

# **sqlite3 driver manual**

**A libdbi driver using the SQLite3 embedded  
database engine**

**Markus Hoenicka**

**`mhoenicka@users.sourceforge.net`**

## **sqlite3 driver manual: A libdbi driver using the SQLite3 embedded database engine**

by Markus Hoenicka

Copyright © 2005-2008 Markus Hoenicka

Permission is granted to copy, distribute and/or modify this document under the terms of the *GNU Free Documentation License*, Version 1.1 or any later version published by the Free Software Foundation; with no Invariant Sections, with no Front-Cover Texts, and with no Back-Cover Texts. A copy of the license is included in Appendix A.

### Revision History

Revision \$Revision: 1.9 \$ \$Date: 2008/07/28 21:07:49 \$

# Table of Contents

<b>Preface</b> .....	<b>v</b>
<b>1. Introduction</b> .....	<b>1</b>
<b>2. Installation</b> .....	<b>2</b>
2.1. Prerequisites .....	2
2.2. Build and install the sqlite3 driver.....	2
<b>3. Driver options</b> .....	<b>4</b>
<b>4. Peculiarities you should know about</b> .....	<b>5</b>
4.1. SQLite3 (mis)features .....	5
4.2. sqlite driver misfeatures .....	7
<b>A. GNU Free Documentation License</b> .....	<b>9</b>

# List of Tables

4-1. SQL column types supported by the sqlite driver .....	5
--	---

# Preface

libdbi (<http://libdbi.sourceforge.net>) is a database abstraction layer written in C. It implements a framework that can utilize separate driver libraries for specific database servers. The libdbi-drivers (<http://libdbi-drivers.sourceforge.net>) project provides the drivers necessary to talk to the supported database servers.

This manual provides information about the sqlite3 driver. The manual is intended for programmers who write applications linked against libdbi and who want their applications to work with the sqlite3 driver.

Questions and comments about the sqlite3 driver should be sent to the libdbi-drivers-devel (<mailto:libdbi-drivers-devel@lists.sourceforge.net>) mailing list. Visit the libdbi-drivers-devel list page (<http://lists.sourceforge.net/lists/listinfo/libdbi-drivers-devel>) to subscribe and for further information. Questions and comments about the libdbi library should be sent to the appropriate libdbi mailing list.

The sqlite3 driver is maintained by Markus Hoenicka (<mailto:mhoenicka@users.sourceforge.net>).

# Chapter 1. Introduction

SQLite (<http://www.sqlite.org>) is a smart library that implements an embeddable SQL database engine. No need for an external database server - an application linked against libsqlite can do it all by itself. Of course there are a few limitations of this approach compared to "real" SQL database servers, mostly for massively parallel high-throughput database applications, but on the other hand, installation and administration are a breeze.

SQLite3 is a redesign of SQLite which is incompatible with the older 2.x versions. As the API functions and the library itself were renamed, SQLite3 also requires a slightly modified libdbi driver. You can have both the sqlite and the sqlite3 driver installed on your system, but you have to make sure that you access your databases with the driver that matches the database version. The easiest way to accomplish this is to use different database directories for each version.

Your application should support the sqlite3 driver if one of the following applies:

- You want to support potential users of your application who don't have the skills to administer a database server.
- You want to offer the simplest possible installation of your application.
- You want to let users test-drive your application without the need to fiddle with their production database servers.

# Chapter 2. Installation

This chapter describes the prerequisites and the procedures to build and install the sqlite3 driver from the sources.

## 2.1. Prerequisites

The following packages have to be installed on your system:

libdbi

This library provides the framework of the database abstraction layer which can utilize the sqlite3 driver to perform database operations. The download page as well as the mailing lists with bug reports and patches are accessible at [sourceforge.net/projects/libdbi](http://sourceforge.net/projects/libdbi) (<http://sourceforge.net/projects/libdbi>).

sqlite3

This library implements the embedded database engine. Find the most recent release at [www.sqlite.org](http://www.sqlite.org) (<http://www.sqlite.org>). The current version of the sqlite driver was tested with SQLite3 version 3.0.8 and should work ok with later releases.

## 2.2. Build and install the sqlite3 driver

First you have to unpack the libdbi-drivers archive in a suitable directory. Unpacking will create a new subdirectory `libdbi-drivers-X.Y` where "X.Y" denotes the version:

```
$ tar -xzf libdbi-drivers-0.7.2.tar.gz
```

The libdbi-drivers project consists of several drivers that use a common build system. Therefore you *must* tell configure explicitly that you want to build the sqlite3 driver (you can list as many drivers as you want to build):

```
$ cd libdbi-drivers
```

```
$ ./configure --with-sqlite3
```

Run `./configure --help` to find out about additional options.

