# Announcements

- Free copy of Access, Vista, etc., for educational/academic use:
  - ∗ Links on Computing page on Course Web site
    - Search for CSE or INFO to find the link on the page
    - Username is your full UW email address
    - Password is different!
      - – Click on "send a reminder"
      - – Check wherever your email forwards to

# Announcements

- Rubrics for Quick Writes will be available next week

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# Announcements

- Due date for Project 3A moved to Wednesday before noon
- Project 3B will be available Monday

# A Table with a View (continued)

*Primary keys, normalization, and SQL*

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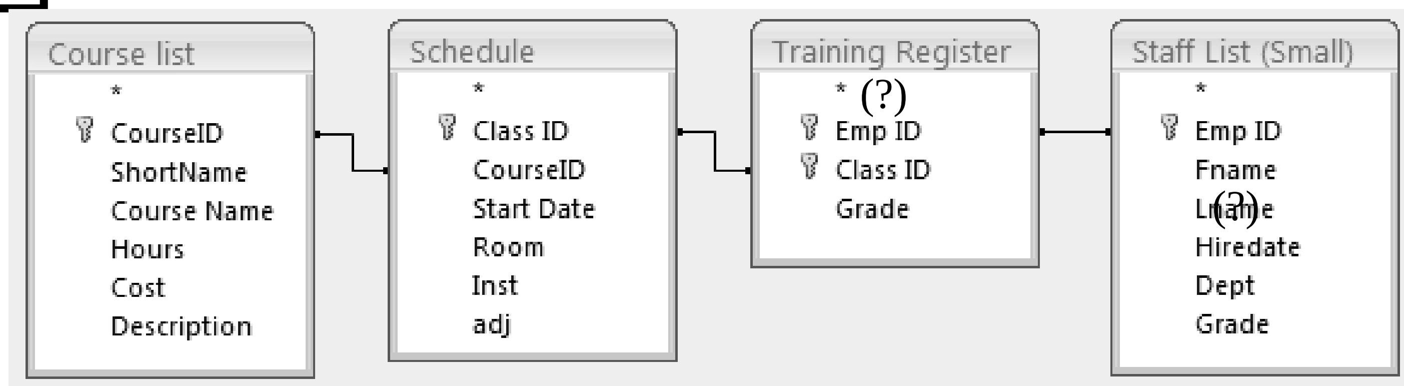
# Video

- Primary Keys (5 min.)

# Primary/Foreign Key




- Controlled redundancy:
  - Stores relationship between tables
  - Database tables share common attributes only to enable the tables to be linked
  - True redundancy exists only when there is unnecessary duplication of attribute values

# Problem Fields (Don'ts)

Calculated Field — Multipart Field — Calculated Field — Multivalue Field

| Last Name | First Name | Full Name | City State Zip | Hourly | Weekly | Invoices |
|---|---|---|---|---|---|---|
| Sullivan | Frank | Frank Sullivan | Kent, WA 98032 | 20.07 | 802.85 | 123 |
| Silby | Judy | Judy Silby | Yakima, WA 98902 | 16.73 | 669.04 | 127, 217, 319 |
| Harding | Joel | Joel Harding | Auburn, WA 98001 | 13.38 | 535.23 | 124, 297 |
| Rathke | Nicole | Nicole Rathke | Renton, WA 98055 | 9.37 | 374.66 | 176 |
| Lee | Allen | Allen Lee | Kent, WA 98032 | 16.73 | 669.04 | 151, 165 |
| Allert | Maria | Maria Allert | Yakima, WA 98902 | 8.03 | 321.14 | 143 |
| Young | Jim | Jim Young | Selah, WA 98942 | 18.06 | 722.57 | 161, 181 |

- Calculated field – can be computed by mathematical calculation or text concatenation
  - Waste of storage space (redundant),
  - No assurance the calculated value is updated when the user changes the input field(s)
- Multipart field – contains that should be two or more fields
  - Extra work when you want to analyze your data
- Multivalue field – multiple correct entries for the field
  - Create a separate subset table with each value in its own record.
- Derived field – contents of one or more fields absolutely predicts the contents of another
  - Should be dropped from the table

# Video

- Redundancy and Normalization (5 min.)

