

# GNU Sqltutor

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Web based interactive tutorial of SQL  
11 December 2017, Sqltutor version 1.0

by Ales Cepek

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This manual (11 December 2017) is for GNU Sqltutor (version 1.0).

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## 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/>

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 constructs 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.

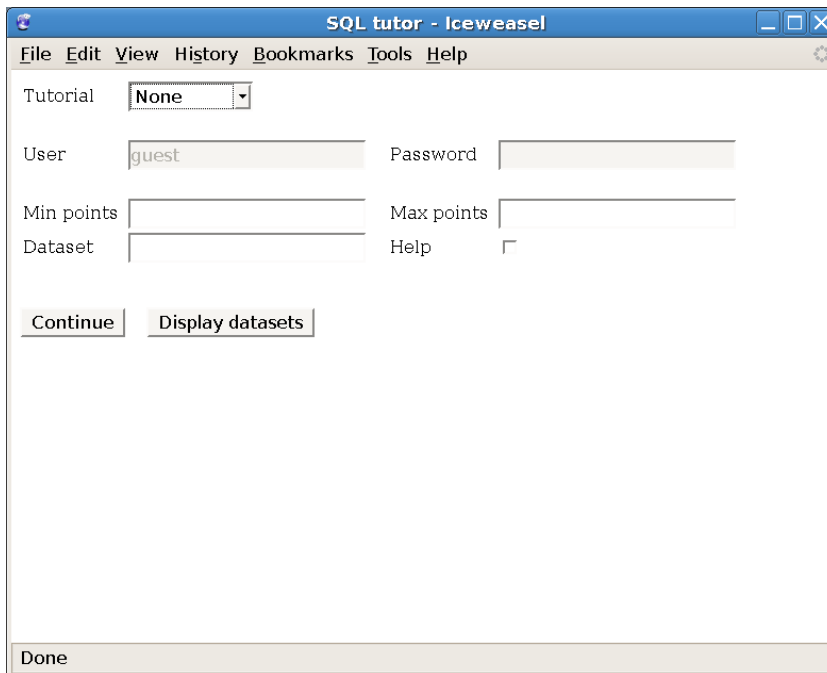


Figure 1.1: Opening dialog

**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 and their columns and text area for entering SQL code.

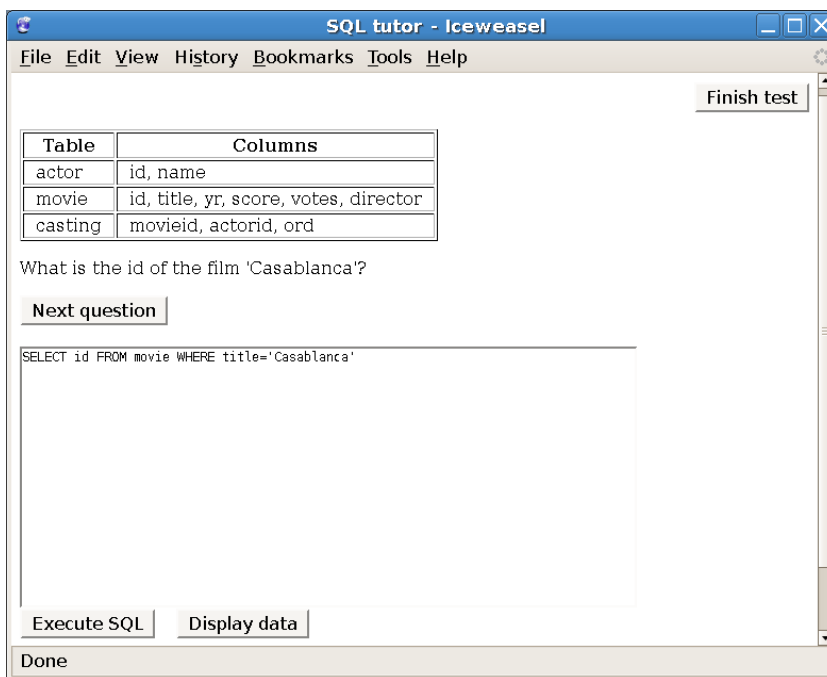


Figure 1.2: Tutorial dialog

**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, Sqtutor 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 session 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 reduce by penalty points for wrong and missing answers. Penalty points are defined as a Fibonacci series 1, 2, 3, 5, 8, ... .

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.

