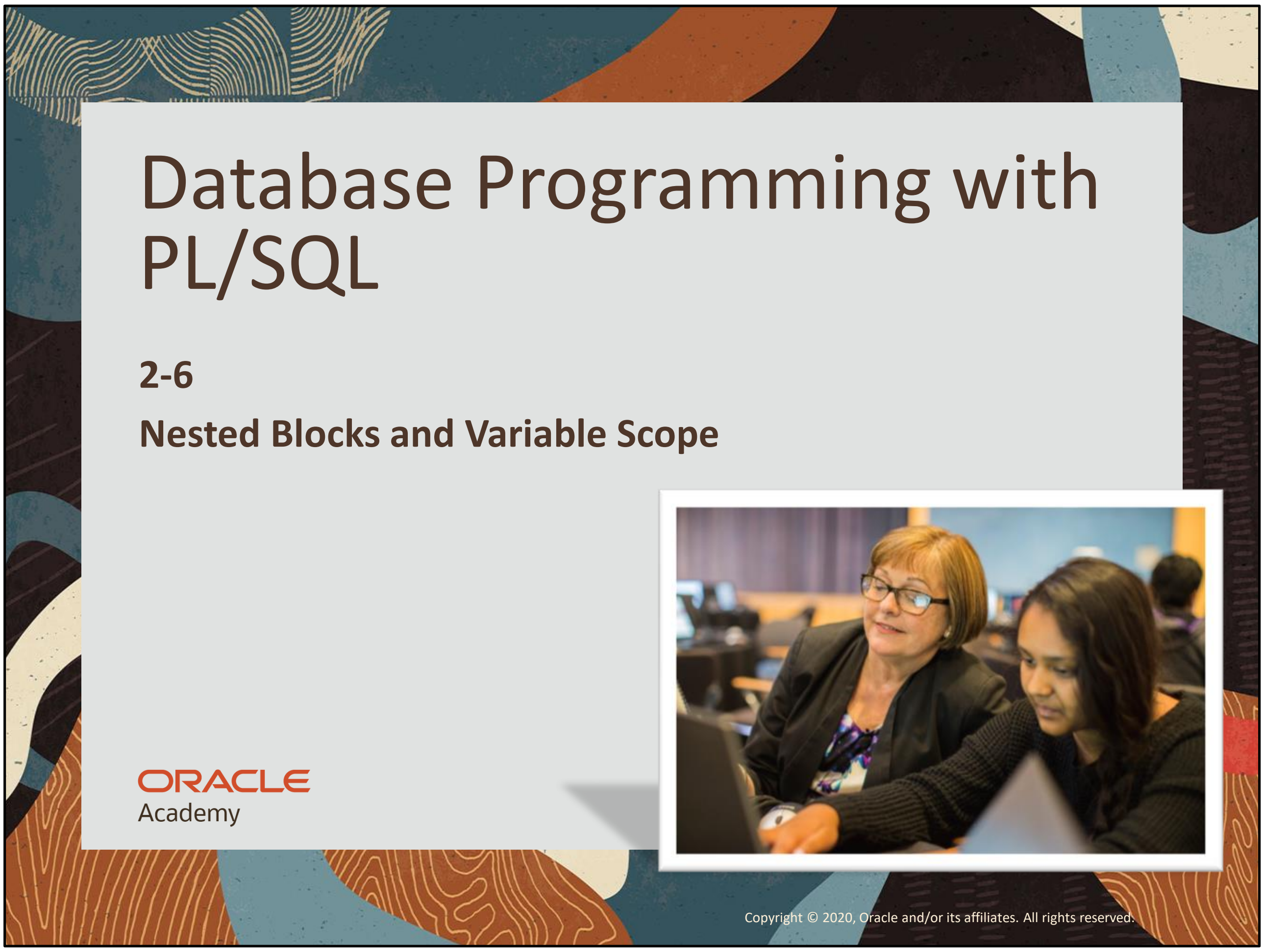
ORACLE
Academy



Database Programming with PL/SQL

2-6

Nested Blocks and Variable Scope

ORACLE
Academy

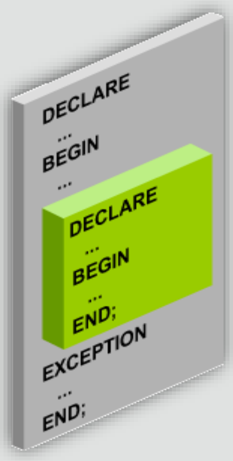
Objectives

- 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

ORACLE
Academy

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



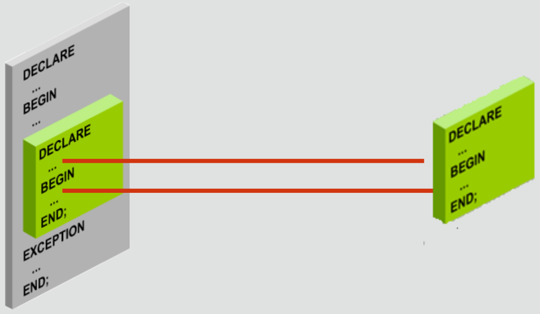
Nested Blocks

- 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

ORACLE
Academy

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

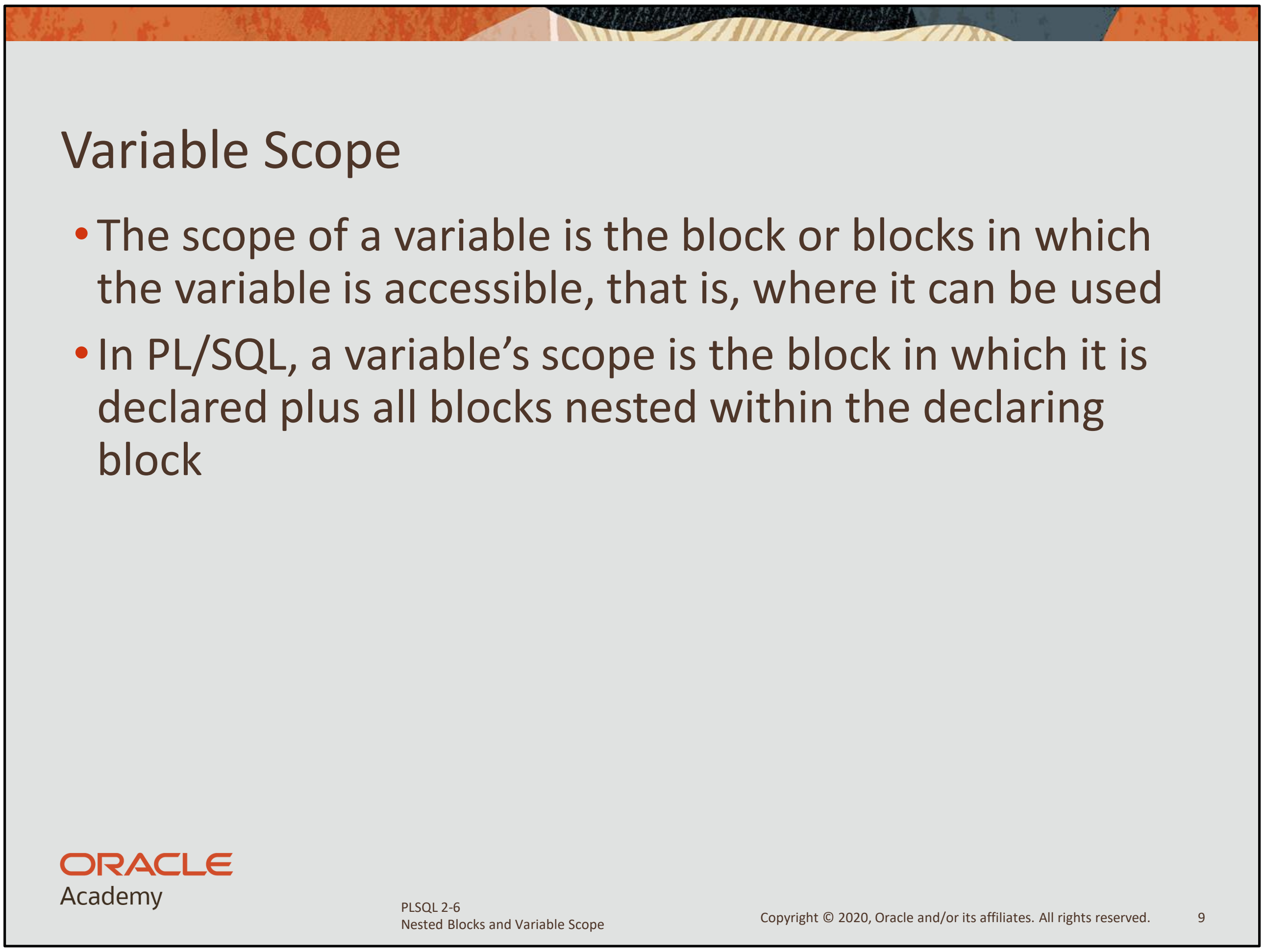


Nested Block Example

- 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

