traKmeter

Loudness meter for correctly setting up
tracking and mixing levels

Last edited on 4th June 2020

Contents

1 Digital recordings

The digital revolution brought many advantages to the field of audio processing: higher fidelity, less noise, non-degrading copies and the endless possibilities of digital signal processing. Unfortunately, however, digital audio also introduced some problems of its own.

Whereas the analogue domain is relatively inert against very high levels (overdriving some analogue equipment actually sounds pretty good), the digital domain punishes even small transgressions into forbidden territory with harsh clipping.

And while digital audio can be transferred without loss in quality, it is degraded by each and every calculation, be it a simple change in level, equalisation or a fancy effect. Crossing domains from analogue to digital and *vice versa* leads to additional degradation. Finally, changes in bit depth or sampling rate, jitter and inter-sample peaks are nothing for the weak of heart.

However, most of these obstacles can easily be overcome by proper gain staging, dithering, minimising the crossing of domains and choosing appropriate bit depths and sampling rates right from the beginning.

If you carefully choose, test and operate your equipment, you're well on your way to pure audio bliss ...

1.1 Definitions

RMS *root mean square*	statistical method used for calculating an average from fluctuating values
dBu *decibel unterminated*	level ratio with an analogue reference level of 0.7746 V_{RMS}
dB FS *decibel relative to digital full-scale*	level ratio with a reference level equal to the maximum representable value of a digital signal
dBr *decibel relative to reference level*	level ratio with an arbitrary reference level that must be specified; for instance, 0 dBr may be equal to –20 dB FS

1.2 Gain staging

The process of setting audio devices to run at optimal input and output levels is called *gain staging*.

Professional analogue audio equipment is designed to be run at a nominal level of +4 dBu. This leaves a headroom for peaks of at least **20 dB** to the clipping point. Thus, driving

all analogue audio equipment at +4 dBu ensures an optimal signal-to-noise ratio while preventing clipping and keeping all transients intact.

Now let's transfer this to the digital domain. First, choose an analogue reference level for your converter.[1] Then, record with an average input level of **–20 dB FS RMS**. Again, this ensures a good signal-to-noise ratio while preventing clipping. In addition, this level drives your outboard equipment and most of your plug-ins at their "sweet spot".

I also recommend recording with a maximum level of **–10 dB FS peak**. This will leave enough space for sudden jumps in level and may also improve the sound of your recordings. Some analogue-to-digital converters already degrade audio when fed with levels close to digital full-scale (0 dB FS), resulting in the "harshness" that is often attributed to digital audio.

Try this: record a clearly defined signal (such as a sine wave) and increase its level while analysing the obtained signal with a spectrum meter. Overtones will probably appear at levels way below clipping point (see section 1.5). Their individual level may be low but will accumulate when you mix recordings – and our ears are sensitive for distortion.

Gain staging doesn't stop here. Set up your mixer so that channel levels are lower than subgroup levels, which in turn should be lower than the master output levels. No

[1] for more information, see Level Practices (Part 1) by Bob Katz; a reference level of +4 dBu = –15 dB FS works well for me

clipping should occur anywhere in the mixer, which is especially important if you want to insert external analogue gear.[2] Do not overload effects or plug-ins and (if possible) try to match their input and output volume.[3]

Speaking of me, once I transitioned to proper gain staging, my recordings and mixes became much cleaner. And the effort involved was pretty small!

1.3 Digital audio myths

I can almost hear you: digital recordings should be made at peak levels close to but not exceeding 0 dB FS. Unfortunately, this misleading information has ended up in many manuals for professional audio equipment. But that doesn't make it any truer ...

Even if you record at *peak* levels of –18 dB FS, a bit depth of 16 bits will yield a signal-to-noise ratio of 78 dB. That is about what you can expect from the best professional analogue tape machines and recording desks!

But think of the approximate 19 bits modern converters can capture.[4] In this case, recording at peak levels of –18 dB FS

[2] for mixer inserts, I recommend maximum input and output levels of **–10 dB FS peak** for the same reasons mentioned above

[3] many digital signal processors use floating-point calculations and handle clipping gracefully; others, especially those modelling old analogue equipment, may clip badly

[4] all real-world analogue circuits are contaminated with thermal noise which limits the achievable signal-to-noise ratio of converters

yields an incredible signal-to-noise ratio of 96 dB. This is *fully equivalent* to using a bit depth of 16 bits and recording at levels close to clipping point!

So there really is no point in recording at extreme levels.

If you are still sceptical, read these three Gearslutz posts written by a renowned engineer: #1, #2 and #3. The highly regarded manufacturer *Harrison Audio* also recommends a maximum peak recording level of –15 dB FS for their *Mixbus 32C* digital audio workstation. Finally, I highly recommend reading this article in *Sound On Sound*.

1.4 Introducing traKmeter

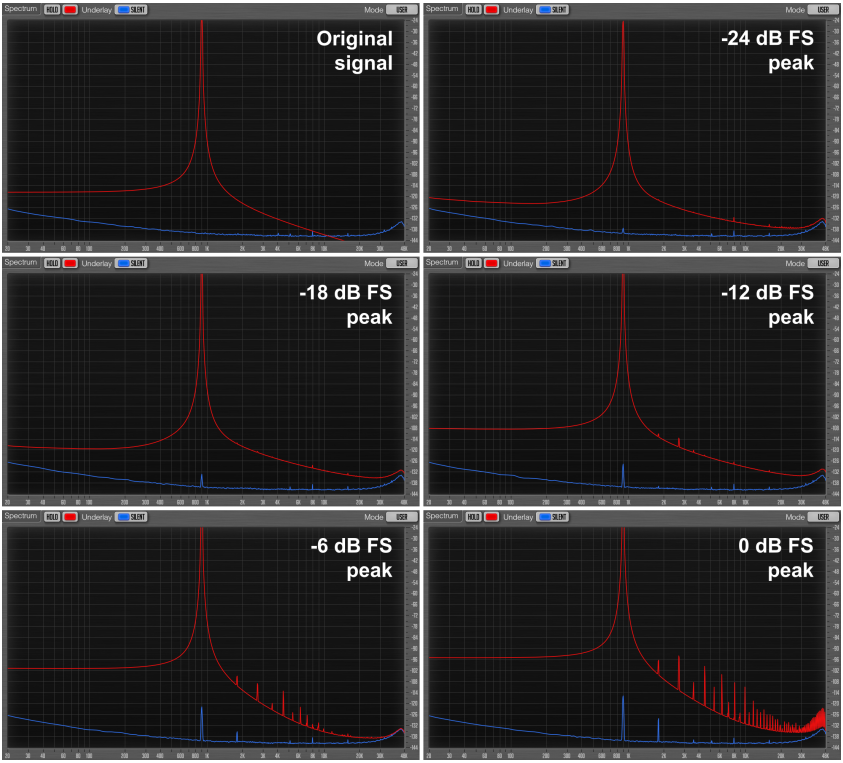
Sadly, most digital audio equipment only has peak meters. This is readily understandable as you want to avoid digital clippings by all means. However, badly chosen meter ranges and scales often render these meters useless. And the lack of average meters does not exactly facilitate gain staging.

