Databases

Chapter 16

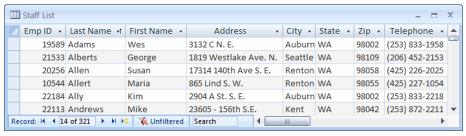
Databases

- A **database** is a structured collection of records or data that is stored in a computer system.
- Any organized collection of similar data.
- Examples of databases:
  - Telephone book white pages
  - T.V. Guide
  - Airline reservation system
  - Motor vehicle registration records
  - Papers in your filing cabinet
  - Files on your computer hard drive

Relational Databases

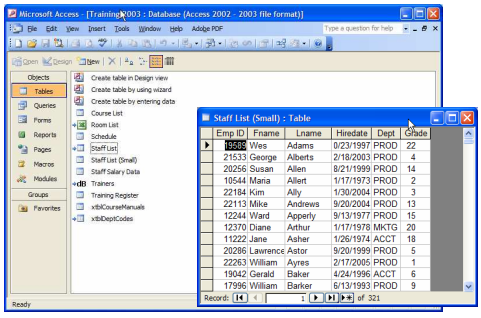
- A *relational database* describes the relationships among different kinds of data
  - Allows the software to answer queries about them
- A relational database allows you to:
  - … easily find specific information.
  - … sort based on any field and generate reports that contain only certain fields from each record.

Tables

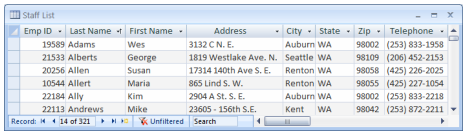


- Advantages – structural and data independence
- Conceptually resembles a file
  - Note that a file is actually a physical structure
- Easier to understand than its hierarchical and network database predecessors

Tables



Characteristics Of Tables



1	A table is perceived as a two-dimensional structure composed of rows and columns.
2	Each table row (**tuple**) represents a single entity occurrence within the entity set.
3	Each table column represents an attribute, and each column has a distinct name.
4	Each row/column intersection represents a single data value.
5	All values in a column must conform to the same data format. For example, if the attribute is assigned an integer data format, all values in the column representing that attribute must be integers.
6	Each column has a specific range of values known as the **attribute domain**.
7	The order of the rows and columns is immaterial to the DBMS.
8	Each table must have an attribute or a combination of attributes that uniquely identifies each row.

Entities

- Anything that can de identified by a fixed number of its characteristics (*attributes*)
  - Attributes have names and values
  - The values are the data that's stored in the table
- An entity defines a table
  - Name of the entity is the name of the table
  - Each attribute is assigned a column with column heading being the attribute name

Example Table

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.

Entities And Tables

- Entity instances
  - Rows of data which defines particular objects.
- Table instance
  - Any table containing specific rows.
- Data type
  - Defines the form of the information that can be stored in a field
    - Number, text, image, …

Terminology

Phone book:

Fields (columns)

Records (rows)

Anderson	Thomas	A	123 Marine View Dr.	237-1234
Benson	Karen	C	1300 California Ave	237-1098
Casserly	Rick	W	12492 Rd 19	342-0502
Drummond	Lynn	M	12059 30th Ave W	931-1105

Table

Field (the columns in a table)	▪ Smallest unit of information in a table ▪ Also called "attributes"	▪ First name ▪ Last name ▪ Middle initial ▪ Street address ▪ Phone number(s)
Record (the rows in a table)	▪ All related fields are collectively called a record or tuple.	▪ All fields for one person are a record
Table	▪ A collection of records is a data table	▪ Collection of everyone's records

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
- 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

Keys: Primary Key

- Primary Key
  - The primary key of a relational table uniquely identifies each record in the table.
  - Primary keys may consist of a single attribute or multiple attributes in combination
- Example:
  - Student ID in table STUDENT which has collection of the data for each student.
  - Course ID in table COURSES.

Keys: Foreign Key

- Foreign Keys
  - A foreign key is a field in a relational table that matches the primary key column of another table.
  - The foreign key can be used to cross-reference tables.
- Example:
  - Course ID in STUDENT table is a Foreign key.

Keys: Candidate Key

- **candidate key**: any set of attributes for which all attributes are different
  - Set of attributes that uniquely define an entity instance.
  - Candidate key must distinguish all potential and actual entities.
  - If no combination of attributes qualify as a candidate key, must assign a unique ID to each entity (e.g. student ID)

Database Schema

- **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
```


Database Management System (DBMS)

- A DBMS is a suite of software applications that together make it possible to store, modify, and extract information from a database.
- Examples of DBMS:
  - ATM's
  - UW Library system