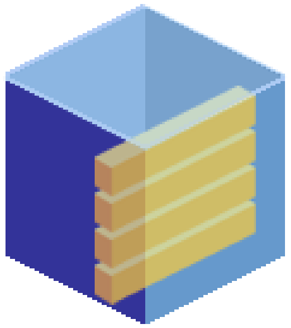
Using Explicit Cursors

Objectives

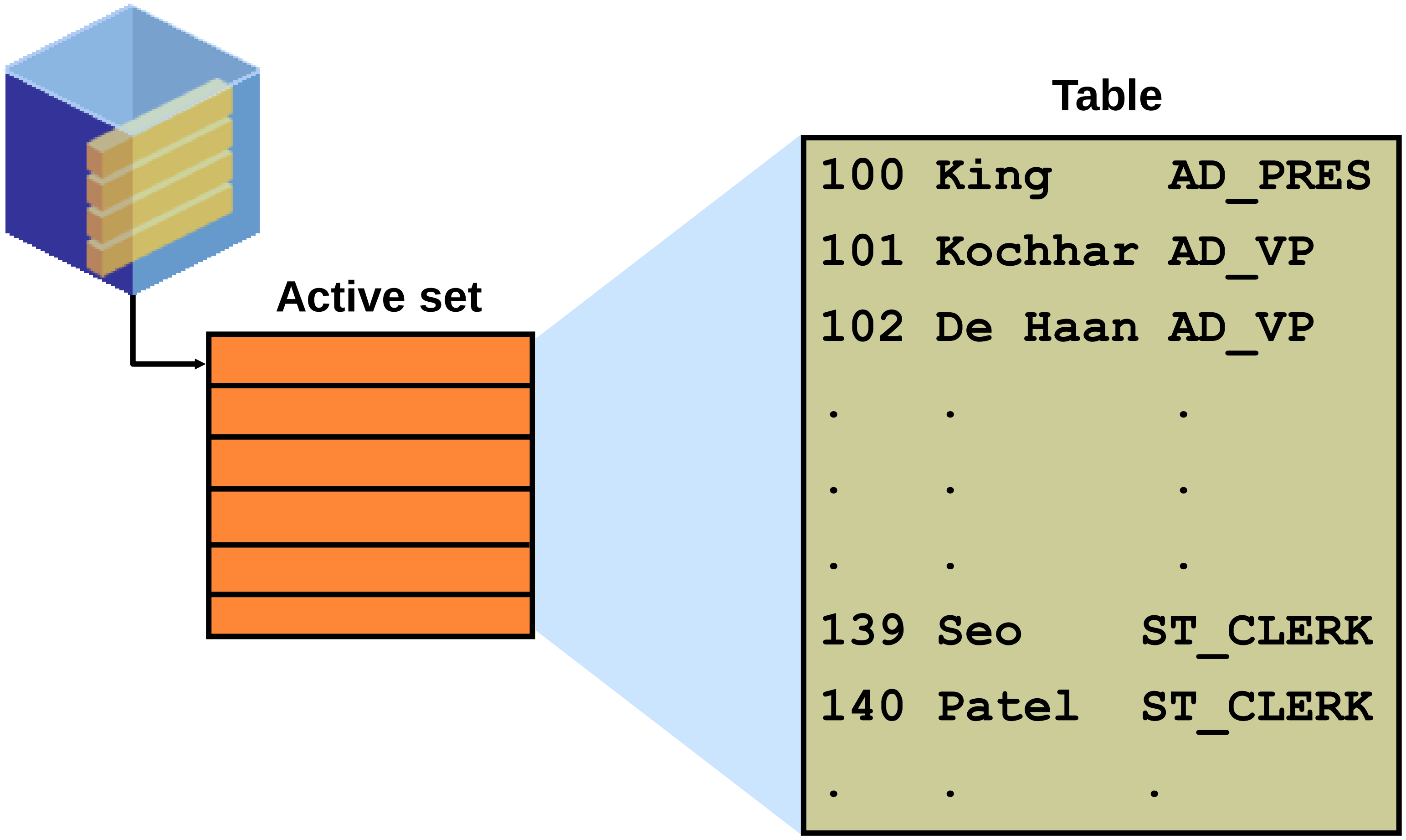
- After completing this lesson, you should be able to do the following:
  - Distinguish between implicit and explicit cursors
  - Discuss the reasons for using explicit cursors
  - Declare and control explicit cursors
  - Use simple loops and cursor `FOR` loops to fetch data
  - Declare and use cursors with parameters
  - Lock rows with the `FOR UPDATE` clause
  - Reference the current row with the `WHERE CURRENT` clause

