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Database Programming with PL/SQL

2-6
Nested Blocks and Variable Scope

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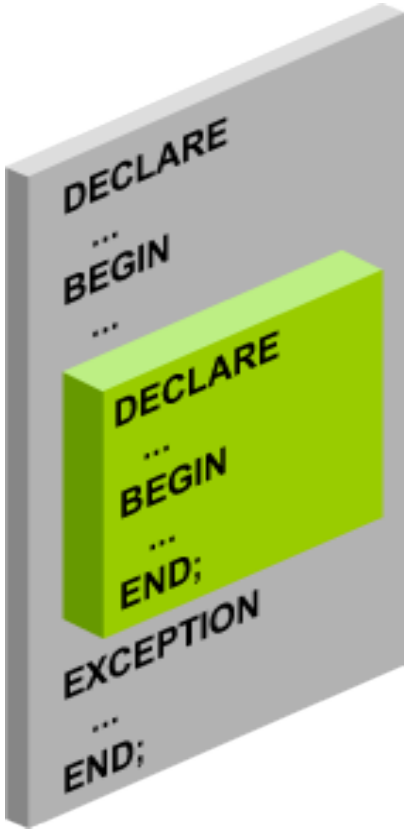
Objectives

This lesson covers the following objectives:

- Understand the scope and visibility of variables
- Write nested blocks and qualify variables with labels
- Describe the rules for variable scope when a variable is nested in a block
- Recognize a variable scope issue when a variable is used in nested blocks
- Qualify a variable nested in a block with a label

Purpose

- A large, complex block can be hard to understand.
- You can break it down into smaller blocks that are nested one inside the other, making the code easier to read and correct.
- When you nest blocks, declared variables might not be available depending on their scope and visibility.
- You can make invisible variables available by using block labels.

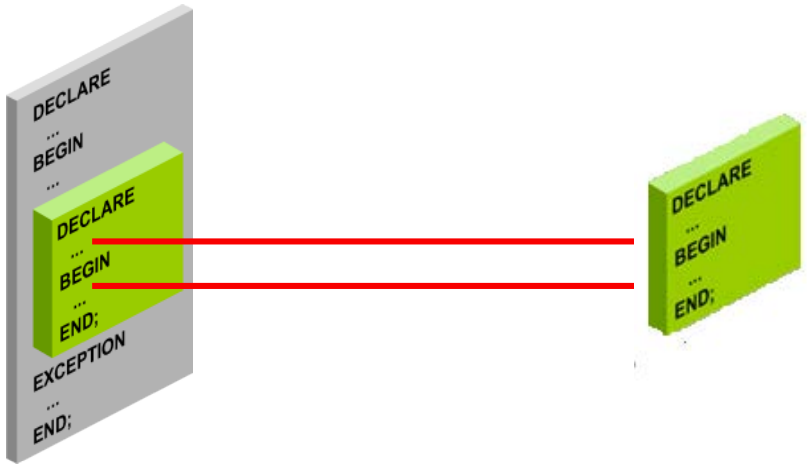


Nested Blocks

- PL/SQL is a block-structured language.
- The basic units (procedures, functions, and anonymous blocks) are logical blocks, which can contain any number of nested sub-blocks.
- Each logical block corresponds to a problem to be solved.

Nested Blocks Illustrated

- Nested blocks are blocks of code placed within other blocks of code.
- There is an outer block and an inner block.
- You can nest blocks within blocks as many times as you need to; there is no practical limit to the depth of nesting Oracle allows.