When I had realised this, I started coding traKmeter. It has evolved with my growing knowledge and recording experience, but the underlying ideas haven't changed at all.

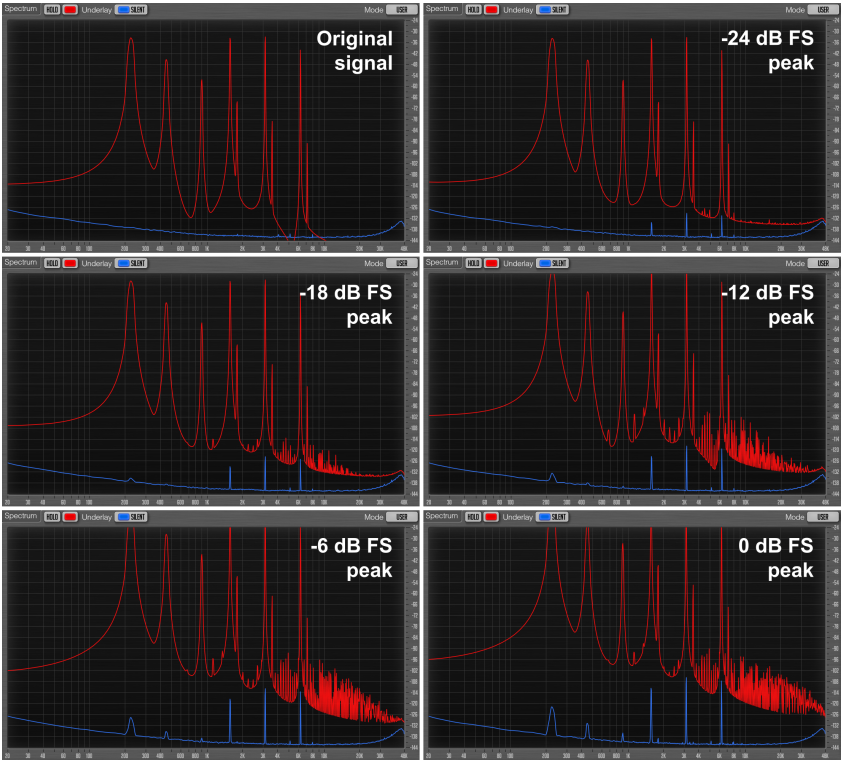
1.5 Converter clipping

This experiment was conducted with a *RME Fireface 800* interface (96 kHz, 24 bits, 0 dB FS set to +19 dBu). Signals were sent to an output connected directly to an input (**red lines**). A floating input served as reference (**blue lines**).

1.5.1 Single sine wave

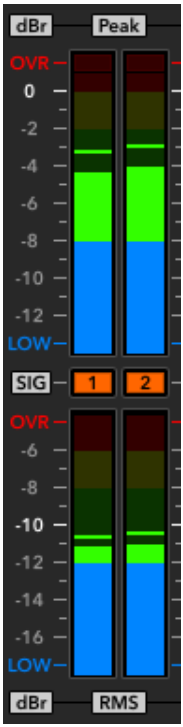


1.5.2 Complex signal (several sine waves)



2 traKmeter

traKmeter consists of two meters, a peak meter on top and an average meter below. The meters are separated by an orange signal LED and consist of a green area that is enclosed by a blue one (lower levels) or a yellow and red one (higher levels).



The average meter's green area is centred around the **–10 dBr RMS** mark. With a reference level of –10 dB FS, this corresponds to the **–20 dB FS RMS** we have determined to be the optimal average recording level in the digital domain.

The peak meter's yellow area reaches up to **0 dBr peak**. Given the same reference level, this corresponds to **–10 dB FS peak** and peak levels shouldn't exceed this level.

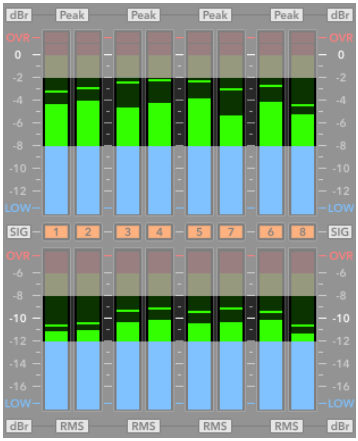
Thus, by keeping the meter's readout **in the green** and yellow areas and **out of the red** areas, you will automatically track at optimal audio levels. It's as simple as that!

2.1 Tracking with traKmeter

Open up an instance of traKmeter and set it up so that it measures your audio input. That can be done either by starting the stand-alone version and connecting it to one or more input channels of your analogue-to-digital converter, or by inserting a plug-in instance into an input channel of your digital audio workstation (no latency is added).

In the second case, take care that your digital audio workstation doesn't add additional headroom and that no processing takes place before traKmeter. This can be ascertained by feeding calibration tones into your converter or by directly comparing the readouts of stand-alone and plug-in version.

Now, feed the signal you want to record into an audio input channel and adjust its level (in the analogue domain!). Try to set the input level so that it falls into the average meter's **–10 dBr** area.



Make sure that peak levels very rarely (if ever) exceed **0 dBr**. In case both conditions cannot be met simultaneously, adjust the peak level only.

2.2 Mixing with traKmeter

When you get someone else's tracks for mixing, chances are that they have been recorded far too hot. While you can't change that, you should adjust the tracks to optimal loudness in the gain staging phase. This is easily accomplished using traKmeter and either the mixer's trim knob or a (properly dithered!) gain plug-in. Just make sure that the gain change precedes all future processing.

Mixing levels will now be much lower than what you might be used to. This can easily be corrected by either adjusting the output gain of your subgroups or by inserting a gain plug-in in your master track.

To preserve all transients, the final loudness of your mix should stay within certain average level ranges. My plug-in **K-Meter** may help you with setting up correct mixing levels. Remember that smashed transients will be gone forever, whereas you can always bring up the volume during mastering!

3 Installation

In order to use the pre-compiled binaries, simply extract the traKmeter files from the downloaded archive. For the plug-ins, you'll then have to move the extracted files to your respective plug-in folder.

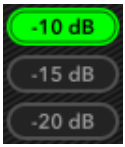
The folder `trakmeter` is mandatory and must be moved to the plug-in (or stand-alone) folder!

traKmeter requires a processor which supports the SSE2 instruction set. On Windows, you might also have to install the Visual C++ Redistributable for Visual Studio 2017.