# Entities

- Entity
  - Anything that can be identified by a fixed number of its characteristics (*attributes*)
- Attributes have
  - Names—field name, attribute, or column name
  - Values—the data stored in the table

# Entities

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- An entity defines a table
  - Name of the entity is the name of the table
  - Each attribute of that entity
    - The column heading is the attribute name

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| **Island** | | |
|---|---|---|
| *Name* | *Area* | *Elevation* |
| Isabela | 4588 | 1707 |
| Fernandina | 642 | 1494 |
| Tower | 14 | 76 |
| Santa Cruz | 986 | 846 |

**Figure 16.4** A table instance for the island entity.

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# Properties of Entities

- A relational database table can be empty
- Instances Are Unordered
  - Order of the rows and columns does not matter in databases
  - Freedom to move the data is limited to exchanging entire rows or exchanging entire columns

# Properties of Entities cont'd)

- Uniqueness
  - ∗ No two rows can be the same
  - ∗ Two rows can have the same value for some attributes, just not all attributes

# Properties Of Entities (cont'd)

- Atomic Data
  - ∗ Not decomposable into any smaller parts
    - Separate fields for street, city, state, postal code
  - ∗ "Only atomic data" rule relaxed for certain types of data
    - Dates, times, currency

# Database schemes

- Database schema – way to define a table
  - Collection of table definitions that gives the name of the table, lists the attributes and their data types, and identifies the primary key

**Island**

| | | |
|---|---|---|
| iName | Text | *Island Name* |
| area | Number | *Area in square kilometers* |
| elevation | Number | *Highest point on the island* |

Primary Key: iName

**Figure 16.5** Database table definition for an `Island` table.

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# Database Tables Recap

- Tables in databases have a structure that is specified by metadata
- The structure is separate from its content
- A table structures a set of entities
  - Things that we can tell apart by their attributes
- The entities of the table are represented as rows
  - Rows and columns are unordered
- Tables and fields should have names that describe their contents
  - Fields must be atomic (indivisible)
  - One of more attributes define the primary key

# TABLE OPERATIONS

# Operations on Tables

- A database is a collection of tables
- Main use of database is to look up information
  - Users specify what they want to know and the database software finds it
- We can perform operations on tables to produce new tables
- The questions we ask of a database are answered with a whole new table, or view

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**Nations**

| | | |
|---|---|---|
| Name | text | *Common rather than official name* |
| Domain | text | *Internet top-level domain name* |
| Capital | text | *Nation's capital* |
| Latitude | number | *Approx. latitude of capital* |
| N_S | Boolean | *Latitude is N(orth) or S(outh)* |
| Longitude | number | *Approx. longitude of capital* |
| E_W | Boolean | *Longitude is E(ast) or W(est)* |
| Interest | text | *A short description of the country* |

Primary Key: Name

| Name | Dom | Capital | Lat | NS | Lon | EW | Interest |
|---|---|---|---|---|---|---|---|
| Ireland | IE | Dublin | 52 | N | 7 | W | History |
| Israel | IR | Jerusalem | 32 | N | 35 | E | History |
| Italy | IT | Rome | 42 | N | 12 | E | Art |
| Jamaica | JM | Kingston | 18 | N | 77 | W | Beach |
| Japan | JP | Tokyo | 35 | N | 143 | E | Kabuki |

**Figure 16.6** The Nations table definition and sample entries.

# **Select** Operation

- Takes rows from one table to create a new table
  - Specify the table from which rows are to be taken, and the *test* for selection

    Syntax: **`SELECT`** *Test* **`FROM`** *Table*

  - Test is applied to each rows of the table to determine if it should be included in result table
  - Test uses attribute names, constants, and relational operators
  - If the test is true for a given row, the row is included in the result table; otherwise it is ignored

    **`SELECT`** `Interest='Beach'` **`FROM`** *`Nations`*

| Name | Dom | Capital | Lat | NS | Lon | EW | Interest |
|---|---|---|---|---|---|---|---|
| Australia | AU | Canberra | 37 | S | 148 | E | Beach |
| Bahamas | BS | Nassau | 25 | N | 78 | W | Beach |
| Barbados | BB | Bridgetown | 13 | N | 59 | W | Beach |
| Belize | BZ | Belmopan | 17 | N | 89 | W | Beach |
| Bermuda | BM | Hamilton | 32 | N | 64 | W | Beach |

