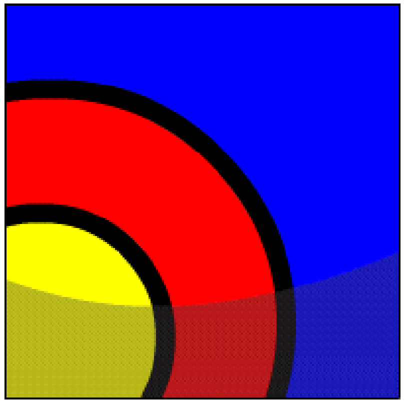
Introduction to Explicit Cursors

What Will I Learn?

In this lesson, you will learn to:

- Distinguish between an implicit and an explicit cursor
- Describe why and when to use an explicit cursor in PL/SQL code
- List two or more guidelines for declaring and controlling explicit cursors
- Create PL/SQL code that successfully opens a cursor and fetches a piece of data into a variable
- Use a simple loop to fetch multiple rows from a cursor
- Create PL/SQL code that successfully closes a cursor after fetching data into a variable



Why Learn It?

You have learned that an SQL SELECT statement in a PL/SQL block is successful only if it returns exactly one row.

What if you need to write a SELECT statement that returns more than one row? For example, you need to produce a report of all employees?

To return more than one row, you must declare and use an explicit cursor.

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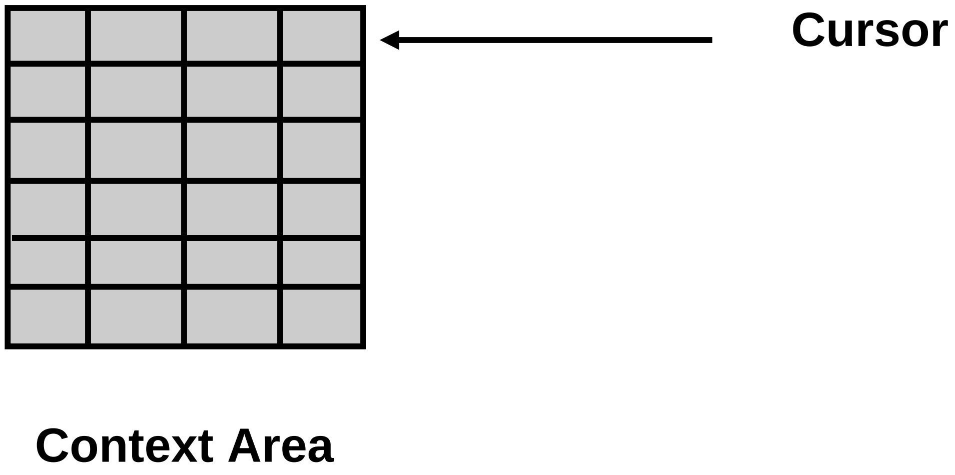
Context Areas and Cursors

The Oracle server allocates a private memory area called a context area to store the data processed by an SQL statement.

Every context area (and therefore every SQL statement) has a cursor associated with it. You can think of a cursor either as a label for the context area, or as a pointer to the context area. In fact, a cursor is both of these items.



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Implicit and Explicit Cursors

There are two types of cursors:

- Implicit cursors: Defined automatically by Oracle for all SQL DML statements (`INSERT`, `UPDATE`, `DELETE`, and `MERGE`), and for `SELECT` statements that return only one row.
- Explicit cursors: Declared by the programmer for queries that return more than one row. You can use explicit cursors to name a context area and access its stored data.

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Limitations of Implicit Cursors

There is more than one row in the EMPLOYEES table:

```
DECLARE
  v_salary employees.salary%TYPE;
BEGIN
  SELECT salary INTO v_salary
    FROM employees;
  DBMS_OUTPUT.PUT_LINE(' Salary is : '||v_salary);
END;
```

```
ORA-01422: exact fetch returns more than requested number of rows
```

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Explicit Cursors

With an explicit cursor, you can retrieve multiple rows from a database table, have a pointer to each row that is retrieved, and work on the rows one at a time.

