Introduction to Database Systems: CS312
SQL Query Structures

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10 March 2022

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EASTMAN KODAK COMPANY, Rochester 4, N.Y.

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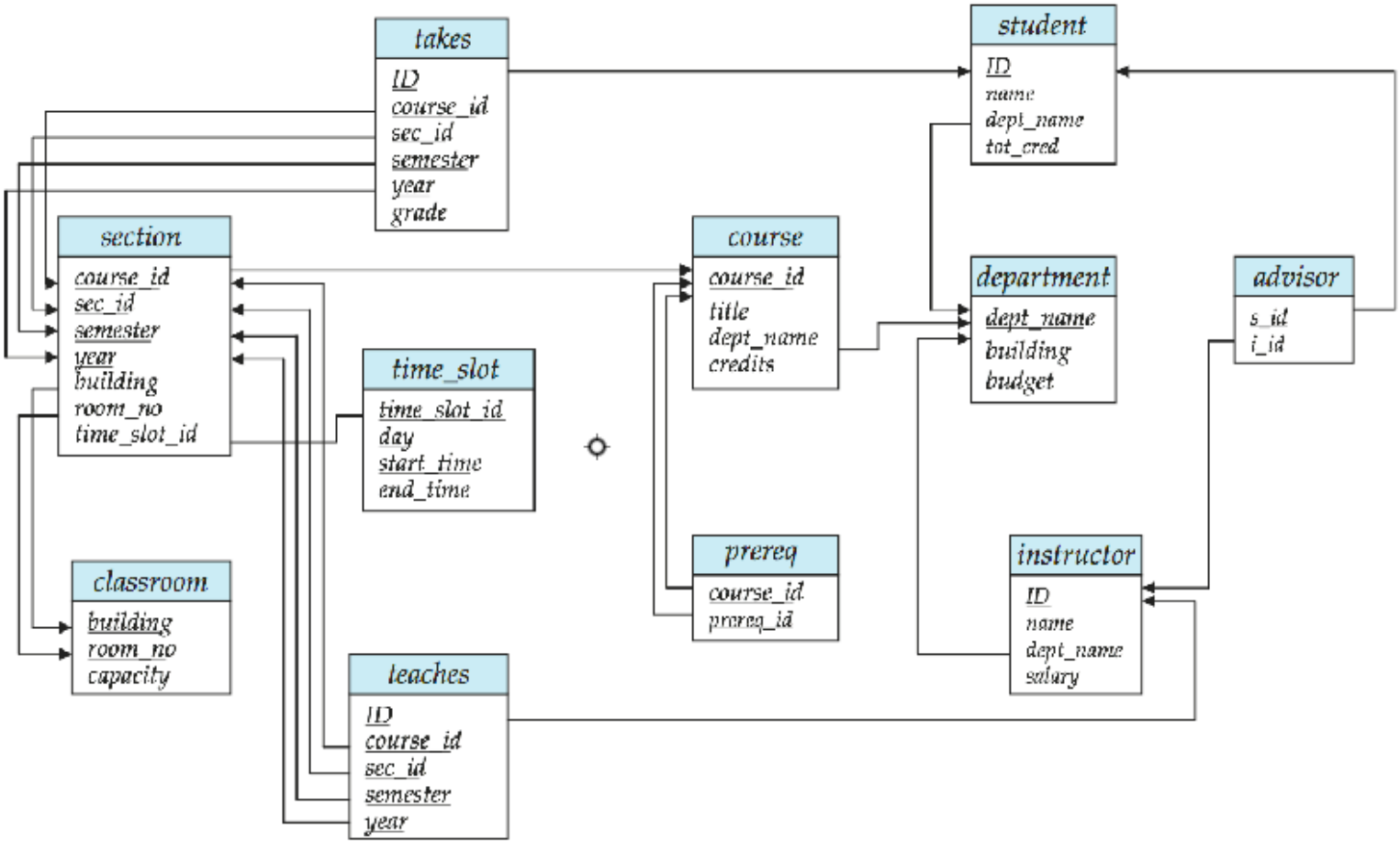
How to Connect The Information?

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 pseudo code query has the form:

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

- A_i represents an attribute
- R_i 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

New Table Columns

Adding *cost* information to TeaDB

Build file: `sandbox/teaDB/teaDB_Build.txt`

```
cat builder_teaDB.txt | sqlite3 teaDB.sqlite3
```

The **SELECT** Clause

TeaDB

- 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

TeaDB

- 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;
  /*count unique occurrences*/
- 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

TeaDB

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

TeaDB

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

- SELECT * FROM tea WHERE cost $<$ 15;

- 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;

- Find out what kinds of *sandwich*es are going to each *dept*

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

The **WHERE** clause

TeaDB

- Find out which professors are presenting posters

- SELECT * FROM session WHERE material == “poster”; /* show all*/
- SELECT ID, material FROM session WHERE material == “poster”; /*which professor is doing what?*/

- 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;

Moving On

And now this!

New Database Tables!

CampusDB

Build file: `sandbox/campusDB_Build.txt`

```
cat campusDB_build.txt | sqlite3 CampusDB.sqlite3
```

Abbreviations in queries

CampusDB

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
CampusDB

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

CampusDB

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

- SELECT name FROM instructor WHERE deptName = "CompSci" AND salary > 80000;

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

Faults of The WHERE Clause

CampusDB

- 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";

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())

CampusDB

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

CampusDB: Adding data to Student table

- DROP TABLE student
  - Deletes the table and its contents
- DELETE FROM student
  - Deletes all contents of table, but retains table

Remember, to use a builder file to re-create a 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;`

- Add a column to a table
  - `ALTER table course ADD COLUMN courseTag char(1);`
  - `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;
```

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
```

Try these with `campusDB.sqlite3`!

Work by yourself or together with others

- 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`!

Work by yourself or together with others

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

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

Try these with `campusDB.sqlite3`!

Work by yourself or together with others

- What are the Instructor names and their IDs who taught which Students (show names and IDs)?

- What are the Instructor names and their IDs who taught which Students (show names and IDs)?

Try these with `campusDB.sqlite3`!

Work by yourself or together with others

- 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.