Cursors

- Every SQL statement executed by the Oracle server has an associated individual cursor:
  - Implicit cursors: Declared and managed by PL/SQL for all DML and PL/SQL `SELECT` statements
  - Explicit cursors: Declared and managed by the programmer

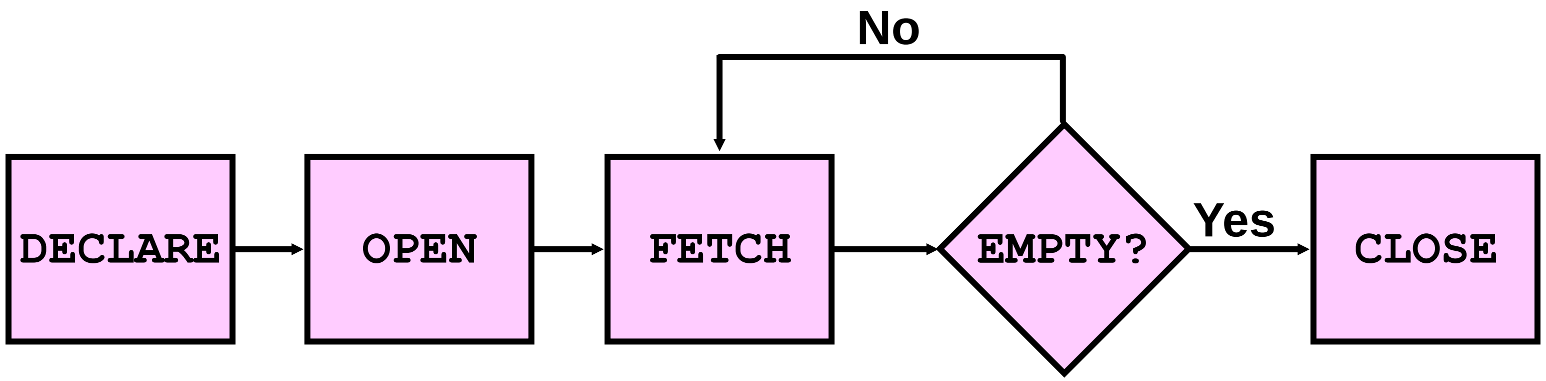


Explicit Cursor Operations



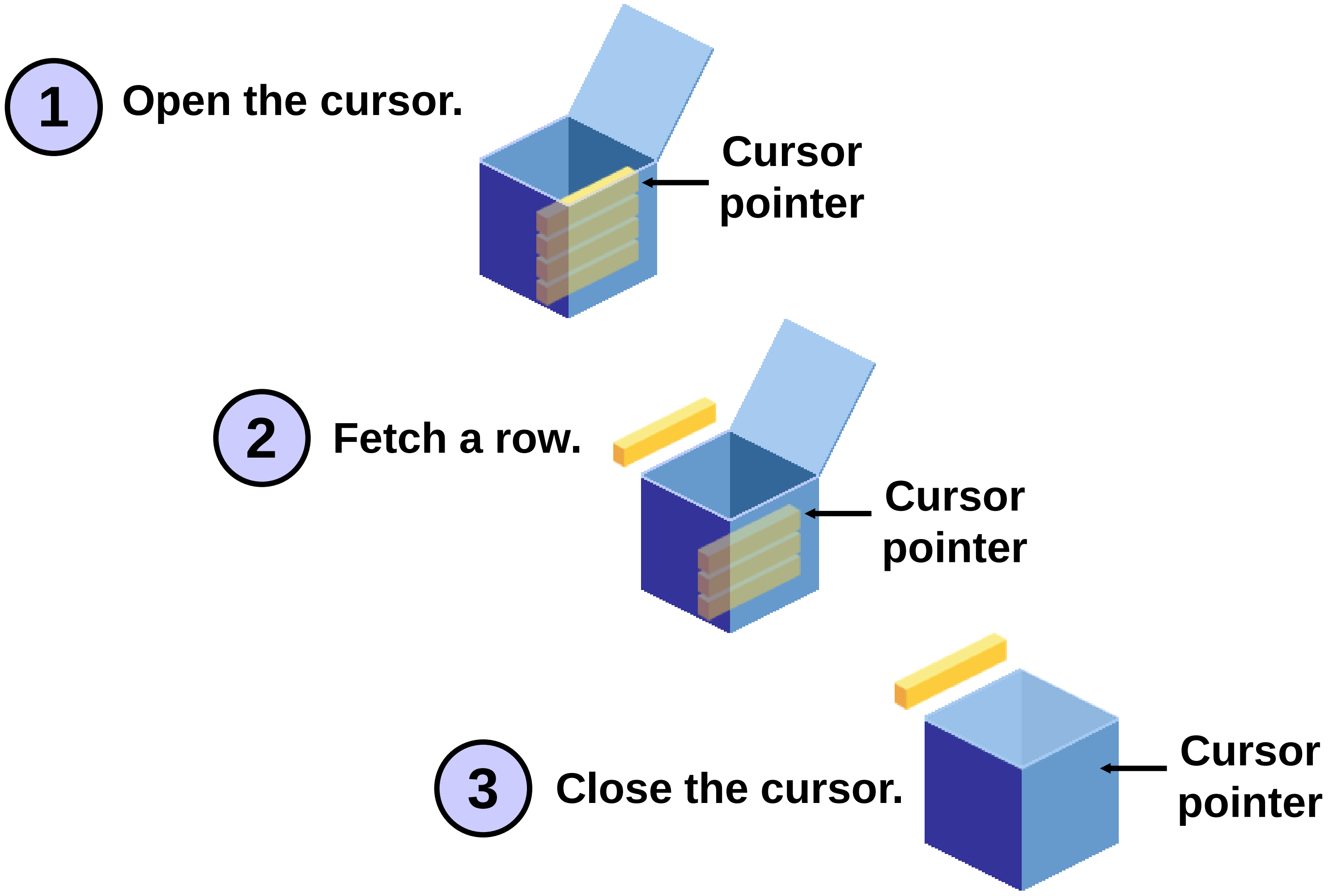
```
100 King    AD_PRES
101 Kochhar AD_VP
102 De Haan AD_VP
.   .       .
.   .       .
.   .       .
139 Seo    ST_CLERK
140 Patel  ST_CLERK
.   .      .
```

