ITMD 462/562
Web Site Application Development

Lecture 8

Fall 2015 – October 14, 2015

Tonight's Agenda

- Next Week
- Database
- SQL Introduction

Next Week

- No Physical Class Next Week
- I will be uploading a replacement video (auth demo)
- Read/Watch the SQL tutorials
- Play with MySQL and SQLite. Get environment working
- Midterm Exam will be assigned Sunday Night at midnight. You must complete by Wednesday Oct 21 11:59pm Chicago time. **NO EXCEPTIONS**
  - Once you start you will have a time limit, probably 2 hours.
  - You must finish it once you start it.
  - Email will be sent from blackboard when it is available with all the details

Databases

Database

- Databases are collections of data stored in an organized way.
  - Tables
  - Queries
  - Reports
  - Views
  - Other Objects
- Access to this data is provided by a DBMS (Database Management System)

Databases

- Technically the database is the data and how it is organized. The DBMS is how you access the data.
- DBMS provides functions to allow 4 basic groups of functionality: Data Definition, Update, Retrieval, and administration.
- Read about the history of DBs here
  - https://en.wikipedia.org/wiki/Database
- Why Use a Database?
  - http://arstechnica.com/information-technology/2013/05/why-use-a-database-instead-of-just-saving-your-data-to-disk/

DBMS

- Database Management System (DBMS)
  - Computer software that has interactions with the user, other software, the database itself to allow for storage, and analysis of data.
  - Database itself is not portable between different DBMS
  - Examples include MySQL, PostgreSQL, Microsoft SQL Server, Oracle, Sybase, DB2, SQLite
  - Typically client-server model, except SQLite
- We will look at SQLite and MySQL over the coming weeks
- Most follow a Relational Model using a SQL based language, but there are others including NoSQL DBMS that do not use SQL.

Relational Database

- Based on a relation model invented by E. F. Codd of IBM in 1970.
  - Presents data as relations. Collections of tables made up of rows and columns.
  - Provides operations to manipulate the tabular data
  - Codd's 12 Rules https://en.wikipedia.org/wiki/Codd's_12_rules
- Basic definition is that it presents a view of data as a collection of rows and columns. Using this definition RDBMS don't always implement all of the 12 rules.
- Some say for a database to truly Relational it needs to implement all 12 rules.
- Most RDBMS use SQL as the query language
- Most popular are Oracle, Microsoft SQL, IBM DB2, and MySQL
- https://en.wikipedia.org/wiki/Relational_database_management_system

NoSQL Database

- Data is modeled in a way other than relational tables
- Doesn't use SQL but some systems do support some SQL like languages
- Some advantages or RDBMS with scaling and performance for certain tasks
- Data model based on Column, Document, Key-value, Graph, Multi-model
- Document based hold individual documents in collections. Subclass of a Key-Value model. MongoDB and CouchDB two popular Document based. Often modeled/stored as JSON data.
- Key-value model works like an associative array (map or dictionary) where data is stored in a key.
- https://en.wikipedia.org/wiki/NoSQL

MySQL

- Open source RDBMS written in C and C++
- Runs on many platforms
- Most widely used open source RDBMS and a top DB overall
- Originally created by a Swedish company MySQL AB and Michael Widenius
- Bought by Sun in 2008 and then Oracle in 2010 when they bought Sun
- https://en.wikipedia.org/wiki/MySQL
- Some concern when Oracle aquired MySQL led Michael Widenius to fork a GPL only version called MariaDB. Same codebase as MySQL 5.5 and aims to maintain compatibility with Oracle versions.
- https://en.wikipedia.org/wiki/MariaDB

SQLite

- RDBMS written and used as a C programming Library
- Designed in 2000 by D. Richard Hipp
- It is not a client-server database system. No outside process.
- It is used as a library, linked, and embedded in the application
- It stores the database as a cross platform compatible file on the hosts machine / application. The file is locked while writing.
- No Users. Access control by file system.
- Supports most standard SQL with some limits
- Bindings for all major programming languages
- https://en.wikipedia.org/wiki/SQLite

