



Database Programming with PL/SQL

4-4

Iterative Control: WHILE and FOR Loops



Objectives

This lesson covers the following objectives:

- Construct and use the `WHILE` looping construct in PL/SQL
- Construct and use the `FOR` looping construct in PL/SQL
- Describe when a `WHILE` loop is used in PL/SQL
- Describe when a `FOR` loop is used in PL/SQL

Purpose

- The previous lesson discussed the basic loop, which allows the statements inside the loop to execute at least once.
- This lesson introduces the `WHILE` loop and `FOR` loop.
- The `WHILE` loop is a looping construct which requires the controlling condition be evaluated at the start of each iteration.
- The `FOR` loop should be used if the number of iterations is known.

WHILE Loops

- You can use the `WHILE` loop to repeat a sequence of statements until the controlling condition is no longer `TRUE`.
- The condition is evaluated at the start of each iteration.
- The loop terminates when the condition is `FALSE` or `NULL`.
- If the condition is `FALSE` or `NULL` at the initial execution of the loop, then no iterations are performed.

```
WHILE condition LOOP
  statement1;
  statement2;
  . . .
END LOOP;
```

WHILE Loops

- In the syntax:

```
WHILE condition LOOP
  statement1;
  statement2;
  . . .
END LOOP;
```

- Condition is a Boolean variable or expression (TRUE, FALSE, or NULL)
- Statement can be one or more PL/SQL or SQL statements

WHILE

- In the syntax:

```
WHILE condition LOOP
  statement1;
  statement2;
  . . .
END LOOP;
```

- If the variables involved in the conditions do not change during the body of the loop, then the condition remains `TRUE` and the loop does not terminate.
- Note: If the condition yields `NULL`, then the loop is bypassed and control passes to the statement that follows the loop.

WHILE Loops

- In this example, three new location IDs for Montreal, Canada, are inserted in the LOCATIONS table.
- The counter is explicitly declared in this example.

```
DECLARE
  v_loc_id      locations.location_id%TYPE;
  v_counter     NUMBER := 1;
BEGIN
  SELECT MAX(location_id) INTO v_loc_id FROM locations
     WHERE country_id = 'CA';
  WHILE v_counter <= 3 LOOP
    INSERT INTO locations(location_id, city, country_id)
      VALUES((v_loc_id + v_counter), 'Montreal', 'CA');
    v_counter := v_counter + 1;
  END LOOP;
END;
```


WHILE Loops

- With each iteration through the `WHILE` loop, a counter (`v_counter`) is incremented.
- If the number of iterations is less than or equal to the number 3, then the code within the loop is executed and a row is inserted into the `locations` table.

```
DECLARE
  v_loc_id      locations.location_id%TYPE;
  v_counter    NUMBER := 1;
BEGIN
  SELECT MAX(location_id) INTO v_loc_id FROM locations
     WHERE country_id = 'CA';
  WHILE v_counter <= 3 LOOP
    INSERT INTO locations(location_id, city, country_id)
      VALUES((v_loc_id + v_counter), 'Montreal', 'CA');
    v_counter := v_counter + 1;
  END LOOP;
END;
```

WHILE Loops

After the counter exceeds the number of new locations for this city and country, the condition that controls the loop evaluates to FALSE and the loop is terminated.

```
DECLARE
  v_loc_id      locations.location_id%TYPE;
  v_counter     NUMBER := 1;
BEGIN
  SELECT MAX(location_id) INTO v_loc_id FROM locations
     WHERE country_id = 'CA';
  WHILE v_counter <= 3 LOOP
    INSERT INTO locations(location_id, city, country_id)
      VALUES((v_loc_id + v_counter), 'Montreal', 'CA');
    v_counter := v_counter + 1;
  END LOOP;
END;
```

FOR Loops Described

- FOR loops have the same general structure as the basic loop.
- In addition, they have a control statement before the LOOP keyword to set the number of iterations that PL/SQL performs.

```
FOR counter IN [REVERSE]
    lower_bound..upper_bound LOOP
    statement1;
    statement2;
    . . .
END LOOP;
```

FOR Loop Rules

FOR loop rules:

- Use a FOR loop to shortcut the test for the number of iterations.
- Do not declare the counter; it is declared implicitly.
- *lower_bound* .. *upper_bound* is the required syntax.

```
FOR counter IN [REVERSE]
    lower_bound..upper_bound LOOP
    statement1;
    statement2;
    . . .
END LOOP;
```

FOR Loops Syntax

- *Counter* is an implicitly declared integer whose value automatically increases or decreases (decreases if the REVERSE keyword is used) by 1 on each iteration of the loop until the upper or lower bound is reached.
- REVERSE causes the counter to decrement with each iteration from the upper bound to the lower bound.
- (Note that the lower bound is referenced first.)

```
FOR counter IN [REVERSE]
    lower_bound..upper_bound LOOP
    statement1;
    statement2;
    . . .
END LOOP;
```

FOR Loops Syntax

- *lower_bound* specifies the lower bound for the range of counter values.
- *upper_bound* specifies the upper bound for the range of counter values.

```
FOR counter IN [REVERSE]
    lower_bound..upper_bound LOOP
    statement1;
    statement2;
    . . .
END LOOP;
```

FOR Loop Example

- You have already learned how to insert three new locations for the country code CA and the city Montreal by using the simple LOOP and the WHILE loop.
- This slide shows you how to achieve the same by using the FOR loop.

```
DECLARE
  v_loc_id      locations.location_id%TYPE;
BEGIN
  SELECT MAX(location_id) INTO v_loc_id FROM locations
     WHERE country_id = 'CA';
  FOR i IN 1..3 LOOP
    INSERT INTO locations(location_id, city, country_id)
      VALUES((v_loc_id + i), 'Montreal', 'CA');
  END LOOP;
END;
```

FOR Loop Guidelines

FOR loops are a common structure of programming languages.

- A FOR loop is used within the code when the beginning and ending value of the loop is known.
- Reference the counter only within the loop; its scope does not extend outside the loop.
- Do not reference the counter as the target of an assignment.
- Neither loop bound (lower or upper) should be `NULL`.

FOR Loop Expression Example

- While writing a FOR loop, the lower and upper bounds of a LOOP statement do not need to be numeric literals.
- They can be expressions that convert to numeric values.

```
DECLARE
  v_lower  NUMBER := 1;
  v_upper  NUMBER := 100;
BEGIN
  FOR i IN v_lower..v_upper LOOP
    ...
  END LOOP;
END;
```

Guidelines For When to Use Loops

- Use the basic loop when the statements inside the loop must execute at least once.
- Use the `WHILE` loop if the condition has to be evaluated at the start of each iteration.
- Use a `FOR` loop if the number of iterations is known.



Terminology

Key terms used in this lesson included:

- FOR loops
- Lower Bound
- REVERSE
- Upper Bound
- WHILE loops

Summary

In this lesson, you should have learned how to:

- Construct and use the `WHILE` looping construct in PL/SQL
- Construct and use the `FOR` looping construct in PL/SQL
- Describe when a `WHILE` loop is used in PL/SQL
- Describe when a `FOR` loop is used in PL/SQL