The following are some reasons to use an explicit cursor:

- It is the only way in PL/SQL to retrieve more than one row from a table.
- Each row is fetched by a separate program statement, giving the programmer more control over the processing of the rows.

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Example of an Explicit Cursor

The following example uses an explicit cursor to obtain the country name and national holiday for countries in Asia.

```
DECLARE
  CURSOR wf_holiday_cursor IS
  SELECT country_name, national_holiday_date
  FROM wf_countries where region_id IN(30,34,35);
  v_country_name  wf_countries.country_name%TYPE;
  v_holiday       wf_countries.national_holiday_date%TYPE;
BEGIN
  OPEN wf_holiday_cursor;
  LOOP
    FETCH wf_holiday_cursor INTO v_country_name, v_holiday;
    EXIT WHEN wf_holiday_cursor%NOTFOUND;
    DBMS_OUTPUT.PUT_LINE(v_country_name||' '||v_holiday);
  END LOOP;
  CLOSE wf_holiday_cursor;
END;
```

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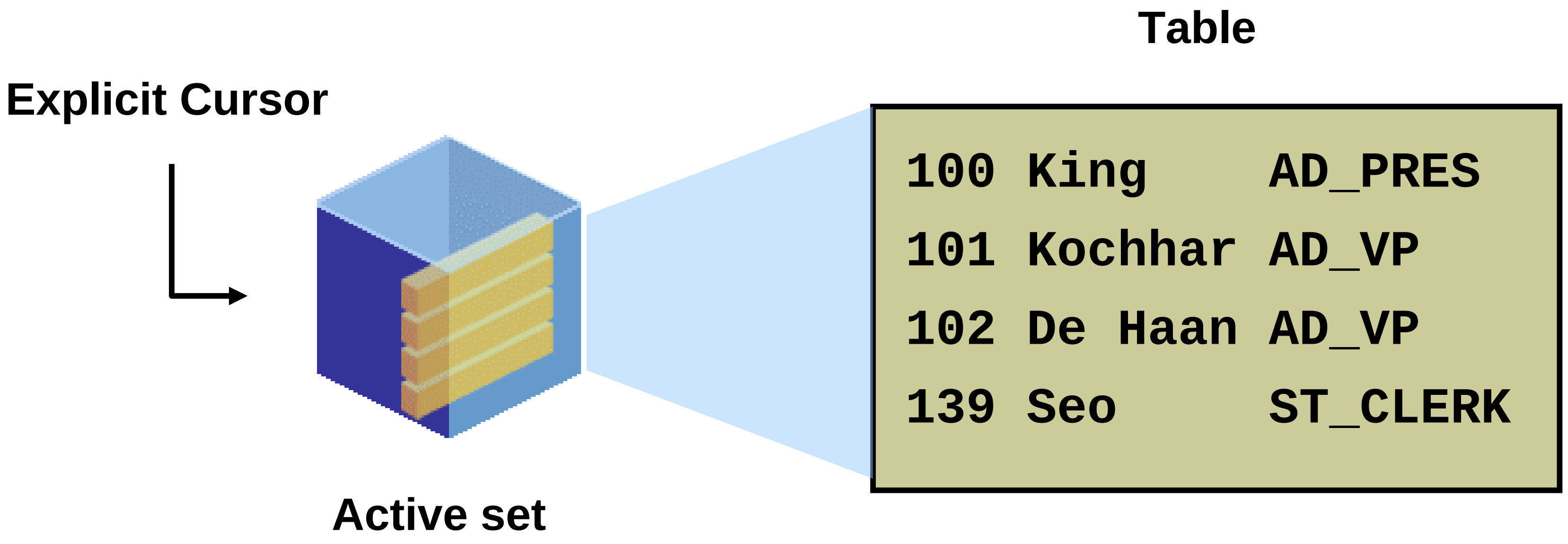
Explicit Cursor Operations

The set of rows returned by a multiple-row query is called the **active set**, and is stored in the context area. Its size is the number of rows that meet your search criteria.