SQL

A quick introduction to basic SQL

Basic SQL

- This lecture is not meant to be a compressive lesson on SQL.
- We will talk about the basics. There are two database courses that go into much more detail
- If you have not taken those courses you need to read/watch one or more of the following tutorials
- https://www.codeschool.com/courses/try-sql
- http://www.w3schools.com/sql/default.asp
- http://www.tutorialspoint.com/sql/

Basic SQL

- SQL – Structured Query Language
- Special programming language for accessing and managing data stored in a RDBMS.
- Based on relational algebra and tuple calculus
- One of the first languages developed for Codd's relational model and has become the most widely used language for databases.
- Became standardized in 1986-87 by ANSI and ISO
- Not completely portable between RDBMS. Sometimes some statements need slight modifications but mostly compatible.
- Consists of a data definition language, data manipulation language, and a data control language.
- https://en.wikipedia.org/wiki/SQL

Basic SQL Components

- data definition language
  - Syntax for defining data structures and especially database schemas
  - CREATE, DROP, ALTER, rename
  - https://en.wikipedia.org/wiki/Data_definition_language
- data manipulation language
  - Syntax for selecting, inserting, deleting, and updating data
  - SELECT, INSERT, UPDATE, DELETE
  - SELECT is technically outside DML because it is read only but considered DML
  - https://en.wikipedia.org/wiki/Data_manipulation_language
- data control language
  - Syntax to control access to data
  - GRANT, REVOKE
  - https://en.wikipedia.org/wiki/Data_control_language

Data Definition Language

- CREATE – Used to create Databases and Tables
  - `CREATE DATABASE dbname;`
  - `CREATE TABLE table_name`
    `(`
    `column_name1 data_type(size),`
    `column_name2 data_type(size),`
    `column_name3 data_type(size),`
    `....`
    `);`
- DROP – Used to delete indexes, tables, and databases
  - `DROP TABLE table_name`
- ALTER - Used to add, delete, or modify columns in an existing table.
  - `ALTER TABLE table_name ADD column_name datatype`

Data Manipulation Language - SELECT

- Simple Query with SELECT - Used to select data from a database.
  - Results are stored in a result table or result set
  - ```
    SELECT column_name,column_name
    FROM table_name;
    ```
  - ```
    SELECT * FROM table_name;
    ```
- Can add a WHERE clause to filter results or ORDER BY to sort
  - ```
    SELECT column_name,column_name
    FROM table_name
    WHERE column_name operator value;
    ```
  - Single quotes required around non-numeric values
  - ```
    SELECT column_name, column_name
    FROM table_name
    ORDER BY column_name ASC|DESC, column_name ASC|DESC;
    ```

Data Manipulation Language - INSERT

- INSERT - Used to insert new records in a table.
- Do not specify column names
- `INSERT INTO table_name`
  `VALUES (value1,value2,value3,...);`
- Specify column names
- `INSERT INTO table_name`
  `(column1,column2,column3,...)`
  `VALUES (value1,value2,value3,...);`
- Remember to single quote all non-numeric values

Data Manipulation Language - UPDATE

- UPDATE - Used to update records in a table
-
```
UPDATE table_name
SET column1=value1,column2=value2,...
WHERE some_column=some_value;
```
- The WHERE clause selects which record or records that should be updated. If there is no WHERE clause, **all records will be updated!**
- Remember to single quote all non-numeric values

Data Manipulation Language - DELETE

- DELETE - Used to delete records in a table.
- Deletes rows in a table
- `DELETE FROM table_name`
  `WHERE some_column=some_value;`
- The WHERE clause selects which record or records that should be deleted. If there is no WHERE clause, **all records will be deleted!**
- Remember to single quote all non-numeric values

