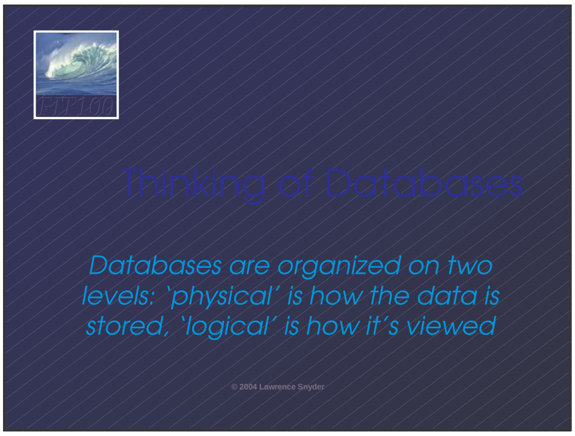
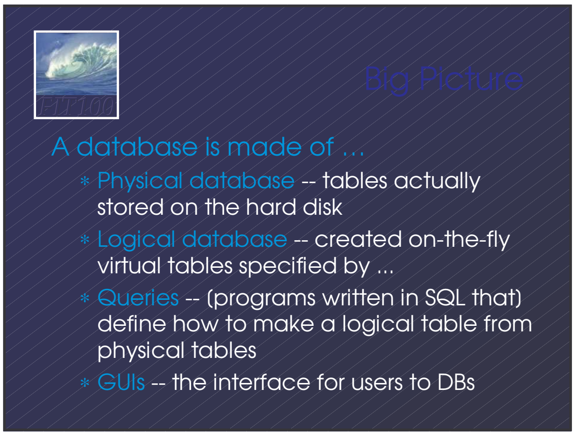


# Thinking of Databases

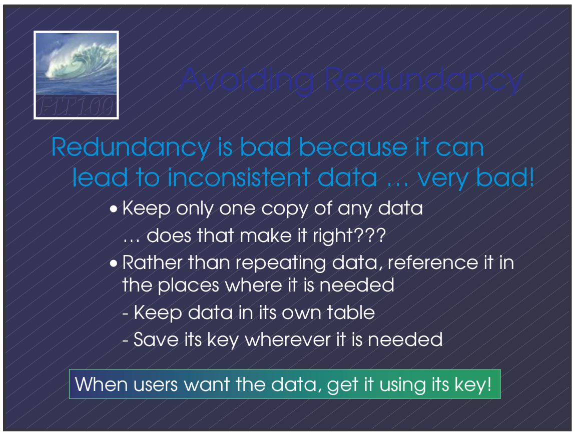
*Databases are organized on two levels: 'physical' is how the data is stored, 'logical' is how it's viewed*



## 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

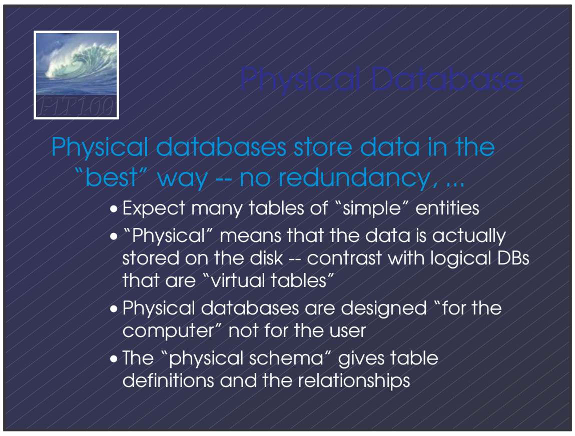


## Avoiding Redundancy

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

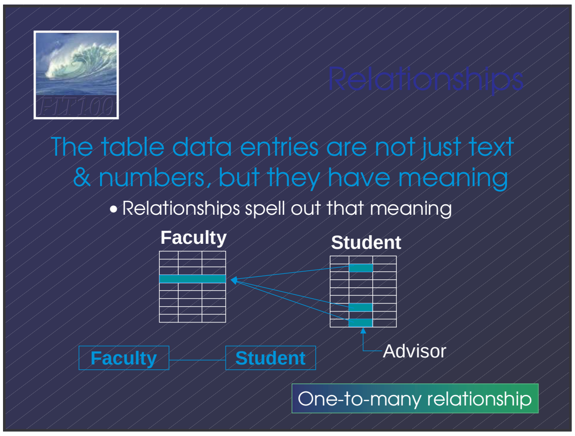
When users want the data, get it using its key!