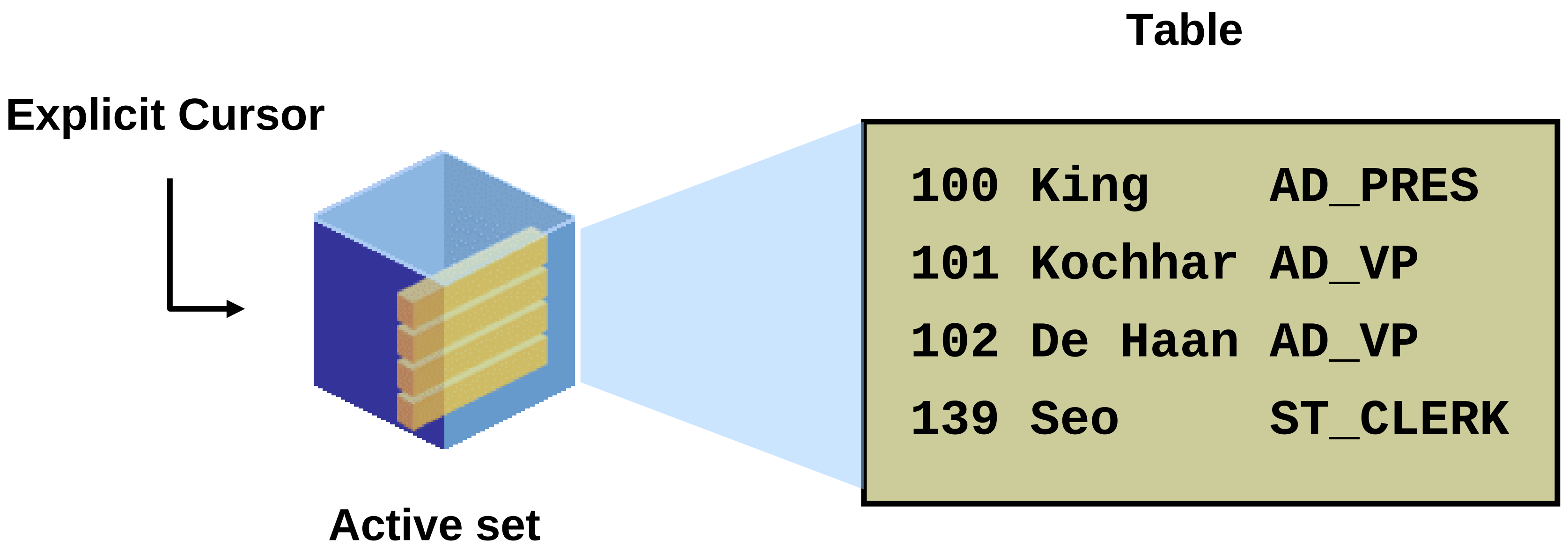


```
100 King    AD_PRES
101 Kochhar AD_VP
102 De Haan AD_VP
139 Seo     ST_CLERK
```

