GNU Sqltutor

Web based interactive tutorial of SQL
22 February 2009, Sqltutor version 0.6

by Ales Cepek

This manual (22 February 2009) is for GNU Sqltutor (version 0.6).

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Table of Contents

Introduction **1**
SQLzoo 1

1 The Concepts of Sqltutor **3**
1.1 Tutorial Dialog 3
1.1.1 Opening Dialog 3
1.1.2 Tutorial Dialog 4
1.1.3 Evaluation page 5
1.2 Sessions, questions and answers 5
1.2.1 Final evaluation 6

2 How to install Sqltutor **7**
2.1 How to get Sqltutor 7
2.1.1 How to change implicit settings 7
2.2 Creating the database 7
2.3 Building and installing Sqltutor 8
2.3.1 Sqltutor modules 8
2.3.1.1 Creating schema and general tables 9
2.3.1.2 Populating tutorials and datasets 9

3 Internals **11**
3.1 How to add new tutorial 11
3.2 How to add new dataset 11
3.3 Doxygen 11

GNU GENERAL PUBLIC LICENSE **13**

Appendix A Copying This Manual **25**

Index **33**

Introduction

GNU Sqltutor is a web based interactive tutorial of *Structured Query Language* (SQL). You can try Sqltutor online from

`http://sqltutor.fsv.cvut.cz/cgi-bin/sqltutor`

First, a tutorial must be selected from the opening page and started. A series of tutorial questions follows in a simple dialog. When finished Sqltutor displays final evaluation with the review of all questions asked during the session together with user's SQL queries and correct answers for wrong solutions.

Sqltutor is implemented on the top of a relational database system PostgreSQL. The project consists in part of a C++ program of the same name '`sqltutor`' released under the GNU General Public License (GNU GPL). The '`sqltutor`' program is a CGI script that selects SQL questions from its database, checks the answers and evaluates the final score. The second part of the project is a free collection of SQL questions and answers representing SQL tutorials. Sqltutor enables to run one or more tutorials in different languages from a single database.

SQLzoo

Sqltutor was inspired by an interactive tutorial SQLzoo by Andrew Cumming from the School of Computing, Napier University, Edinburg, UK. Implementation of the database and the '`sqltutor`' program is not dependent neither derived from the SQLzoo tutorial.

English SQLzoo tutorial distributed with Sqltutor is based on the collection of SQL questions and answers and datasets from `http://sqlzoo.net/`. We would like to thank Andrew Cumming for his kind approval to use his data and tutorials in our project.

1 The Concepts of Sqltutor

This chapter introduces basic concepts of Sqltutor project.

1.1 Tutorial Dialog

Sqltutor dialog consists of three main pages: opening dialog, tutorial and final evaluation page. Tutorial dialog is designed to be as simple as possible and is based on the very basic HTML construct so it hopefully should run safely on any web browser. The dialog is going to be described on a case of trivial session in which we answer one simple SQL query.

1.1.1 Opening Dialog

From the drop down list tutorial must be selected from the opening dialog page. Other options are optional.

