

## Database Programming with SQL

### 10-1: Fundamentals of Subqueries

#### Practice Activities

##### Objectives

- Define and explain the purpose of subqueries for retrieving data
- Construct and execute a single-row subquery in the WHERE clause
- Distinguish between single-row and multiple-row subqueries

##### Vocabulary

Identify the vocabulary word for each definition below.

|                          |   |
|--------------------------|---|
| Correlated Subquery      | It accepts a value from the inner query to complete its SELECT statement.               |
| Multi-row Subquery       | An inner query that returns one or more rows to the outer query                         |
| Nested Subquery          | An inner query that is nested within an outer query                                     |
| Multiple Column Subquery | An inner query that compares multiple columns at the same time                          |
| Single-row Subquery      | An inner query that returns only one row to the outer query                             |
| Independent Subqueries   | An inner query that compares the multiple columns one at a time in different subqueries |
| Inner Query              | Another name for a subquery   |

##### Try It / Solve It

###### 1. What is the purpose of using a subquery?

Allows data retrieval by using results from one query to filter or define conditions in another.

###### 2. What is a subquery?

A query embedded within another query that executes first to provide data for the main query.

###### 3. What DJs on Demand d\_play\_list\_items song\_id's have the same event\_id as song\_id 45?

```
SELECT song_id
FROM d_play_list_items
WHERE event_id = (SELECT event_id FROM d_play_list_items WHERE song_id = 45);
```

| SONG_ID |
|---------|
| 45      |
| 46      |
| 47      |

###### 4. Which events in the DJs on Demand database cost more than event\_id = 100?

```
SELECT id, cost
FROM d_events
WHERE cost > (SELECT cost FROM d_events WHERE id = 100);
```

| ID  | COST  |
|-----|-------|
| 105 | 10000 |

###### 5. Find the track number of the song that has the same CD number as "Party Music for All Occasions."

```
SELECT track
FROM D_TRACK_LISTINGS
WHERE cd_number = (SELECT cd_number FROM D_CDS WHERE title = 'Party Music for All Occasions');
```

| TRACK |
|-------|
| 2     |
| 3     |

###### 6. List the DJs on Demand events whose theme code is the same as the code for "Tropical."

```
SELECT id, theme_code
FROM d_events
WHERE theme_code = (SELECT code FROM d_themes WHERE description = 'Tropical');
```

| ID  | THEME_CODE |
|-----|------------|
| 100 | 200        |
| 105 | 200        |

7. What are the names of the Global Fast Foods staff members whose salaries are greater than the staff member whose ID is 12?

|   |                   |                  |
|---|-------------------|------------------|
| SELECT first_name, last_name                                | <b>FIRST_NAME</b> | <b>LAST_NAME</b> |
| FROM f_staffs   | Bob               | Miller           |
| WHERE salary > (SELECT salary FROM f_staffs WHERE id = 12); | Monique           | Tuttle           |

8. What are the names of the Global Fast Foods staff members whose staff types are not the same as Bob Miller's?

|   |                   |                  |
|---|-------------------|------------------|
| SELECT first_name, last_name                        | <b>FIRST_NAME</b> | <b>LAST_NAME</b> |
| FROM f_staffs                                       | Sue               | Doe              |
| WHERE staff_type <> (SELECT staff_type              | Monique           | Tuttle           |
| FROM f_staffs                                       |                   |                  |
| WHERE first_name = 'Bob' and last_name = 'Miller'); |                   |                  |

9. Which Oracle employees have the same department ID as the IT department?

|   |                   |                  |
|---|-------------------|------------------|
| SELECT first_name, last_name                | <b>FIRST_NAME</b> | <b>LAST_NAME</b> |
| FROM employees                              | Alexander         | Hunold           |
| WHERE department_id = (SELECT department_id | Bruce             | Ernst            |
| FROM departments                            | Diana             | Lorentz          |
| WHERE department_name = 'IT');              | Chen              | Li               |
|   | Alain             | Fontaine         |

10. What are the department names of the Oracle departments that have the same location ID as Seattle?

|   |                        |
|---|------------------------|
| SELECT department_name                  | <b>DEPARTMENT_NAME</b> |
| FROM departments                        | Administration         |
| WHERE location_id = (SELECT location_id | Executive              |
| FROM locations                          | Accounting             |
| WHERE city = 'Seattle');                | Contracting            |

11. Indicate whether the statement regarding subqueries is True or False.

- It is good programming practice to place a subquery on the right side of the comparison operator. **TRUE**
- A subquery can reference a table that is not included in the outer query's FROM clause. **TRUE**
- Single-row subqueries can return multiple values to the outer query. **FALSE**

## Database Programming with SQL

### 10-2: Single-Row Subqueries

#### Practice Activities

##### Objectives

- Construct and execute a single-row subquery in the WHERE clause or HAVING clause
- Construct and execute a SELECT statement using more than one subquery
- Construct and execute a SELECT statement using a group function in the subquery

