Tip of the Day: When building a database, build the GUI *last*.

Thinking of Databases

Databases are organized on two levels: 'physical' is how the data is stored, 'logical' is how it's viewed

Big Picture

A database is made of ...

- Physical database -- tables actually stored on the hard disk
- Logical database -- created on-the-fly virtual tables specified by ...
- Queries -- [programs written in SQL that] define how to make a logical table from physical tables
- GUIs -- the interface for users to DBs

Avoiding Redundancy

Redundancy is bad because it can lead to inconsistent data ... very bad!

- Keep only one copy of any data

  ... does that make it right???

- Rather than repeating data, reference it in the places where it is needed

  - Keep data in its own table

  - Save its key wherever it is needed

When users want the data, get it using its key!

Physical Database

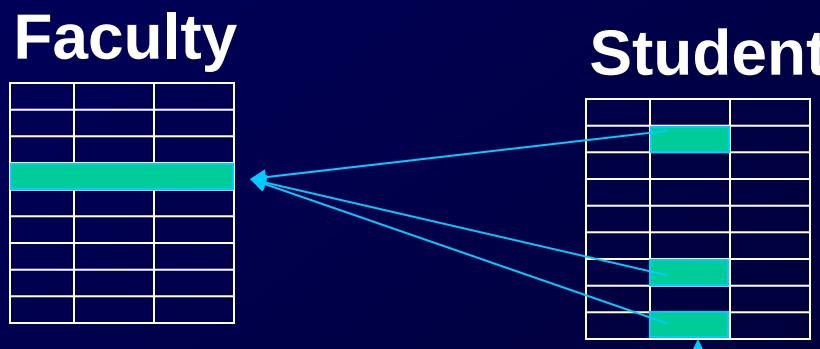
Physical databases store data in the "best" way -- no redundancy, ...

- Expect many tables of "simple" entities
- "Physical" means that the data is actually stored on the disk -- contrast with logical DBs that are "virtual tables"
- Physical databases are designed "for the computer" not for the user
- The "physical schema" gives table definitions and the relationships

Relationships

The table data entries are not just text & numbers, but they have meaning

- Relationships spell out that meaning



One-to-many relationship

Kinds of Relationships

One-to-One

One-to-Many

Many-to-Many

Name relationships by their meaning

Logical Databases

Users want & need different information

- Different tasks require different information
- Different authority levels, e.g. need to know
- Customizing to users means everyone sees exactly what they need to see

* A *view* is a user's customized database
* *Views* are virtual, built on-the-fly from the physical database and not kept
  - Data is always current
  - Custom structure can be very adaptable

Queries

Queries are commands (using the 5 table operations) that create logical database (views) from physical

Tables produced by queries are just tables

SQL

The structured query language is the industry standard query language

- "Structured" means the queries have a standard form
- Common clauses --
  - SELECT <fields desired>
  - FROM <list of tables>
  - INNER JOIN <table> ON <conditions>
  - WHERE <criterion>

Like Project!

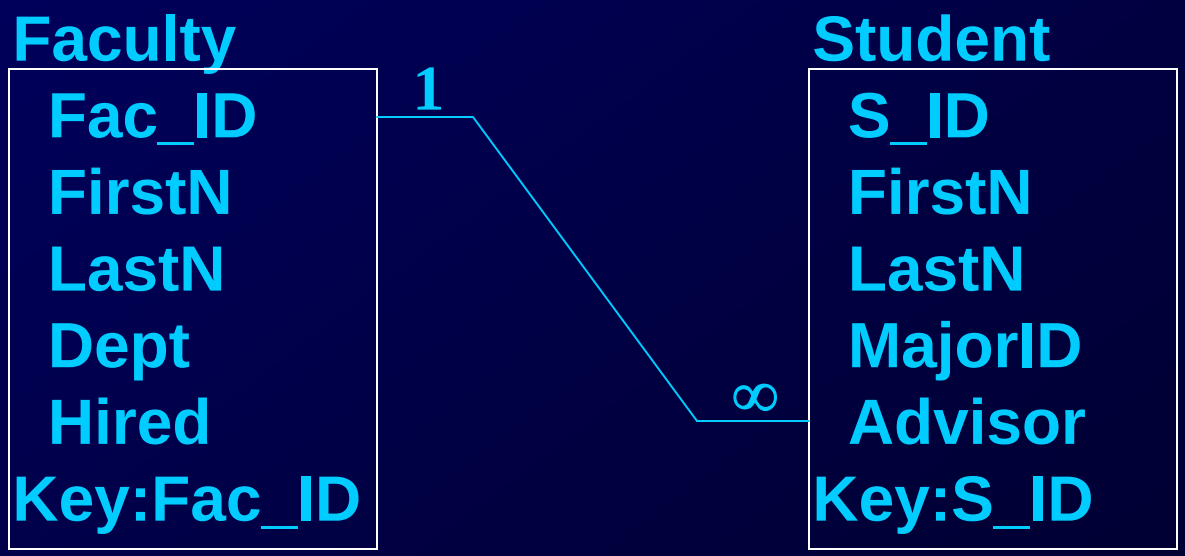
SQL is not case sensitive

Sample Database

Define a university DB schema

- ER Diagram

- Specifying a 1-to-many relationship



Sample SQL Queries

Typical: SELECT<attribs>FROM<tables>

```
SELECT Student.FirstN, Student.LastN,
  Student.MajorID
FROM Student
WHERE Student.S_ID= 0206125;

SELECT Student.FirstN, Student.LastN
FROM Student
WHERE MajorID=14;
```

Join Example

Find the students of a given professor

```
SELECT Student.FirstN, Student.LastN,
  Faculty.LastN
FROM (Student INNER JOIN Faculty
  ON Student.Advisor = Faculty.Fac_ID)
```

- Notice that selection comes from the combined (by Inner Join) table

DB Design Paradigm

Guidelines for good databases:

- Build physical DB to avoid redundancy, etc
- Each physical table represents 1 entity
- Expect that no physical table gives any user their exact view
- To build view, build a query that ...
  - Joins tables together into a ‘super’ table
  - Trims out only the items the user wants

These guidelines are not an algorithm, but they usually produce good results

The Summary

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