Should the stand-alone version ever fail to start, you can reset its settings by deleting `traKmeter (Stereo).settings` or `traKmeter (Multi).settings`. These files are located in `~/.config` (GNU/Linux) or `%appdata%\.config\` (Windows).

4 Controls

4.1 Reference level buttons



Set your reference level (corresponding to the preferred maximum peak recording level) with these buttons. To follow the advice in section 1.2, leave this at the default setting of **–10 dB FS**.

If you record very dynamic material or have problems getting a clean signal, you can try the other settings. They shift both meter scales down by 5 dB to 10 dB and add additional headroom at the cost of a higher noise floor. Which you probably won't even notice, as the signal-to-noise ratio of modern converters is extremely high.

4.2 Reset button

Click on this button to reset all meters. This action will also reload the current skin and re-draw everything.

4.3 Select a skin

Click on this button to select the currently used traKmeter skin. You can also set a default skin that will be loaded when new plug-in instances are started.

4.4 Validation button

Click on this button to open the **validation window** (see chapter 7) which allows you to play an audio file through traKmeter and dump internal data. During validation, the button will light up and clicking on it will stop validation early.

On Linux, dumped data will be written to `stderr`, so just start the traKmeter stand-alone or your plug-in host from the shell and watch the output coming. On Windows, you can use DebugView by Sysinternals (stand-alone) or have a look at Ableton Live's log files (plug-in). If none of that works, you might have to start either the stand-alone or your plug-in host from a debugger.

As a side note, **SMA(50)** designates the simple moving average of 50 values, a neat way to emphasise trends and eliminate short-term fluctuations.

4.5 About button

Clicking on this button will open the **about window** where you will be informed about version number, contributors, copyright and the GNU General Public License.

4.6 Display license

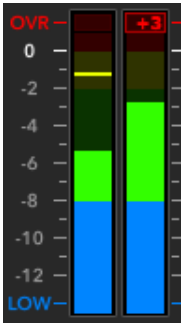
This button is located in the **about window** and does not only advertise that you are using free software licensed under the **GNU General Public License** – when clicked, it will also open the license's website in your web browser …

5 Meters

All meters possess a flat frequency response. Meter scales are in dBr and their reference level is adjustable (see section 4.1). This way, scales remain the same even when the reference level changes.

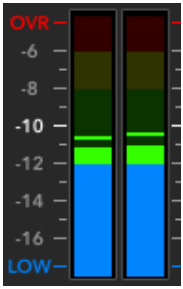
5.1 Peak level meter

This meter shows the current peak level in dBr. Rise time is one sample and fall time is 8.67 dB/s. Peak levels exceeding 0 dBr are displayed on the red LED marked “OVR”.



The highest encountered peak level will be held indefinitely until the meter is reset.

5.2 Average level meter



The average level meter uses an averaging period of 1024 samples. It has been calibrated so that sine wave signals read the same on both peak and average meters. Similar to a VU meter, it takes 300 ms for the meter to reach 99 % of the final reading. There is no overshoot, however.

Peaks will be held for 10 s and then fall with a speed of 8.67 dB/s.

5.3 Signal meter

The orange signal meter detects peak levels at a threshold of –60 dB FS. It has a rise time of one sample and fades out when the level falls below the threshold.

6 Recording advice

Over the years, I have learned how to and how not to record, and this seems like a good place to summarise my knowledge. For controversial advice, I will try to reference the opinion of professionals.

Use a good pre-amplifier. "Good" doesn't mean your pre-amplifier has to have a lot of channels or features. To the contrary! Go for a simple design and invest your money in professional quality instead. Recordings made with a good pre-amplifier sound better and make mixing much easier – the tracks simply seem to fall into place.

Use the pre-amplifier's gain control. If necessary, crank up the gain control to yield the correct output level. Do not fear the pre-amplifier's internal noise – boosting a low-gain recording in later stages will result in even more noise!

Avoid unbalanced equipment. Run all signals on balanced lines with a nominal level of +4 dBu. If you can't, use DI boxes and transformers to convert the signals as early in the audio chain as possible.

And do not even *think* of buying equipment that has analogue RCA connectors![1]

Use short audio chains. All equipment adds noise or may otherwise degrade audio, so keep your audio recording chains short and simple. This has the additional benefit that you can focus on recording.

Here is an example: instead of routing your mixer between pre-amplifier and converter, connect the mixer to your converter's outputs. This simple change can lead to much better recordings (especially with cheap mixers) and the artist will still be able to hear playback and herself during recording.

Work at a defined reference level. See the article Level Practices (Part 1) by Bob Katz.

Record at lower levels. During recording, do not let peak levels exceed **–10 dB FS**. For an in-depth explanation and references, see section 1.2.

Record in mono. Most audio sources do not contain stereo information that is useful in a mixing context (notable exceptions are audience recordings, orchestras and occasionally pianos). The pseudo-stereo effects of synthesizers often cause phasing issues.

Recording such sources in stereo wastes space on your hard disk – and someone's time at a later stage.

[1] "I have a real aversion to anything that calls itself 'professional' and has RCA jacks on it. That's just contradictory."
Whitlock B. Audio System Grounding & Interfacing – An Overview. *126th AES Convention; Munich; May 2009.*

Use high bit depths. Do yourself a favour and record at a bit depth of 24 bits instead of 16 bits. The additional bits allow recording at lower levels and provide an incredible amount of extra detail. When disk space runs low, choose more bits over a higher sampling rate.[2]

The usable bit depth of converters is limited to approximately 20 bits by thermal noise. However, the mixer in your digital audio workstation should use floating point numbers with 32 bits *at the very least*. Calculation errors are inevitable in digital signal processing, so more bits mean smaller (and thus quieter) errors.

Use sensible sampling rates. The preferred sampling rate for recording audio is 96 kHz (88.1 kHz is just as good, but sees less support).[3] Additionally, latency is lower at higher sample rates, and many plug-ins that internally use 96 kHz can bypass their oversampling.

Concentrate on recording. When tracking, try to not interfere with the flow of the session. Keep editing and mixing to the bare minimum!

Fix it now. Contrary to popular belief, you cannot "fix it in the mix" – a bad recording is nothing more than a bad recording. So editing and tools like Auto-Tune and extreme EQ should be seen as a last resort.

[2] see the AES Pro Audio Reference for more information

[3] "Although 60 kHz would [be ideal], 88.2 kHz and 96 kHz are closest to the optimal sample rate." I highly recommend reading this paper! **Lavry D.** The Optimal Sample Rate For Quality Audio. *Lavry Engineering; White Paper; May 2012.*

Apart from the precious time lost in editing, it's easy to kill all of a track's vibe in the process.

Instead, keep recording until you capture a great take. Treat your room acoustically and in terms of positive vibe. Experiment with microphone placement. And try absolutely everything that may help the artist in achieving a stunning performance!