**Figure 16.7** Part of the table created by selecting countries with a Test for Interest equal to Beach.

# Animation

- A natural join

Physical and Logical Database

# TABLES AND VIEWS

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# Structure of a Database

- Physical database and logical database
  - Physical database is the files, records in any order, no logical organization other than tables
  - Logical database is a view of database that shows only the rows and fields needed by the users
    - Solves Information Overload:
      - Users see only what they need
      - Users see only what they have permission to see

# Physical vs. Logical

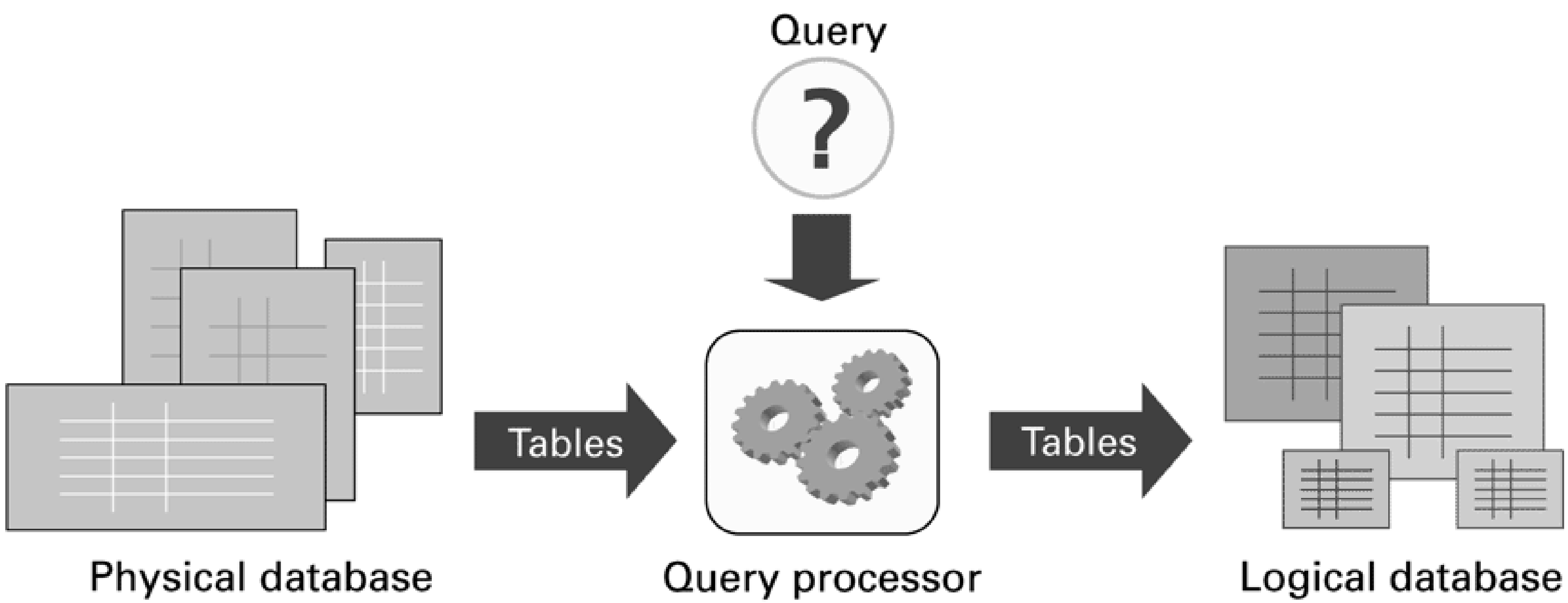



**Figure 16.15** Structure of a database system. The physical database is the permanent repository of the data; the logical database, or view of the database, is the form of the database the users see. The transformation is implemented by the query processor, and is based on queries that define the logical database tables from the physical database tables.