Tell Me/Show Me

Explicit Cursor Operations

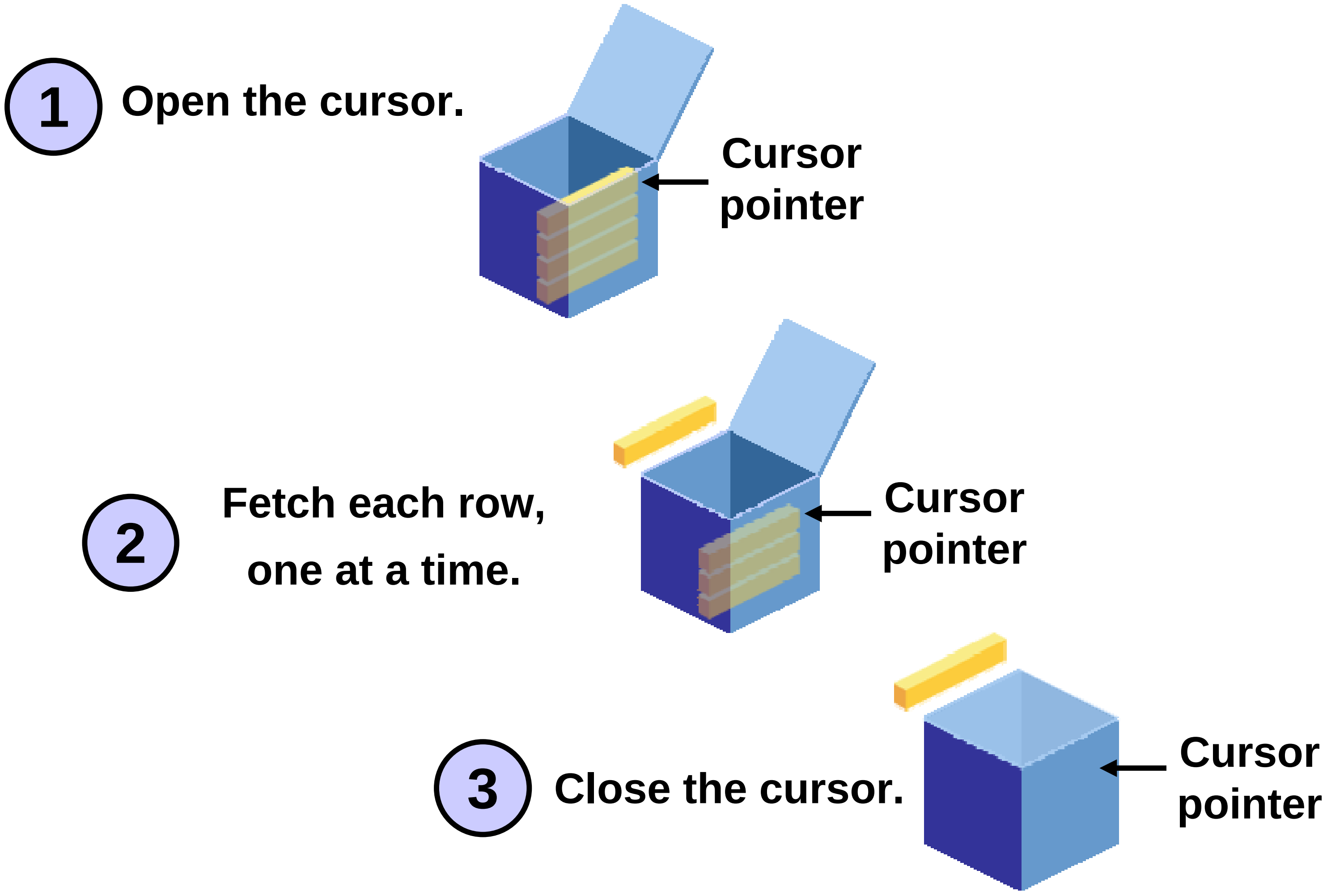
Think of the context area (named by the cursor) as a box, and the active set as the contents of the box. To get at the data, you must `OPEN` the box and `FETCH` each row from the box one at a time. When finished, you must `CLOSE` the box.



```
100 King     AD_PRES
101 Kochhar  AD_VP
102 De Haan  AD_VP
139 Seo      ST_CLERK
```