Make it exciting. A lot of today's music sounds like (and actually is) one short loop that was "arranged" by muting different tracks at different times. This takes away all the small inaccuracies of human players and often leads to boring and lifeless songs.

So think of a good arrangement before you even start recording. And instead of looping a track, record a couple of takes and comp the best ones. You'll be surprised at the difference it makes!

7 Validation

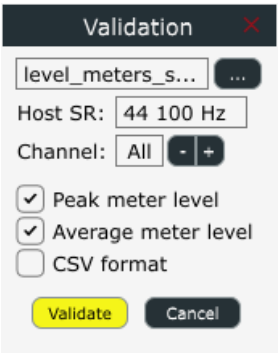
I have gone to great lengths to ensure that the meters read correctly. You want to validate for yourself? Just download and extract the source code. The directory `validation` contains instructions and FLAC-compressed wave files. A word of warning: these audio files may **damage your ears** and speakers, so please watch your monitor levels!

Begin by starting traKmeter. If in a Bash shell, try this:

32 and 64 bit

```
./trakmeter_stereo 2>&1 | tee /tmp/validate.log
```

After opening the **validation window** (see section 4.4), click on the ellipsis button (the one with the dots) to select an audio file for playback through traKmeter. Please make sure that the sampling rates of your host (**Host SR**) and the audio file match, otherwise the results will not be correct.



Now, select which **variables** (if any) should be dumped. You may also re-

strict dumped data to a specific audio **channel**. Check **CSV** if you want to feed the output to a parser.

Finally, click on the **validate** button to reset all meters and start playback of the selected audio file. All audio input will be discarded during playback and for an additional twenty seconds. To stop playback early, simply click on the **validate** button again.

7.1 Validation status

	Test	**Valid**
Average level meter	visuals	✓
	readout	✓
Peak level meter	visuals	✓
	readout	✓
Signal meter	visuals	✓

8 Help needed

As traKmeter was coded using cross-platform code, it should be easy to compile on Mac OS X. Unfortunately, I happen to not have a Mac ...

In case you want to help, please see the next chapter for an email address. You'll need sufficient experience in coding, compiling and debugging, though, so no beginners please!

9 Final words

I want to thank **Rickard** of Interfearing Sounds for asking me how to use K-Meter for tracking. This question and the following thoughts really got traKmeter started. I'd like to thank **bram@smartelectronix** for his code to calculate logarithmic rise and fall times.

I must also thank the **beta testers** and **users of traKmeter** for sending kind words, suggestions and bug reports. Finally, I want to thank the **open source community** for making all of this possible.

Although coding traKmeter has been a lot of fun, it has also been a lot of work. So if you like traKmeter, why not send me an email and tell me so? Write a few words about yourself, send suggestions for future updates or volunteer to create a nice skin. I also really enjoy listening to music that you have produced using my software ...

Thanks for using free software. I hope you'll enjoy it!

A Build process

A.1 Dependencies

A.1.1 premake

Importance: required
Version: 5.0.0 (alpha15)
License: BSD
Homepage: premake.github.io

Installation

Place the binary somewhere in your `PATH`. Depending on your platform, you should run `premake` using the scripts `Builds/render_templates.sh` or `Builds/render_templates.bat`.

To change the premake file using Jinja templates, you'll also have to install the necessary dependencies.

A.1.2 Compilers

Importance: required
Linux: Clang 6.0 (or gcc 7.5.0)
Windows: Visual Studio 2017 (and above)
License: proprietary (Visual Studio) / Open Source

Use premake (section A.1.1) to generate the Make files (or project) files needed by different compilers.

Different compiler versions may work, and premake supports other compiler tool sets as well. But in this case, you're on your own!

A.1.3 JUCE library

Importance: required
Version: 5.4.7
License: ISC and GPL v3 (among others)
Homepage: www.juce.com

Installation

Extract the archive into the directory `libraries/juce`.

A.1.4 Virtual Studio Technology SDK

Importance: optional
Version: 2.4 / 3.6.14
License: proprietary / GPL v3
Homepage: www.steinberg.net

Installation

Extract the archives into the directories `libraries/vst2` and `libraries/vst3`. The proprietary VST2 SDK is not available anymore. **You may only distribute VST2 plug-ins if you have signed the old license agreement!**

A.1.5 Python

Importance: optional
Version: 3.6 (or higher)
License: Python Software Foundation License
Homepage: www.python.org

You'll only need Python if you want to auto-generate files from Jinja templates.

Installation (Windows)

You can download an installer from the website.

A.1.6 Jinja

Importance: optional
Version: 2.10 (or higher)
License: BSD
Homepage: jinja.pocoo.org

You'll only need Jinja if you want to auto-generate files such as the premake file from templates (see section A.1.1).

A.1.7 Artistic Style

Importance: optional
Version: 3.1
License: LGPL v3
Homepage: astyle.sourceforge.net

This application formats the code so it looks more beautiful and consistent. Thus, you only have to install it if you plan to help me with coding.

Installation

Place the binary somewhere in your `PATH`. Depending on your platform, you should run `astyle` using the scripts `Source/format_code.sh` or `Source/format_code.bat`.

A.1.8 googletest

Importance: optional
Version: 1.10.0
License: BSD 3-clauses
Homepage: github.com/google/googletest

This is a framework for testing and mocking. You only need to install it if you plan to help me with coding.

Installation on GNU/Linux

Extract the archive into the directory `libraries/googletest`, change into this directory and run:

32 and 64 bit

```
mkdir googletest/build
cd googletest/build
```

32 bit

```
rm -f ./CMakeCache.txt
cmake ..
make
mkdir -p lib/linux/i386/
mv lib/*.a lib/linux/i386/
make clean
```

64 bit

```
rm -f ./CMakeCache.txt
cmake ..
make
mkdir -p lib/linux/amd64/
mv lib/*.a lib/linux/amd64/
make clean
```

A.2 General preparation

Copy `Source/build_id-COPY.h` to `Source/build_id.h`.

Edit the copied file to add a custom build ID to the "About" dialog. Or set up Git hooks that update the file for you.

A.3 GNU/Linux

A.3.1 Environment

To build this application yourself, I recommend setting up a `chroot` environment. This is fast and easy to do on Debian-based systems and might save you a **lot** of trouble. At the time of writing, I'm using Linux Mint 19, but the procedure should be similar on your distribution of choice.

