Relational Database Operations in SQL - Part II - Subquery

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Outline

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

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Selected Topics in SQL

Discussed

- Ordering the Output
- Eliminating Duplicates
- Aggregate Processing
- 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 relation 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

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Assignment

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