Nested Block 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

- 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

ORACLE Academy

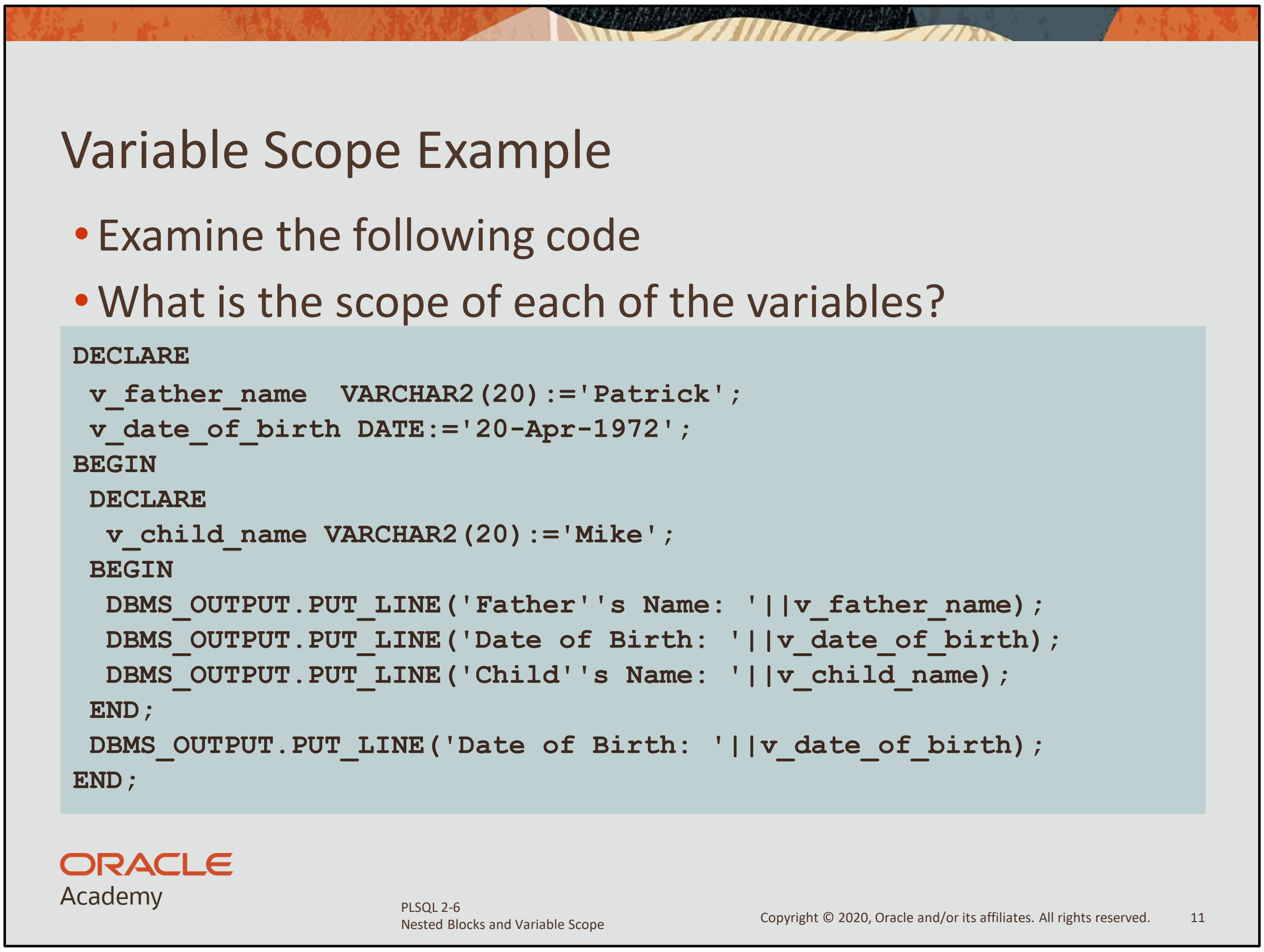
Answer: The scope of v_outer_variable includes both the outer and inner blocks. The scope of v_inner_variable includes only the inner block. It is valid to refer to v_outer_variable within the inner block, but referencing v_inner_variable within the outer block would return an error.

Each block allows the grouping of logically related declarations and statements. This makes structured programming easy to use due to placing declarations close to where they are used (in each block).