Start by installing the necessary packages:

32 and 64 bit

```
sudo apt install debootstrap schroot
```

Then install the `chroot` base system by executing the following statements:

32 bit

```
sudo debootstrap --variant=buildd \
  --arch i386 bionic \
  /srv/chroot/bionic_i386 \
  http://archive.ubuntu.com/ubuntu
```

64 bit

```
sudo debootstrap --variant=buildd \
  --arch amd64 bionic \
  /srv/chroot/bionic_amd64 \
  http://archive.ubuntu.com/ubuntu
```

Running `debootstrap` will take some time. Meanwhile, add the following lines to `/etc/schroot/schroot.conf` (make sure you remove all preceding white space so that each line begins in the first column):

32 and 64 bit

```
[bionic-i386]
description=Ubuntu bionic (i386)
directory=/srv/chroot/bionic_i386
profile=default
personality=linux32
type=directory
users=username

[bionic-amd64]
description=Ubuntu bionic (amd64)
directory=/srv/chroot/bionic_amd64
profile=default
personality=linux
type=directory
users=username
```

Please make the necessary changes to `username`. If you experience problems, you can try to change `bionic` to a release name such as `wheezy`.

When `debootstrap` is done, log in as superuser:

32 bit

```
sudo schroot -c bionic-i386
```

64 bit

```
sudo schroot -c bionic-amd64
```

You'll have to change the file `/etc/apt/sources.list` first (ignore the line break, it should be a single line):

32 and 64 bit

```
deb http://archive.ubuntu.com/ubuntu bionic
main restricted universe
```

Now install a few packages – `less` and `vim` are optional, but might come in handy:

32 and 64 bit

```
apt update
apt -y install bash-completion clang \
  cmake libasound2-dev libjack-jackd2-dev \
  libpthread-workqueue-dev mesa-common-dev \
  xorg-dev less vim
apt clean
```

If you like `bash` completion, you might also want to open the file `/etc/bash.bashrc` and unquote these lines:

32 and 64 bit

```
# enable bash completion in interactive shells
if [...]
  [a couple of lines...]
fi
```

Finally, log out and log in as normal user:

32 bit

```
schroot -c bionic-i386
```

64 bit

```
schroot -c bionic-amd64
```

In this `chroot` shell, install the dependencies (section A.1). Congratulations – you are now ready to build!

A.3.2 Build

After preparing the dependencies, start your `chroot` environment

32 bit

```
schroot -c bionic-i386
```

64 bit

```
schroot -c bionic-amd64
```

change into the directory `Builds` and execute

32 and 64 bit

```
./render_templates.sh
make config=CFG TARGET
```

where `CFG` is one of `debug_x32`, `debug_x64`, `release_x32` and `release_x64`, and `TARGET` is the version you want to compile, such as `linux_standalone_stereo`.

In case you run into problems, you can try to switch compilers by opening the file `run_premake.sh` and using the premake options `--cc=clang` or `--cc=gcc`.

The compiled binaries will end up in the directory `bin`.

A.4 Microsoft Windows

A.4.1 Build

After setting up the dependencies, open the directory `Builds` and execute

32 and 64 bit

```
./render_templates.bat
```

Then change into the directory `Builds/windows/vs20xx`, open the project file with the corresponding version of Visual Studio and build the project.

The compiled binaries will end up in the directory `bin`.

B Licenses

B.1 GNU General Public License

GNU GENERAL PUBLIC LICENSE
Version 3, 29 June 2007

Copyright (C) 2007 Free Software Foundation, Inc. <http://fsf.org/>
Everyone is permitted to copy and distribute verbatim copies
of this license document, but changing it is not allowed.

Preamble

The GNU General Public License is a free, copyleft license for software and other kinds of works.

The licenses for most software and other practical works are designed to take away your freedom to share and change the works. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change all versions of a program--to make sure it remains free software for all its users. We, the Free Software Foundation, use the GNU General Public License for most of our software; it applies also to any other work released this way by its authors. You can apply it to your programs, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for them if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs, and that you know you can do these things.

To protect your rights, we need to prevent others from denying you these rights or asking you to surrender the rights. Therefore, you have

certain responsibilities if you distribute copies of the software, or if you modify it: responsibilities to respect the freedom of others.

For example, if you distribute copies of such a program, whether gratis or for a fee, you must pass on to the recipients the same freedoms that you received. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

Developers that use the GNU GPL protect your rights with two steps: (1) assert copyright on the software, and (2) offer you this License giving you legal permission to copy, distribute and/or modify it.

For the developers' and authors' protection, the GPL clearly explains that there is no warranty for this free software. For both users' and authors' sake, the GPL requires that modified versions be marked as changed, so that their problems will not be attributed erroneously to authors of previous versions.

Some devices are designed to deny users access to install or run modified versions of the software inside them, although the manufacturer can do so. This is fundamentally incompatible with the aim of protecting users' freedom to change the software. The systematic pattern of such abuse occurs in the area of products for individuals to use, which is precisely where it is most unacceptable. Therefore, we have designed this version of the GPL to prohibit the practice for those products. If such problems arise substantially in other domains, we stand ready to extend this provision to those domains in future versions of the GPL, as needed to protect the freedom of users.

Finally, every program is threatened constantly by software patents. States should not allow patents to restrict development and use of software on general-purpose computers, but in those that do, we wish to avoid the special danger that patents applied to a free program could make it effectively proprietary. To prevent this, the GPL assures that patents cannot be used to render the program non-free.

The precise terms and conditions for copying, distribution and modification follow.

TERMS AND CONDITIONS

0. Definitions.

"This License" refers to version 3 of the GNU General Public License.

"Copyright" also means copyright-like laws that apply to other kinds of works, such as semiconductor masks.

"The Program" refers to any copyrightable work licensed under this License. Each licensee is addressed as "you". "Licensees" and "recipients" may be individuals or organizations.

To "modify" a work means to copy from or adapt all or part of the work in a fashion requiring copyright permission, other than the making of an exact copy. The resulting work is called a "modified version" of the earlier work or a work "based on" the earlier work.

A "covered work" means either the unmodified Program or a work based on the Program.

To "propagate" a work means to do anything with it that, without permission, would make you directly or secondarily liable for infringement under applicable copyright law, except executing it on a computer or modifying a private copy. Propagation includes copying, distribution (with or without modification), making available to the public, and in some countries other activities as well.

To "convey" a work means any kind of propagation that enables other parties to make or receive copies. Mere interaction with a user through a computer network, with no transfer of a copy, is not conveying.

An interactive user interface displays "Appropriate Legal Notices" to the extent that it includes a convenient and prominently visible feature that (1) displays an appropriate copyright notice, and (2) tells the user that there is no warranty for the work (except to the extent that warranties are provided), that licensees may convey the work under this License, and how to view a copy of this License. If the interface presents a list of user commands or options, such as a menu, a prominent item in the list meets this criterion.

1. Source Code.

The "source code" for a work means the preferred form of the work for making modifications to it. "Object code" means any non-source form of a work.

A "Standard Interface" means an interface that either is an official standard defined by a recognized standards body, or, in the case of interfaces specified for a particular programming language, one that is widely used among developers working in that language.