Nested Block Example

- The example shown in the slide has an outer (parent) block (illustrated in blue text) and a nested (child) block (illustrated in red text).
- The variable v_outer_variable is declared in the outer block and the variable v_inner_variable is declared in the inner block.

```
DECLARE
 v_outer_variable VARCHAR2(20):='GLOBAL VARIABLE';
BEGIN
 DECLARE
  v_inner_variable VARCHAR2(20):='LOCAL VARIABLE';
 BEGIN
  DBMS_OUTPUT.PUT_LINE(v_inner_variable);
  DBMS_OUTPUT.PUT_LINE(v_outer_variable);
 END;
 DBMS_OUTPUT.PUT_LINE(v_outer_variable);
END;
```

Variable Scope

- The scope of a variable is the block or blocks in which the variable is accessible, that is, where it can be used.
- In PL/SQL, a variable's scope is the block in which it is declared plus all blocks nested within the declaring block.
- What are the scopes of the two variables declared in this example?

```
DECLARE
 v_outer_variable VARCHAR2(20):='GLOBAL VARIABLE';
BEGIN
 DECLARE
  v_inner_variable VARCHAR2(20):='LOCAL VARIABLE';
 BEGIN
  DBMS_OUTPUT.PUT_LINE(v_inner_variable);
  DBMS_OUTPUT.PUT_LINE(v_outer_variable);
 END;
 DBMS_OUTPUT.PUT_LINE(v_outer_variable);
END;
```

Variable Scope Example

- Examine the following code.
- What is the scope of each of the variables?

```
DECLARE
 v_father_name  VARCHAR2(20):='Patrick';
 v_date_of_birth DATE:='20-Apr-1972';
BEGIN
 DECLARE
  v_child_name VARCHAR2(20):='Mike';
 BEGIN
  DBMS_OUTPUT.PUT_LINE('Father''s Name: '||v_father_name);
  DBMS_OUTPUT.PUT_LINE('Date of Birth: '||v_date_of_birth);
  DBMS_OUTPUT.PUT_LINE('Child''s Name: '||v_child_name);
 END;
 DBMS_OUTPUT.PUT_LINE('Date of Birth: '||v_date_of_birth);
END;
```

Local and Global Variables

- Variables declared in a PL/SQL block are considered local to that block and global to all blocks nested within it.
- V_outer_variable is local to the outer block but global to the inner block.

```
DECLARE
 v_outer_variable  VARCHAR2(20):='GLOBAL VARIABLE';
BEGIN
 DECLARE
 v_inner_variable VARCHAR2(20):='LOCAL VARIABLE';
 BEGIN
 DBMS_OUTPUT.PUT_LINE(v_inner_variable);
 DBMS_OUTPUT.PUT_LINE(v_outer_variable);
 END;
 DBMS_OUTPUT.PUT_LINE(v_outer_variable);
END;
```

Local and Global Variables

- When you access this variable in the inner block, PL/SQL first looks for a local variable in the inner block with that name.
- If there are no similarly named variables, PL/SQL looks for the variable in the outer block.

```
DECLARE
 v_outer_variable  VARCHAR2(20):='GLOBAL VARIABLE';
BEGIN
 DECLARE
 v_inner_variable VARCHAR2(20):='LOCAL VARIABLE';
 BEGIN
 DBMS_OUTPUT.PUT_LINE(v_inner_variable);
 DBMS_OUTPUT.PUT_LINE(v_outer_variable);
 END;
 DBMS_OUTPUT.PUT_LINE(v_outer_variable);
END;
```

Local and Global Variables

- The v_inner_variable variable is local to the inner block and is not global because the inner block does not have any nested blocks.
- This variable can be accessed only within the inner block.

```
DECLARE
 v_outer_variable  VARCHAR2(20):='GLOBAL VARIABLE';
BEGIN
 DECLARE
 v_inner_variable VARCHAR2(20):='LOCAL VARIABLE';
 BEGIN
 DBMS_OUTPUT.PUT_LINE(v_inner_variable);
 DBMS_OUTPUT.PUT_LINE(v_outer_variable);
 END;
 DBMS_OUTPUT.PUT_LINE(v_outer_variable);
END;
```

Local and Global Variables

- If PL/SQL does not find the variable declared locally, it looks upward in the declarative section of the parent blocks.
- PL/SQL does not look downward into the child blocks.

```
DECLARE
 v_outer_variable  VARCHAR2(20):='GLOBAL VARIABLE';
BEGIN
 DECLARE
 v_inner_variable VARCHAR2(20):='LOCAL VARIABLE';
 BEGIN
 DBMS_OUTPUT.PUT_LINE(v_inner_variable);
 DBMS_OUTPUT.PUT_LINE(v_outer_variable);
 END;
 DBMS_OUTPUT.PUT_LINE(v_outer_variable);
END;
```

