CSC 355 Database Systems
Lecture 8

Eric J. Schwabe

School of Computing, DePaul University

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Topics:

- SQL queries
  - Subqueries
  - Set operations

Subqueries

- The result of one query may be needed by another to compute its result
  - A *subquery* is nested (using parentheses) within an *outer query*
  - Outer query uses the result of the subquery, which can be either single value or a table
- The subquery usually appears in a WHERE or HAVING clause (sometimes in a FROM)

Uses of Subqueries

- "Find all employees that receive the highest salary." (Find the highest salary)
- "Find IDs of all course sections being taken by Paul Konrad". (Find his StudentID)
- "Find IDs of all students who are taking some course section with Student 1234567 this quarter." (Find all sections being taken by 1234567)

Returning a Single Value

- When a single value is returned, it can be used like any other value on the right-hand side of a WHERE or HAVING condition

```
SELECT * FROM ASSIGNMENT
    WHERE Hours >
    (SELECT AVG(Hours) FROM ASSIGNMENT);
```

Returning a Table

- Can check whether the returned table is empty:
  - EXISTS (*query*) is true if table is not empty
  - NOT EXISTS (*query*) is true if table is empty
- Can check contents of table:
  - *tuple* IN (*query*) returns true if *tuple* appears in the returned table
    - (in most cases, the tuple is just one attribute and the SELECT in the subquery contains just one attribute…)

Returning a Table

- Can compare an attribute to table contents:
  - …only when SELECT contains just one attribute
  - *Attribute* > ALL (*query*) returns true if *Attribute* is greater than all values in the returned column
  - *Attribute* > ANY (*query*) returns true if *Attribute* is greater than any value in the returned column

(Any type of comparison is allowed, not just > …)

Correlated Subqueries

- A subquery may refer to attributes of the table in the outer query
  - The subquery will be evaluated repeatedly, once for each tuple in the table in the outer query
  - Attributes from outer query table must be qualified with the table name if they appear in the subquery
  - If the tables in the outer query and subquery are the same, must create an alias for the outer query table

Subquery Problems

- Give the names of all courses that Abigail Winter has enrolled in
- Give the IDs of all students who started as part of the most recent incoming group of students
- List the names of all members of DeFrag
- List the IDs of all courses that have been taken by Information Systems majors
- Give the IDs (names?) of all group presidents who are not members of their groups

Set Operations

Given two sets A and B:

- $A \cup B = \{x \mid x \in A \vee x \in B\}$ ("union")
  - The set of all elements that are in A or B (or both)
- $A \cap B = \{x \mid x \in A \wedge x \in B\}$ ("intersection")
  - The set of all elements that are in both A and B
- $A - B = \{x \mid x \in A \wedge x \notin B\}$ ("difference")
  - The set of all elements that are in A but not in B

Set Operations in SQL

- Combine the results of two queries, as long as the results contain compatible tuples:
  - UNION: rows that appear in at least one result
  - INTERSECT: rows that appear in both results
  - MINUS: rows that appear in the first result but not in the second
- The final result must be a set, so duplicates are removed from the two results first…

Next Time:

- Transactions