Controlling Explicit Cursors



- Create a named SQL area.
- Identify the active set.
- Load the current row into variables.
- Test for existing rows.
- Return to `FETCH` if rows are found.
- Release the active set.

Controlling Explicit Cursors



Declaring the Cursor

- Syntax:

```
CURSOR cursor_name IS
     select_statement;
```

Examples

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

```
DECLARE
  locid NUMBER:= 1700;
  CURSOR dept_cursor IS
  SELECT * FROM departments
  WHERE location_id = locid;
...
```

Opening the Cursor

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

Fetching Data from the Cursor

```
SET SERVEROUTPUT ON
DECLARE
  CURSOR emp_cursor IS
   SELECT employee_id, last_name FROM employees
   WHERE department_id =30;
  empno employees.employee_id%TYPE;
  lname employees.last_name%TYPE;
BEGIN
  OPEN emp_cursor;
  FETCH emp_cursor INTO empno, lname;
  DBMS_OUTPUT.PUT_LINE( empno ||' '||lname);
  ...
END;
/
```

Fetching Data from the Cursor

```
SET SERVEROUTPUT ON
DECLARE
  CURSOR emp_cursor IS
   SELECT employee_id, last_name FROM employees
   WHERE  department_id =30;
  empno employees.employee_id%TYPE;
  lname employees.last_name%TYPE;
BEGIN
  OPEN emp_cursor;
  LOOP
    FETCH emp_cursor INTO empno, lname;
    EXIT WHEN emp_cursor%NOTFOUND;
    DBMS_OUTPUT.PUT_LINE( empno ||' '||lname);
  END LOOP;
  ...
END;
/
```

Closing the Cursor

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

Cursors and Records

- Process the rows of the active set by fetching values into a PL/SQL record.

```
DECLARE
  CURSOR emp_cursor IS
   SELECT employee_id, last_name FROM employees
   WHERE  department_id =30;
   emp_record  emp_cursor%ROWTYPE;
BEGIN
  OPEN emp_cursor;
  LOOP
    FETCH emp_cursor INTO emp_record;
  ...
```

CURSOR FOR LOOPS

- Syntax:

```
FOR record_name IN cursor_name LOOP
  statement1;
  statement2;
  . . .
END LOOP;
```

  - The cursor `FOR` loop is a shortcut to process explicit cursors.
  - Implicit open, fetch, exit, and close occur.
  - The record is implicitly declared.

Cursor for Loops

```
SET SERVEROUTPUT ON
DECLARE
  CURSOR emp_cursor IS
   SELECT employee_id, last_name FROM employees
   WHERE department_id =30;
BEGIN
   FOR emp_record IN emp_cursor
    LOOP
     DBMS_OUTPUT.PUT_LINE( emp_record.employee_id
     ||' ' ||emp_record.last_name);
    END LOOP;
END;
/
```

Explicit Cursor Attributes

- Obtain status information about a cursor.