Variable Scope

- 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

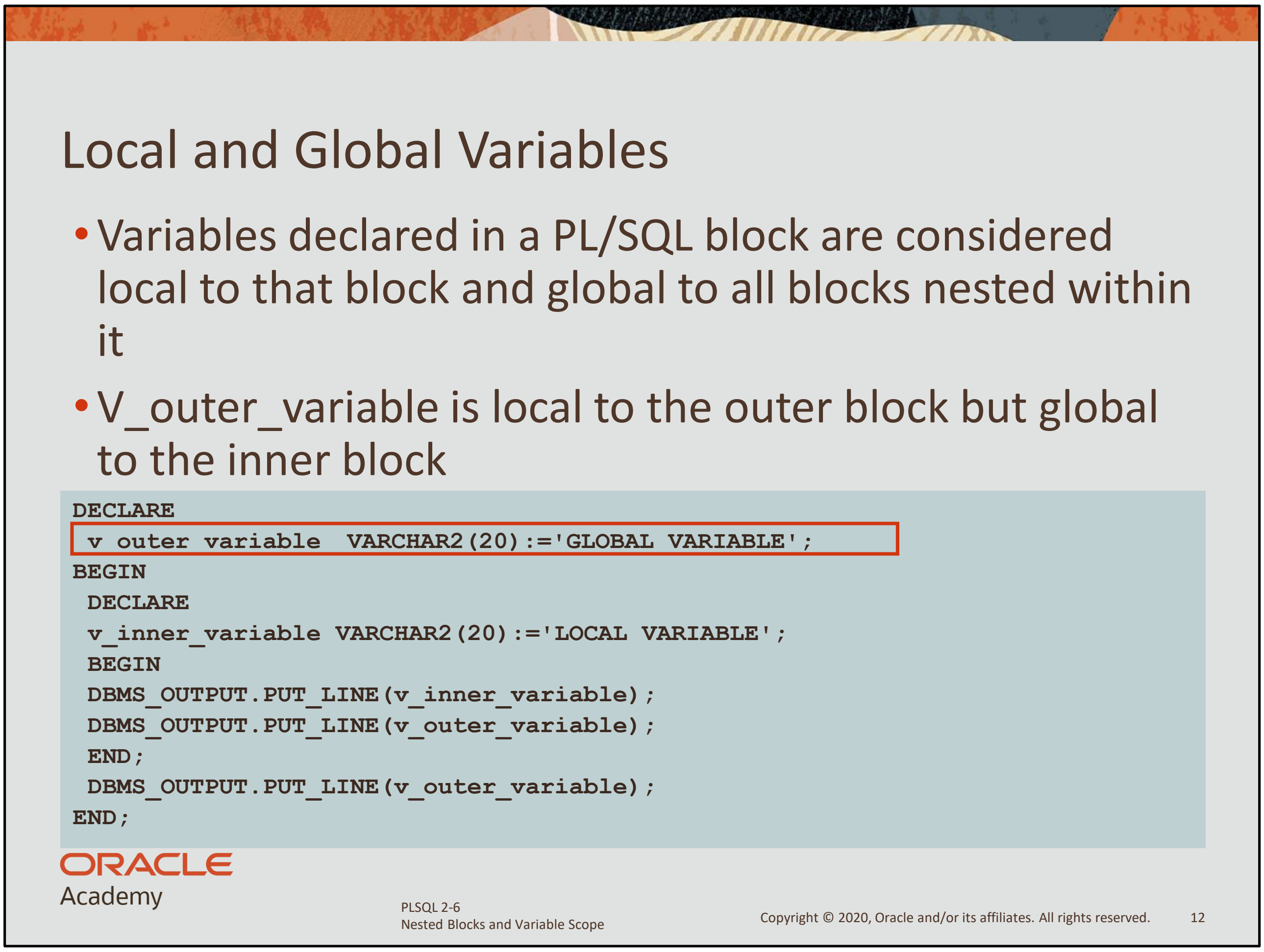
- Examine the following code
- What is the scope of each of the variables?

```
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;
```

ORACLE
Academy

Answer: The scope of v_father_name and v_date_of_birth is both blocks (inner and outer). The scope of v_child_name is the inner block only.

The scope of a variable is the block in which it is declared plus all blocks nested within the declaring block.



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;
```

ORACLE
Academy

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

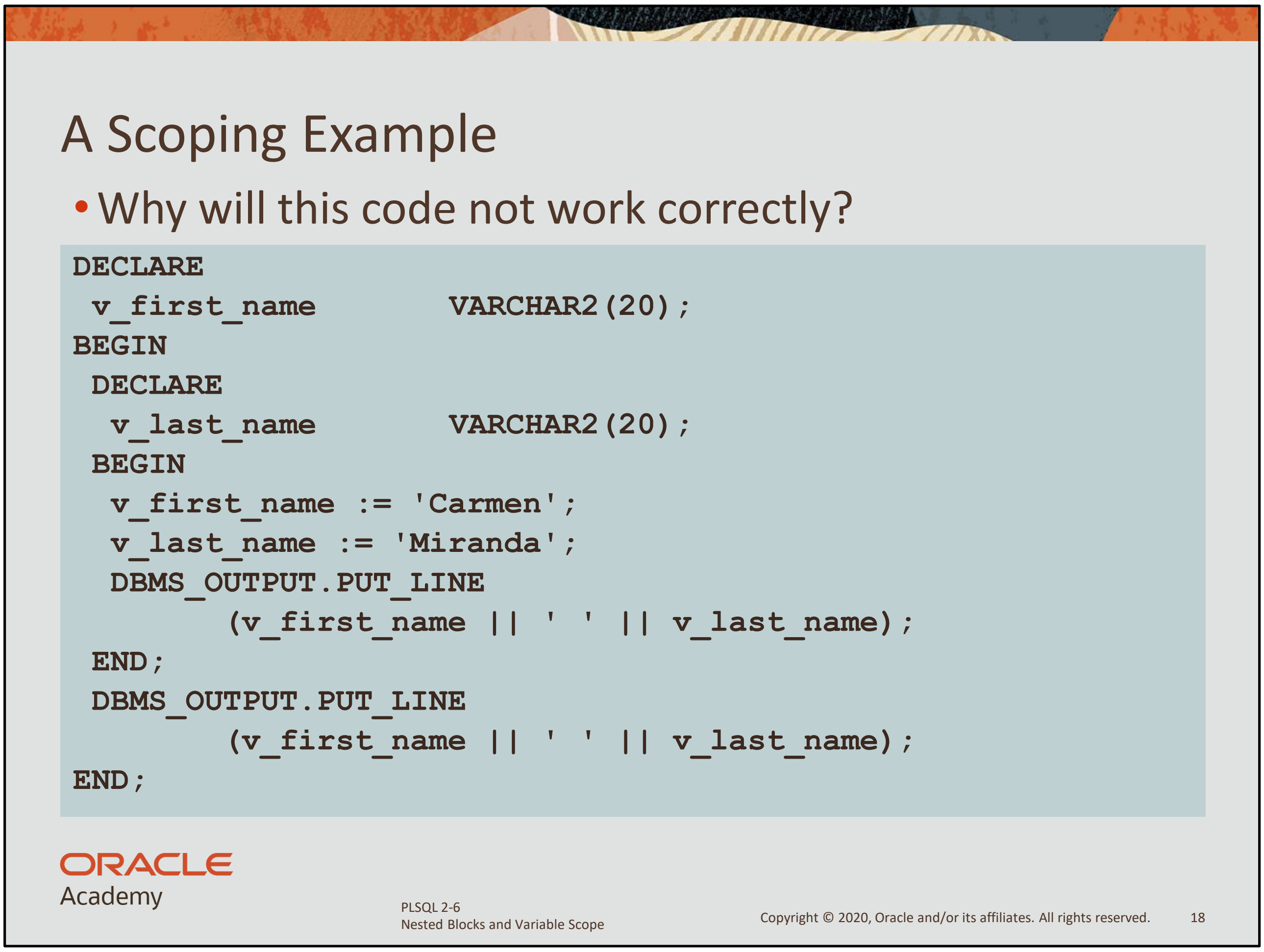
```
DECLARE
 v_father_name  VARCHAR2(20):='Patrick';
 v_date_of_birth DATE:='20-Apr-1972';
BEGIN
 DECLARE
  v_child_name VARCHAR2(20):='Mike';
 ...
```

ORACLE
Academy

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';
 ...
```



