Databases

Chapter 16

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

Characteristics Of Tables

1. A table is perceived as a two-dimensional structure composed of rows and columns.
2. Each table row, called a 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 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 be 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 entry is the name of the table
  - Each attribute is assigned a column with column heading being the attribute name

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, ...

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

Example Table

<table>
<thead>
<tr>
<th>Island</th>
<th>Name</th>
<th>Area</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isabela</td>
<td></td>
<td>4588</td>
<td>1707</td>
</tr>
<tr>
<td>Fernandina</td>
<td></td>
<td>642</td>
<td>1494</td>
</tr>
<tr>
<td>Tower</td>
<td></td>
<td>14</td>
<td>76</td>
</tr>
<tr>
<td>Santa Cruz</td>
<td></td>
<td>986</td>
<td>846</td>
</tr>
</tbody>
</table>

Figure 16.4 A table instance for the island entity.

Terminology

<table>
<thead>
<tr>
<th>Phone book:</th>
<th>Records (rows)</th>
<th>Fields (columns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson</td>
<td>Thomas</td>
<td>A 123 Marine Dr</td>
</tr>
<tr>
<td>Benson</td>
<td>Karen</td>
<td>C 1300 California Ave</td>
</tr>
<tr>
<td>Casserly</td>
<td>Rick</td>
<td>W 12492 Rd 19</td>
</tr>
<tr>
<td>Drummond</td>
<td>Lynn</td>
<td>M 12059 30th Ave W</td>
</tr>
</tbody>
</table>

Table

<table>
<thead>
<tr>
<th>Field</th>
<th>Smallest unit of information in a table</th>
<th>Also called &quot;attributes&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>First name</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Last name</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle initial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Street address</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone number(s)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Record</th>
<th>All related fields are collectively called a record or tuple.</th>
<th>All fields for one person are a record</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Table</th>
<th>A collection of records is a data table</th>
<th>Collection of everyone's records</th>
</tr>
</thead>
</table>


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.

<table>
<thead>
<tr>
<th>Island</th>
<th>iName</th>
<th>Text</th>
<th>Island Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>area</td>
<td>Number</td>
<td>Area in square kilometers</td>
<td></td>
</tr>
<tr>
<td>elevation</td>
<td>Number</td>
<td>Highest point on the island</td>
<td></td>
</tr>
</tbody>
</table>

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