18

Advanced Subqueries

Objectives

After completing this lesson, you should be able to do the following:

- Write a multiple-column subquery
- Describe and explain the behavior of subqueries when null values are retrieved
- Write a subquery in a `FROM` clause
- Use scalar subqueries in SQL
- Describe the types of problems that can be solved with correlated subqueries
- Write correlated subqueries
- Update and delete rows using correlated subqueries
- Use the `EXISTS` and `NOT EXISTS` operators
- Use the `WITH` clause

What Is a Subquery?

A subquery is a `SELECT` statement embedded in a clause of another SQL statement.

Main query

```
SELECT  ...
FROM    ...
WHERE   ...
        (SELECT  ...
         FROM    ...
         WHERE   ...)
```

Subquery

Subqueries

```
SELECT select_list
FROM   table
WHERE  expr operator (SELECT select_list
                      FROM   table);
```

- The subquery (inner query) executes once before the main query.
- The result of the subquery is used by the main query (outer query).

Using a Subquery

```
SELECT last_name
FROM   employees
WHERE  salary >
       (SELECT salary
        FROM   employees
        WHERE  employee_id = 149) ;
```

10500

LAST_NAME
King
Kochhar
De Haan
Abel
Hartstein
Higgins

6 rows selected.

Multiple-Column Subqueries

Main query

WHERE (MANAGER_ID, DEPARTMENT_ID) IN

Subquery

100	90
102	60
124	50

Each row of the main query is compared to values from a multiple-row and multiple-column subquery.

Column Comparisons

Column comparisons in a multiple-column subquery can be:

- Pairwise comparisons
- Nonpairwise comparisons

Pairwise Comparison Subquery

Display the details of the employees who are managed by the same manager *and* work in the same department as the employees with `EMPLOYEE_ID` 178 or 174.

```
SELECT employee_id, manager_id, department_id
FROM   employees
WHERE  (manager_id, department_id) IN
                    (SELECT manager_id, department_id
                     FROM   employees
                     WHERE  employee_id IN (178,174))
AND    employee_id NOT IN (178,174);
```

Nonpairwise Comparison Subquery

Display the details of the employees who are managed by the same manager as the employees with `EMPLOYEE_ID` 174 or 141 *and* work in the same department as the employees with `EMPLOYEE_ID` 174 or 141.

```
SELECT   employee_id, manager_id, department_id
FROM     employees
WHERE    manager_id IN
                      (SELECT  manager_id
                       FROM    employees
                       WHERE   employee_id IN (174,141))
AND      department_id IN
                      (SELECT  department_id
                       FROM    employees
                       WHERE   employee_id IN (174,141))

AND    employee_id NOT IN(174,141);
```

Using a Subquery in the FROM Clause

```
SELECT   a.last_name, a.salary,
         a.department_id, b.salavg
FROM     employees a, (SELECT   department_id,
                       AVG(salary) salavg
                       FROM     employees
                       GROUP BY department_id) b
WHERE    a.department_id = b.department_id
AND      a.salary > b.salavg;
```

LAST_NAME	SALARY	DEPARTMENT_ID	SALAVG
Hartstein	13000	20	9500
Mourgos	5800	50	3500
Hunold	9000	60	6400
Zlotkey	10500	80	10033.3333
Abel	11000	80	10033.3333
King	24000	90	19333.3333
Higgins	12000	110	10150

7 rows selected.

Scalar Subquery Expressions

- A scalar subquery expression is a subquery that returns exactly one column value from one row.
- Scalar subqueries were supported in Oracle8*i* only in a limited set of cases, For example:
  - `SELECT` statement (`FROM` and `WHERE` clauses)
  - `VALUES` list of an `INSERT` statement
- In Oracle9*i*, scalar subqueries can be used in:
  - Condition and expression part of `DECODE` and `CASE`
  - All clauses of `SELECT` except `GROUP BY`

Scalar Subqueries: Examples

Scalar Subqueries in CASE Expressions

```
SELECT employee_id, last_name,
       (CASE
        WHEN department_id =
             (SELECT department_id FROM departments
              WHERE location_id = 1800)
        THEN 'Canada' ELSE 'USA' END) location
FROM   employees;
```

