CSE 344 Introduction to Data Management

Section 1: Introduction to SQLite

Review: Database and DBMS

- What is a database?
  - Collection of files storing related data
  - Organized collection of data with some data model
- What is a DBMS?
  - Program that allows for efficient management of large database and allows it to persist over time

Review: Database and DBMS

- What kind of features and operations would you want from DBMS?
  - Persistence
  - Efficiency
  - Failure recovery
  - Modularity
  - Reliability
  - Integrity
  - Security
  - …

SQL (Structural Query Language)

- A special-purpose programming language designed for managing data held in a relational database management system (RDBMS)
- It is a declarative query language:
  - Describes what the program should accomplish, not how to go about accomplishing it
- What can it do?
  - Data insert, query, update and delete, schema creation and modification, and data access control

SQLite: What is it

- SQLite is a C library that implements a relational database management system (DBMS).
  - Simple, lightweight: good for embedded software
  - But does not provide all of the functionalities that other DBMSs do
- sqlite3: a standalone program that can run queries and manage an SQLite database

References:

http://www.sqlite.org/lang.html (SQL Syntax)

http://www.sqlite.org/datatype3.html (SQL Data type)

http://www.w3schools.com/sql/default.asp (w3school SQL tutorial)

SQLite: How to Run it (1/2)

- Linux or Mac:
  - Open a terminal, then run the command:

    sqlite3 [database]

    where "database" is the name of the database file you want to use.
    - Older Mac versions may need to download sqlite
  - WARNING: If you don't specify a database file, sqlite3 won't complain, but your data will be lost!

SQLite: How to Run it (2/2)

- On the Windows machines:
  - Open a Cygwin terminal, then proceed as if you were on Linux.
  - If that doesn't work, you may need to install the "sqlite3" Cygwin package from Cygwin Setup.
  - If *that* doesn't work, try downloading sqlite yourself.

- Download it yourself:
  - Get the "sqlite-shell" binary for your OS from:

    http://www.sqlite.org/download.html
  - Extract "sqlite3" or "sqlite3.exe" from the archive and run it from a command line.

- Make sure your solutions run on the CSE Linux machines

SQLite: . Commands (Not SQL)

- .help - list other . commands
- .header(s) ON/OFF - show/hide column headers in query results
- .mode [mode type]- change how to separate the columns in each row/tuple (for better formatting)
- .read [file name] - read and execute SQL code from the given file
- .separator [string] - change the separator for output mode or importing files, i.e. .separator ,
- .nullvalue [string] - print the given string in place of NULL values
- .import [file name] [table name] - load the file to the table
  - be careful to set the separator correctly!
- .show - see how we have set our parameters
- .exit - exit from sqlite3

SQLite: Basic SQL statements

- CREATE - creates a new table
  ex) CREATE TABLE [table] (…);
- INSERT INTO - inserts new data into a table
  ex) INSERT INTO [table] VALUES ([value1], [value2], …);
- SELECT - extracts data from a table
  ex) SELECT [column(s)] FROM [table_name];
- UPDATE - updates data in a table
  ex) UPDATE FROM [table] SET … WHERE …;
- DELETE - deletes data from a table
  ex) DELETE FROM [table] WHERE …;

*Note: Queries are case-insensitive in SQLite

SQLite: SQL keyword, operator, etc

- WHERE clause - filter records
- AND, OR operator - filter records based on more than one condition
- LIKE operator - used in a WHERE clause to search for a specified pattern in a column
- AS - give an alias name to a table or a column
- Relational operators: =, >, >=, <, <=
- Special functions: DATE(…), LENGTH(string), SUBSTR(string, start index, end index), etc

SQLite: things to watch out for

- SQLite allows a key to be null
- Older versions of sqlite do not enforce FOREIGN KEY constraints.
  - Newer versions are opt-in at both compile time and runtime (with PRAGMA FOREIGN_KEYS = ON)
- SQLite ignores string length maximums or fixed string lengths: N in VARCHAR(N) or CHAR(N)
- SQLite does not have a separate data type for dates, times, or combined date and time.
  - Instead, these are represented as specially formatted strings; dates are represented as yyyy-mm-dd
- And many more as you will discover!

SQLite: Formatting output

- .headers on
- .mode column
- Use .help for more

```
sqlite> .headers on
sqlite> .mode column
select * from class;
dept        number      title
----------  ----------  ----------------------------------------
CSE         378         Machine Organization and Assembly Language
CSE         451         Introduction to Operating Systems
CSE         461         Introduction to Computer Communication Net
```

SQLite: Example

Class

dept	number	title
CSE	378	Machine Organization and Assembly Language
CSE	451	Introduction to Operating Systems
CSE	461	Introduction to Computer Communication Networks

Teaches

username	dept	number
zahorjan	cse	378
tom	cse	451
tom	cse	461
zahorjan	cse	451
zahorjan	cse	461
djw	cse	461
levy	cse	451

Instructor

username	fname	lname	started_on
zahorjan	John	Zahorjan	1985-01-01
djw	David	Wetherall	1999-07-01
tom	Tom	Anderson	1997-10-01
levy	Hank	Levy	1988-04-01

SQLite: Example (cont.)

- Simple example queries
  - What courses are offered?
  - What's the first name of the instructor with login 'zahorjan'?
  - What 400-level CSE classes are offered?

SQLite: Example (cont.)

- The LIKE Operator
  - What classes have title starting with Introduction?
  - If we misspell Introduction as IMtroduction, let's catch that by matching any second character, and find the classes that have titles starting with the proper and the misspelling of Introduction
  - Use '_' to match any single character
  - Use '%' to match an arbitrary number of characters

SQLite: Example (cont.)

- Fun with strings
  - Show the class titles and their lengths
  - Truncate all class titles to 12 characters
- Date and time representations
  - Which instructors started before 1990?
  - Which instructors started before now?
  - Which instructors started on or after January 1, 15 years ago?

Homework 1

- Create a table in sqlite3 and issue queries
- What to turn in: .sql file containing sql commands that answer each question and relevant comments
  - Do not turn in input/output files
  - Don't forget a semicolon at the end of each sql command
  - You can add comments to sql file (for numbering each question)

    /* comment */ or -- comment

Upcoming deadlines

- Webquiz 1 – Due Tuesday 10/4, 11 pm
- Homework 1 – Due Wednesday 10/5, 11 pm