Tell Me/Show Me

Controlling Explicit Cursors



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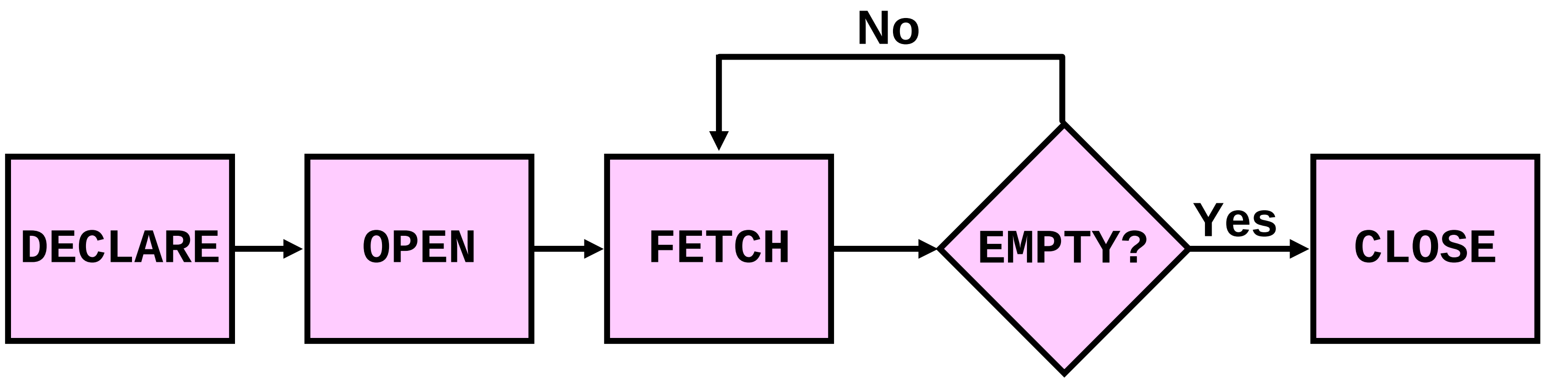
Declaring and Controlling Explicit Cursors



- Name an active set.
- Fill the active set with data.
- Retrieve the current row into variables.
- Test for existing rows.
- Return to FETCH if rows are found.
- Release the active set.

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Declaring the Cursor

The active set of a cursor is determined by the SELECT statement in the cursor declaration.

Syntax:

```
CURSOR cursor_name IS
     select_statement;
```

In the syntax:

cursor_name	Is a PL/SQL identifier
select_statement	Is a SELECT statement without an INTO clause

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Declaring the Cursor: Example 1

The `emp_cursor` cursor is declared to retrieve the `employee_id` and `last_name` columns of the employees working in the department with a `department_id` of 30.

```
DECLARE
  CURSOR emp_cursor IS
  SELECT employee_id, last_name FROM employees
  WHERE department_id =30;
...
```

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Declaring the Cursor: Example 2

The dept_cursor cursor is declared to retrieve all the details for the departments with the location_id 1700. You want to fetch and process these rows in ascending sequence by department_name.

```
DECLARE
  CURSOR dept_cursor IS
    SELECT * FROM departments
      WHERE location_id = 1700
      ORDER BY department_name;
...
```

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Declaring the Cursor: Example 3

A SELECT statement in a cursor declaration can include joins, group functions, and subqueries. This example retrieves each department that has at least two employees, giving the department name and number of employees.

```
DECLARE
  CURSOR dept_emp_cursor IS
    SELECT department_name, COUNT(*) AS how_many
      FROM departments d, employees e
         WHERE d.department_id = e.department_id
      GROUP BY d.department_name
      HAVING COUNT(*) > 1;
...
```

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Guidelines for Declaring the Cursor

- Do not include the `INTO` clause in the cursor declaration because it appears later in the `FETCH` statement.
- If processing rows in a specific sequence is required, then use the `ORDER BY` clause in the query.
- The cursor can be any valid `SELECT` statement, including joins, subqueries, and so on.
- If a cursor declaration references any PL/SQL variables, these variables must be declared before declaring the cursor.

