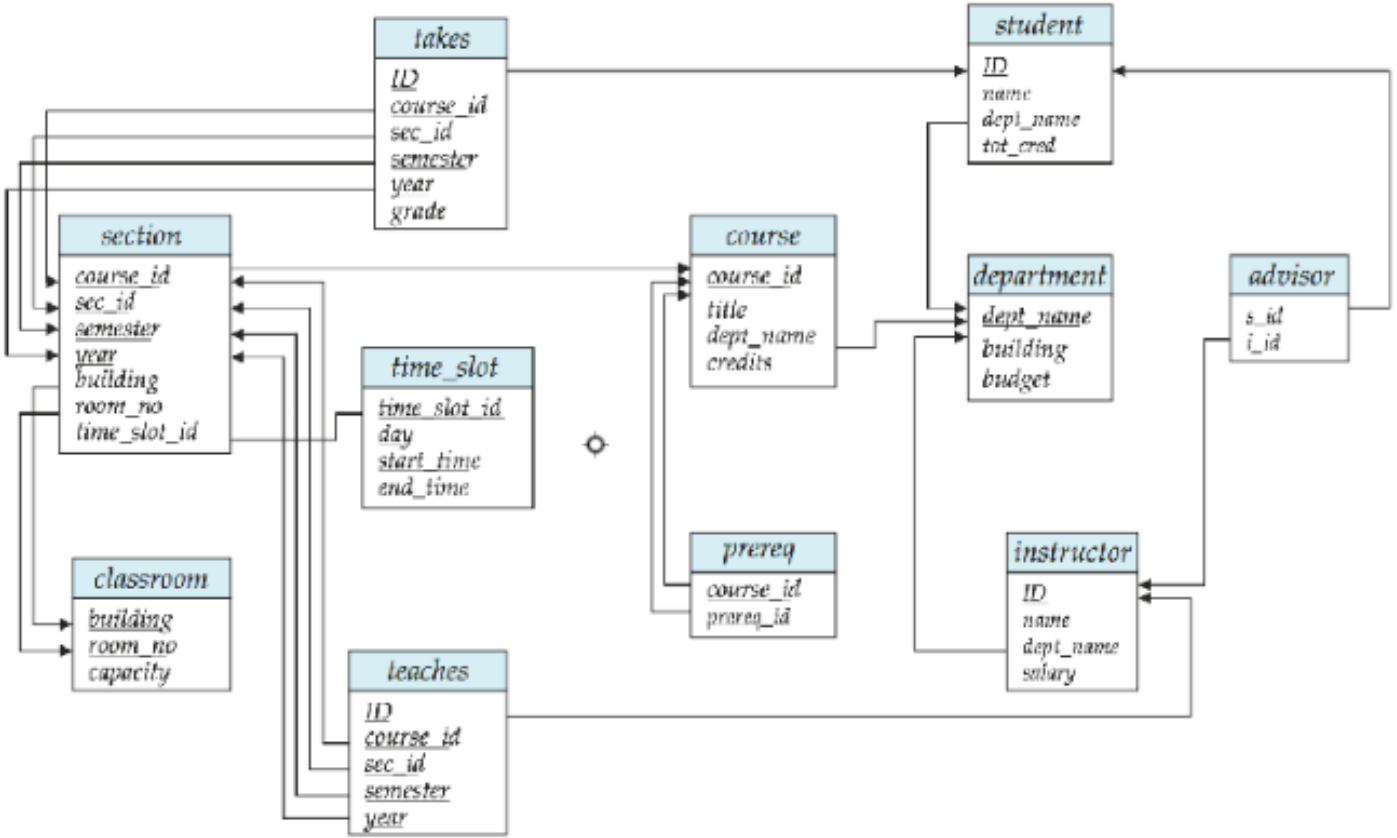
Multiple Tables

CMPSC 305 – Database Systems

ALLEGHENY COLLEGE

How to Connect Information? - No free-standing tables allowed!



