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

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Relationships

The table data entries are not just text & numbers, but they have meaning
- Relationships spell out that meaning

One-to-One

- Faculty

One-to-Many

- Dorm
- Student

Many-to-Many

- Student
- Club

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>

SQL is not case sensitive

#### Sample Database

Define a university DB schema

- ER Diagram
- Specifying a 1-to-many relationship

**Faculty**
- Fac_ID
- FirstN
- LastN
- Dept
- Hired
- Key: Fac_ID

**Student**
- S_ID
- FirstN
- LastN
- Major_ID
- Advisor
- Key: S_ID

**Sample SQL Queries**

Typical: SELECT <attrs> 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

Project 3: SLAMA

Design DB to support a small mythical WA town’s police department...
- “San Lucas Arrest Monitoring Application”
- The DB keeps track of suspects, police, and arrests. It monitors the blood alcohol and drug testing process while protecting the privacy of the citizens
- You will create the DB in MS Access, including tables, queries, forms and reports

What Happens???

When someone is arrested for drunk driving, what happens?
For Monday, find out …
http://dui.findlaw.com/index3.html

Filling Tables

Things are slow in San Lucas, so you will have to generate data

Defining Queries

The logical database (views) remove data from tables for users

We can write SQL directly, or we can use Query By Example
The GUIs (forms) for users must be neat and attractive, with a slogan.

To protect privacy, lab samples are not coded with suspect’s name.

The Summary

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