Relational Database Operations in SQL - Part II - Subquery

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Outline

1. Recap and Project
   - Project
   - Recap: SQL and Relational Algebra
2. Subquery
3. Summary and Questions
4. Assignment

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Reminder: Project Meeting

Before final project demo, each group should schedule a meeting with me in this or the next week – more scheduling details will be on Blackboard.

Agenda and Objectives

- Discuss group and individual progress
- Identify gaps and improvements
- Prepare for the final and a successful project demo and presentation
- Any issues you may have regarding the class

Selected Topics in SQL

Discussed

- Ordering the Output
- Eliminating Duplicates
- Aggregate Processsing
- Grouping

Now discuss

- Subquery

and do some exercises in class, and continue on (next class)

- Views
- Procedural SQL

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Subquery

A query returns (or outputs) a relation. The resulting relation can be used in another query.

Subquery: a query that is part of another. Subqueries can be a number of ways:

- In `WHERE` clause
  - Subqueries can return a "single value" (or a scalar value), and this value can be compared with another value in a `WHERE` clause
  - Subqueries can return relations that can be used in `WHERE` clauses
- In `FROM` clause
  - Subqueries can return relations that can be used in `FROM` clauses

Subquery Producing Scalar Values

Subquery Producing Scalar Values – Somtimes we can deduce from the information about keys or from other information, a query will result in a single tuple that has a single component of an atomic value.

Example.

```
SELECT t.tname
FROM Courses AS c INNER JOIN Teaching AS t
WHERE c.idnum = t.cidnum AND c.idnum = '1111';
```

We can use this query as a subquery in a WHERE clause

Subquery Producing Scalar Values: Example

```
SELECT email
FROM Instructors
WHERE name =
  (
    SELECT t.tname
    FROM  Courses AS c INNER JOIN Teaching AS t
    WHERE c.idnum = t.cidnum AND c.idnum = '1111'
  );
```

Subquery Producing Multiple Tuples

For a query returns a reqlation that may contain multiple tuples, we can use it in either a `WHERE` clause or a `FROM` clause with the help of a tuple variable

- `WHERE` clause
- `FROM` clause

Subquery Producing Multiple Tuples: `WHERE`

Use operators `EXISTS`, `IN`, `ALL`, and `ANY`, e.g.,

- `EXISTS R`: true if and only if R is not empty
- `s IN R`: true if s is equal to onen of the values in R
- `s > ALL R`: true if s is greater than every value in unary relation R
- `s > ANY R`: true if s is greater than at least one value in unary relation R

Subquery Producing Multiple Tuples: WHERE: Example 1

Example 1:

```
SELECT email
FROM Instructors
WHERE name IN
   (
     SELECT t.tname
     FROM  Courses AS c INNER JOIN Teaching AS t
     WHERE c.idnum = t.cidnum
   );
```

Subquery Producing Multiple Tuples: WHERE: Example 2

Example 2:

```
SELECT email
FROM Instructors
WHERE (name, phone) IN
  (
    SELECT t.tname, t.phone
    FROM  Courses AS c INNER JOIN Teaching AS t
    WHERE c.idnum = t.cidnum
  );
```

Do these two queries (Examples 1 and 2) always return the same results?

Subquery Producing Multiple Tuples: FROM

Using a tuple variable, we can use a subquery in a FROM clause

Subquery Producing Multiple Tuples: FROM: Example

```
SELECT i.email
FROM
  Instructors AS i
    INNER JOIN
  (
    SELECT t.tname, t.tphone
    FROM
      Courses AS c
        INNER JOIN
      Teaching AS t
    WHERE c.idnum = t.cidnum
  ) AS a
WHERE
  i.name = a.tname AND i.phone = a.tphone;
```

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Summary and Questions?

Discussed

- Ordering the Output
- Eliminating Duplicates
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- Subquery

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Assignment

Let's work on an assignment using paper and pencil/pen ...

Consider the database in Q8 on Blackboard, answer the following questions in SQL, and order the output by one or more attributes of your choice.

1. Find the makers of PC's with a speed of at least 3.0
2. Find the printers with the highest price
3. (hard question) Find the laptops whose speed is slower than that of any PC
4. (hard question) Find the model number of the item (PC, laptop, or printer) with the highest price
5. (hard question) Find the maker of the color printer with the lowest price