Misc SQL

- LIKE clause - Used to search for a specified pattern in a column
  - ```
    SELECT column_name(s)
    FROM table_name
    WHERE column_name LIKE pattern;
    ```
- IN operator - Specify multiple values in a WHERE clause
  - ```
    SELECT column_name(s)
    FROM table_name
    WHERE column_name IN (value1,value2,...);
    ```
- JOINS - Combine rows from two or more tables
- NOT NULL constraint enforces a column to NOT accept NULL values
- SELECT DISTINCT - Used to return only distinct (different) values
  - ```
    SELECT DISTINCT column_name,column_name FROM table_name;
    ```
    ```

Misc SQL

- PRIMARY KEY constraint uniquely identifies each record in a database table.
- A FOREIGN KEY in one table points to a PRIMARY KEY in another table.
- SQL includes functions to calculate certain results for example: sum, avg, count, min, max, group by, and more.
- SQL Datatypes, functions, and some syntax may vary from DBMS, consult specific documentation

SQL Injection

- Be careful to prevent SQL injection so a hacker cannot destroy or alter your database in ways you don't expect.
- Be cautious to allow user entered data directly in your SQL string.
- Either carefully sanitize the data or use another method.
  - `mysqli_real_escape_string`
  - http://php.net/manual/en/mysqli.real-escape-string.php
- Using SQL bound parameters, prepared statements, or Specific Object-based APIs will help to prevent this.
- http://wiki.hashphp.org/Validation
- http://www.w3schools.com/sql/sql_injection.asp
- http://www.tutorialspoint.com/sql/sql-injection.htm

SQL and PHP

SQL in PHP

- We are going to talk about MySQL and SQLite in class
- There are numerous native PHP APIs and also the newer PHP PDO API
- PDO is a lightweight, consistent interface for accessing databases in PHP. Often you can change database technology by just changing the connection.
  - PDO - http://php.net/manual/en/intro.pdo.php
  - mysqli - http://php.net/manual/en/book.mysqli.php
  - SQLite3 - http://php.net/manual/en/book.sqlite3.php
  - sqlite - http://php.net/manual/en/book.sqlite.php
- PHP Database Access Tutorial - http://code.tutsplus.com/tutorials/php-database-access-are-you-doing-it-correctly--net-25338

SQLite & MySQL PDO

- Here are three SQLite tutorials for PHP to help you
- http://zetcode.com/db/sqlitephp/
- http://henryranch.net/software/ease-into-sqlite-3-with-php-and-pdo/
- http://www.tutorialspoint.com/sqlite/sqlite_php.htm
- http://wiki.hashphp.org/A_PDO_Example_Using_SQLite
- Here is a MySQL PDO Tutorial
- http://wiki.hashphp.org/PDO_Tutorial_for_MySQL_Developers

Tools to work with databases

- These tools will let you interact with the underlying database
- SQLite
  - SQLite Browser
    - http://sqlitebrowser.org/
  - Firefox Extension SQLite Manager
    - https://addons.mozilla.org/en-US/firefox/addon/sqlite-manager/
- MySQL
  - MySQL Workbench – Official Oracle App
    - https://www.mysql.com/products/workbench/
  - phpMyAdmin – (should be already installed in your local environment)
    - https://www.phpmyadmin.net/
- There are others for both. These are just a couple.

Assignments

Reading

- If you have not taken those courses you need to read/watch one or more of the following tutorials
  - https://www.codeschool.com/courses/try-sql
  - http://www.w3schools.com/sql/default.asp
  - http://www.tutorialspoint.com/sql/
- Read PHP PDO Tutorial
  - http://code.tutsplus.com/tutorials/php-database-access-are-you-doing-it-correctly--net-25338
- Attempt to create a SQLite Database and MySQL database using the database management applications we discussed in class.
- Good PHP resource -> http://wiki.hashphp.org/Main_Page

Assignments

- Assignment 2 is up and due this Sunday Oct 18 11:59 Chicago time.
- Remember to use the discussion board. There is a very small amount of points allocated to participating in the discussion board.
- Take Quiz 1 – online – before Sunday Oct 18 11:59 Chicago time.
- Midterm will be assigned next Monday. You will have until Wednesday October 21 11:59pm Chicago Time to take.
  - Once you start a timer will start. Probably 2 hours.
  - Can take it anytime between Monday and Wednesday
  - I will send an email with details as soon as it is posted.
  - You will not be able to take the midterm after this time.