Then build the driver with the command:

```
$ make
```

**Note:** Please note that you may have to invoke **gmake**, the GNU version of make, on some systems.

Then install the driver with the command (you'll need root permissions to do this):

```
$ make install
```

To test the operation of the newly installed driver, use the command:

```
$ make check
```

This command creates and runs a test program that performs a few basic input and output tests. The program will ask for a database name. This can be any name that is a valid filename on your system. It will also ask for a data directory. This is the directory that is used to create the test database. Needless to say that you need write access to that directory. If you accept the default ".", the database will be created in the `tests` subdirectory.



# Chapter 3. Driver options

Your application has to initialize libdbi drivers by setting some driver options with the `dbi_conn_set_option()` and the `dbi_conn_set_option_numeric()` library functions. The sqlite driver supports the following options:

`dbname`

The name of the database you want to work with. As a SQLite database corresponds to one file in your filesystem, `dbname` can be any legal filename. If the database/file doesn't exist when you first try to access it, SQLite will create it on the fly.

It is important to understand that the full path of the database is composed of `sqlite3_dbdir` and `dbname`. Therefore `dbname` should not contain the full path of a file, but just the name.

`sqlite3_dbdir`

This is the directory that contains all sqlite databases. Use the full path please. If this option is not specified, a compile-time default directory will be used. By default, this directory (usually `/usr/local/var/lib/libdbi/sqlite3`) has read and write permissions for everyone with the sticky bit set. If this is not suitable for your application, use a custom directory with your preferred permissions instead.

**Note:** It is necessary to keep all sqlite databases in one directory to make it possible to list all existing databases through the libdbi API. However, you are free to open more than one connection simultaneously, each one using a different setting of `sqlite3_dbdir`.

`timeout (numeric)`

The connection timeout in seconds.

`sqlite3_timeout (numeric)`

The design of SQLite3 does not allow fully concurrent access by two clients. However, if the timeout is larger than zero, the second client will wait for the given amount of time for the first client to release its lock, if necessary. If the timeout is set to zero, the second client will return immediately, indicating a busy status. The numerical value of this option specifies the timeout in milliseconds.

**Note:** This option is deprecated. Use the generic option `timeout` instead. In the current implementation, `sqlite3_timeout` overrides `timeout` if both are set. Please be aware that these options use different time scales.

# Chapter 4. Peculiarities you should know about

This chapter lists known peculiarities of the sqlite3 driver. This includes SQLite3 features that differ from what you know from the other database servers supported by libdbi, and it includes features and misfeatures introduced by the sqlite3 driver. It is the intention of the driver author to reduce the number of misfeatures in future releases if possible.

## 4.1. SQLite3 (mis)features

As the SQLite3 package is constantly being improved, you should refer to the original documentation about the SQL features it supports (<http://www.sqlite.org/lang.html>) and about the SQL features it doesn't support (<http://www.sqlite.org/omitted.html>).

One noticeable difference between SQLite3 and other SQL database engines is that the former uses something called "manifest typing". The practical difference to the typeless nature of SQLite 2.x is negligible as it still does not support the rich typing used by most other SQL database engines. In order to satisfy the needs of the strongly typed retrieval functions of libdbi, the only way out is to declare the column types in a **CREATE TABLE** statement just as you would with any other SQL database engine. As an example, the following statement is perfectly fine with SQLite3, but not with the sqlite3 driver:

```
CREATE TABLE foo (a,b,c)
```

However, the following statement is fine with SQLite3, the sqlite3 driver, and just about any other SQL database engine out there:

```
CREATE TABLE foo (a INTEGER,b TEXT,c VARCHAR(64))
```

The following table lists the column types which are positively recognized by the sqlite driver. Essentially all column types supported by MySQL and PostgreSQL are supported by this driver as well, making it reasonably easy to write portable SQL code. All other column types are treated as strings.

**Table 4-1. SQL column types supported by the sqlite driver**

type	description
TINYBLOB, BLOB, MEDIUMBLOB, LONGBLOB, BYTEA	String types of unlimited length. Binary data must be safely encoded, see text.
CHAR(), VARCHAR(), TINYTEXT, TEXT, MEDIUMTEXT, LONGTEXT	String types of unlimited length. There is no chopping or padding performed by the database engine.
ENUM	String type of unlimited length. In contrast to MySQL, choosing ENUM over VARCHAR does not save any storage space.
SET	String type of unlimited length. In contrast to MySQL, the input is not checked against the list of allowed values.