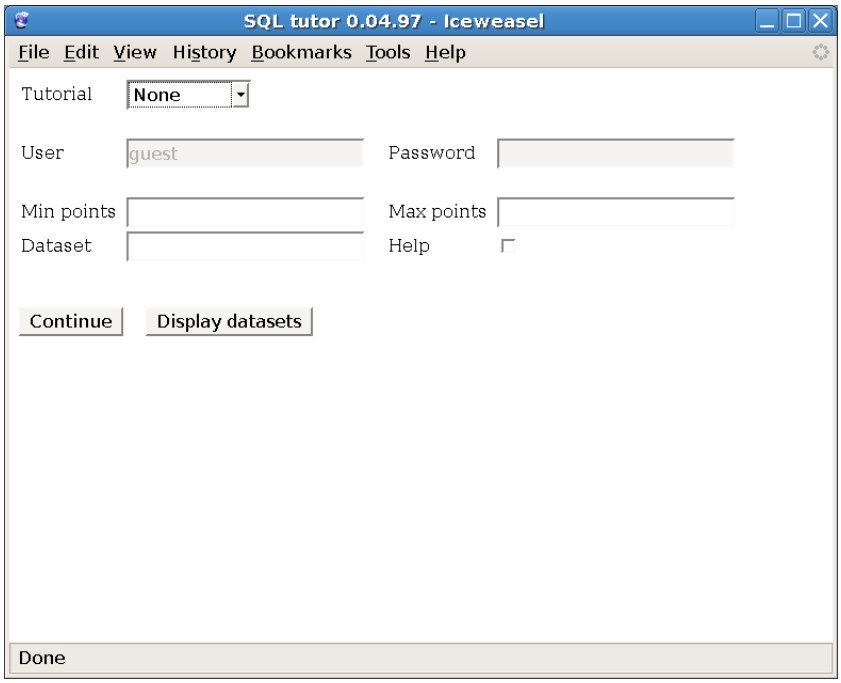

Figure 1.1: Opening dialog

`Tutorial` Mandatory selection of the SQL tutorial.

`Continue` Press the *Continue* button to open new session and start the selected tutorial.

`Display datasets`
For the selected tutorial displays the table of available datasets, tables and columns. Datasets are ordered by number of columns.

`User`
`Password` Unused in the current version.

`Min points`
`Max points`
: Options to limit the tutorial questions according to their point rating.

`Help`
: When checked, *help* button is displayed during the dialog, where *help* displays the correct answer(s) for the given tutorial question.

1.1.2 Tutorial Dialog

Tutorial dialog page displays selected tutorial question, its corresponding tables an their columns and text area for entering SQL code.

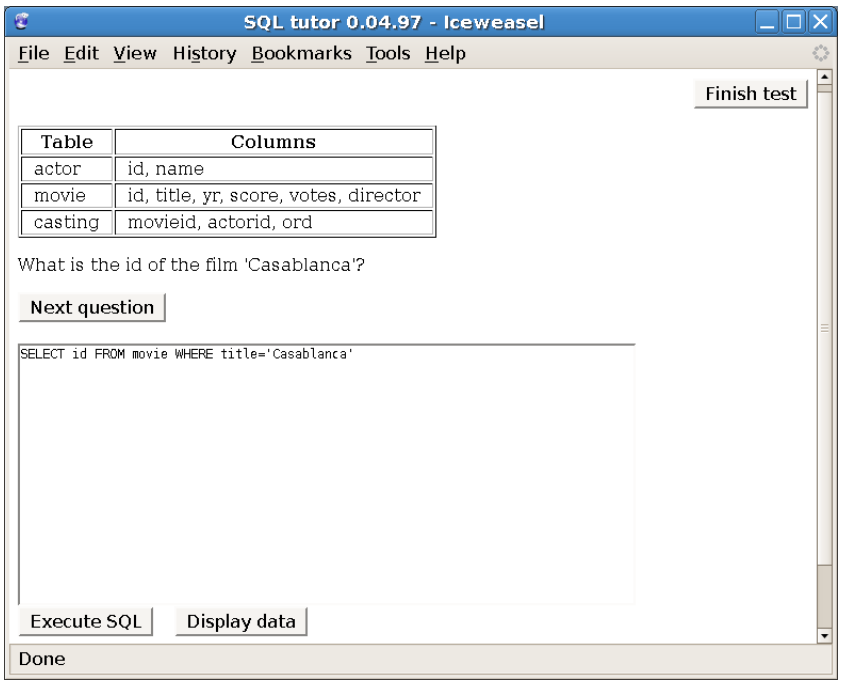

Figure 1.2: Tutorial dialog

`Execute SQL`
: Executes SQL query written in the text area edit component, evaluates the result (correct or wrong answer) and displays the resulting rows. Only correct answers are registered, user can execute his/her query as many times as needed for getting a correct solution.

`Display data`
: Display rows for all tables from the given dataset. Number of rows or a table is limited to 50 for larger tables.

`Help`
: This button is available if *help* was checked in the Opening dialog page. When clicked, Sqltutor displays one or more correct SQL queries for the given question.