The "System Libraries" of an executable work include anything, other than the work as a whole, that (a) is included in the normal form of packaging a Major Component, but which is not part of that Major Component, and (b) serves only to enable use of the work with that Major Component, or to implement a Standard Interface for which an implementation is available to the public in source code form. A "Major Component", in this context, means a major essential component (kernel, window system, and so on) of the specific operating system (if any) on which the executable work runs, or a compiler used to produce the work, or an object code interpreter used to run it.

The "Corresponding Source" for a work in object code form means all the source code needed to generate, install, and (for an executable work) run the object code and to modify the work, including scripts to control those activities. However, it does not include the work's System Libraries, or general-purpose tools or generally available free programs which are used unmodified in performing those activities but which are not part of the work. For example, Corresponding Source includes interface definition files associated with source files for the work, and the source code for shared libraries and dynamically linked subprograms that the work is specifically designed to require, such as by intimate data communication or control flow between those subprograms and other parts of the work.

The Corresponding Source need not include anything that users can regenerate automatically from other parts of the Corresponding Source.

The Corresponding Source for a work in source code form is that same work.

2. Basic Permissions.

All rights granted under this License are granted for the term of copyright on the Program, and are irrevocable provided the stated conditions are met. This License explicitly affirms your unlimited permission to run the unmodified Program. The output from running a covered work is covered by this License only if the output, given its content, constitutes a covered work. This License acknowledges your rights of fair use or other equivalent, as provided by copyright law.

You may make, run and propagate covered works that you do not convey, without conditions so long as your license otherwise remains in force. You may convey covered works to others for the sole purpose of having them make modifications exclusively for you, or provide you with facilities for running those works, provided that you comply with

the terms of this License in conveying all material for which you do not control copyright. Those thus making or running the covered works for you must do so exclusively on your behalf, under your direction and control, on terms that prohibit them from making any copies of your copyrighted material outside their relationship with you.

Conveying under any other circumstances is permitted solely under the conditions stated below. Sublicensing is not allowed; section 10 makes it unnecessary.

3. Protecting Users' Legal Rights From Anti-Circumvention Law.

No covered work shall be deemed part of an effective technological measure under any applicable law fulfilling obligations under article 11 of the WIPO copyright treaty adopted on 20 December 1996, or similar laws prohibiting or restricting circumvention of such measures.

When you convey a covered work, you waive any legal power to forbid circumvention of technological measures to the extent such circumvention is effected by exercising rights under this License with respect to the covered work, and you disclaim any intention to limit operation or modification of the work as a means of enforcing, against the work's users, your or third parties' legal rights to forbid circumvention of technological measures.

4. Conveying Verbatim Copies.

You may convey verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice; keep intact all notices stating that this License and any non-permissive terms added in accord with section 7 apply to the code; keep intact all notices of the absence of any warranty; and give all recipients a copy of this License along with the Program.

You may charge any price or no price for each copy that you convey, and you may offer support or warranty protection for a fee.

5. Conveying Modified Source Versions.

You may convey a work based on the Program, or the modifications to produce it from the Program, in the form of source code under the terms of section 4, provided that you also meet all of these conditions:

a) The work must carry prominent notices stating that you modified

it, and giving a relevant date.

b) The work must carry prominent notices stating that it is released under this License and any conditions added under section 7. This requirement modifies the requirement in section 4 to "keep intact all notices".

c) You must license the entire work, as a whole, under this License to anyone who comes into possession of a copy. This License will therefore apply, along with any applicable section 7 additional terms, to the whole of the work, and all its parts, regardless of how they are packaged. This License gives no permission to license the work in any other way, but it does not invalidate such permission if you have separately received it.

d) If the work has interactive user interfaces, each must display Appropriate Legal Notices; however, if the Program has interactive interfaces that do not display Appropriate Legal Notices, your work need not make them do so.

A compilation of a covered work with other separate and independent works, which are not by their nature extensions of the covered work, and which are not combined with it such as to form a larger program, in or on a volume of a storage or distribution medium, is called an "aggregate" if the compilation and its resulting copyright are not used to limit the access or legal rights of the compilation's users beyond what the individual works permit. Inclusion of a covered work in an aggregate does not cause this License to apply to the other parts of the aggregate.

6. Conveying Non-Source Forms.

You may convey a covered work in object code form under the terms of sections 4 and 5, provided that you also convey the machine-readable Corresponding Source under the terms of this License, in one of these ways:

a) Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by the Corresponding Source fixed on a durable physical medium customarily used for software interchange.

b) Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by a written offer, valid for at least three years and valid for as long as you offer spare parts or customer support for that product

model, to give anyone who possesses the object code either (1) a copy of the Corresponding Source for all the software in the product that is covered by this License, on a durable physical medium customarily used for software interchange, for a price no more than your reasonable cost of physically performing this conveying of source, or (2) access to copy the Corresponding Source from a network server at no charge.

c) Convey individual copies of the object code with a copy of the written offer to provide the Corresponding Source. This alternative is allowed only occasionally and noncommercially, and only if you received the object code with such an offer, in accord with subsection 6b.

d) Convey the object code by offering access from a designated place (gratis or for a charge), and offer equivalent access to the Corresponding Source in the same way through the same place at no further charge. You need not require recipients to copy the Corresponding Source along with the object code. If the place to copy the object code is a network server, the Corresponding Source may be on a different server (operated by you or a third party) that supports equivalent copying facilities, provided you maintain clear directions next to the object code saying where to find the Corresponding Source. Regardless of what server hosts the Corresponding Source, you remain obligated to ensure that it is available for as long as needed to satisfy these requirements.

e) Convey the object code using peer-to-peer transmission, provided you inform other peers where the object code and Corresponding Source of the work are being offered to the general public at no charge under subsection 6d.

A separable portion of the object code, whose source code is excluded from the Corresponding Source as a System Library, need not be included in conveying the object code work.

A "User Product" is either (1) a "consumer product", which means any tangible personal property which is normally used for personal, family, or household purposes, or (2) anything designed or sold for incorporation into a dwelling. In determining whether a product is a consumer product, doubtful cases shall be resolved in favor of coverage. For a particular product received by a particular user, "normally used" refers to a typical or common use of that class of product, regardless of the status of the particular user or of the way in which the particular user actually uses, or expects or is expected to use, the product. A product is a consumer product regardless of whether the product has substantial

commercial, industrial or non-consumer uses, unless such uses represent the only significant mode of use of the product.

"Installation Information" for a User Product means any methods, procedures, authorization keys, or other information required to install and execute modified versions of a covered work in that User Product from a modified version of its Corresponding Source. The information must suffice to ensure that the continued functioning of the modified object code is in no case prevented or interfered with solely because modification has been made.

If you convey an object code work under this section in, or with, or specifically for use in, a User Product, and the conveying occurs as part of a transaction in which the right of possession and use of the User Product is transferred to the recipient in perpetuity or for a fixed term (regardless of how the transaction is characterized), the Corresponding Source conveyed under this section must be accompanied by the Installation Information. But this requirement does not apply if neither you nor any third party retains the ability to install modified object code on the User Product (for example, the work has been installed in ROM).