## 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

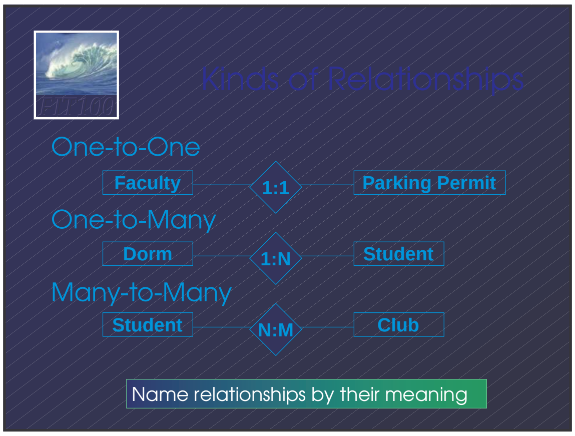


## Relationships

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

- Relationships spell out that meaning

One-to-many relationship



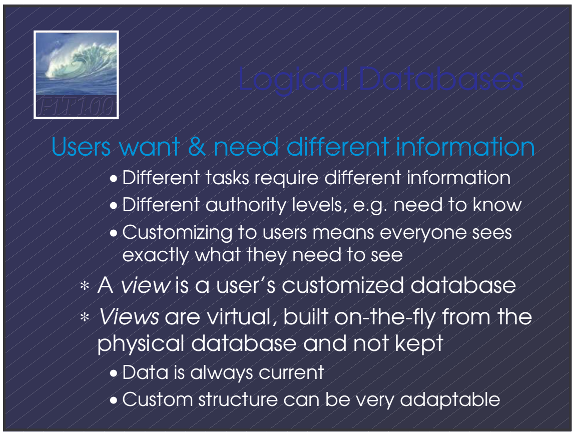
## Kinds of Relationships

One-to-One

One-to-Many

Many-to-Many

Name relationships by their meaning



FIT100

## Logical Databases

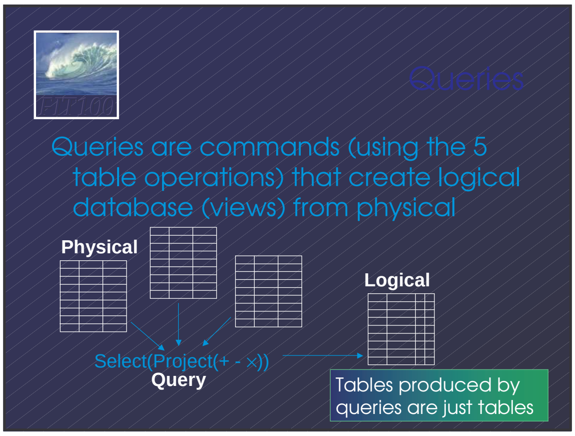
Users want & need different information

- 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



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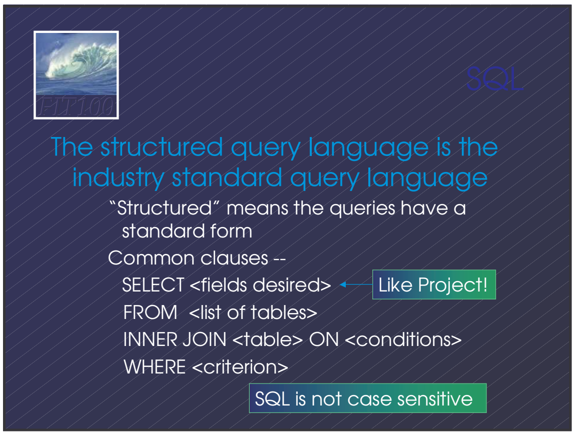
## Queries

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

Tables produced by queries are just tables



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## SQL

The structured query language is the industry standard query language

"Structured" means the queries have a standard form

Common clauses --

SELECT <fields desired>

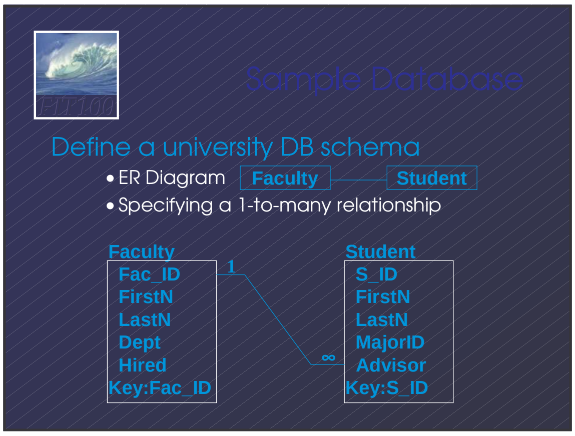
FROM <list of tables>

INNER JOIN <table> ON <conditions>

WHERE <criterion>

Like Project!