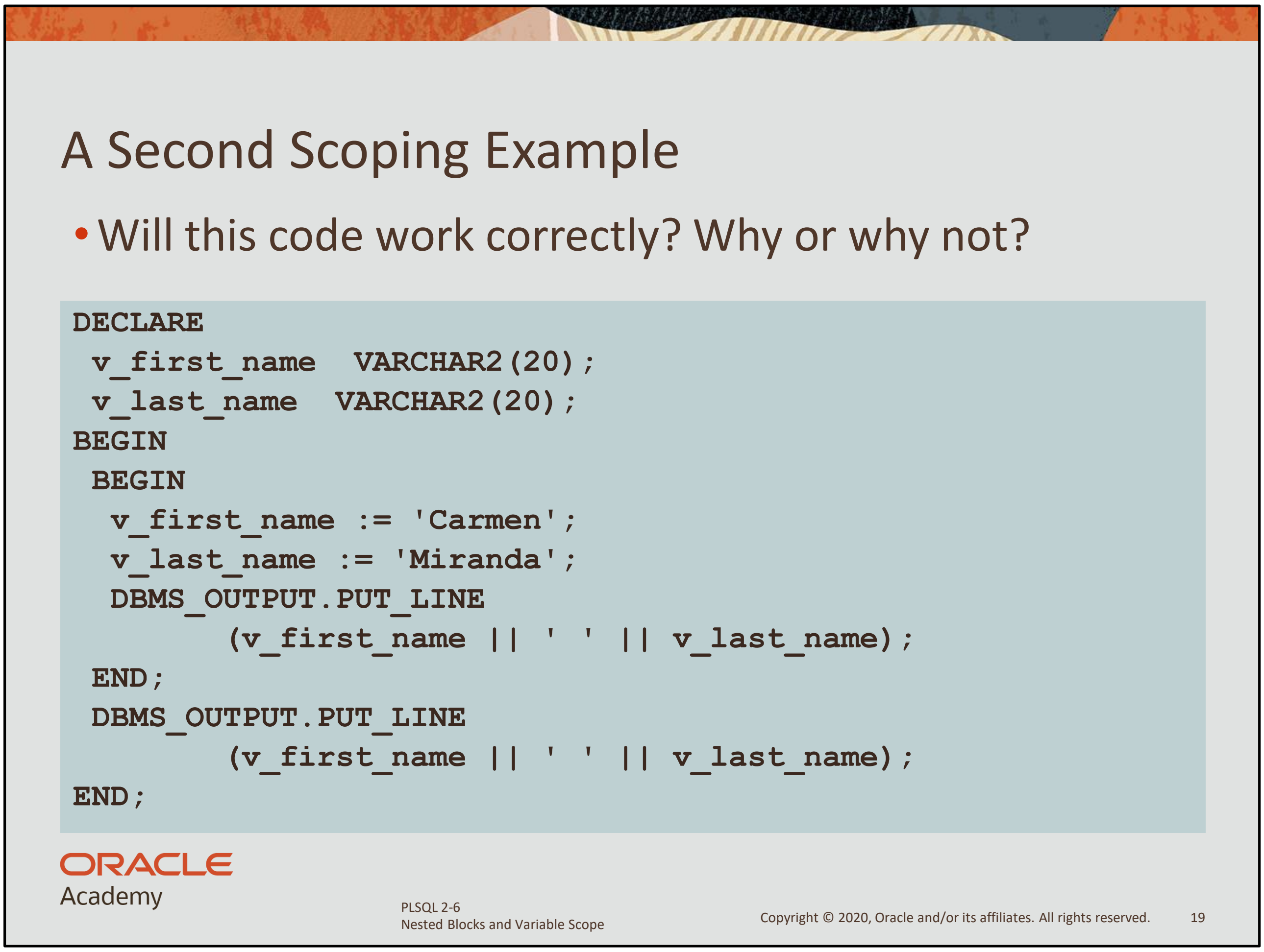
A Scoping Example

- 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;
```

ORACLE Academy

Answer: v_last_name is defined in the inner block and is not accessible in the outer block.



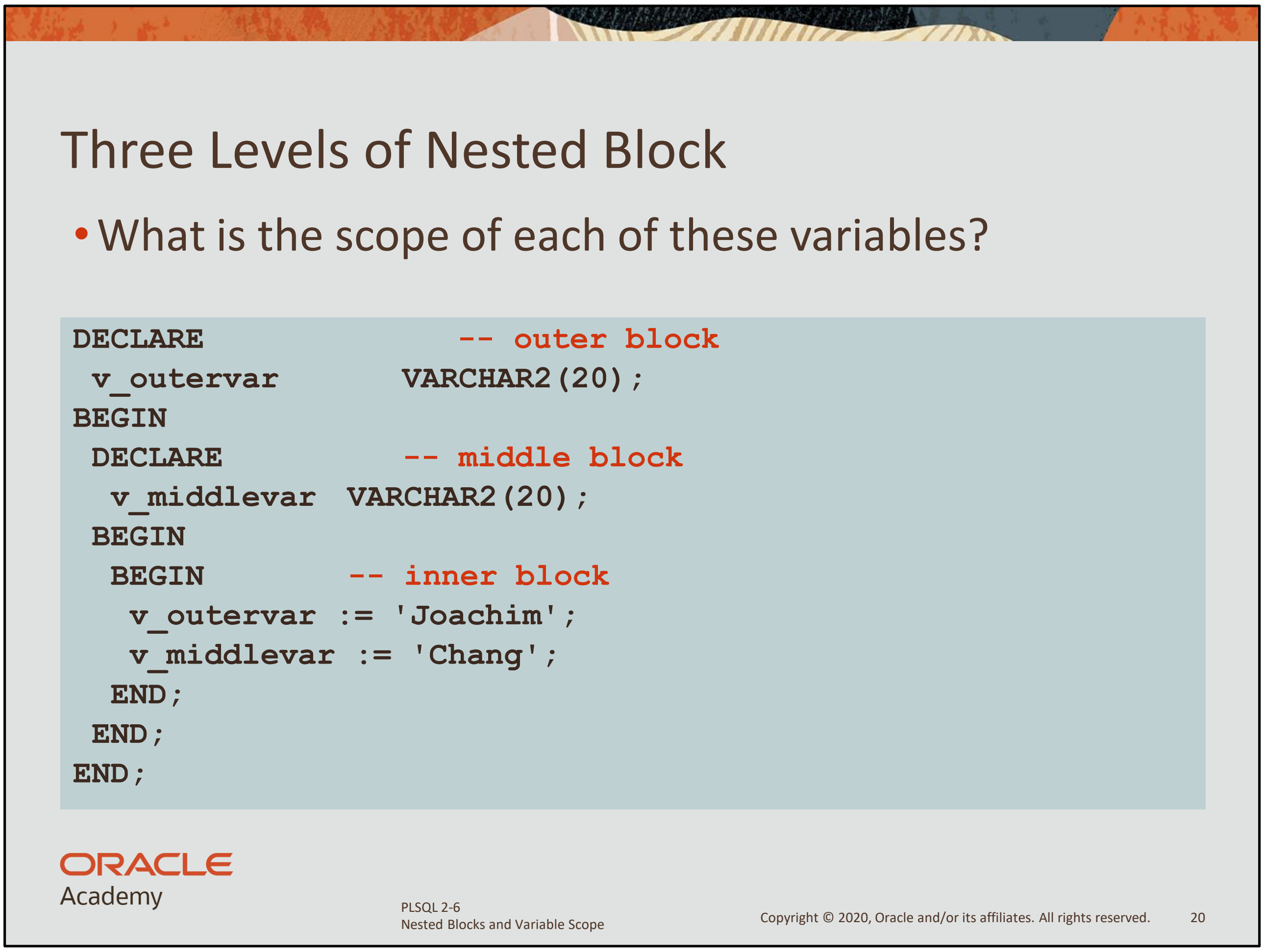
A Second Scoping Example

- 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;
```

ORACLE Academy

Answer: Yes. Both variables are defined in the outer block, so they are accessible in the inner block and the outer block.