##### Try It / Solve It

1. Write a query to return all those employees who have a salary greater than that of Lorentz and are in the same department as Abel.

```
SELECT employee_id, first_name, last_name, salary, department_id
FROM employees
WHERE salary > (SELECT salary FROM employees WHERE last_name = 'Lorentz')
AND department_id = (SELECT department_id FROM employees WHERE last_name = 'Abel');
```

2. Write a query to return all those employees who have the same job id as Rajs and were hired after Davies.

```
SELECT employee_id, first_name, last_name, job_id, hire_date
FROM employees
WHERE job_id = (SELECT job_id FROM employees WHERE last_name = 'Rajs')
AND hire_date > (SELECT hire_date FROM employees WHERE last_name = 'Davies');
```

3. What DJs on Demand events have the same theme code as event ID = 100?

| ID  | THEME_CODE |
|-----|------------|
| 100 | 200        |
| 105 | 200        |

```
SELECT id, theme_code
FROM d_events
WHERE theme_code = (SELECT theme_code FROM d_events WHERE id = 100);
```

4. What is the staff type for those Global Fast Foods jobs that have a salary less than those of any Cook staff-type jobs?

| STAFF_TYPE  |
|-------------|
| Order Taker |

```
SELECT DISTINCT staff_type
FROM F_STAFFS
WHERE salary < (SELECT MIN(salary) FROM F_STAFFS WHERE staff_type = 'Cook');
```

5. Write a query to return a list of department id's and average salaries where the department's average salary is greater than Ernst's salary.

```
SELECT department_id, AVG(salary) AS avg_salary
FROM employees
GROUP BY department_id
HAVING AVG(salary) > (SELECT salary FROM employees WHERE last_name = 'Ernst');
```

6. Return the department ID and minimum salary of all employees, grouped by department ID, having a minimum salary greater than the minimum salary of those employees whose department ID is not equal to 50.

| DEPARTMENT_ID | MIN_SALARY |
|---------------|------------|
| 90            | 17000      |
| 10            | 4100       |
| 110           | 5200       |
| 80            | 8600       |
| -             | 7000       |
| 60            | 4200       |
| 85            | 7300       |

```
SELECT department_id, MIN(salary) AS min_salary
FROM employees
GROUP BY department_id
HAVING MIN(salary) > (SELECT MIN(salary) FROM employees WHERE department_id <> 50);
```

## Database Programming with SQL

### 10-3: Multiple-Row Subqueries

#### Practice Activities

##### Objectives

- Correctly use the comparison operators IN, ANY, and ALL in multiple-row subqueries
- Describe what happens if a multiple-row subquery returns a null value
- Construct and execute a multiple-row subquery in the WHERE clause or HAVING clause
- Understand when multiple-row subqueries should be used, and when it is safe to use a single-row subquery
- Distinguish between pair-wise and non-pair-wise subqueries
- Create a query using the EXISTS and NOT EXISTS operators to test for returned rows from the subquery

##### Try It / Solve It

1. What will be returned by a query if it has a subquery that returns a null ?

If a subquery returns NULL, any comparison with it in the outer query will yield no rows, as comparisons with NULL result in a NULL outcome.

2. Write a query that returns jazz and pop songs. Write a multi-row subquery and use the d\_songs and d\_types tables. Include the id, title, duration, and the artist name.

```
SELECT d_songs.id, d_songs.title, d_songs.duration, d_songs.artist
FROM d_songs
WHERE d_songs.type_code IN (SELECT type_code FROM d_types WHERE description IN ('Jazz', 'Pop'));
```

3. Find the last names of all employees whose salaries are the same as the minimum salary for any department.

```
SELECT department_id, last_name
FROM employees
WHERE salary = ANY (SELECT MIN(salary) FROM employees GROUP BY department_id);
```

4. Which Global Fast Foods employee earns the lowest salary? Hint: You can use either a single-row or a multiple-row subquery.

```
SELECT first_name, last_name
FROM f_staffs
WHERE salary = (SELECT MIN(salary) FROM f_staffs);
```

| FIRST_NAME | LAST_NAME |
|------------|-----------|
| Sue        | Doe       |

5. Place the correct multiple-row comparison operators in the outer query WHERE clause of each of the following:

- a. Which CDs in our d\_cds collection were produced before "Carpe Diem" was produced? WHERE year < (SELECT year ...
- b. Which employees have salaries lower than any one of the programmers in the IT department? WHERE salary < ANY (SELECT salary ...
- c. What CD titles were produced in the same year as "Party Music for All Occasions" or "Carpe Diem"? WHERE year IN (SELECT year ...
- d. What song title has a duration longer than every type code 77 title? WHERE duration > ALL (SELECT duration ...