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Opening the Cursor

The `OPEN` statement executes the query associated with the cursor, identifies the active set, and positions the cursor pointer to the first row. The `OPEN` statement is included in the executable section of the PL/SQL block.

```
DECLARE
  CURSOR emp_cursor IS
    SELECT employee_id, last_name FROM employees
      WHERE department_id =30;
...
BEGIN
  OPEN emp_cursor;
...
```

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Opening the Cursor (continued)

- The `OPEN` statement performs the following operations:

  1. Allocates memory for a context area (creates the box)
  2. Executes the `SELECT` statement in the cursor declaration, returning the results into the active set (fills the box with data)
  3. Positions the pointer to the first row in the active set

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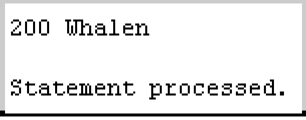
Fetching Data from the Cursor

The FETCH statement retrieves the rows from the cursor one at a time. After each fetch, the cursor advances to the next row in the active set. Two variables, v_empno and v_lname, are declared to hold the fetched values from the cursor.

```
DECLARE
  CURSOR emp_cursor IS
    SELECT employee_id, last_name FROM employees
      WHERE department_id =10;
  v_empno employees.employee_id%TYPE;
  v_lname employees.last_name%TYPE;
BEGIN
  OPEN emp_cursor;
  FETCH emp_cursor INTO v_empno, v_lname;
  DBMS_OUTPUT.PUT_LINE( v_empno ||' '||v_lname);
  ...
END;
```



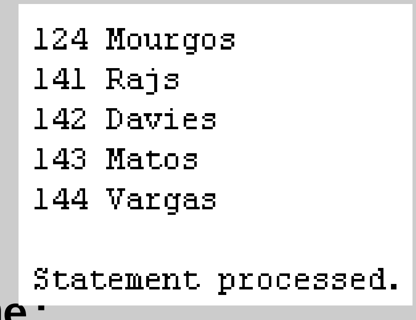
```
200 Whalen

Statement processed.
```

Tell Me/Show Me

Fetching Data from the Cursor

You have successfully fetched the values from the cursor into the variables. However, there are six employees in department 30. Only one row has been fetched. To fetch all the rows, you have to make use of loops.

```
DECLARE
  CURSOR emp_cursor IS
    SELECT employee_id, last_name FROM employees
       WHERE  department_id =50;
  v_empno employees.employee_id%TYPE;
  v_lname employees.last_name%TYPE;
BEGIN
  OPEN emp_cursor;
   LOOP
    FETCH emp_cursor INTO v_empno, v_lname;
    EXIT WHEN emp_cursor%NOTFOUND;
    DBMS_OUTPUT.PUT_LINE( v_empno ||' '||v_lname);
  END LOOP; …
END;
```



```
124 Mourgos
141 Rajs
142 Davies
143 Matos
144 Vargas

Statement processed.
```

Tell Me/Show Me

Guidelines for Fetching Data From the Cursor

- Include the same number of variables in the `INTO` clause of the `FETCH` statement as columns in the `SELECT` statement, and be sure that the data types are compatible.
- Match each variable to correspond to the columns positionally.
- Test to see whether the cursor contains rows. If a fetch acquires no values, then there are no rows left to process in the active set and no error is recorded. The last row is re-processed.
- You can use the `%NOTFOUND` cursor attribute to test for the exit condition.

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Fetching Data From the Cursor

What is wrong with this example?

```
DECLARE
  CURSOR emp_cursor IS
    SELECT employee_id, last_name, salary FROM employees
      WHERE  department_id =30;
  v_empno employees.employee_id%TYPE;
  v_lname employees.last_name%TYPE;
  v_sal   employees.salary%TYPE;
BEGIN
  OPEN emp_cursor;
  LOOP
    FETCH emp_cursor INTO v_empno, v_lname;
    EXIT WHEN emp_cursor%NOTFOUND;
    DBMS_OUTPUT.PUT_LINE( v_empno ||' '||v_lname);
  END LOOP; …
END;
```

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Fetching Data From the Cursor (continued)