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;
```

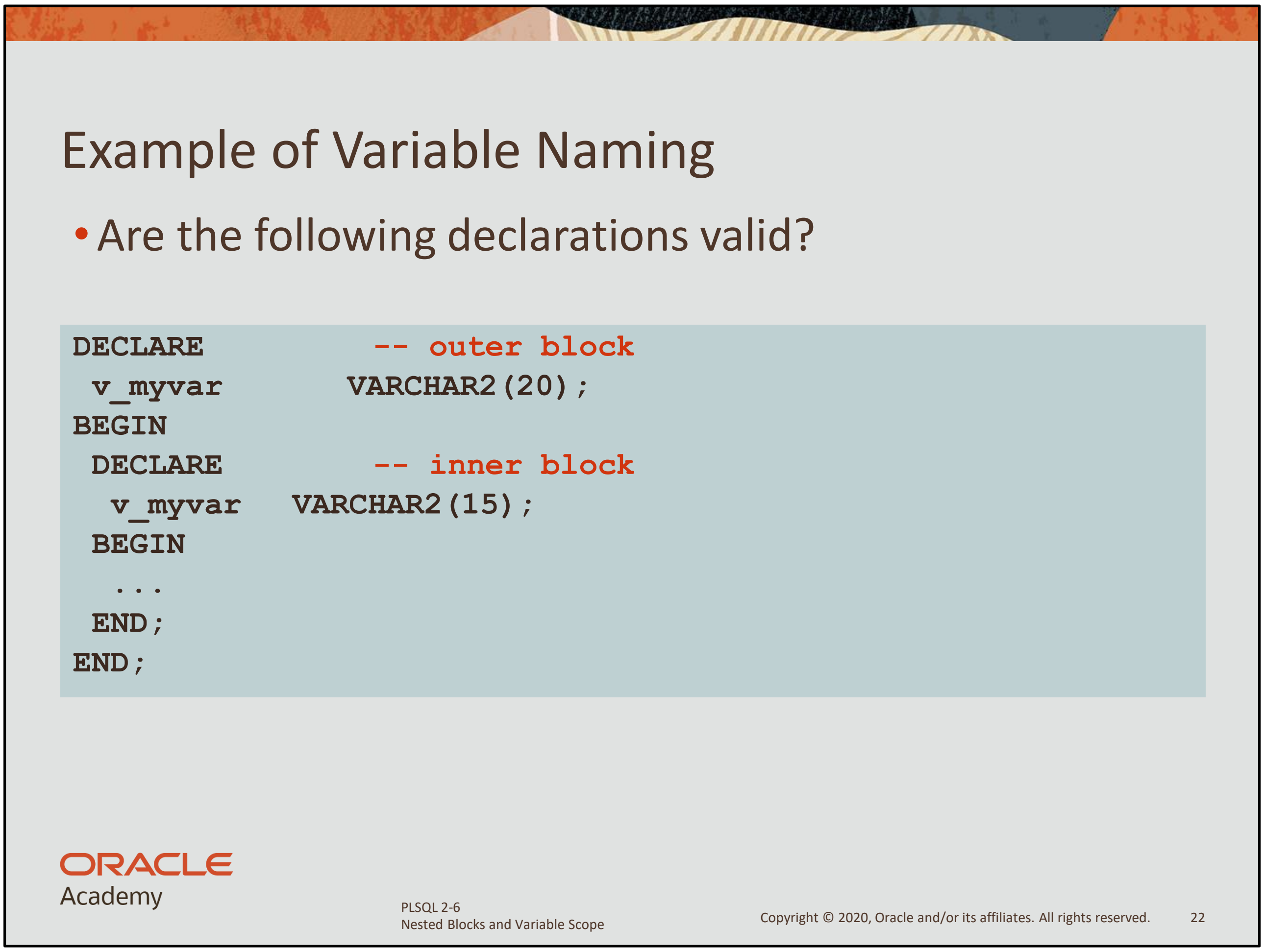
ORACLE Academy

cccc

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

ORACLE
Academy



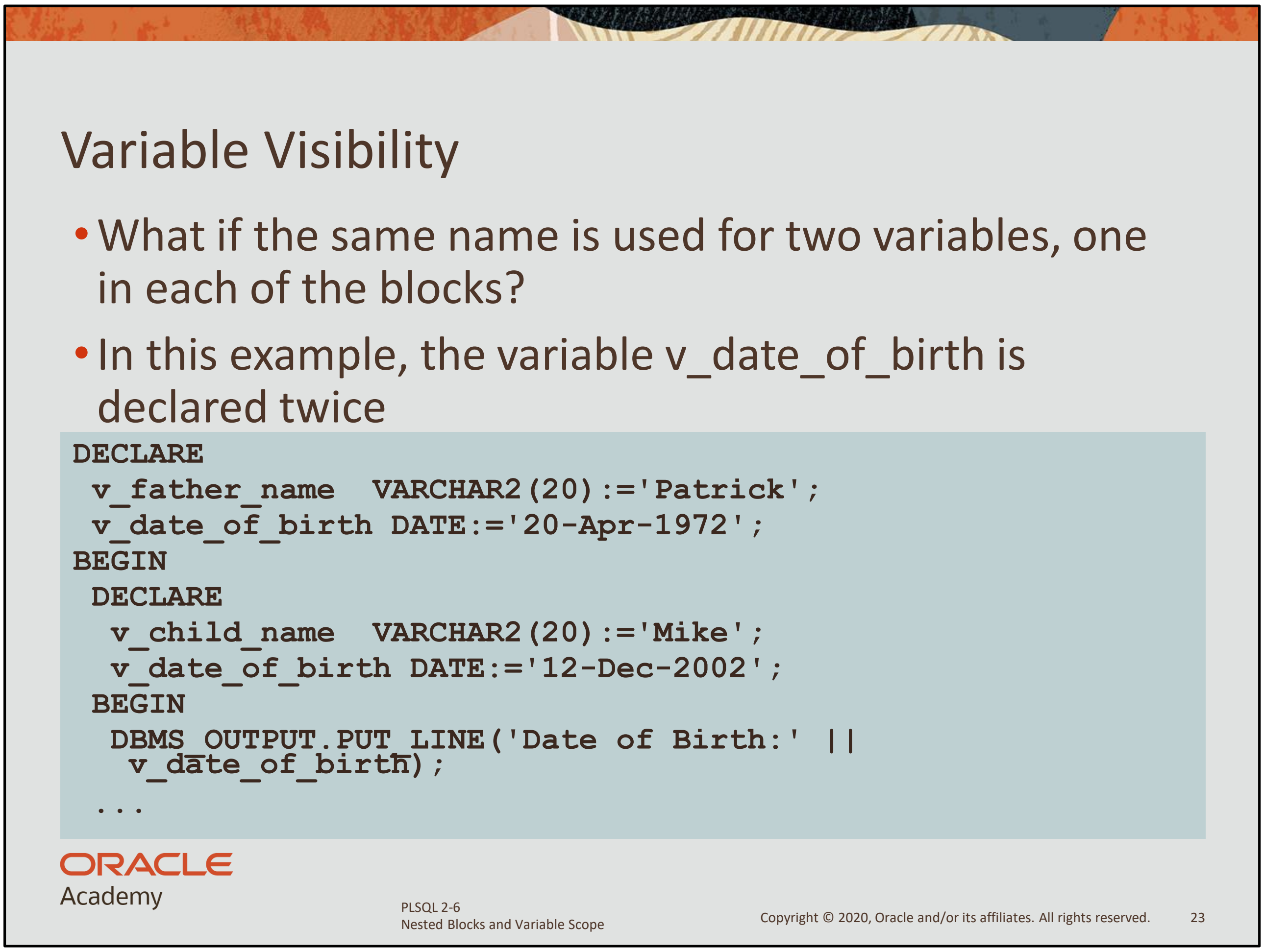
Example of Variable Naming

- Are the following declarations valid?