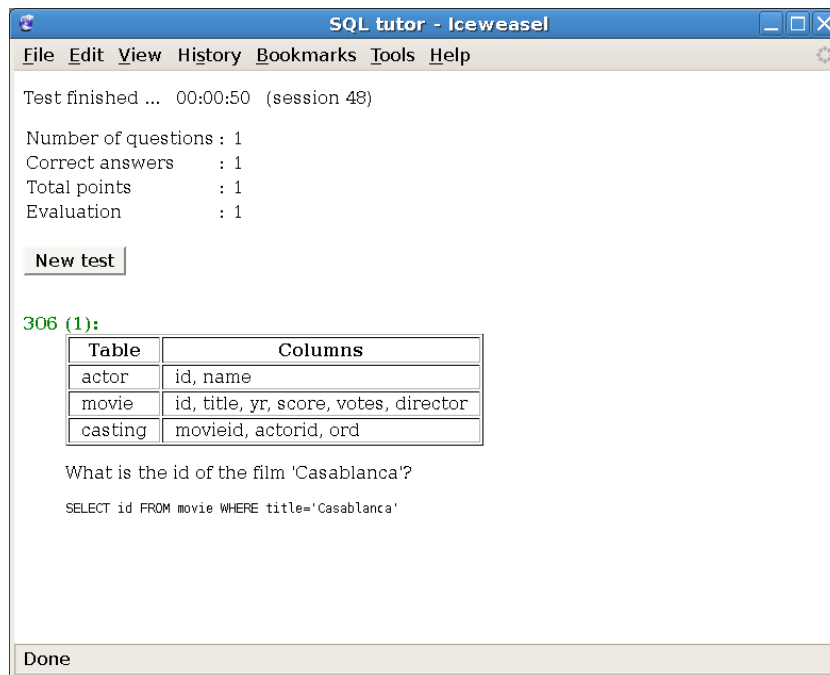


Figure 1.3: Evaluation page

**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. Sqtutor selects questions in random manner, starting from easy ones to nontrivial.<sup>1</sup>

### 1.2.1 Final evaluation

Final evaluation of sessions is calculated as  $p \times (c/t) - n$ , where  $p$  is the sum of points for correct answers,  $c$  is the number of correct answers,  $t$  is the number of all questions asked and  $n$  is a number of penalty points for wrong answers (1, 2, 3, ...).

---

<sup>1</sup> If you explicitly chose min/max value of points and/or dataset during opening dialog, questions are selected simply in random.

## 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 GIT access

```
git clone git://git.sv.gnu.org/sqltutor.git
```

```
git clone git://git.sv.gnu.org/sqltutor/datasets.git
```

If you download Sqltutor from GIT, you must generate `configure` script by running `./autogen.sh` first (which is not needed if you download the package from an FTP server).

### 2.2 Installer script

Under most circumstances installing Sqltutor is a very simple process and takes only answering a few questions to be completed. The whole installation is guided by `sqltutor-installer.sh` script found in Sqltutor git repository.

```
$ ./sqltutor-installer.sh
```

To run the script you need to have `sudo` installed and must be listed in the list of users which may execute `sudo` (`sudoers`). The user running the script needs also rights to create PostgreSQL databases and create and maintain database roles.

Installer calls script `autogen.sh` to create standard `configure` script, patches implicit settings and finally installs database, CGI script, info files and datasets and tutorials.

```

cepek@sqltutor: ~/sqltutor
File Edit View Terminal Help
cepek@sqltutor:~/sqltutor$ ./sqltutor-install.sh
GNU Sqltutor installer v. 1.0
=====

To install sqltutor you must have git repositories for sqltutor and
datasets and tutorials ready.

    $ git clone git://git.savannah.gnu.org/sqltutor.git
    $ git clone git://git.sv.gnu.org/sqltutor/datasets.git

Where is sqltutor git repository? .
Where is datasets git repository? ../datasets

Sqltutor database name      ? sqltutor
Sqltutor WWW user          ? sqlquiz
Sqltutor WWW user password? sqlkrok
Sqltutor EXEC user         ? sqlexec
Sqltutor EXEC user password? sqlkrok

The directory for installing CGI binaries ? /usr/lib/cgi-bin
The directory for installing Info documentation? ~/work
Do you want to enable PostGIS extension? (y/n) : y

The PostGIS directory? /usr/share/postgresql/8.4/contrib/postgis-1.5

```

Figure 2.1: Installer script

## 2.3 How to change implicit settings

All Sqtutor 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 Sqtutor.

`SQLTUTOR_WWW_USER=sqlquiz`

WWW user for CGI script `sqltutor` 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 rights 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.

## 2.4 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;
```

## 2.5 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

```
./autogen.sh
```

to create a `configure` script (if it is not already present) and then

```
./configure --bindir=/usr/lib/cgi-bin [ --infodir=/usr/share/info ]
```

Parameter `--bindir` defines to which directory CGI script `sqltutor` will be installed. For general information on using GNU autotool see the standard Basic Installation instructions in the `INSTALL`.

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 right for writing to `/usr/local/cgi-bin` and `/usr/share/info` (implicit values).

## 2.6 Populating tutorials and datasets

Tutorials and dataset are stored in a separate git repository

```
$ git clone git://git.sv.gnu.org/sqltutor/datasets.git
```

Because `configure` script is not included in the repository, you have to create it first

```
$ ./autogen
```

Then run

```
$ ./configure  
$ make install
```

and that's all. Datasets and tutorial can be reinstalled as many times as needed.

To enable `postgis` extension, you must create geometry type in your database (`sqltutor` in the following example)

```
$ su  
# su postgres  
$ psql -d sqltutor -f /usr/share/postgresql/9.6/contrib/postgis-2.3/postgis.sql  
$ psql -d sqltutor -f /usr/share/postgresql/9.6/contrib/postgis-2.3/spatial_ref_sys.sql
```

and explicitly enable `postgis` tutorials