<b>type</b>	<b>description</b>
YEAR	String type of unlimited length. MySQL stores 2 or 4 digit years as a 1 byte value, whereas the SQLite drivers stores the string as provided.
TINYINT, INT1, CHAR	A 1 byte type used to store one character, a signed integer between -128 and 127, or an unsigned integer between 0 and 255.
SMALLINT, INT2	2 byte (short) integer type used to store a signed integer between -32768 and 32767 or an unsigned integer between 0 and 65535.
MEDIUMINT	3 byte integer type used to store a signed integer between -8388608 and 8388607 or an unsigned integer between 0 and 16777215.
INT, INTEGER, INT4	4 byte (long) integer type used to store a signed integer between -2147483648 and 2147483647 or an unsigned integer between 0 and 4294967295.
BIGINT, INT8, INTEGER PRIMARY KEY	8 byte (long long) integer type used to store a signed integer between -9223372036854775808 and 9223372036854775807 or an unsigned integer between 0 and 18446744073709551615. See below for a discussion of INTEGER PRIMARY KEY.
DECIMAL, NUMERIC	A string type of unlimited length used to store floating-point numbers of arbitrary precision.
TIMESTAMP, DATETIME	A string type of unlimited length used to store date/time combinations. The required format is 'YYYY-MM-DD HH:MM:SS', anything following this pattern is ignored.
DATE	A string type of unlimited length used to store a date. The required format is 'YYYY-MM-DD', anything following this pattern is ignored.
TIME	A string type of unlimited length used to store a time. The required format is 'HH:MM:SS', anything following this pattern is ignored.
FLOAT, FLOAT4, REAL	A 4 byte floating-point number. The range is -3.402823466E+38 to -1.175494351E-38, 0, and 1.175494351E-38 to 3.402823466E+38. Please note that MySQL treats REAL as an 8 byte instead of a 4 byte float like PostgreSQL.
DOUBLE, DOUBLE PRECISION, FLOAT8	An 8 byte floating-point number. The range is -1.7976931348623157E+308 to -2.2250738585072014E-308, 0, and 2.2250738585072014E-308 to 1.7976931348623157E+308.

Another difference is the lack of access control on the database engine level. Most SQL database servers implement some mechanisms to restrict who is allowed to fiddle with the databases and who is not. As SQLite3 uses regular files to store its databases, all available access control is on the filesystem level. There is no SQL interface to this kind of access control, but **chmod** and **chown** are your friends.

## 4.2. sqlite driver misfeatures

And now we have to discuss how successful the sqlite driver is in squeezing the SQLite idea of a database engine into the libdbi framework which was shaped after MySQL and PostgreSQL. Keep in mind that the limitations mentioned here are not intrinsic (except maybe the first one which is beyond our control), that is a sufficient amount of coding might fix these problems eventually.

- SQLite3 handles auto-increment columns in a fairly non-intuitive way. Only the type INTEGER PRIMARY KEY auto-increments. As a user of other database engine you might expect the row IDs to be 4-byte integers (they were in 2.x), but nope: they are in fact 8-byte integers, and therefore equivalent to INT8 or BIGINT of other engines. This leaves us with the odd "feature" of the sqlite3 driver that INTEGER is a 4-byte integer, whereas INTEGER PRIMARY KEY is a 8-bit integer type. If this were not the case, auto-incrementing columns would be artificially limited to the range of 4-byte integers. On the other hand this means that you cannot declare a real 4-byte integer auto-incrementing column.

### Warning

Do not forget to use `dbi_result_get_longlong()` or `dbi_result_get_ulonglong` to retrieve values from columns declared as INTEGER PRIMARY KEY.

- The (essentially) typeless nature of SQLite has some nasty consequences. The sqlite driver takes great care to reconstruct the type of a field that you request in a query, but this isn't always successful. To help the driver get things right, please stick to the following rules:
  - When using a function as a result column [e.g. `count(*)`], the opening bracket *must* hug the function name as shown. The function call *must* also be aliased.
  - When using an expression as a result column [e.g. `(count(*) + 6)`], the entire expression *must* be enclosed in brackets as shown and *must* also be aliased.
- The sqlite driver currently assumes that the directory separator of your filesystem is a slash (/). This may be wrong on your particular system. It is not a problem for Windows systems as long as the sqlite driver is built with the Cygwin tools (see `README.win32`).
- Listing tables with the `dbi_conn_get_table_list()` libdbi function currently returns only permanent tables. Temporary tables are ignored.