The requirement to provide Installation Information does not include a requirement to continue to provide support service, warranty, or updates for a work that has been modified or installed by the recipient, or for the User Product in which it has been modified or installed. Access to a network may be denied when the modification itself materially and adversely affects the operation of the network or violates the rules and protocols for communication across the network.

Corresponding Source conveyed, and Installation Information provided, in accord with this section must be in a format that is publicly documented (and with an implementation available to the public in source code form), and must require no special password or key for unpacking, reading or copying.

7. Additional Terms.

"Additional permissions" are terms that supplement the terms of this License by making exceptions from one or more of its conditions. Additional permissions that are applicable to the entire Program shall be treated as though they were included in this License, to the extent that they are valid under applicable law. If additional permissions apply only to part of the Program, that part may be used separately under those permissions, but the entire Program remains governed by this License without regard to the additional permissions.

When you convey a copy of a covered work, you may at your option remove any additional permissions from that copy, or from any part of it. (Additional permissions may be written to require their own removal in certain cases when you modify the work.) You may place additional permissions on material, added by you to a covered work, for which you have or can give appropriate copyright permission.

Notwithstanding any other provision of this License, for material you add to a covered work, you may (if authorized by the copyright holders of that material) supplement the terms of this License with terms:

a) Disclaiming warranty or limiting liability differently from the terms of sections 15 and 16 of this License; or

b) Requiring preservation of specified reasonable legal notices or author attributions in that material or in the Appropriate Legal Notices displayed by works containing it; or

c) Prohibiting misrepresentation of the origin of that material, or requiring that modified versions of such material be marked in reasonable ways as different from the original version; or

d) Limiting the use for publicity purposes of names of licensors or authors of the material; or

e) Declining to grant rights under trademark law for use of some trade names, trademarks, or service marks; or

f) Requiring indemnification of licensors and authors of that material by anyone who conveys the material (or modified versions of it) with contractual assumptions of liability to the recipient, for any liability that these contractual assumptions directly impose on those licensors and authors.

All other non-permissive additional terms are considered "further restrictions" within the meaning of section 10. If the Program as you received it, or any part of it, contains a notice stating that it is governed by this License along with a term that is a further restriction, you may remove that term. If a license document contains a further restriction but permits relicensing or conveying under this License, you may add to a covered work material governed by the terms of that license document, provided that the further restriction does not survive such relicensing or conveying.

If you add terms to a covered work in accord with this section, you

must place, in the relevant source files, a statement of the
additional terms that apply to those files, or a notice indicating
where to find the applicable terms.

  Additional terms, permissive or non-permissive, may be stated in the
form of a separately written license, or stated as exceptions;
the above requirements apply either way.

  8. Termination.

  You may not propagate or modify a covered work except as expressly
provided under this License. Any attempt otherwise to propagate or
modify it is void, and will automatically terminate your rights under
this License (including any patent licenses granted under the third
paragraph of section 11).

  However, if you cease all violation of this License, then your
license from a particular copyright holder is reinstated (a)
provisionally, unless and until the copyright holder explicitly and
finally terminates your license, and (b) permanently, if the copyright
holder fails to notify you of the violation by some reasonable means
prior to 60 days after the cessation.

  Moreover, your license from a particular copyright holder is
reinstated permanently if the copyright holder notifies you of the
violation by some reasonable means, this is the first time you have
received notice of violation of this License (for any work) from that
copyright holder, and you cure the violation prior to 30 days after
your receipt of the notice.

  Termination of your rights under this section does not terminate the
licenses of parties who have received copies or rights from you under
this License. If your rights have been terminated and not permanently
reinstated, you do not qualify to receive new licenses for the same
material under section 10.

  9. Acceptance Not Required for Having Copies.

  You are not required to accept this License in order to receive or
run a copy of the Program. Ancillary propagation of a covered work
occurring solely as a consequence of using peer-to-peer transmission
to receive a copy likewise does not require acceptance. However,
nothing other than this License grants you permission to propagate or
modify any covered work. These actions infringe copyright if you do
not accept this License. Therefore, by modifying or propagating a
covered work, you indicate your acceptance of this License to do so.

10. Automatic Licensing of Downstream Recipients.

Each time you convey a covered work, the recipient automatically receives a license from the original licensors, to run, modify and propagate that work, subject to this License. You are not responsible for enforcing compliance by third parties with this License.

An "entity transaction" is a transaction transferring control of an organization, or substantially all assets of one, or subdividing an organization, or merging organizations. If propagation of a covered work results from an entity transaction, each party to that transaction who receives a copy of the work also receives whatever licenses to the work the party's predecessor in interest had or could give under the previous paragraph, plus a right to possession of the Corresponding Source of the work from the predecessor in interest, if the predecessor has it or can get it with reasonable efforts.

You may not impose any further restrictions on the exercise of the rights granted or affirmed under this License. For example, you may not impose a license fee, royalty, or other charge for exercise of rights granted under this License, and you may not initiate litigation (including a cross-claim or counterclaim in a lawsuit) alleging that any patent claim is infringed by making, using, selling, offering for sale, or importing the Program or any portion of it.

11. Patents.

A "contributor" is a copyright holder who authorizes use under this License of the Program or a work on which the Program is based. The work thus licensed is called the contributor's "contributor version".

A contributor's "essential patent claims" are all patent claims owned or controlled by the contributor, whether already acquired or hereafter acquired, that would be infringed by some manner, permitted by this License, of making, using, or selling its contributor version, but do not include claims that would be infringed only as a consequence of further modification of the contributor version. For purposes of this definition, "control" includes the right to grant patent sublicenses in a manner consistent with the requirements of this License.

Each contributor grants you a non-exclusive, worldwide, royalty-free patent license under the contributor's essential patent claims, to make, use, sell, offer for sale, import and otherwise run, modify and propagate the contents of its contributor version.

In the following three paragraphs, a "patent license" is any express agreement or commitment, however denominated, not to enforce a patent (such as an express permission to practice a patent or covenant not to sue for patent infringement). To "grant" such a patent license to a party means to make such an agreement or commitment not to enforce a patent against the party.

If you convey a covered work, knowingly relying on a patent license, and the Corresponding Source of the work is not available for anyone to copy, free of charge and under the terms of this License, through a publicly available network server or other readily accessible means, then you must either (1) cause the Corresponding Source to be so available, or (2) arrange to deprive yourself of the benefit of the patent license for this particular work, or (3) arrange, in a manner consistent with the requirements of this License, to extend the patent license to downstream recipients. "Knowingly relying" means you have actual knowledge that, but for the patent license, your conveying the covered work in a country, or your recipient's use of the covered work in a country, would infringe one or more identifiable patents in that country that you have reason to believe are valid.