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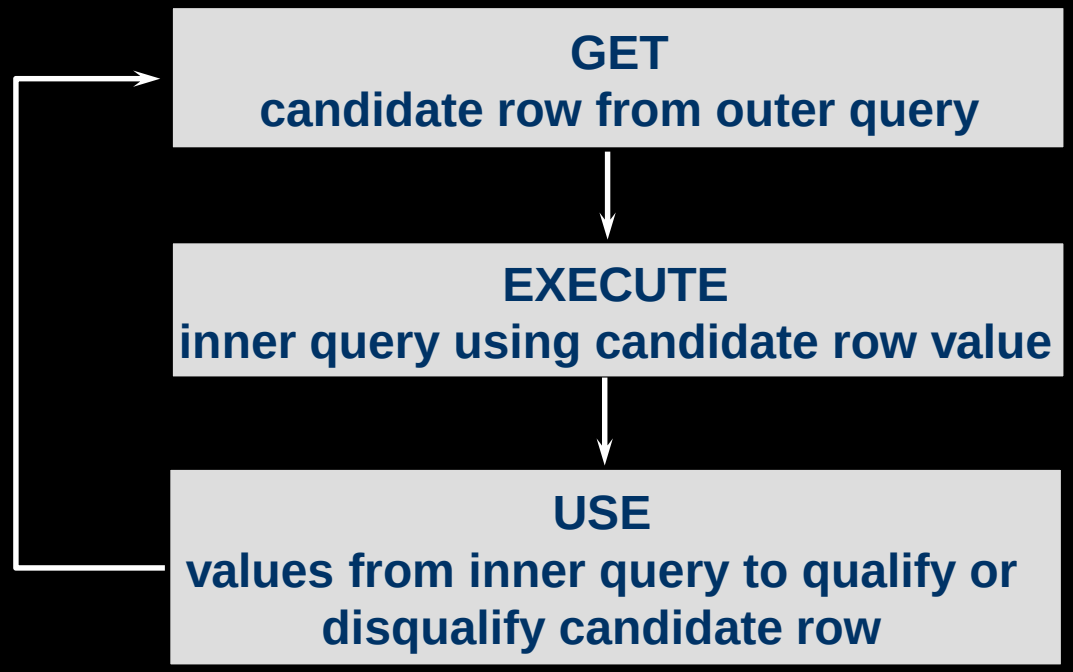
Scalar Subqueries in ORDER BY Clause

```
SELECT   employee_id, last_name
FROM     employees e
ORDER BY (SELECT department_name
          FROM departments d
          WHERE e.department_id = d.department_id);
```

Correlated Subqueries

Correlated subqueries are used for row-by-row processing. Each subquery is executed once for every row of the outer query.



Correlated Subqueries

```
SELECT column1, column2, ...
FROM   table1  outer
WHERE  column1 operator
                      (SELECT  colum1, column2
                       FROM    table2
                       WHERE   expr1 =
                                  outer.expr2);
```

The subquery references a column from a table in the parent query.

Using Correlated Subqueries

Find all employees who earn more than the average salary in their department.

```
SELECT last_name, salary, department_id
FROM   employees outer
WHERE  salary >
       (SELECT AVG(salary)
        FROM   employees
        WHERE  department_id =
               outer.department_id) ;
```

Each time a row from the outer query is processed, the inner query is evaluated.

Using Correlated Subqueries

Display details of those employees who have switched jobs at least twice.

```
SELECT e.employee_id, last_name,e.job_id
FROM   employees e
WHERE  2 <= (SELECT COUNT(*)
             FROM   job_history
             WHERE  employee_id = e.employee_id);
```

EMPLOYEE_ID	LAST_NAME	JOB_ID
101	Kochhar	AD_VP
176	Taylor	SA_REP
200	Whalen	AD_ASST

Using the `EXISTS` Operator

- The `EXISTS` operator tests for existence of rows in the results set of the subquery.
- If a subquery row value is found:
  - The search does not continue in the inner query
  - The condition is flagged `TRUE`
- If a subquery row value is not found:
  - The condition is flagged `FALSE`
  - The search continues in the inner query