- The sqlite driver assumes that table and field names do not exceed 128 characters in length, including the trailing \0. I don't know whether SQLite internally has such a limit or not (both MySQL and PostgreSQL have a lower limit). The limit can be increased by changing a single #define in the `dbd_sqlite.h` header file.
- In a few cases, the sqlite driver expects you to type SQL keywords in all lowercase or all uppercase, but not mixed. This holds true for the `'from'` in a SELECT statement. Type it either as `'from'` or as `'FROM'`, but refrain from using `'fRoM'` or other funny mixtures of uppercase and lowercase. Most other database engines treat the keywords as case-insensitive and would accept all variants.

# Appendix A. GNU Free Documentation License

Version 1.1, March 2000

Copyright (C) 2000 Free Software Foundation, Inc. 59 Temple Place, Suite 330, Boston, MA 02111-1307 USA Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

## 0. PREAMBLE

The purpose of this License is to make a manual, textbook, or other written document "free" in the sense of freedom: to assure everyone the effective freedom to copy and redistribute it, with or without modifying it, either commercially or noncommercially. Secondly, this License preserves for the author and publisher a way to get credit for their work, while not being considered responsible for modifications made by others.

This License is a kind of "copyleft", which means that derivative works of the document must themselves be free in the same sense. It complements the GNU General Public License, which is a copyleft license designed for free software.

We have designed this License in order to use it for manuals for free software, because free software needs free documentation: a free program should come with manuals providing the same freedoms that the software does. But this License is not limited to software manuals; it can be used for any textual work, regardless of subject matter or whether it is published as a printed book. We recommend this License principally for works whose purpose is instruction or reference.

## 1. APPLICABILITY AND DEFINITIONS

This License applies to any manual or other work that contains a notice placed by the copyright holder saying it can be distributed under the terms of this License. The "Document", below, refers to any such manual or work. Any member of the public is a licensee, and is addressed as "you".

A "Modified Version" of the Document means any work containing the Document or a portion of it, either copied verbatim, or with modifications and/or translated into another language.

A "Secondary Section" is a named appendix or a front-matter section of the Document that deals exclusively with the relationship of the publishers or authors of the Document to the Document's overall subject (or to related matters) and contains nothing that could fall directly within that overall subject. (For example, if the Document is in part a textbook of mathematics, a Secondary Section may not explain any mathematics.) The relationship could be a matter of historical connection with the subject or with related matters, or of legal, commercial, philosophical, ethical or political position regarding them.

The "Invariant Sections" are certain Secondary Sections whose titles are designated, as being those of Invariant Sections, in the notice that says that the Document is released under this License.

The "Cover Texts" are certain short passages of text that are listed, as Front-Cover Texts or Back-Cover Texts, in the notice that says that the Document is released under this License.

A "Transparent" copy of the Document means a machine-readable copy, represented in a format whose specification is available to the general public, whose contents can be viewed and edited directly and straightforwardly with generic text editors or (for images composed of pixels) generic paint programs or (for drawings) some widely available drawing editor, and that is suitable for input to text formatters or for automatic translation to a variety of formats suitable for input to text formatters. A copy made in an otherwise Transparent file format whose markup has

been designed to thwart or discourage subsequent modification by readers is not Transparent. A copy that is not "Transparent" is called "Opaque".

Examples of suitable formats for Transparent copies include plain ASCII without markup, Texinfo input format, LaTeX input format, SGML or XML using a publicly available DTD, and standard-conforming simple HTML designed for human modification. Opaque formats include PostScript, PDF, proprietary formats that can be read and edited only by proprietary word processors, SGML or XML for which the DTD and/or processing tools are not generally available, and the machine-generated HTML produced by some word processors for output purposes only.

The "Title Page" means, for a printed book, the title page itself, plus such following pages as are needed to hold, legibly, the material this License requires to appear in the title page. For works in formats which do not have any title page as such, "Title Page" means the text near the most prominent appearance of the work's title, preceding the beginning of the body of the text.

## 2. VERBATIM COPYING

You may copy and distribute the Document in any medium, either commercially or noncommercially, provided that this License, the copyright notices, and the license notice saying this License applies to the Document are reproduced in all copies, and that you add no other conditions whatsoever to those of this License. You may not use technical measures to obstruct or control the reading or further copying of the copies you make or distribute. However, you may accept compensation in exchange for copies. If you distribute a large enough number of copies you must also follow the conditions in section 3.