`Next question`
: Next tutorial question. If all questions has been answered, tutorial is ended.

`Finish test`
: Close the session and go to the final evaluation page and close the test.

1.1.3 Evaluation page

Evaluation page contains only one dialog button

`New test` Close the evaluation page and return to the new seession opening dialog.

Evaluation page presents the basic review of the closed session: elapsed time, session number, number of questions. correct answers, total points from correct answers and session evaluation. The final evaluation is calculated as the number of correct points multiplied by ratio of correct to all questions.

All questions from the session dataset tables and answers are shown at the evaluation page. For wrong answers correct solution is also given. For each question internal id and the number of points is displayed in green font for correct answers and red for wrong or missing queries.

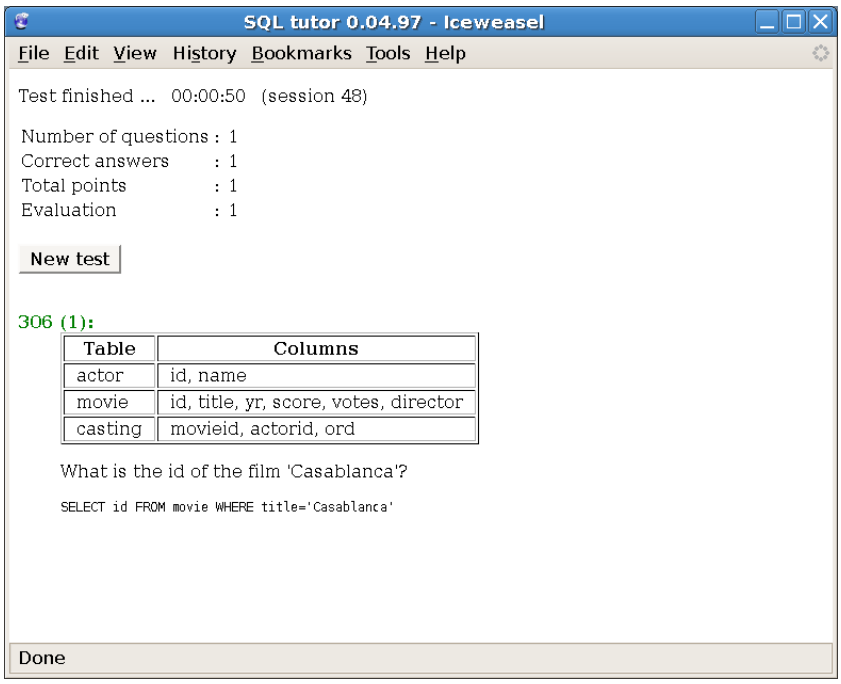

Figure 1.3: Evaluation page

1.2 Sessions, questions and answers

When tutorial is selected from the opening dialog page and started a new *session* is opened. Sessions record all options selected in the opening dialogue, the start time and the session status which can be *open* or *closed*. Session is closed when the tutorial dialogue is regularly finished.

All *questions* asked during the tutorial sessions are recorded keeping the track of your SQL answered queries. Number of tries during tutorial dialog is not relevant for the final evaluation, only the latest solution is recorded. An answer is registered when *Execute SQL*, *Next question* or *Finish test* button is pressed.

Each *question* registered in the tutorial database has a point evaluation. Trivial questions are rated by 1 point, nontrivial questions can have point rating up to 15 points. For each question one or more correct answer is stored in the database. When help is enabled during opening dialog, correct answers are displayed when *help* button is pressed.

Questions are asked about data from *datasets*, where dataset is one or more SQL tables. Datasets can be shared by different tutorials, unlike questions which are indivisible part of its tutorial.

Sqltutor select questions in a random manner, starting from easy ones to the nontrivial. The test starts with a trivial questions with one point evaluation, first correct answer switches the level to two points where two correct answers must be given. Then similarly three and four correct answers must be solved for point levels 3 and 4. Thus at least ten simple questions must be answered in the first test stage (1+2+3+4). In the second stage questions are randomly selected by Sqltutor with point evaluation 5 or higher.[1]

The algorihm for selecting questions described in the previous paragraph is not used if you explicitly chose min/max value of points and/or dataset. I any of these three parametres is entered during opening dialog, questions are selected from the resulting subset simply in random.