The Basic Query Structure

The SQL data-manipulation language (DML) provides the ability to query information, and insert, delete and update tuples

A typical SQL code has the form:

```
SELECT A1, A2, ..., An
FROM r1, r2, ..., rm
WHERE P;
```

- Ai represents an attribute
- Ri represents a relation
- P is a predicate
- The result of an SQL query is a relation

The SELECT Clause

The SELECT clause filters out particular data from a table.

- SQL allows duplicates in relations as well as in query results.
- The SELECT statement has many optional clauses:
    - WHERE specifies which rows to retrieve.
    - GROUP BY groups rows sharing a property so that an aggregate function can be applied to each group.
    - HAVING selects among the groups defined by the GROUP BY clause.
    - ORDER BY specifies an order in which to return the rows.
    - AS provides an alias which can be used to temporarily rename tables or columns.

Given table ‘T’

Table "T"	Query	Result
C1 C2 1 a 2 b	`SELECT * FROM T;`	C1 C2 1 a 2 b
C1 C2 1 a 2 b	`SELECT C1 FROM T;`	C1 1 2
C1 C2 1 a 2 b	`SELECT * FROM T WHERE C1 = 1;`	C1 C2 1 a
C1 C2 1 a 2 b	`SELECT * FROM T ORDER BY C1 DESC;`	C1 C2 2 b 1 a

The TeaDB

Build file: sandbox/teaDB/teaDB Build.txt

- cat builder_teaTableDB.txt | sqlite3 teaDB.sqlite3

(or just copy in the text into SQLite3!)

The SELECT Clause

Find everything in the Department table.

- SELECT * FROM Department;

Find all entries for dept's of the Department table

- SELECT dept from Department;

Count entries of dept's in Department table,

- SELECT COUNT(dept) FROM department;

The SELECT Clause

Find all unique entries for depts in Department table,

- SELECT DISTINCT(dept) FROM department;

Count unique entries of depts in Department table,

- SELECT COUNT(DISTINCT(dept)) FROM Department;

Return an exhaustive set of sandwiches that are being ordered.

- SELECT DISTINCT(sandwich) FROM Tea;

What query to use to count these types of sandwiches?

The WHERE Clause

The WHERE clause: conditions that the result must satisfy

- Corresponds to the selection predicate of the relational algebra
- Comparison results can be combined using the logical connectives and, or, and not
- Comparisons can be applied to results of arithmetic expressions

The WHERE Clause

Find out who is ordering a sandwich less than $15 (from the new cost column)

- SELECT * FROM tea WHERE cost < 15;

Find out what kinds of sandwiches are going to each dept

- SELECT department.dept, tea.sandwich FROM department, tea
  WHERE department.id == tea.id;

The WHERE Clause

Find department, Session material, sandwich type for orders of sandwiches less than $15.

```
SELECT
        Department.id, Session.session,
        tea.sandwich, tea.cost
FROM
        Tea, Department, Session
WHERE
        cost < 15
AND
        Department.id == Session.id
AND
        Department.id == Tea.id;
```

The WHERE Clause

Find out which professors are presenting posters

- SELECT * FROM session WHERE material == ”poster”;
- SELECT ID, material FROM session WHERE material == ”poster”;

Find how who is presenting a poster, having what kind of sandwich which costs over $10

- SELECT session.ID, session.material, tea.sandwich, tea.cost FROM session, tea WHERE session.material == “poster” AND tea.cost >10 AND session.id == tea.id;

New Database Tables!

cat campusDB_build.txt | sqlite3 CampusDB.sqlite3

Abbreviations in Queries

Find which students are working with what instructors.

- SELECT Instructor.ID, Instructor.name, Instructor.studentId, Student.name, Student.Id FROM Instructor, Student WHERE Instructor.studentId == Student.ID;

Shorter way to write query by using abbreviations

- SELECT i.ID, i.name, i.studentId, s.name, s.Id FROM Instructor i, Student s WHERE i.studentId == s.ID;

- The "Instructor" table name can be replaced with an i
- The "Student" table name can be replaced by an "s"

Aggregate Functions

These functions operate on the multiset of values of a column of a relation, and return a value

- avg: average value
- min: minimum value
- max: maximum value
- sum: sum of values
- count: number of values

