing an `ALTER SESSION` SQL statement:

```
ALTER SESSION SET PLSQL_CODE_TYPE = NATIVE;

CREATE OR REPLACE PROCEDURE run_faster_proc ...;

ALTER SESSION SET PLSQL_CODE_TYPE = INTERPRETED;

CREATE OR REPLACE PROCEDURE run_slower_proc ...;
```

- The new parameter value will be used until you log off, or until you change the value again.

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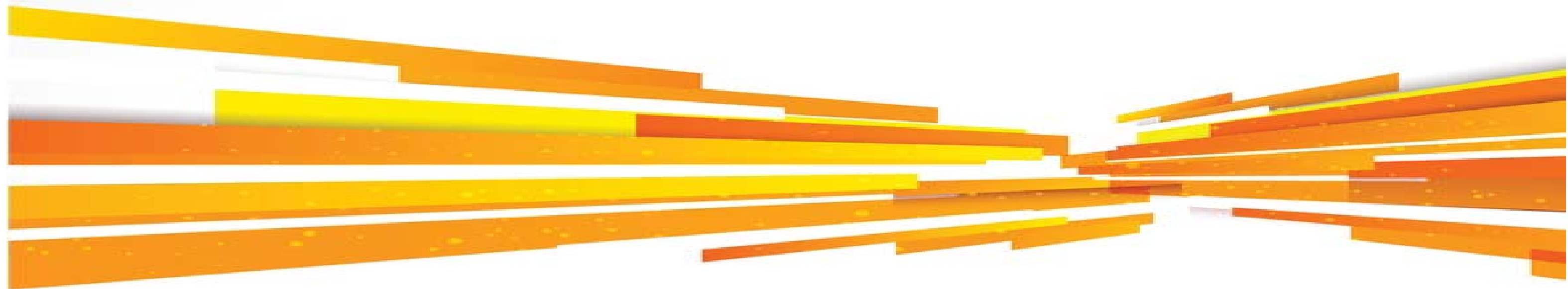
Using PLSQL_CODE_TYPE

- If PLSQL_CODE_TYPE is set to INTERPRETED (the default), your source code is compiled to *bytecode* format.
- If the parameter value is changed to NATIVE, your source code will be compiled to *native machine code* format.
- You don’t need to know what these formats mean or how they work; the important thing is that native machine code PL/SQL executes faster than bytecode PL/SQL.



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Using PLSQL_CODE_TYPE: Example

- To see the change in performance, we need some PL/SQL code that takes a long time to execute: 0.02 seconds doesn't seem much slower than 0.01!
- Let's compile a long-running procedure using INTERPRETED (notice how quickly it compiles):

```
CREATE OR REPLACE PROCEDURE longproc IS
  v_number PLS_INTEGER;
BEGIN
  FOR i IN 1..50000000 LOOP
    v_number := v_number * 2;
    v_number := v_number / 2;
  END LOOP;
END longproc;
```

```
Procedure created.

0.02 seconds
```


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Using PLSQL_CODE_TYPE: Example

- The compile was quick, but see how long the procedure takes to run.
- Eleven seconds!
- That's much longer than most of the procedures and functions you have been writing.

```
BEGIN
  longproc;
END;
```

```
Statement processed.

11.34 seconds
```


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Using PLSQL_CODE_TYPE: Example

- Let's compile it again using NATIVE:

```
ALTER SESSION SET PLSQL_CODE_TYPE = NATIVE;

CREATE OR REPLACE PROCEDURE longproc IS
  v_number PLS_INTEGER;
BEGIN
  FOR i IN 1..50000000 LOOP
    v_number := v_number * 2;
    v_number := v_number / 2;
  END LOOP;
END longproc;
```

```
Procedure created.

0.08 seconds
```

- Notice the procedure takes longer to compile than before (0.08 seconds compared to 0.02 seconds).