1.2.1 Final evaluation

Final evaluation of sessions is calculated as $p \times (c/t)$, where p is the sum of points for correct answers, c is the number of correct answers and t is the number of all questions asked.

[1] In future versions the algorithm for selecting questions may take into account also question categories.

2 How to install Sqltutor

Sqltutor is a CGI script and a PostgreSQL database of SQL tutorials, collections of SQL questions and answers.

2.1 How to get Sqltutor

The project is hosted at the Savannah software forge

```
http://savannah.gnu.org/projects/sqltutor/
```

A copy of the Sqltutor can be get by anonymous CVS access

```
cvs -z3 -d:pserver:anonymous@cvs.savannah.gnu.org:/sources/sqltutor co
sqltutor
```

2.1.1 How to change implicit settings

All Sqltutor database objects are defined in the SCHEMA `sqltutor`. Five output variables are defined in '`configure.ac`' with the following implicit values.

`SQLTUTOR_DATABASE=sqltutor`
: PostgreSQL database name used by Sqltutor.

`SQLTUTOR_WWW_USER=sqlquiz`
: WWW user for CGI script `sqlutor` with full access rights to all tables.

`SQLTUTOR_PASSWORD=sqlkrok`
: Password for CGI script for the user `SQLTUTOR_WWW_USER`

`SQLTUTOR_WWW_EXEC=sqlexec`
: Database role used for running queries entered by users. `SQLTUTOR_WWW_EXEC` is granted `SLECT` to datasets' tables and revoked all rigths on all other `sqltutor` tables.

`SQLTUTOR_PASSEXEC=sqlkrok`
: Password for CGI script for the user `SQLTUTOR_WWW_EXEC` (implicitly the same password as for `SQLTUTOR_WWW_USER`).

These macros are used by all modules and you can change their implicit values if needed in the '`configure.ac`' file.

2.2 Creating the database

To create a database, the PostgreSQL server must be up and running. Database is created with SQL command

```
CREATE DATABASE SQLTUTOR_DATABASE
```

Two database roles must be created for Sqltutor with SQL command `CREATE ROLE`

```
CREATE ROLE SQLTUTOR_WWW_USER LOGIN;
CREATE ROLE SQLTUTOR_WWW_EXEC LOGIN;
```

To set passwords for these new roles run `psql` and enter SQL `ALTER` command

```
ALTER USER SQLTUTOR_WWW_USER WITH PASSWORD 'xxx';
ALTER USER SQLTUTOR_WWW_EXEC WITH PASSWORD 'yyy';
```

or passwords can be set directly when creating roles

```
CREATE ROLE SQLTUTOR_WWW_USER PASSWORD 'xxx' LOGIN;
CREATE ROLE SQLTUTOR_WWW_EXEC PASSWORD 'yyy' LOGIN;
```

If PostgreSQL language is not defined in datatabase `template1` you must create it explicitly in the Sqltutor database

```
su -
su - postgres
psql SQLTUTOR_DATABASE
CREATE LANGUAGE plpgsql;
```

2.3 Building and installing Sqltutor

To create all Makefiles needed for building binary CGI script '`sqltutor`', populating Sqltutor database and making info manual go to Sqltutor home directory and run

```
./configure --bindir=/usr/lib/cgi-bin
```

Parameter `--bindir` defines to which directory CGI script '`sqltutor`' will be installed.[1]

Sqltutor CGI binary with info manual is installed and the database is populated by running

```
make DESTDIR=install_root_directory install
```

from the main source directory. Parameter `DESTDIR` is optional and defines a root directory into which binary '`sqltutor`' and '`sqltutor.info`' will be installed. This parameter is needed if you do not have access ritght for writing to '`/usr/local/cgi-bin`' and '`/usr/share/info`' (implicit values).