# Physical Database

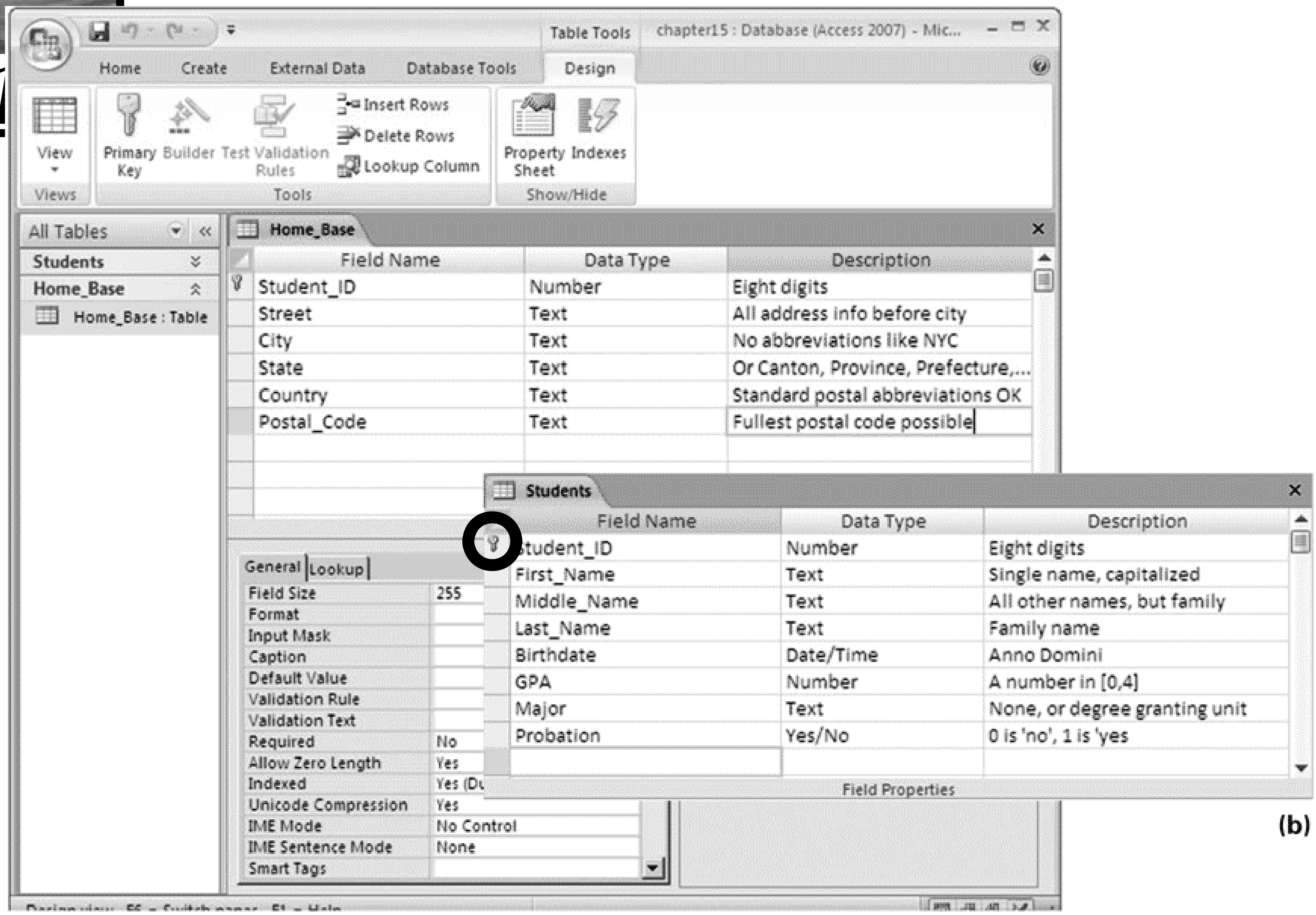
- Designed by database administrators
  - ∗ Fast to access
  - ∗ No redundancy/duplicating information
    - Multiple data can lead to inconsistent data
  - ∗ Backup copies in case of accidental data deletion or disk crash

# Logical Database

- Creating specialized views of the data for different users' needs
  - Creating a new “result set” from the current data each time
    - Fresh
    - Accurate

# Defining Physical Tables

- Database schemes (schema)
  - Metadata specification that describes the database design




(a) (b)

**Figure 16.16** Table declarations from Microsoft Access 2007: (a) `Home_Base` table declaration shown in the design view; and (b) students table declaration. Notice that the key is specified by the tiny key next to `Student_ID` in the first column.