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

ORACLE
Academy

Answer: Yes, they are valid, but the code could be confusing if it needs to be modified later. This is not recommended.

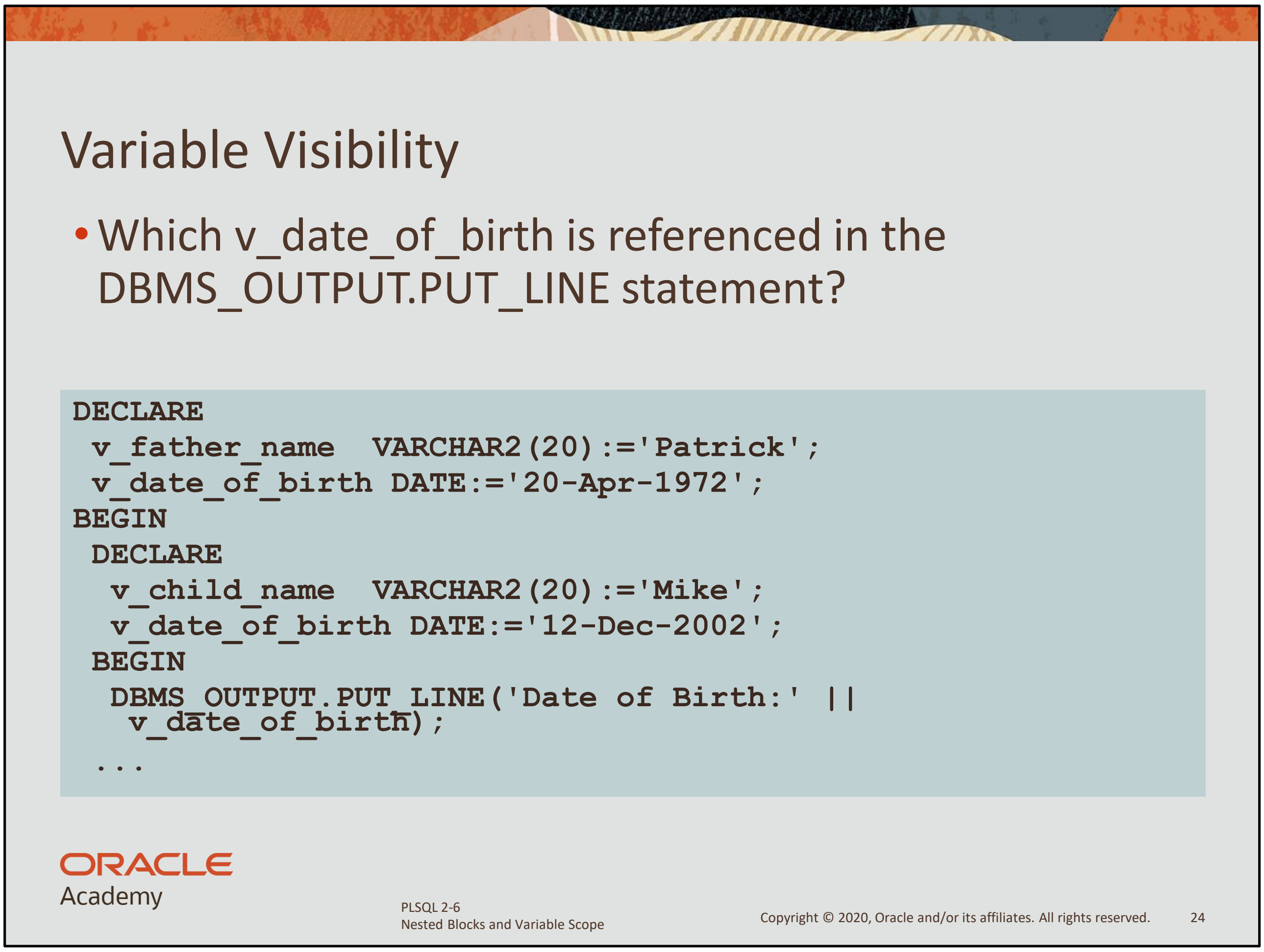


Variable Visibility

- 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);
 ...
```