2.3.1 Sqltutor modules

For installing Sqltutor you normally need only the commands described in previous sections. However, it is possible to install individual modules separatelly, for example in cases like preparing new dataset, new tutorial etc.

Apart from module `sqltutor` there are three modules responsible for populating the database

'`database`'
: SQL schema `sqltutor`, general SQL tables and functions

'`tutorial`'
: tutorials table

'`datasets`'
: dataset tables which are used by one or more tutorials

These three modules can be installed explicitly by running `make install` in their corresponding subdirectories.

[1] For general information on using GNU autotool see the standard Basic Installation instructions in the '`INSTALL`'.

2.3.1.1 Creating schema and general tables

Module `database` creates SQL SCHEMA sqltutor and all system tables used by Sqltutor . This module must be installed before populating the database.

```
make -C database install
```

The `database` modules creates a lock file '`lock..database`' that protects against inelligible recreation of the database. If you want to rebuild the dayabase from the scratch, you must remove the lock file either manully or by running

```
make -C database clean
```

2.3.1.2 Populating tutorials and datasets

Run in any order from the project home directory

```
make -C tutorials install
make -C datasets  install
```

If old tutorials and/or datasets have been installed, run

```
make -C tutorials clean install
make -C datasets  clean install
```

3 Internals

3.1 How to add new tutorial

Tutorials are stored in the directory '`tutorials`'. Each tutorial is by convention placed in a single directory named '`xx.name`' wher xx is a two letter language code (for example '`en.zqlzoo`').

To add the a tutorial to the database run SQL function `init_tutorial` like

```
SELECT sqltutor.init_tutorial('English', 'SQLzoo', 'en.sqlzoo');
```

where first two parameters define tutorial language and name (used in the opening dialogue) and internal tutorial label.

To populate the new tutorial with questions you can use '`quiz`' files, which are just plain SQL scripts with some functionality and parameters defined in SQL comments.[1] Quiz files are converted to a standard SQL batch by helper program '`quiz`'.

```
../.quiz/quiz en.sqlzoo $(QUIZ_FILES) | psql $(SQLTUTOR_DATABASE)
```

where first parameter is the tutorial label.

3.2 How to add new dataset

Datasets are organized similarly to tutorials in a directory '`tutorials`' in separate subdirectories. After populating the database with tutoral tables and data you run SQL function `sqltutor.init_dataset('buses', 2008, 'http://sqlzoo.net/')` with parameters tutorial name, year and data source. For each table the function `sqltutor.add_ds_table('buses', 1, 'route', 'num, company, pos, stop')"` where second parameter is the order in which the table is listed in tutorial dialog, table name and list of columns.

Example:

```
psql $(SQLTUTOR_DATABASE) \
   -c "SELECT sqltutor.init_dataset('buses', 2008, 'http://sqlzoo.net/')"
psql $(SQLTUTOR_DATABASE) \
   -c "SELECT sqltutor.add_ds_table('buses', 1, 'stops',   'id, name')"
psql $(SQLTUTOR_DATABASE) \
   -c "SELECT sqltutor.add_ds_table('buses', 2, 'route',   \
                                    'num, company, pos, stop')"
```

3.3 Doxygen

Doxygen generated source documentation is available only partly for classes implementing CGI interface for Sqltutor. Change to directory '`doc`' and run '`make doxygen`'. Generated output is stored in directories '`html`' and '`latex`'.

[1] SQL comments, both `/* ... */` and `-- ...`, in quiz files must not be used recursively.

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If you have Invariant Sections, Front-Cover Texts and Back-Cover Texts, replace the "with. . . Texts." line with this:

```
with the Invariant Sections being list their titles, with
the Front-Cover Texts being list, and with the Back-Cover Texts
being list.
```

If you have Invariant Sections without Cover Texts, or some other combination of the three, merge those two alternatives to suit the situation.

If your document contains nontrivial examples of program code, we recommend releasing these examples in parallel under your choice of free software license, such as the GNU General Public License, to permit their use in free software.

Index

H

how to install 7

I

internals 11
introduction 1