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Using PLSQL_CODE_TYPE: Example

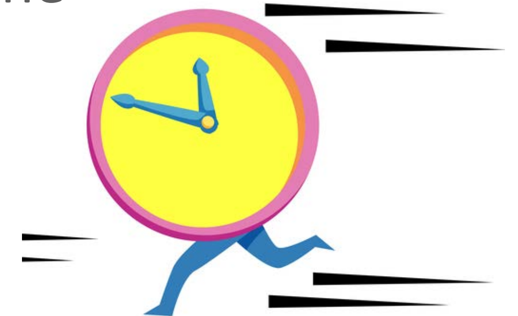
- But now let's execute the NATIVE mode procedure:

```
BEGIN
  longproc;
END;
```

```
Statement processed.

5.70 seconds
```

- The execution is about twice as fast in this case (5.7 seconds compared to 11.34 seconds).
- NATIVE mode will always execute faster than INTERPRETED mode, and depending on the source code, it may execute much faster.



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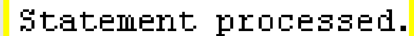
Using PLSQL_CODE_TYPE: A Second Example

Let's compile and execute an even longer procedure that includes a SQL statement:

```
ALTER SESSION SET PLSQL_CODE_TYPE = INTERPRETED;

CREATE OR REPLACE PROCEDURE sqlproc IS
  v_count PLS_INTEGER;
BEGIN
  FOR i IN 1..500000 LOOP
    SELECT COUNT(*) INTO v_count FROM countries;
  END LOOP;
END sqlproc;

BEGIN
  sqlproc;
END;
```



39.07 seconds

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Using PLSQL_CODE_TYPE: A Second Example

- Now compile and execute it using NATIVE:

```
ALTER SESSION SET PLSQL_CODE_TYPE = NATIVE;

CREATE OR REPLACE PROCEDURE sqlproc IS
  v_count PLS_INTEGER;
BEGIN
  FOR i IN 1..500000 LOOP
    SELECT COUNT(*) INTO v_count FROM countries;
  END LOOP;
END sqlproc;

BEGIN
  sqlproc;
END;
```

```
Statement processed.

35.74 seconds
```

- Not much faster this time, is it? Why not?

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NATIVE Compilation and SQL Statements

- Compiling a PL/SQL program with PLSQL_CODE_TYPE = NATIVE creates native PL/SQL code, but *not* native SQL code (there's no such thing!).
- So the PL/SQL Engine executes faster, but SQL statements execute at the same speed as before.
- And SQL statements usually take far longer to execute than PL/SQL statements, especially when the tables contain thousands of rows.
- To speed up SQL statements, you use other techniques, such as Bulk Binding and choosing the correct indexes for your tables.

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Does your PL/SQL Program Contain Useless Code?

- Examine this code:

```
CREATE OR REPLACE PROCEDURE obviouslybadproc IS
  v_number PLS_INTEGER := 1;
BEGIN
  IF v_number = 1 THEN
    DBMS_OUTPUT.PUT_LINE(‘This will always be displayed');
  ELSE
    DBMS_OUTPUT.PUT_LINE('This will never be displayed');
  END IF;
END obviouslybadproc;
```

- Silly, isn’t it?
- Of course, you would never write useless lines of code that can never be executed, would you?
- Look at the next example:

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Does your PL/SQL Program Contain Useless Code?

- Not quite so obvious now, is it?
- In large, complex PL/SQL programs, it is all too easy to write code that can never be executed, or exceptions that can never be raised.

```
CREATE OR REPLACE PROCEDURE notsoobviousproc IS
  v_number  PLS_INTEGER;
BEGIN
  FOR i IN REVERSE 1..50 LOOP
    v_number := 50 – i;
    IF MOD(i,v_number) > 25 THEN
      DBMS_OUTPUT.PUT_LINE(‘Could this ever be displayed?');
    ELSE
      DBMS_OUTPUT.PUT_LINE('This will be displayed');
  END IF;
END notsoobviousproc;
```


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Does your PL/SQL Program Contain Useless Code?

- Unnecessary code can slow down both creating and executing the program.

```
CREATE OR REPLACE PROCEDURE notsoobviousproc IS
  v_number  PLS_INTEGER;
BEGIN
  FOR i IN REVERSE 1..50 LOOP
    v_number := 50 – i;
    IF MOD(i,v_number) > 25 THEN
      DBMS_OUTPUT.PUT_LINE('Could this ever be displayed?');
    ELSE
      DBMS_OUTPUT.PUT_LINE('This will be displayed');
  END IF;
END notsoobviousproc;
```


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The PLSQL_OPTIMIZE_LEVEL Initialization Parameter

- PLSQL_OPTIMIZE_LEVEL can be used to control what the PL/SQL Compiler does with useless code, as well as giving other performance benefits.
- Its value must be an integer between 0 and 3, inclusive.
- The higher the value, the more effort the compiler makes to optimize the code for execution.
- The optimizing compiler is enabled to level 2 by default.