ORACLE Academy



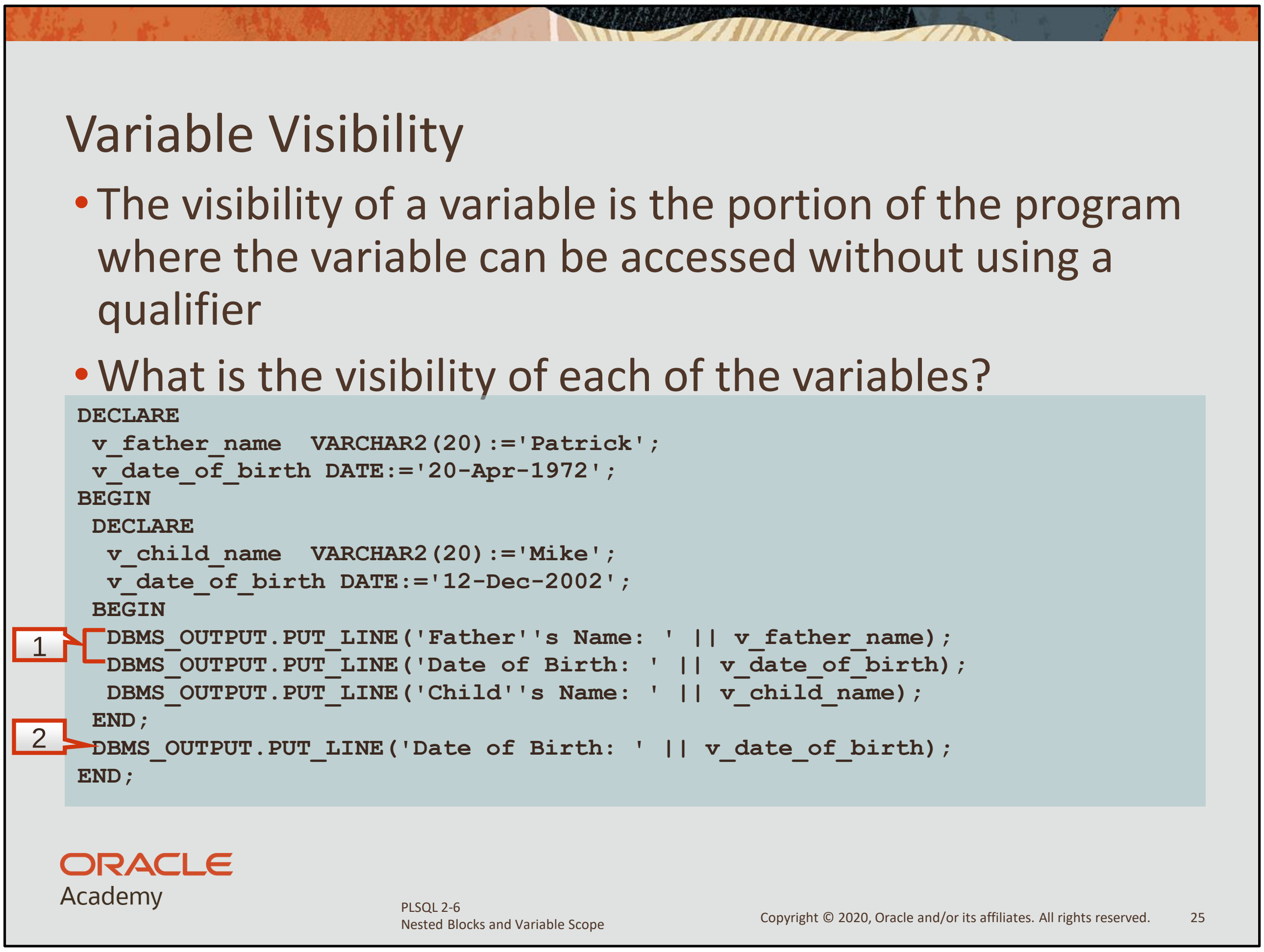
Variable Visibility

- 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);
 ...
```

ORACLE
Academy

Answer: The PUT_LINE will reference the v_date_of_birth declared in the inner block.



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
1   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;
2  DBMS_OUTPUT.PUT_LINE('Date of Birth: ' || v_date_of_birth);
  END;
```

ORACLE Academy

1 Observe the code in the executable section of the inner PL/SQL block. You can print the father's name, the child's name, and the child's date of birth.
   Only the child's date of birth can be printed within the inner block because the father's date of birth is not visible here.

