Database Technology

Topic 3: SQL

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Outline

- SQL data model
- SQL as a data definition language
- SQL queries
  - simple queries
  - join queries
  - grouping + aggregation
  - subqueries
  - set operations
- SQL data manipulation operations
- SQL views

SQL Data Model

SQL Data Model

- Based on the relational data model
- Terminology:

Relational Model	SQL
relation	table
tuple	row
attribute	column

- In contrast to the relational model, SQL allows duplicate rows in table and in query results

Question

Go to **www.menti.com** and use the code ...

Why does SQL allow duplicate tuples
in a table or in a query result?

SQL Data Model

- Based on the relational data model
- Terminology:

Relational Model	SQL
relation	table
tuple	row
attribute	column

- In contrast to the relational model, SQL allows duplicate rows in table and in query results
  - Removing duplicates is expensive
  - User may want information about duplicates
  - Aggregation operators (e.g., sum)

SQL Data Model

- Based on the relational data model
- Terminology:

Relational Model	SQL
relation	table
tuple	row
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- In contrast to the relational model, SQL allows duplicate rows in table and in query results
  - Removing duplicates is expensive
  - User may want information about duplicates
  - Aggregation operators (e.g., sum)
- *Syntax notes*:
  - Some interfaces require each statement to end with a semicolon
  - SQL is not case-sensitive

SQL DDL

Group Activity

- Consider the following two tables

Instructor

ID	Name	Office
4	Jennifer	B308
35	Paul	B311
12	Kim	E112

Course

CourseID	Year	Instructor
cid444	2012	35
cid598	2013	4
cid444	2013	35

- Assume that the *Instructor* table has already been created; provide the SQL statement to create the *Course* table, including all of its integrity constraints.

SQL Queries

Simple Queries

Quiz

Consider the following two tables

Instructor

ID	Name	Office
4	Jennifer	B308
35	Paul	B311
12	Kim	E112

Course

CourseID	Year	Instructor
cid444	2012	35
cid598	2013	4
cid444	2013	35

What is the result of the following query?

SELECT CourseID **FROM** Course **WHERE** Instructor = 35;

1:

CourseID
cid444
cid598
cid444

2:

CourseID	Instructor
cid444	35
cid444	35

3:

CourseID
cid444

4:

CourseID
cid444
cid444

SQL Queries

Join Queries

Quiz

Consider the following two tables

Instructor

ID	Name	Office
4	Jennifer	B308
35	Paul	B311
12	Kim	E112

Course

CourseID	Year	Instructor
cid444	2012	35
cid598	2013	4
cid444	2013	35

How many rows do we have in the result of the following query?

SELECT CourseID **FROM** Course, Instructor **WHERE** Year = 2013;

1) 2 rows
2) 4 rows
3) 6 rows
4) 8 rows

Quiz

Consider the following two tables

Instructor

ID	Name	Office
4	Jennifer	B308
35	Paul	B311
12	Kim	E112

Course

CourseID	Year	Instructor
cid444	2012	35
cid598	2013	4
cid444	2013	35

How many rows do we have in the result of the following query?

```
SELECT Name, CourseID
FROM Instructor LEFT OUTER JOIN Course ON ID = Instructor;
```

1) 2 rows
2) 3 rows
3) 4 rows
4) 6 rows

Quiz

Which of the following statements *is correct*?

1) The SELECT clause is the only part of an SQL query that can influence the number of columns in the query result.
2) Every table can be mentioned only once in the FROM clause.
3) The join condition of a join query must be specified in the WHERE clause.
4) There is no way the SELECT clause can have an effect on the number of rows of the query result.

SQL Queries

Grouping and Aggregation

Quiz

Consider the table:

Instructor

ID	Name	Office	Salary
4	Jennifer	B308	40000
35	Paul	B311	20000
12	Kim	E112	*NULL*

Consider the following query:

```
SELECT  COUNT(*), COUNT(Salary), AVG(Salary)
FROM Instructor;
```

The result of this query consists of a single row. Which of the following rows would that be for the Instructor table given above?

1) [3, 3, 30000]
2) [3, 3, 20000]
3) [3, 2, 30000]
4) [3, 2, NULL]

Quiz

Given the *Course* table shown here:

… how many rows do we have in the result of the following query?

```
SELECT  CourseID
FROM Course
WHERE Year > 2012
GROUP BY CourseID
HAVING COUNT(*) > 2;
```

1) 1 row
2) 2 rows
3) 3 rows
4) 4 rows

Course

CourseID	Year	Instructor
cid444	2012	35
cid444	2013	35
cid444	2014	35
cid610	2014	12
cid610	2015	4
cid610	2016	12
cid598	2013	4
cid598	2014	4
cid777	2014	35