6. If each WHERE clause is from the outer query, which of the following are true?
- T a. WHERE size > ANY -- If the inner query returns sizes ranging from 8 to 12, the value 9 could be returned in the outer query.
  - F b. WHERE book\_number IN -- If the inner query returns books numbered 102, 105, 437, and 225 then 325 could be returned in the outer query.
  - T c. WHERE score <= ALL -- If the inner query returns the scores 89, 98, 65, and 72, then 82 could be returned in the outer query.
  - T d. WHERE color NOT IN -- If the inner query returns red, green, blue, black, and then the outer query could return white.
  - F e. WHERE game\_date = ANY -- If the inner query returns 05-Jun-1997, 10-Dec-2002, and 2-Jan-2004, then the outer query could return 10-Sep-2002.

7. The goal of the following query is to display the minimum salary for each department whose minimum salary is less than the lowest salary of the employees in department 50. However, the subquery does not execute because it has five errors. Find them, correct them, and run the query.

|                           |   |
|---------------------------|---|
| SELECT department_id      | SELECT department_id, MIN(salary)                             |
| FROM employees            | FROM employees  |
| WHERE MIN(salary)         | GROUP BY department_id  |
| HAVING MIN(salary) >      | HAVING MIN(salary) < (SELECT MIN(salary) FROM employees WHERE |
| GROUP BY department_id    | department_id = 50);  |
| SELECT MIN(salary)        |   |
| WHERE department_id < 50; |   |

8. Which statements are true about the subquery below?

```
SELECT employee_id, last_name
FROM employees
WHERE salary =
      (SELECT MIN(salary) FROM
       employees GROUP BY
       department_id);
```

- F a. The inner query could be eliminated simply by changing the WHERE clause to WHERE MIN(salary).
  - T b. The query wants the names of employees who make the same salary as the smallest salary in any department.
  - T c. The query first selects the employee ID and last name, and then compares that to the salaries in every department.
  - F d. This query will not execute.
9. Write a pair-wise subquery listing the last\_name, first\_name, department\_id, and manager\_id for all employees that have the same department\_id and manager\_id as employee 141. Exclude employee 141 from the result set.
- ```
SELECT last_name, first_name, department_id, manager_id
FROM employees
WHERE (department_id, manager_id) = (SELECT department_id, manager_id FROM employees WHERE
employee_id = 141)
AND employee_id <> 141;
```
10. Write a non-pair-wise subquery listing the last\_name, first\_name, department\_id, and manager\_id for all employees that have the same department\_id and manager\_id as employee 141.

```
SELECT last_name, first_name, department_id, manager_id
FROM employees
WHERE department_id = (SELECT department_id FROM employees WHERE employee_id = 141)
AND manager_id = (SELECT manager_id FROM employees WHERE employee_id = 141);
```

## Database Programming with SQL

### 10-4: Correlated Subqueries

#### Practice Activities

##### Objectives

- Identify when correlated subqueries are needed
- Construct correlated subqueries
- Construct named subqueries using the WITH clause

##### Try It / Solve It

1. Explain the main difference between correlated and non-correlated subqueries?

A correlated subquery is a subquery that depends on the outer query for each row it processes, meaning it executes once for each row in the outer query.

A non-correlated subquery is independent of the outer query, running only once and returning a result set used by the outer query.

2. Write a query that lists the highest earners for each department. Include the last\_name, department\_id, and the salary for each employee.

```
SELECT last_name, department_id, salary
FROM employees outer
WHERE salary = (SELECT MAX(salary) FROM employees inner WHERE inner.department_id =
outer.department_id);
```

3. Examine the following select statement and finish it so that it will return the last\_name, department\_id, and salary of employees who have at least one person reporting to them. So we are effectively looking for managers only. In the partially written SELECT statement, the WHERE clause will work as it is. It is simply testing for the existence of a row in the subquery.

```
SELECT (enter columns here)
FROM (enter table name here) outer
WHERE 'x' IN (SELECT 'x'
              FROM (enter table name here) inner
              WHERE inner(enter column name here) = inner(enter column name here)
ORDER BY department_id;
```

Finish off the statement by sorting the rows on the department\_id column.

4. Using a WITH clause, write a SELECT statement to list the job\_title of those jobs whose maximum salary is more than half the maximum salary of the entire company. Name your subquery MAX\_CALC\_SAL. Name the columns in the result JOB\_TITLE and JOB\_TOTAL, and sort the result on JOB\_TOTAL in descending order.

Hint: Examine the jobs table. You will need to join JOBS and EMPLOYEES to display the job\_title.

```
WITH MAX_CALC_SAL AS (
  SELECT MAX(salary) AS max_salary
  FROM employees
)
SELECT job_title AS JOB_TITLE, MAX(salary) AS JOB_TOTAL
FROM jobs j
JOIN employees e ON j.job_id = e.job_id
GROUP BY job_title
HAVING MAX(salary) > (SELECT max_salary / 2 FROM MAX_CALC_SAL)
ORDER BY JOB_TOTAL DESC;
```