2 The father's date of birth is visible here (having now returned to the outer block) and can now be printed.

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

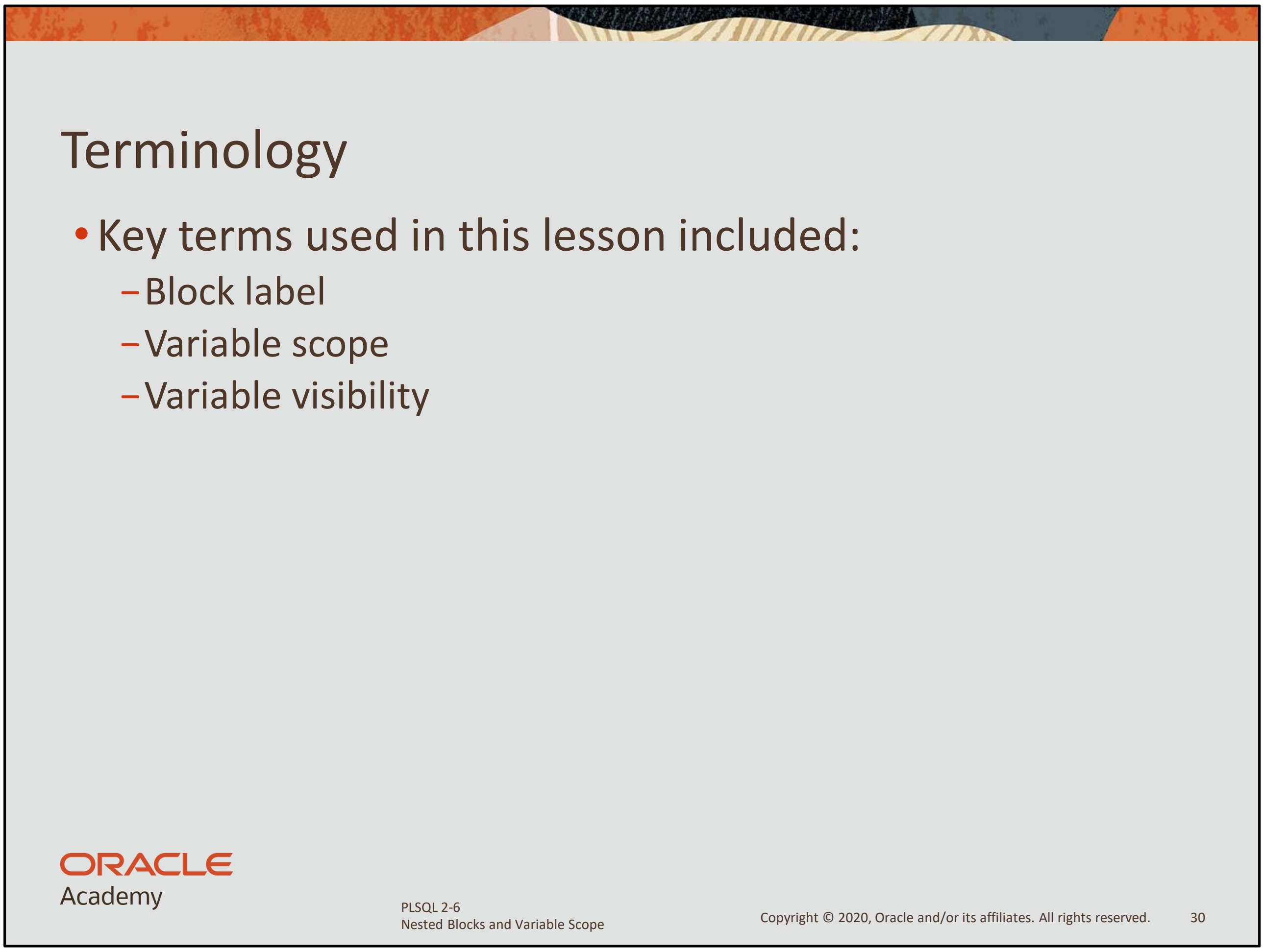
Qualifying an Identifier

- 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

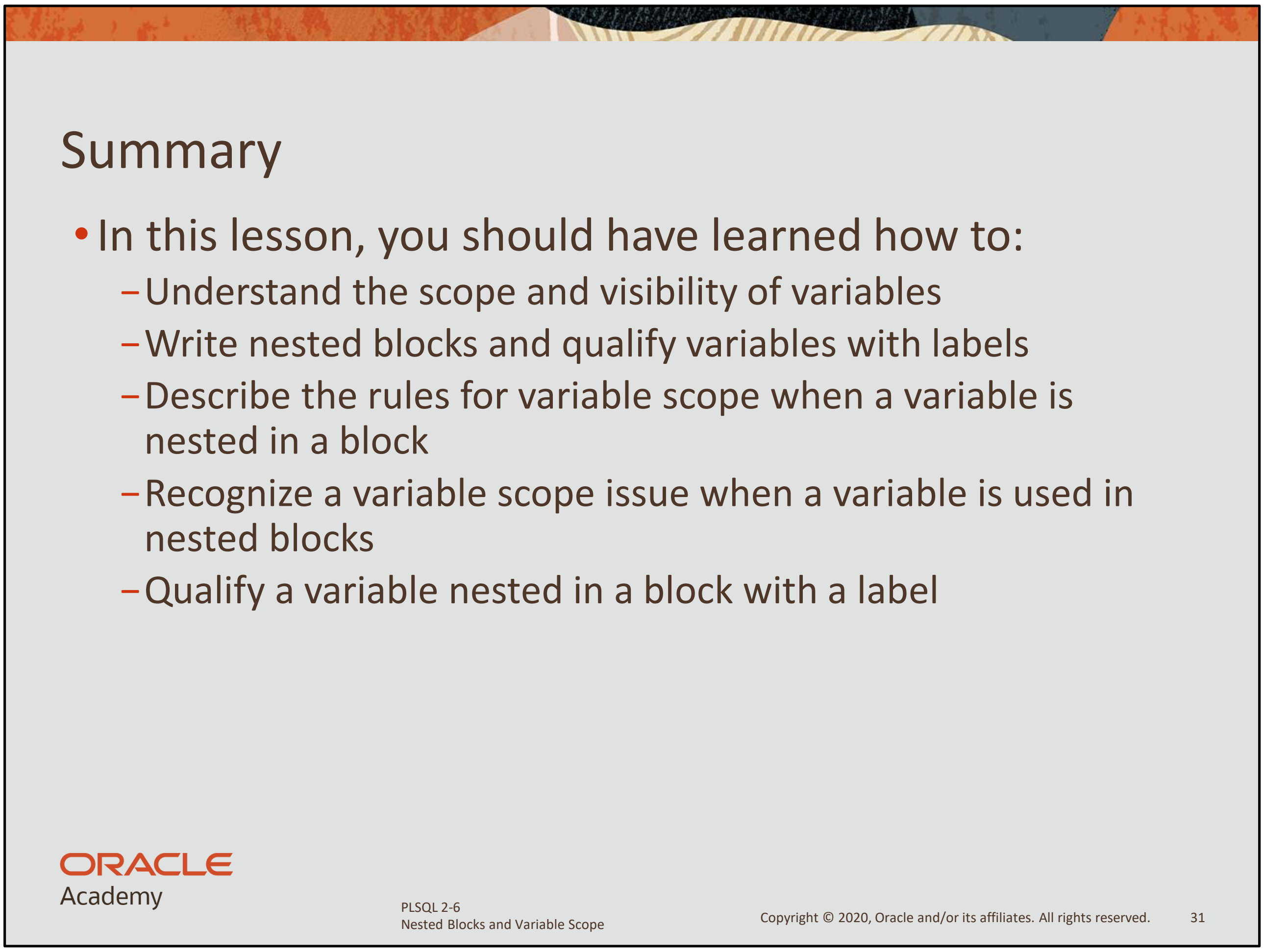
- Key terms used in this lesson included:
  - Block label
  - Variable scope
  - Variable visibility

ORACLE
Academy

- Block label – A name given to a block of code which allows references to be made back to the variables and their values within that block of code from other blocks of code.

- Variable scope – Consists of all the blocks in which the variable is either local (the declaring block) or global (nested blocks within the declaring block).

- Variable visibility – The portion of the program where the variable can be accessed without using a qualifier.



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

ORACLE
Academy