Mathematical Functions

To find all instructors in Comp. Sci. dept with salary > 80000

- SELECT
  name FROM instructor
  WHERE
  department = ”CompSci”
  AND
  salary > 80000;

Mathematical Functions

Using built-in functions

- SELECT AVG (salary) FROM instructor WHERE deptName = "CompSci";
- SELECT MIN (salary) FROM instructor WHERE deptName = "CompSci";
- SELECT MAX (salary) FROM instructor WHERE deptName = "CompSci";

Mathematical Functions

To find all instructors in Comp. Sci. dept with salary > 80000

- SELECT name FROM instructor

WHERE deptName = "CompSci" AND salary > 80000;

Using functions

- SELECT SUM (salary) FROM instructor WHERE deptName = "CompSci";

- SELECT COUNT (salary) FROM instructor WHERE deptName = "CompSci";

Attention to the WHERE clause

Find the ID, name and total credit students who are taking a course where the total credit is 3 or 4 hours.

Why will "AND" NOT work

- SELECT ID, name, totCred FROM student WHERE totCred == ”3” OR totCred == ”4”;

Attention to the WHERE clause

Watch out for cross products that give no usable information!!

- SELECT s.name, i.name from student s, instructor i WHERE s.deptName == i.deptName and s.deptName == ”CompSci”;

- Common Solution – Use two queries instead
  - SELECT s.name from student s WHERE s.deptName == ”CompSci”;
  - SELECT i.name from instructor i WHERE i.deptName == ”CompSci”;

Using Count and Count(Distinct(…))

Find the number of tuples in the course relation

- SELECT COUNT(credits) FROM course;
- SELECT COUNT(distinct(credits)) FROM course;
- SELECT COUNT (*) FROM course;
- SELECT COUNT(distinct(*)) FROM course;
- Question: Why will the above distinct line not work?

Removing Tables or Data

- DROP TABLE IF EXISTS student
  Deletes the table student and its contents if present
- DROP TABLE student
  Deletes the table student and its contents, report error if table not present
- DELETE FROM student
  Deletes all contents from table student, but retains table

Play with your database!

Remember, you can use your builder file to re-create the database if it becomes corrupt or unstable.

Changing Table Contents

ALTER TABLE

- Alter TABLE r ADD AD
- where A is the name of the attribute to be added to relation r and D is the domain of A.
- All tuples in the relation are assigned null as the value for the new attribute.
- EX: ALTER TABLE Department ADD Email varchar;

Change name of table:

- ALTER TABLE Department RENAME TO newDept;

Changing Table Contents

Add a column to a table

- ALTER TABLE course ADD COLUMN courseTag VARCHAR;
- Check your additional column:

  .schema course

Dropping a column of a table

- ALTER TABLE course DROP COLUMN courseTag;
- Check your additional column:

  .schema course

Complex Queries

Instructor names, IDs and their Students?

```
SELECT
        instructor.name, instructor.id,
        instructor.studentID, student.ID,
        student.name
FROM
        instructor, student
WHERE
        student.id == instructor.studentID;
```

Complex Queries

Output

Miller|10101|S1|S1|Michaels
Johnson|10102|S1|S1|Michaels
Charleson|10103|S2|S2|Peterson
Thompson|10104|S2|S2|Peterson
Mauler|10105|S3|S3|Mullen
…
Farber|10112|S5|S5|Beuller

Try these with campusDB.sqlite3!

- What is the average salary of computer science teachers?
- What is the average salary of computer science teachers who make less than $98000?

Try these with campusDB.sqlite3!

- What are the average salaries of instructors who worked during the Spring?
- What are the average salaries of instructors who worked during the Fall?

Try these with campusDB.sqlite3!

- What are the Instructor names and their IDs who taught which Students (show names and IDs)?
- What are the Instructor IDs their Student's IDs in cases where the instructors and students are NOT in the same department?

Try these with campusDB.sqlite3!

- What are the Instructor names and their IDs who taught which Students (show names and IDs) for classes taught in the year 2010?
- What are the Instructor names and their IDs who taught which Students (show names and IDs) for classes taught in the year 2010. In which semester were they teaching?
- Come-up with your own complex question and query solution.