A Relational DB Example

<table>
<thead>
<tr>
<th>employees</th>
<th>projects</th>
<th>project_members</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>first_name</td>
<td>last_name</td>
</tr>
<tr>
<td>1</td>
<td>Chengyu</td>
<td>Sun</td>
</tr>
<tr>
<td>2</td>
<td>John</td>
<td>Doe</td>
</tr>
</tbody>
</table>

Web and Databases

- E-commerce sites
  - Products, order, customers
- News sites
  - Subscribers, articles
- Web boards
  - Users, postings
- ... anywhere where a large amount of information needs to be managed safely and efficiently

Terminology

- DBMS
  - Database Management System
    - An application or module that manages databases

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 (relation) schema: students( student_id, name )

Database schema: database name + table schemas

SQL

Structured Query Language
Standard query language of relational databases
Supported by all major relational databases with some variations

SQL Script

A text file contains SQL statements and comments
- Statements: select, insert, create ...
- Comments
  - lines started with --
  - MySQL also supports C-style comment syntax, i.e. /* */
- Usually uses the .sql suffix

MySQL

Very popular in web development
- Open source
- Very fast search
- Full text indexing and search
- Developer-friendly features
  - drop table if exists
  - insert ... on duplicate key update
  - /* */
  - ...

Databases in MySQL

MySQL on the CS3 Server

Version 5.5
One database per account
- DB name is the same as the server account username. E.g. cs320stu31
- Username and password are the same as the ones for the server account
Client-Server Architecture of MySQL

Connect to a MySQL Database
- Use one of the client software
- Create a connection with the information about the server
  - Host
  - Port (default 3306)
  - Username
  - Password
  - Default Database/Schema

Connect to Your MySQL Database on CS3
- [http://csns.calstatela.edu/wiki/content/cysun/course_materials/cs3](http://csns.calstatela.edu/wiki/content/cysun/course_materials/cs3)
  - Command line client mysql
  - MySQL Workbench
  - phpMyAdmin
  - Change password
    - set password = password ('something');

Run SQL Scripts
- Command line client
  - `\ path/to/script.sql`
  - `source path/to/script.sql`;
- MySQL Workbench
  - `SQL Editor` → `File` → `Open SQL Script` → `Execute`
- phpMyAdmin
  - Import
    - Format of the imported file: `SQL`

Schema Design Example

Employee and Project
```java
public class Employee {
    int id;
    String firstName;
    String lastName;
    String address;
    Employee supervisor;
}
```

Simple Schema Design Rules

<table>
<thead>
<tr>
<th>OO</th>
<th>Relational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>Table</td>
</tr>
<tr>
<td>Class variables</td>
<td>Attributes</td>
</tr>
<tr>
<td>Java types</td>
<td>SQL types</td>
</tr>
<tr>
<td>Object References</td>
<td>IDs</td>
</tr>
<tr>
<td>Collection</td>
<td>New Table (possibly)</td>
</tr>
</tbody>
</table>
Create a Table

create table table_name (  
    field_name field_type [NOT NULL] [UNIQUE] [DEFAULT value],  
    [PRIMARY KEY(field_name, ...)]  
);  

create table employees (  
    id integer auto_increment primary key,  
    first_name varchar(255) not null,  
    last_name varchar(255) not null,  
    address varchar(255),  
    supervisor_id integer references employees(id)  
);  

Naming Conventions

- Use plural form for table names  
- Use singular form for column names  
- Use underscore to concatenate multiple words, e.g. employee_id  
- Do not use mixed cases in names (e.g. ArtistName) because many DBMS treat names as case-insensitive  

About CREATE TABLE

- Field types  
  - integer, real, char(n), varchar(n)  
  - date, time, datetime, timestamp  
- auto_increment  
- Integrity constraints  
  - unique, not null, primary key  
  - foreign key  

Populate Tables

insert into table values (value1, value2, ...);  
insert into table (field, ...) values (value, ...);  

Search for Records

select field(s) from table(s) where condition(s);  

- Find the name and address of employee with id=1  
- Find the name of employee who leads the project Firestone  
- Find the name of John Doe's supervisor  
- Find the number of projects led by John Doe  

Update Records

update table set field=value [, ...]  
where condition(s);  

- Change John Doe's address to 123 Main St.  
- Change John Doe's name to Tom Smith
Delete Records

```sql
delete from table where condition(s);
```

- Delete all the projects led by John Doe
- Delete all the projects

Delete Tables and Databases

- Delete a database
  - `drop database cs320stu31;` -- don't do this!
- Delete a table
  - `drop table projects;`
  - `drop table if exists projects;` -- MySQL only

Readings

- CS122 Textbook
- MySQL Reference Manual
  - String functions
  - Date and time functions