You may also lend copies, under the same conditions stated above, and you may publicly display copies.

## 3. COPYING IN QUANTITY

If you publish printed copies of the Document numbering more than 100, and the Document's license notice requires Cover Texts, you must enclose the copies in covers that carry, clearly and legibly, all these Cover Texts: Front-Cover Texts on the front cover, and Back-Cover Texts on the back cover. Both covers must also clearly and legibly identify you as the publisher of these copies. The front cover must present the full title with all words of the title equally prominent and visible. You may add other material on the covers in addition. Copying with changes limited to the covers, as long as they preserve the title of the Document and satisfy these conditions, can be treated as verbatim copying in other respects.

If the required texts for either cover are too voluminous to fit legibly, you should put the first ones listed (as many as fit reasonably) on the actual cover, and continue the rest onto adjacent pages.

If you publish or distribute Opaque copies of the Document numbering more than 100, you must either include a machine-readable Transparent copy along with each Opaque copy, or state in or with each Opaque copy a publicly-accessible computer-network location containing a complete Transparent copy of the Document, free of added material, which the general network-using public has access to download anonymously at no charge using public-standard network protocols. If you use the latter option, you must take reasonably prudent steps, when you begin distribution of Opaque copies in quantity, to ensure that this Transparent copy will remain thus accessible at the stated location until at least one year after the last time you distribute an Opaque copy (directly or through your agents or retailers) of that edition to the public.

It is requested, but not required, that you contact the authors of the Document well before redistributing any large number of copies, to give them a chance to provide you with an updated version of the Document.

## 4. MODIFICATIONS

You may copy and distribute a Modified Version of the Document under the conditions of sections 2 and 3 above, provided that you release the Modified Version under precisely this License, with the Modified Version filling the role of the Document, thus licensing distribution and modification of the Modified Version to whoever possesses a copy of it. In addition, you must do these things in the Modified Version:

- A. Use in the Title Page (and on the covers, if any) a title distinct from that of the Document, and from those of previous versions (which should, if there were any, be listed in the History section of the Document). You may use the same title as a previous version if the original publisher of that version gives permission.
- B. List on the Title Page, as authors, one or more persons or entities responsible for authorship of the modifications in the Modified Version, together with at least five of the principal authors of the Document (all of its principal authors, if it has less than five).
- C. State on the Title page the name of the publisher of the Modified Version, as the publisher.
- D. Preserve all the copyright notices of the Document.
- E. Add an appropriate copyright notice for your modifications adjacent to the other copyright notices.
- F. Include, immediately after the copyright notices, a license notice giving the public permission to use the Modified Version under the terms of this License, in the form shown in the Addendum below.
- G. Preserve in that license notice the full lists of Invariant Sections and required Cover Texts given in the Document's license notice.
- H. Include an unaltered copy of this License.
- I. Preserve the section entitled "History", and its title, and add to it an item stating at least the title, year, new authors, and publisher of the Modified Version as given on the Title Page. If there is no section entitled "History" in the Document, create one stating the title, year, authors, and publisher of the Document as given on its Title Page, then add an item describing the Modified Version as stated in the previous sentence.
- J. Preserve the network location, if any, given in the Document for public access to a Transparent copy of the Document, and likewise the network locations given in the Document for previous versions it was based on. These may be placed in the "History" section. You may omit a network location for a work that was published at least four years before the Document itself, or if the original publisher of the version it refers to gives permission.
- K. In any section entitled "Acknowledgements" or "Dedications", preserve the section's title, and preserve in the section all the substance and tone of each of the contributor acknowledgements and/or dedications given therein.
- L. Preserve all the Invariant Sections of the Document, unaltered in their text and in their titles. Section numbers or the equivalent are not considered part of the section titles.
- M. Delete any section entitled "Endorsements". Such a section may not be included in the Modified Version.
- N. Do not retitle any existing section as "Endorsements" or to conflict in title with any Invariant Section.

If the Modified Version includes new front-matter sections or appendices that qualify as Secondary Sections and contain no material copied from the Document, you may at your option designate some or all of these sections as invariant. To do this, add their titles to the list of Invariant Sections in the Modified Version's license notice. These titles must be distinct from any other section titles.



You may add a section entitled "Endorsements", provided it contains nothing but endorsements of your Modified Version by various parties--for example, statements of peer review or that the text has been approved by an organization as the authoritative definition of a standard.