Using the EXISTS Operator

Find employees who have at least one person reporting to them.

```
SELECT employee_id, last_name, job_id, department_id
FROM   employees outer
WHERE  EXISTS ( SELECT 'X'
                FROM   employees
                WHERE  manager_id =
                       outer.employee_id);
```

EMPLOYEE_ID	LAST_NAME	JOB_ID	DEPARTMENT_ID
100	King	AD_PRES	90
101	Kochhar	AD_VP	90
102	De Haan	AD_VP	90
103	Hunold	IT_PROG	60
124	Mourgos	ST_MAN	50
149	Zlotkey	SA_MAN	80
201	Hartstein	MK_MAN	20
205	Higgins	AC_MGR	110

8 rows selected.

Using the NOT EXISTS Operator

Find all departments that do not have any employees.

```
SELECT department_id, department_name
FROM departments d
WHERE NOT EXISTS (SELECT 'X'
                  FROM   employees
                  WHERE  department_id
                         = d.department_id);
```

DEPARTMENT_ID	DEPARTMENT_NAME
190	Contracting

Correlated UPDATE

```
UPDATE  table1 alias1
SET     column = (SELECT expression
                  FROM   table2 alias2
                  WHERE  alias1.column =
                         alias2.column);
```

Use a correlated subquery to update rows in one table based on rows from another table.

Correlated UPDATE

- Denormalize the EMPLOYEES table by adding a column to store the department name.
- Populate the table by using a correlated update.

```
ALTER TABLE employees
ADD(department_name VARCHAR2(14));
```

```
UPDATE employees e
SET    department_name =
               (SELECT department_name
                FROM   departments d
                WHERE  e.department_id = d.department_id);
```

Correlated DELETE

```
DELETE FROM table1 alias1
WHERE  column operator
             (SELECT expression
              FROM   table2 alias2
              WHERE  alias1.column = alias2.column);
```

Use a correlated subquery to delete rows in one table based on rows from another table.

Correlated DELETE

Use a correlated subquery to delete only those rows from the EMPLOYEES table that also exist in the EMP_HISTORY table.

```
DELETE FROM employees E
WHERE employee_id =
            (SELECT employee_id
             FROM   emp_history
             WHERE  employee_id = E.employee_id);
```

The `WITH` Clause

- Using the `WITH` clause, you can use the same query block in a `SELECT` statement when it occurs more than once within a complex query.
- The `WITH` clause retrieves the results of a query block and stores it in the user's temporary tablespace.
- The `WITH` clause improves performance

`WITH` Clause: Example

Using the `WITH` clause, write a query to display the department name and total salaries for those departments whose total salary is greater than the average salary across departments.

WITH Clause: Example

```
WITH
dept_costs  AS (
   SELECT  d.department_name, SUM(e.salary) AS dept_total
   FROM    employees e, departments d
   WHERE   e.department_id = d.department_id
   GROUP BY d.department_name),
avg_cost    AS (
   SELECT SUM(dept_total)/COUNT(*) AS dept_avg
   FROM   dept_costs)
SELECT *
FROM   dept_costs
WHERE  dept_total >
        (SELECT dept_avg
         FROM avg_cost)
ORDER BY department_name;
```

Summary

In this lesson, you should have learned the following:

- A multiple-column subquery returns more than one column.
- Multiple-column comparisons can be pairwise or nonpairwise.
- A multiple-column subquery can also be used in the `FROM` clause of a `SELECT` statement.
- Scalar subqueries have been enhanced in Oracle9*i*.

Summary

- Correlated subqueries are useful whenever a subquery must return a different result for each candidate row.
- The `EXISTS` operator is a Boolean operator that tests the presence of a value.
- Correlated subqueries can be used with `SELECT`, `UPDATE`, and `DELETE` statements.
- You can use the `WITH` clause to use the same query block in a `SELECT` statement when it occurs more than once

Practice 18 Overview

This practice covers the following topics:

- Creating multiple-column subqueries
- Writing correlated subqueries
- Using the `EXISTS` operator
- Using scalar subqueries
- Using the `WITH` clause