Attribute	Type	Description
`%ISOPEN`	Boolean	Evaluates to `TRUE` if the cursor is open
`%NOTFOUND`	Boolean	Evaluates to `TRUE` if the most recent fetch does not return a row
`%FOUND`	Boolean	Evaluates to `TRUE` if the most recent fetch returns a row; complement of `%NOTFOUND`
`%ROWCOUNT`	Number	Evaluates to the total number of rows returned so far

%ISOPEN Attribute

- Fetch rows only when the cursor is open.
- Use the %ISOPEN cursor attribute before performing a fetch to test whether the cursor is open.

- Example

```
IF NOT emp_cursor%ISOPEN THEN
    OPEN emp_cursor;
END IF;
LOOP
  FETCH emp_cursor...
```

%ROWCOUNT AND %NOTFOUND: EXAMPLE

```
SET SERVEROUTPUT ON
DECLARE
  empno  employees.employee_id%TYPE;
  ename  employees.last_name%TYPE;
  CURSOR emp_cursor IS SELECT employee_id,
  last_name FROM employees;
BEGIN
  OPEN emp_cursor;
  LOOP
   FETCH emp_cursor INTO empno, ename;
   EXIT WHEN emp_cursor%ROWCOUNT > 10 OR
                    emp_cursor%NOTFOUND;
   DBMS_OUTPUT.PUT_LINE(TO_CHAR(empno)
                      ||' '|| ename);
  END LOOP;
  CLOSE emp_cursor;
END ;
/
```

Cursor for Loops Using Subqueries

- There is no need to declare the cursor.
- Example

```
SET SERVEROUTPUT ON
BEGIN
  FOR emp_record IN (SELECT employee_id, last_name
   FROM employees WHERE department_id =30)
  LOOP
   DBMS_OUTPUT.PUT_LINE( emp_record.employee_id ||'
   '||emp_record.last_name);
  END LOOP;
END;
/
```

Cursors with Parameters

- Syntax:

```
CURSOR cursor_name
  [(parameter_name datatype, ...)]
IS
  select_statement;
```

  - Pass parameter values to a cursor when the cursor is opened and the query is executed.
  - Open an explicit cursor several times with a different active set each time.

```
OPEN  cursor_name(parameter_value,.....) ;
```

Cursors with Parameters

```
SET SERVEROUTPUT ON
DECLARE
  CURSOR   emp_cursor (deptno NUMBER) IS
   SELECT  employee_id, last_name
   FROM    employees
   WHERE   department_id = deptno;
   dept_id NUMBER;
   lname   VARCHAR2(15);
BEGIN
  OPEN emp_cursor (10);
  ...
  CLOSE emp_cursor;
  OPEN emp_cursor (20);
  ...
```

FOR UPDATE CLAUSE

- Syntax:

```
SELECT ...
FROM            ...
FOR UPDATE [OF column_reference][NOWAIT | WAIT n];
```

  - Use explicit locking to deny access to other sessions for the duration of a transaction.
  - Lock the rows *before* the update or delete.

WHERE CURRENT OF CLAUSE

- Syntax:

```
WHERE CURRENT OF cursor ;
```

  - Use cursors to update or delete the current row.
  - Include the FOR UPDATE clause in the cursor query to lock the rows first.
  - Use the WHERE CURRENT OF clause to reference the current row from an explicit cursor.

```
UPDATE employees
   SET    salary = ...
   WHERE CURRENT OF emp_cursor;
```

Cursors with Subqueries

Example

```
DECLARE
  CURSOR my_cursor IS
    SELECT t1.department_id, t1.department_name,
           t2.staff
    FROM   departments t1, (SELECT department_id,
                                   COUNT(*) AS staff
                            FROM employees
                            GROUP BY department_id) t2
    WHERE t1.department_id = t2.department_id
    AND   t2.staff >= 3;
...
```

SUMMARY

- In this lesson, you should have learned how to:
  - Distinguish cursor types:
    - Implicit cursors are used for all `DML` statements and single-row queries.
    - Explicit cursors are used for queries of zero, one, or more rows.
  - Create and handle explicit cursors
  - Use simple loops and cursor `FOR` loops to handle multiple rows in the cursors
  - Evaluate the cursor status by using the cursor attributes
  - Use the `FOR UPDATE` and `WHERE CURRENT OF` clauses to update or delete the current fetched row

PRACTICE 7: OVERVIEW

- This practice covers the following topics:
  - Declaring and using explicit cursors to query rows of a table
  - Using a cursor `FOR` loop
  - Applying cursor attributes to test the cursor status
  - Declaring and using cursors with parameters
  - Using the `FOR UPDATE` and `WHERE CURRENT OF` clauses