Variable Scope Accessible to Outer Block

- The variables v_father_name and v_date_of_birth are declared in the outer block.
- They are local to the outer block and global to the inner block.
- Their scope includes both blocks.

```
DECLARE
 v_father_name  VARCHAR2(20):='Patrick';
 v_date_of_birth DATE:='20-Apr-1972';
BEGIN
 DECLARE
  v_child_name VARCHAR2(20):='Mike';
 ...
```

Variable Scope Accessible to Outer Block

- The variable v_child_name is declared in the inner (nested) block.
- This variable is accessible only within the inner block and is not accessible in the outer block.

```
DECLARE
 v_father_name  VARCHAR2(20):='Patrick';
 v_date_of_birth DATE:='20-Apr-1972';
BEGIN
 DECLARE
  v_child_name VARCHAR2(20):='Mike';
 ...
```

A Scoping Example

- Why will this code not work correctly?

```
DECLARE
 v_first_name          VARCHAR2(20);
BEGIN
 DECLARE
  v_last_name          VARCHAR2(20);
 BEGIN
  v_first_name := 'Carmen';
  v_last_name := 'Miranda';
  DBMS_OUTPUT.PUT_LINE
        (v_first_name || ' ' || v_last_name);
 END;
 DBMS_OUTPUT.PUT_LINE
        (v_first_name || ' ' || v_last_name);
END;
```

A Second Scoping Example

- Will this code work correctly? Why or why not?

```
DECLARE
 v_first_name  VARCHAR2(20);
 v_last_name  VARCHAR2(20);
BEGIN
 BEGIN
  v_first_name := 'Carmen';
  v_last_name := 'Miranda';
  DBMS_OUTPUT.PUT_LINE
        (v_first_name || ' ' || v_last_name);
 END;
 DBMS_OUTPUT.PUT_LINE
        (v_first_name || ' ' || v_last_name);
END;
```

Three Levels of Nested Block

- What is the scope of each of these variables?

```
DECLARE                    -- outer block
 v_outervar      VARCHAR2(20);
BEGIN
 DECLARE          -- middle block
  v_middlevar    VARCHAR2(20);
 BEGIN
  BEGIN       -- inner block
   v_outervar := 'Joachim';
   v_middlevar := 'Chang';
  END;
 END;
END;
```

Variable Naming

- You cannot declare two variables with the same name in the same block.
- However, you can declare variables with the same name in two different blocks when one block is nested within the other block.
- The two items represented by the same name are distinct, and any change in one does not affect the other.

Example of Variable Naming

- Are the following declarations valid?

```
DECLARE          -- outer block
 v_myvar     VARCHAR2(20);
BEGIN
 DECLARE         -- inner block
  v_myvar    VARCHAR2(15);
 BEGIN
  ...
 END;
END;
```

Variable Visibility

- What if the same name is used for two variables, one in each of the blocks?
- In this example, the variable v_date_of_birth is declared twice.

```
DECLARE
 v_father_name  VARCHAR2(20):='Patrick';
 v_date_of_birth DATE:='20-Apr-1972';
BEGIN
 DECLARE
  v_child_name  VARCHAR2(20):='Mike';
  v_date_of_birth DATE:='12-Dec-2002';
 BEGIN
  DBMS_OUTPUT.PUT_LINE('Date of Birth:' || v_date_of_birth);
 ...
```

Variable Visibility

- Which v_date_of_birth is referenced in the DBMS_OUTPUT.PUT_LINE statement?

```
DECLARE
 v_father_name  VARCHAR2(20):='Patrick';
 v_date_of_birth DATE:='20-Apr-1972';
BEGIN
 DECLARE
  v_child_name  VARCHAR2(20):='Mike';
  v_date_of_birth DATE:='12-Dec-2002';
 BEGIN
  DBMS_OUTPUT.PUT_LINE('Date of Birth:' || v_date_of_birth);
 ...
```