Group Activity

Given the *Course* table shown here write an SQL query such that

i) the query contains **no WHERE clause** (SELECT, FROM, GROUP BY, and HAVING are allowed), and

ii) the query results consists of **exactly 7 rows**

Course

CourseID	Year	Instructor
cid444	2012	35
cid444	2013	35
cid444	2014	35
cid610	2014	12
cid610	2015	4
cid610	2016	12
cid598	2013	4
cid598	2014	4
cid777	2014	35

SQL Queries

Subqueries and Set Operations

Quiz

Consider the following two tables

Instructor

ID	Name	Office
4	Jennifer	B308
35	Paul	B311
12	Kim	E112

Course

CourseID	Year	Instructor
cid444	2012	35
cid598	2013	4
cid444	2013	35

Which names are in the result of the following query?

```
SELECT Name
FROM Instructor
WHERE ID NOT IN ( SELECT Instructor FROM Course );
```

1) Paul, Kim
2) Jennifer, Paul
3) Kim
4) Jennifer

Group Activity

Consider the following two tables

Instructor

ID	Name	Office
4	Jennifer	B308
35	Paul	B311
12	Kim	E112

Course

CourseID	Year	Instructor
cid444	2012	35
cid598	2013	4
cid444	2013	35

… and the following query

```
SELECT Name
FROM Instructor
WHERE ID NOT IN ( SELECT Instructor FROM Course );
```

Write another query that is semantically equivalent to the given one (i.e., the result of your query will be the same as the result of the given query, *for all possible instances* of the two tables).

Quiz

Consider the following two tables

Instructor

ID	Name	Office
4	Jennifer	B308
35	Paul	B311
12	Kim	E112

Course

CourseID	Year	Instructor
cid444	2012	35
cid598	2013	4
cid444	2013	35

Is the subquery in the following query a correlated subquery?

```
SELECT Name
FROM Instructor
WHERE ID NOT IN ( SELECT Instructor FROM Course );
```

1) yes
2) no

Correlated Subqueries

Consider the following two tables

Instructor

ID	Name	Office
4	Jennifer	B308
35	Paul	B311
12	Kim	E112

Course

CourseID	Year	Instructor
cid444	2012	35
cid598	2013	4
cid444	2013	35

Here is a semantically equivalent query with a correlated subquery:

```
SELECT Name
FROM Instructor
WHERE NOT EXISTS ( SELECT *
                   FROM Course
                   WHERE Instructor = ID );
```

Queries with Set Operations

Consider the following two tables

Instructor

ID	Name	Office
4	Jennifer	B308
35	Paul	B311
12	Kim	E112

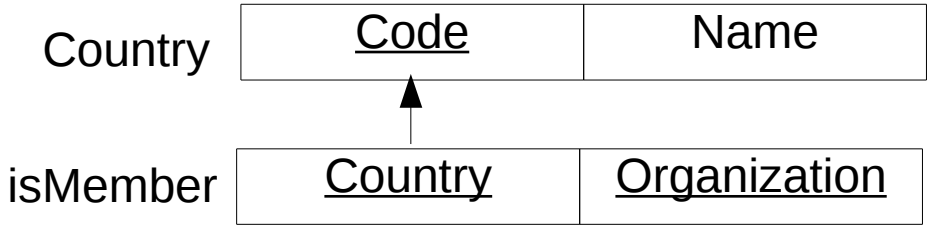
Course

CourseID	Year	Instructor
cid444	2012	35
cid598	2013	4
cid444	2013	35

Here is another semantically equivalent query with a set operation:

```
SELECT Name
FROM Instructor
WHERE ID IN ( SELECT DISTINCT ID FROM Instructor
              EXCEPT
              SELECT DISTINCT Instructor FROM Course );
```

Quiz



- Are the following two SQL queries semantically equivalent? (i.e., are their respective results equivalent to one another, for all possible instances of the two tables)

1) yes 2) no

```
SELECT Name
FROM Country
WHERE Code IN ( SELECT Country
                FROM IsMember
                WHERE Organization = 'EU' );
```

```
SELECT Name
FROM Country, IsMember
WHERE Code = Country
  AND Organization = 'EU';
```

SQL Data Manipulation Operations

Quiz

Consider the following two tables

Instructor

ID	Name	Office
4	Jennifer	B308
35	Paul	B311
12	Kim	E112

Course

CourseID	Year	Instructor
cid444	2012	35
cid598	2013	4
cid444	2013	35

What is the result of executing the following SQL statement?

DELETE FROM Instructor **WHERE** Name **LIKE** "%i%";

1) Removal of the *Kim* tuple from the *Instructor* table
2) Removal of both the *Kim* tuple and the *Jennifer* tuple from the *Instructor* table
3) an error message
4) it depends

SQL Views

Any questions about this concept?

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