# The Idea of Relationship

- A **relationship** is a correspondence between rows of one table and the rows of another table
  - Because the key `Student_ID` is used in each table, can not only find the address for each student (*Lives_At*), but can also find the student for each address (*Home_Of*)
- Relationship examples

# Relationships in Practice

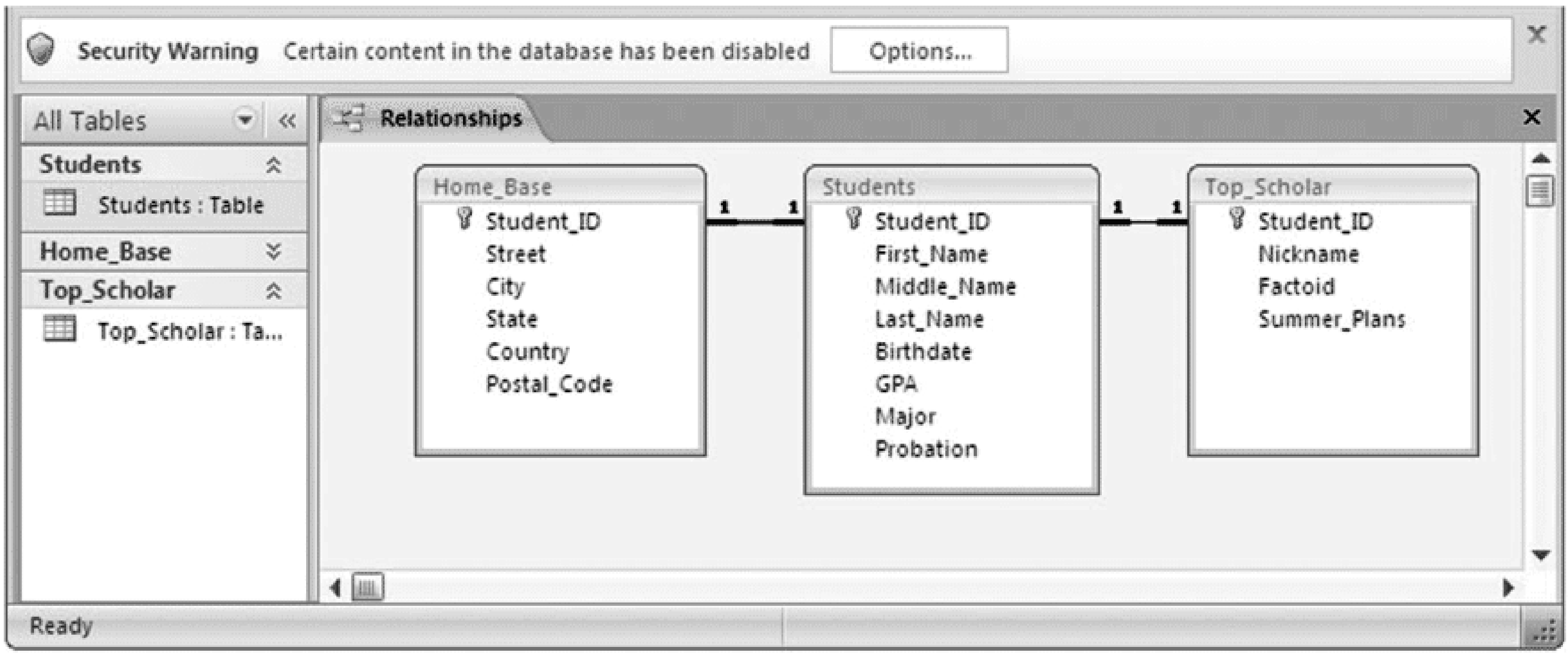



**Figure 16.17** The *Relationships* window from the Microsoft Access database system; the 1-to-1 *Lives_At* and *Home_Of* relationships are shown between `Home_Base` and `Students`.

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# Defining Logical Tables

- Constructing a View Using Join
  - Match on the common field of Student_ID

```
Master_List = Student JOIN Home_Base
  On Student.Student_ID = Home_Base.Student_ID
```

```
Student_ID
First_Name
Middle_Name
Last_Name
Birthdate
On_Probation
Street_Address
City
State
Country
Postal_Code
```

**Figure 16.18** Attributes of the `Master_List` table. Being created from `Student` and `Home_Base` allows `Master_List` to inherit its data types and key (`Student_ID`) from the component tables.