Ubiquity of Databases

- Anywhere where a large amount of information needs to be managed safely and efficiently
  - Utility companies, grocery stores
  - Schools
  - Doctor’s offices, hospitals
  - Government agencies
  - Web sites
  - …

An Example of a Database Application

Hierarchical Model

Network Model

Relational Model

Proposed by Edgar F. Codd in early 1970’s
Data is stored in tables
All major database systems these day are relational

<table>
<thead>
<tr>
<th>student_id</th>
<th>first_name</th>
<th>last_name</th>
<th>birthday</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000001</td>
<td>John</td>
<td>Doe</td>
<td>1970-1-1</td>
</tr>
<tr>
<td>2000002</td>
<td>Jane</td>
<td>Doe</td>
<td>1971-1-1</td>
</tr>
<tr>
<td>2000003</td>
<td>Tom</td>
<td>Smith</td>
<td>1962-2-2</td>
</tr>
</tbody>
</table>

So how do we store the directory structure in a table??

What about material related to both web and database??
The Big Picture

DBMS

- Database Management System (DBMS) is a software that manages databases
- Common DBMS
  - Commercial – Oracle, IBM DB2, MS SQL Server, Access
  - Open source – MySQL, PostgreSQL

Database and Schema

- A database is a collection of data managed by a DBMS
- A database contains one or more schemas
- A schema contains a number of schema elements, such as tables, indexes, stored procedures, and so on.

More Terminology

<table>
<thead>
<tr>
<th>Table (relation)</th>
<th>Attributes (fields)</th>
</tr>
</thead>
<tbody>
<tr>
<td>students</td>
<td>name, student_id</td>
</tr>
<tr>
<td></td>
<td>1001, John Doe</td>
</tr>
<tr>
<td></td>
<td>1002, Jane Doe</td>
</tr>
</tbody>
</table>

- Rows (Records) (Tuples)
- Table (relation) schema: students(student_id, name)
- Database schema: database name + table schemas

Attribute Type

- Determines the storage required for a field
- Common attribute types
  - String types
  - Numeric types
  - Date and time types
  - Other types

SQL

- Structured Query Language
- A standard query language for relational databases
- Supported by all major DBMS (with some variations)
Some SQL Examples

- Create a table
- Populate the table
- Find some information
- Delete the table

Database Development

Design
- Given an application scenario, design the database schema.

Implementation
- Implement the schema in a specific DBMS with constraints, indexes, stored procedures ...

Access
- Input and retrieve data.