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The PLSQL_OPTIMIZE_LEVEL Initialization Parameter

The effects are:

- With PLSQL_OPTIMIZE_LEVEL = 0, the compiled code will run more slowly, but it will work with older versions of the Oracle software.
- This is similar to creating a document using Microsoft Word 2007, but saving it in Word 97-2003 format.
- With PLSQL_OPTIMIZE_LEVEL = 1, the compiler will remove unnecessary code and exceptions from the executable code, such as the useless code in the two examples on previous slides.

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The `PLSQL_OPTIMIZE_LEVEL` Initialization Parameter

- The order of the source code is not typically changed.
- `With PLSQL_OPTIMIZE_LEVEL = 2`, (the default), the compiler will remove useless code as before, but will also sometimes move code to a different place if it will execute faster there.
- For example, if a frequently-called procedure in a large package is coded near the end of the package body, the compiler will move it nearer to the beginning.
- Your source code is never changed, only the compiled code.

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The `PLSQL_OPTIMIZE_LEVEL` Initialization Parameter

- `PLSQL_OPTIMIZE_LEVEL = 3` gives all the benefits of values 1 and 2, plus subprogram inlining.
- This means that the compiled code of another called subprogram is copied into the calling subprogram, so that only one compiled unit of code is executed.
- The source code itself is not changed, it is only the executable code that is optimized.

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PLSQL_OPTIMIZE_LEVEL: An Example

- The compiled code of CALLINGPROC now contains the code of both subprograms, as if it had been written as part of CALLINGPROC instead of as a separate subprogram.
- CALLEDPROC also still exists as a separate subprogram and can still be called from other places.

```
CREATE OR REPLACE PROCEDURE calledproc IS BEGIN...END calledproc;

ALTER SESSION SET PLSQL_OPTIMIZE_LEVEL = 3;

CREATE OR REPLACE PROCEDURE callingproc IS BEGIN
  ...
  calledproc;
  ...
END;
```


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Using USER_PLSQL_OBJECT_SETTINGS

You can see how your PL/SQL programs were compiled by querying the USER_PLSQL_OBJECT_SETTINGS Data Dictionary view:

```
SELECT name, type, plsql_code_type AS CODE_TYPE,
       plsql_optimize_level AS OPT_LVL
  FROM USER_PLSQL_OBJECT_SETTINGS WHERE name = 'TESTPROC';
```

NAME	TYPE	CODE_TYPE	OPT_LVL
TESTPROC	PROCEDURE	INTERPRETED	2

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Using USER_PLSQL_OBJECT_SETTINGS

```
ALTER SESSION SET PLSQL_OPTIMIZE_LEVEL = 1;

CREATE OR REPLACE PROCEDURE testproc ...END testproc;

-- or ALTER PROCEDURE testproc COMPILE;

SELECT name, type, plsql_code_type AS CODE_TYPE,
       plsql_optimize_level AS OPT_LVL
  FROM USER_PLSQL_OBJECT_SETTINGS WHERE name = 'TESTPROC';
```

NAME	TYPE	CODE_TYPE	OPT_LVL
TESTPROC	PROCEDURE	INTERPRETED	1

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Terminology

Key terms used in this lesson included:

- `PLSQL_CODE_TYPE`
- `PLSQL_OPTIMIZE_LEVEL`
- PL/SQL Initialization Parameter
- `USER_PLSQL_OBJECT_SETTINGS`

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Summary

In this lesson, you should have learned how to:

- Describe how `PLSQL_CODE_TYPE` can improve execution speed
- Describe how `PLSQL_OPTIMIZE_LEVEL` can improve execution speed
- Use `USER_PLSQL_OBJECT_SETTINGS` to see how a PL/SQL program was compiled

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