There is only one employee in department 10. What happens when this example is executed?

```
DECLARE
  CURSOR emp_cursor IS
    SELECT employee_id, last_name FROM employees
      WHERE  department_id =10;
  v_empno employees.employee_id%TYPE;
  v_lname employees.last_name%TYPE;
BEGIN
  OPEN emp_cursor;
  LOOP
    FETCH emp_cursor INTO v_empno, v_lname;
    DBMS_OUTPUT.PUT_LINE( v_empno ||' '||v_lname);
  END LOOP; …
END;
```

Tell Me/Show Me

Closing the Cursor

The CLOSE statement disables the cursor, releases the context area, and undefines the active set. Close the cursor after completing the processing of the FETCH statement. You can reopen the cursor later if required.

Think of CLOSE as closing and emptying the box, so you can no longer FETCH its contents.

```
...
  LOOP
    FETCH emp_cursor INTO v_empno, v_lname;
    EXIT WHEN emp_cursor%NOTFOUND;
    DBMS_OUTPUT.PUT_LINE( v_empno ||' '||v_lname);
  END LOOP;
  CLOSE emp_cursor;
END;
```

Tell Me/Show Me

Guidelines for Closing the Cursor

- A cursor can be reopened only if it is closed. If you attempt to fetch data from a cursor after it has been closed, then an `INVALID_CURSOR` exception is raised.
- If you later reopen the cursor, the associated SELECT statement is re-executed to re-populate the context area with the most recent data from the database.

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Putting It All Together

The following example declares and processes a cursor to obtain the country name and national holiday for countries in Asia.

```
DECLARE
  CURSOR wf_holiday_cursor IS
    SELECT country_name, national_holiday_date
      FROM wf_countries where region_id IN(30,34,35);
  v_country_name wf_countries.country_name%TYPE;
  v_holiday      wf_countries.national_holiday_date%TYPE;
BEGIN
  OPEN wf_holiday_cursor;
  LOOP
    FETCH wf_holiday_cursor INTO v_country_name, v_holiday;
    EXIT WHEN wf_holiday_cursor%NOTFOUND;
    DBMS_OUTPUT.PUT_LINE(v_country_name||' '||v_holiday);
  END LOOP;
  CLOSE wf_holiday_cursor;
END;
```

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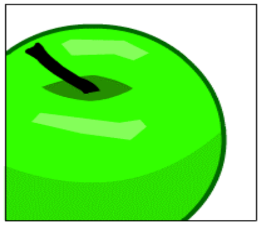


Terminology

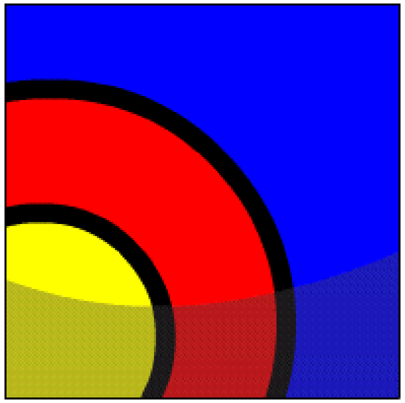
Key terms used in this lesson include:

Context area
Cursor
Implicit cursor
Explicit cursor
Active set
FETCH
OPEN
CLOSE

Summary

In this lesson, you learned to:

- Distinguish between an implicit and an explicit cursor
- Describe why and when to use an explicit cursor in PL/SQL code
- List two or more guidelines for declaring and controlling explicit cursors
- Create PL/SQL code that successfully opens a cursor and fetches a piece of data into a variable
- Use a simple loop to fetch multiple rows from a cursor
- Create PL/SQL code that successfully closes a cursor after fetching data into a variable



Try It/Solve It

The exercises in this lesson cover the following topics:

- Distinguishing between an implicit and an explicit cursor
- Discussing when and why to use an explicit cursor
- Declaring and controlling explicit cursors
- Using a simple loop to fetch multiple rows from a cursor