SQL is not case sensitive



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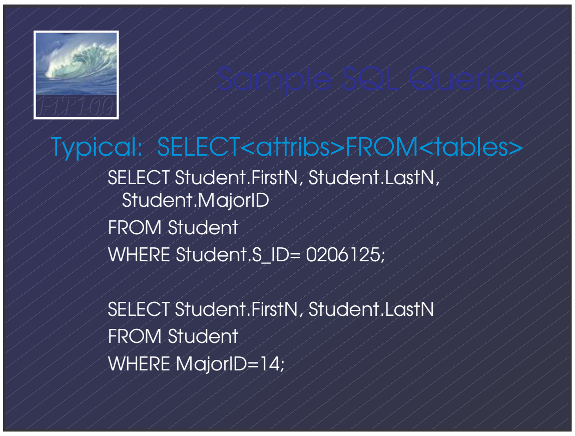
## Sample Database

Define a university DB schema

- ER Diagram Faculty —— Student
- Specifying a 1-to-many relationship



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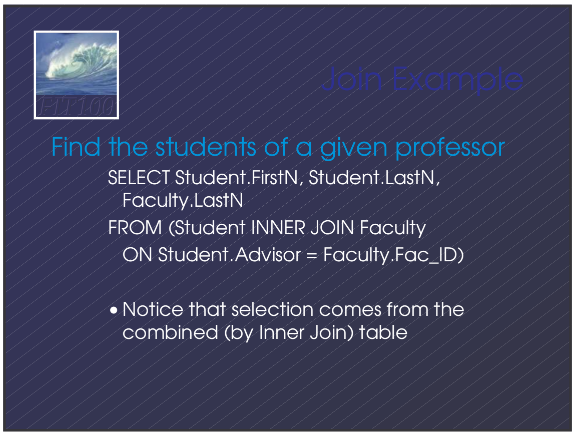
## Sample SQL Queries