```
$ ./configure --enable-postgis  
$ make install
```

PostGIS geometry type must be created by a superuser, because normal users do not have permissions to create C procedures in a database.

### 3 Internals

Sqltutor schema is design to enable multilingual translations of tutorial questions with common *problem* attributes and SQL solutions (answers). For a given problem one or more questions can be defined with one or more possible solutions. A *dataset* is a set of problems with given point evaluation and a common set of tables. Tutorials are defined as selections of datasets.

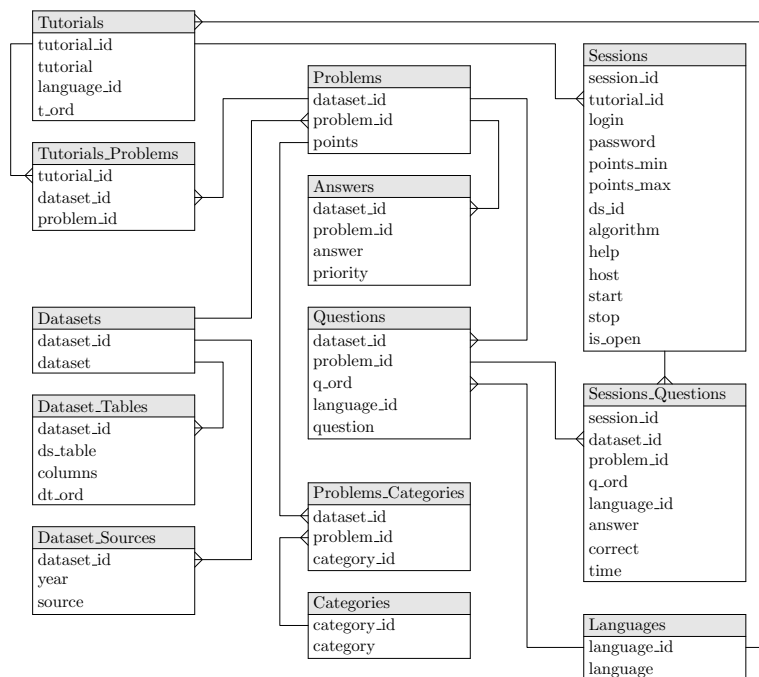


Figure 3.1: Sqltutor database schema

Tutorials, datasets and problems are defined in SQL language with a set of stored procedures. An example of how to define a dataset is given a file `compute_store.sql` with description of all steps in the comments.

#### 3.1 How to add new dataset

To define a dataset we have to introduce its name (function `init_dataset` and optionally describe its data source or sources (function `add_ds_source`). Dataset tables are described by calls to function `add_ds_table` where parameters are dataset name, priority in which tables are listed in tutorial questions, table name and the list of its column names (attributes).

Example:

```
SELECT init_dataset ('computer_store');
SELECT add_ds_source('computer_store', 2010,
    'http://en.wikibooks.org/wiki/SQL_Exercises/The_computer_store');
SELECT add_ds_table ('computer_store', 1, 'manufacturers', 'code, name');
SELECT add_ds_table ('computer_store', 2, 'products',
```

```
'code, name, price, manufacturer');
```

For each *problem* we can formulate one or more questions and one or more answers (sql queries). Within a dataset each problem is described by a unique identification number (second parameter of the function `insert_problem`) followed by its point rating.

```
-- dataset name, internal problem_id, points, category
-- (currently unused)
SELECT insert_problem ('computer_store', 10, 1, 'select');

-- dataset name, internal problem id, order, language, question text
SELECT insert_question('computer_store', 10, 1, 'en',
    'Select the names and the prices of all the products
    in the store.');
```

```
-- dataset name, internal dataset id, order, language, sql answer
SELECT insert_answer ('computer_store', 10, 1,
    'SELECT name FROM products;');
```

Tutorial questions can be translated to other languages.

```
-- Problem defines id, point rating and category
SELECT insert_problem ('computer_store', 30, 2, 'select');
SELECT insert_question('computer_store', 30, 1, 'en',
    'Select the names of the products with a price less
    than or equal to $200.');
```

```
SELECT insert_answer ('computer_store', 30, 1,
    'SELECT name FROM products WHERE price <= 200;');
```

```
-- Czech translation of problem id 30. Answers (SQL code) are shared
-- among all translations
SELECT insert_question('computer_store', 30, 1, 'cs',
    'Vypite jmna vech produkt, jejich cena
    je men nebo rovna 200 dolar.');
```

## 3.2 How to add new tutorial

A tutorial definition is simple, we introduce its language and name and add to it selected datasets.

```
SELECT init_tutorial ('en', 'Demo');
SELECT insert_dataset('Demo', 'en', 'computer_store');
```

```
SELECT init_tutorial ('cs', 'Demo');
SELECT insert_dataset('Demo', 'cs', 'computer_store');
```

Tutorials can be easily deleted. Datasets are independent on tutorials and they are not affected in any way when a tutorial referencing to them is deleted.

```
SELECT delete_tutorial('cs', 'Demo');
```



### 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`.



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Version 1.3, 3 November 2008

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