Variable Visibility

- The visibility of a variable is the portion of the program where the variable can be accessed without using a qualifier.
- What is the visibility of each of the variables?

```
DECLARE
 v_father_name  VARCHAR2(20):='Patrick';
 v_date_of_birth DATE:='20-Apr-1972';
BEGIN
 DECLARE
  v_child_name  VARCHAR2(20):='Mike';
  v_date_of_birth DATE:='12-Dec-2002';
 BEGIN
  DBMS_OUTPUT.PUT_LINE('Father''s Name: ' || v_father_name);
  DBMS_OUTPUT.PUT_LINE('Date of Birth: ' || v_date_of_birth);
  DBMS_OUTPUT.PUT_LINE('Child''s Name: ' || v_child_name);
 END;
 DBMS_OUTPUT.PUT_LINE('Date of Birth: ' || v_date_of_birth);
END;
```

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2

Variable Visibility

- The v_date_of_birth variable declared in the outer block has scope even in the inner block.
- This variable is visible in the outer block.
- However, it is not visible in the inner block because the inner block has a local variable with the same name.

```
DECLARE
 v_father_name        VARCHAR2(20):='Patrick';
 v_date_of_birth      DATE:='20-Apr-1972';
BEGIN
 DECLARE
  v_child_name   VARCHAR2(20):='Mike';
  v_date_of_birth  DATE:='12-Dec-2002';
 ...
```

Variable Visibility

- The v_father_name variable is visible in the inner and outer blocks.
- The v_child_name variable is visible only in the inner block.
- What if you want to reference the outer block's v_date_of_birth within the inner block?

```
DECLARE
 v_father_name        VARCHAR2(20):='Patrick';
 v_date_of_birth      DATE:='20-Apr-1972';
BEGIN
 DECLARE
  v_child_name   VARCHAR2(20):='Mike';
  v_date_of_birth  DATE:='12-Dec-2002';
 ...
```

Qualifying an Identifier

- A qualifier is a label given to a block.
- You can use this qualifier to access the variables that have scope but are not visible.
- The outer block below is labeled <<outer>>.

```
<<outer>>
DECLARE
 v_father_name  VARCHAR2(20):='Patrick';
 v_date_of_birth DATE:='20-Apr-1972';
BEGIN
 DECLARE
  v_child_name  VARCHAR2(20):='Mike';
  v_date_of_birth DATE:='12-Dec-2002';
 ...
```

- Each nested inner block also can be labeled.

Qualifying an Identifier

- Using the outer label to qualify the v_date_of_birth identifier, you can now print the father's date of birth using code in the inner block.

```
<<outer>>
DECLARE
 v_father_name      VARCHAR2(20):='Patrick';
 v_date_of_birth    DATE:='20-Apr-1972';
BEGIN
 DECLARE
 v_child_name        VARCHAR2(20):='Mike';
 v_date_of_birth DATE:='12-Dec-2002';
 BEGIN
 DBMS_OUTPUT.PUT_LINE('Father''s Name: ' || v_father_name);
 DBMS_OUTPUT.PUT_LINE('Date of Birth: ' || outer.v_date_of_birth);
 DBMS_OUTPUT.PUT_LINE('Child''s Name: ' || v_child_name);
 DBMS_OUTPUT.PUT_LINE('Date of Birth: ' || v_date_of_birth);
 END;
END;
```

```
Father's Name: Patrick
Date of Birth: 20-Apr-1972
Child's Name: Mike
Date of Birth: 12-Dec-2002

Statement processed.
```

Terminology

Key terms used in this lesson included:

- Block label
- Variable scope
- Variable visibility

Summary

In this lesson, you should have learned how to:

- Understand the scope and visibility of variables
- Write nested blocks and qualify variables with labels
- Describe the rules for variable scope when a variable is nested in a block
- Recognize a variable scope issue when a variable is used in nested blocks
- Qualify a variable nested in a block with a label


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