You may add a passage of up to five words as a Front-Cover Text, and a passage of up to 25 words as a Back-Cover Text, to the end of the list of Cover Texts in the Modified Version. Only one passage of Front-Cover Text and one of Back-Cover Text may be added by (or through arrangements made by) any one entity. If the Document already includes a cover text for the same cover, previously added by you or by arrangement made by the same entity you are acting on behalf of, you may not add another; but you may replace the old one, on explicit permission from the previous publisher that added the old one.

The author(s) and publisher(s) of the Document do not by this License give permission to use their names for publicity for or to assert or imply endorsement of any Modified Version.

## 5. COMBINING DOCUMENTS

You may combine the Document with other documents released under this License, under the terms defined in section 4 above for modified versions, provided that you include in the combination all of the Invariant Sections of all of the original documents, unmodified, and list them all as Invariant Sections of your combined work in its license notice.

The combined work need only contain one copy of this License, and multiple identical Invariant Sections may be replaced with a single copy. If there are multiple Invariant Sections with the same name but different contents, make the title of each such section unique by adding at the end of it, in parentheses, the name of the original author or publisher of that section if known, or else a unique number. Make the same adjustment to the section titles in the list of Invariant Sections in the license notice of the combined work.

In the combination, you must combine any sections entitled "History" in the various original documents, forming one section entitled "History"; likewise combine any sections entitled "Acknowledgements", and any sections entitled "Dedications". You must delete all sections entitled "Endorsements."

## 6. COLLECTIONS OF DOCUMENTS

You may make a collection consisting of the Document and other documents released under this License, and replace the individual copies of this License in the various documents with a single copy that is included in the collection, provided that you follow the rules of this License for verbatim copying of each of the documents in all other respects.

You may extract a single document from such a collection, and distribute it individually under this License, provided you insert a copy of this License into the extracted document, and follow this License in all other respects regarding verbatim copying of that document.

## 7. AGGREGATION WITH INDEPENDENT WORKS

A compilation of the Document or its derivatives with other separate and independent documents or works, in or on a volume of a storage or distribution medium, does not as a whole count as a Modified Version of the Document, provided no compilation copyright is claimed for the compilation. Such a compilation is called an "aggregate", and this License does not apply to the other self-contained works thus compiled with the Document, on account of their being thus compiled, if they are not themselves derivative works of the Document.

If the Cover Text requirement of section 3 is applicable to these copies of the Document, then if the Document is less than one quarter of the entire aggregate, the Document's Cover Texts may be placed on covers that surround only the Document within the aggregate. Otherwise they must appear on covers around the whole aggregate.

## 8. TRANSLATION

Translation is considered a kind of modification, so you may distribute translations of the Document under the terms of section 4. Replacing Invariant Sections with translations requires special permission from their copyright holders, but you may include translations of some or all Invariant Sections in addition to the original versions of these Invariant Sections. You may include a translation of this License provided that you also include the original English version of this License. In case of a disagreement between the translation and the original English version of this License, the original English version will prevail.

## 9. TERMINATION

You may not copy, modify, sublicense, or distribute the Document except as expressly provided for under this License. Any other attempt to copy, modify, sublicense or distribute the Document is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

## 10. FUTURE REVISIONS OF THIS LICENSE

The Free Software Foundation may publish new, revised versions of the GNU Free Documentation License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns. See <http://www.gnu.org/copyleft/>.

Each version of the License is given a distinguishing version number. If the Document specifies that a particular numbered version of this License "or any later version" applies to it, you have the option of following the terms and conditions either of that specified version or of any later version that has been published (not as a draft) by the Free Software Foundation. If the Document does not specify a version number of this License, you may choose any version ever published (not as a draft) by the Free Software Foundation.

How to use this License for your documents

To use this License in a document you have written, include a copy of the License in the document and put the following copyright and license notices just after the title page:

Copyright (c) YEAR YOUR NAME. Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.1 or any later version published by the Free Software Foundation; with the Invariant Sections being LIST THEIR TITLES, with the Front-Cover Texts being LIST, and with the Back-Cover Texts being LIST. A copy of the license is included in the section entitled "GNU Free Documentation License".

If you have no Invariant Sections, write "with no Invariant Sections" instead of saying which ones are invariant. If you have no Front-Cover Texts, write "no Front-Cover Texts" instead of "Front-Cover Texts being LIST"; likewise for Back-Cover Texts.

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.