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;
```



FIT100

## 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???

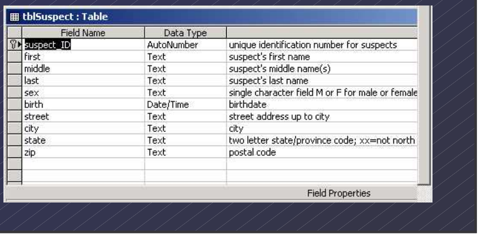
When someone is arrested for drunk driving, what happens?

For Monday, find out …

**http://dui.findlaw.com/index3.html**

## Defining Tables

The physical database is a collection of (3-4) tables

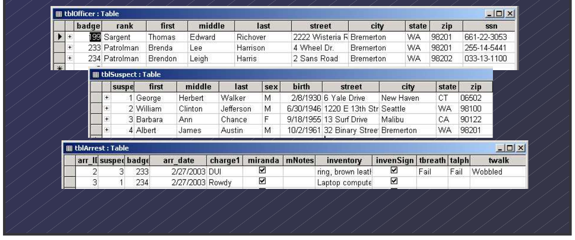


tblSuspect : Table

| Field Name | Data Type | |
|---|---|---|
| suspect_ID | AutoNumber | unique identification number for suspects |
| first | Text | suspect's first name |
| middle | Text | suspect's middle name(s) |
| last | Text | suspect's last name |
| sex | Text | single character field M or F for male or female |
| birth | Date/Time | birthdate |
| street | Text | street address up to city |
| city | Text | city |
| state | Text | two letter state/province code; xx=not north |
| zip | Text | postal code |

## Filling Tables

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



tblOfficer : Table

| badge | rank | first | middle | last | street | city | state | zip | ssn |
|---|---|---|---|---|---|---|---|---|---|
| 199 | Sargent | Thomas | Edward | Richover | 2222 Wisteria R | Bremerton | WA | 98201 | 661-22-3053 |
| 233 | Patrolman | Brenda | Lee | Harrison | 4 Wheel Dr. | Bremerton | WA | 98201 | 255-14-5441 |
| 234 | Patrolman | Brendon | Leigh | Harris | 2 Sans Road | Bremerton | WA | 98202 | 033-13-1100 |

tblSuspect : Table

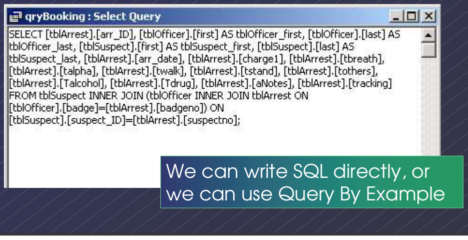
| suspe | first | middle | last | sex | birth | street | city | state | zip |
|---|---|---|---|---|---|---|---|---|---|
| 1 | George | Herbert | Walker | M | 2/8/1930 | 6 Yale Drive | New Haven | CT | 06502 |
| 2 | William | Clinton | Jefferson | M | 6/30/1946 | 1220 E 13th Str | Seattle | WA | 98100 |
| 3 | Barbara | Ann | Chance | F | 9/18/1955 | 13 Surf Drive | Malibu | CA | 90122 |
| 4 | Albert | James | Austin | M | 10/2/1961 | 32 Binary Stree | Bremerton | WA | 98201 |

tblArrest : Table

| arr_II | suspec | badge | arr_date | charge1 | miranda | mNotes | inventory | invenSign | tbreath | talph | twalk |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 3 | 233 | 2/27/2003 | DUI | ☑ | | ring, brown leatl | ☑ | Fail | Fail | Wobbled |
| 3 | 1 | 234 | 2/27/2003 | Rowdy | ☑ | | Laptop compute | ☑ | | | |

## Defining Queries

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



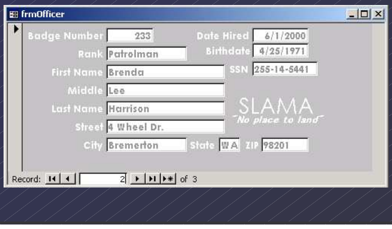
qryBooking : Select Query

```
SELECT [tblArrest].[arr_ID], [tblOfficer].[first] AS tblOfficer_first, [tblOfficer].[last] AS
tblOfficer_last, [tblSuspect].[first] AS tblSuspect_first, [tblSuspect].[last] AS
tblSuspect_last, [tblArrest].[arr_date], [tblArrest].[charge1], [tblArrest].[tbreath],
[tblArrest].[talpha], [tblArrest].[twalk], [tblArrest].[tstand], [tblArrest].[tothers],
[tblArrest].[Talcohol], [tblArrest].[Tdrug], [tblArrest].[aNotes], [tblArrest].[tracking]
FROM tblSuspect INNER JOIN (tblOfficer INNER JOIN tblArrest ON
[tblOfficer].[badge]=[tblArrest].[badgeno]) ON
[tblSuspect].[suspect_ID]=[tblArrest].[suspectno];
```

We can write SQL directly, or we can use Query By Example

## GUIs For The Views

The GUIs (forms) for users must be neat and attractive, with a slogan



frmOfficer

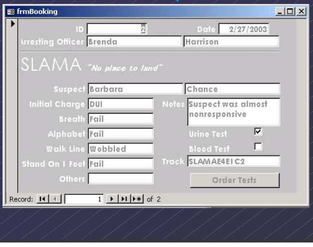
Badge Number 233
Rank Patrolman
First Name Brenda
Middle Lee
Last Name Harrison
Street 4 Wheel Dr.
City Bremerton State WA ZIP 98201
Date Hired 6/1/2000
Birthdate 4/25/1971
SSN 255-14-5441

SLAMA
"No place to land"

Record: 2 of 3

## Tracking Number

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



frmBooking

ID 2
Date 2/27/2003
Arresting Officer Brenda Harrison

SLAMA "No place to land"

Suspect Barbara Chance
Initial Charge DUI
Breath Fail
Alphabet Fail
Walk Line Wobbled
Stand On 1 Foot Fail
Others
Notes Suspect was almost nonresponsive
Urine Test ☑
Blood Test ☐
Track SLAMAE4E1C2

Record: 1 of 2

## The Summary

A database is made of …

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