If, pursuant to or in connection with a single transaction or arrangement, you convey, or propagate by procuring conveyance of, a covered work, and grant a patent license to some of the parties receiving the covered work authorizing them to use, propagate, modify or convey a specific copy of the covered work, then the patent license you grant is automatically extended to all recipients of the covered work and works based on it.

A patent license is "discriminatory" if it does not include within the scope of its coverage, prohibits the exercise of, or is conditioned on the non-exercise of one or more of the rights that are specifically granted under this License. You may not convey a covered work if you are a party to an arrangement with a third party that is in the business of distributing software, under which you make payment to the third party based on the extent of your activity of conveying the work, and under which the third party grants, to any of the parties who would receive the covered work from you, a discriminatory patent license (a) in connection with copies of the covered work conveyed by you (or copies made from those copies), or (b) primarily for and in connection with specific products or compilations that contain the covered work, unless you entered into that arrangement, or that patent license was granted, prior to 28 March 2007.

Nothing in this License shall be construed as excluding or limiting

any implied license or other defenses to infringement that may
otherwise be available to you under applicable patent law.

12. No Surrender of Others' Freedom.

If conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot convey a covered work so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not convey it at all. For example, if you agree to terms that obligate you to collect a royalty for further conveying from those to whom you convey the Program, the only way you could satisfy both those terms and this License would be to refrain entirely from conveying the Program.

13. Use with the GNU Affero General Public License.

Notwithstanding any other provision of this License, you have permission to link or combine any covered work with a work licensed under version 3 of the GNU Affero General Public License into a single combined work, and to convey the resulting work. The terms of this License will continue to apply to the part which is the covered work, but the special requirements of the GNU Affero General Public License, section 13, concerning interaction through a network will apply to the combination as such.

14. Revised Versions of this License.

The Free Software Foundation may publish revised and/or new versions of the GNU General Public 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.

Each version is given a distinguishing version number. If the Program specifies that a certain numbered version of the GNU General Public License "or any later version" applies to it, you have the option of following the terms and conditions either of that numbered version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of the GNU General Public License, you may choose any version ever published by the Free Software Foundation.

If the Program specifies that a proxy can decide which future versions of the GNU General Public License can be used, that proxy's public statement of acceptance of a version permanently authorizes you to choose that version for the Program.

Later license versions may give you additional or different permissions. However, no additional obligations are imposed on any author or copyright holder as a result of your choosing to follow a later version.

15. Disclaimer of Warranty.

THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

16. Limitation of Liability.

IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MODIFIES AND/OR CONVEYS THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

17. Interpretation of Sections 15 and 16.

If the disclaimer of warranty and limitation of liability provided above cannot be given local legal effect according to their terms, reviewing courts shall apply local law that most closely approximates an absolute waiver of all civil liability in connection with the Program, unless a warranty or assumption of liability accompanies a copy of the Program in return for a fee.

END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Programs

If you develop a new program, and you want it to be of the greatest possible use to the public, the best way to achieve this is to make it free software which everyone can redistribute and change under these terms.

```
  To do so, attach the following notices to the program.  It is safest
to attach them to the start of each source file to most effectively
state the exclusion of warranty; and each file should have at least
the "copyright" line and a pointer to where the full notice is found.

    <one line to give the program's name and a brief idea of what it does.>
    Copyright (C) <year>  <name of author>

    This program is free software: you can redistribute it and/or modify
    it under the terms of the GNU General Public License as published by
    the Free Software Foundation, either version 3 of the License, or
    (at your option) any later version.

    This program is distributed in the hope that it will be useful,
    but WITHOUT ANY WARRANTY; without even the implied warranty of
    MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
    GNU General Public License for more details.

    You should have received a copy of the GNU General Public License
    along with this program.  If not, see <http://www.gnu.org/licenses/>.

Also add information on how to contact you by electronic and paper mail.

  If the program does terminal interaction, make it output a short
notice like this when it starts in an interactive mode:

    <program>  Copyright (C) <year>  <name of author>
    This program comes with ABSOLUTELY NO WARRANTY; for details type `show w'.
    This is free software, and you are welcome to redistribute it
    under certain conditions; type `show c' for details.

The hypothetical commands `show w' and `show c' should show the appropriate
parts of the General Public License.  Of course, your program's commands
might be different; for a GUI interface, you would use an "about box".

  You should also get your employer (if you work as a programmer) or school,
if any, to sign a "copyright disclaimer" for the program, if necessary.
For more information on this, and how to apply and follow the GNU GPL, see
<http://www.gnu.org/licenses/>.

  The GNU General Public License does not permit incorporating your program
into proprietary programs.  If your program is a subroutine library, you
may consider it more useful to permit linking proprietary applications with
the library.  If this is what you want to do, use the GNU Lesser General
Public License instead of this License.  But first, please read
```

<http://www.gnu.org/philosophy/why-not-lgpl.html>.

B.2 Creative Commons Attribution-ShareAlike 4.0 International

Creative Commons Corporation ("Creative Commons") is not a law firm and does not provide legal services or legal advice. Distribution of Creative Commons public licenses does not create a lawyer-client or other relationship. Creative Commons makes its licenses and related information available on an "as-is" basis. Creative Commons gives no warranties regarding its licenses, any material licensed under their terms and conditions, or any related information. Creative Commons disclaims all liability for damages resulting from their use to the fullest extent possible.

Using Creative Commons Public Licenses

Creative Commons public licenses provide a standard set of terms and conditions that creators and other rights holders may use to share original works of authorship and other material subject to copyright and certain other rights specified in the public license below. The following considerations are for informational purposes only, are not exhaustive, and do not form part of our licenses.

> Considerations for licensors: Our public licenses are intended for use by those authorized to give the public permission to use material in ways otherwise restricted by copyright and certain other rights. Our licenses are irrevocable. Licensors should read and understand the terms and conditions of the license they choose before applying it. Licensors should also secure all rights necessary before applying our licenses so that the public can reuse the material as expected. Licensors should clearly mark any material not subject to the license. This includes other CC-licensed material, or material used under an exception or limitation to copyright. More considerations for licensors:
> wiki.creativecommons.org/Considerations_for_licensors

Considerations for the public: By using one of our public licenses, a licensor grants the public permission to use the licensed material under specified terms and conditions. If the licensor's permission is not necessary for any reason--for example, because of any applicable exception or limitation to copyright--then that use is not regulated by the license. Our licenses grant only permissions under copyright and certain other rights that a licensor has authority to grant. Use of the licensed material may still be restricted for other reasons, including because others have copyright or other rights in the material. A licensor may make special requests, such as asking that all changes be marked or described. Although not required by our licenses, you are encouraged to respect those requests where reasonable. More considerations for the public:
wiki.creativecommons.org/Considerations_for_licensees

==========

Creative Commons Attribution-ShareAlike 4.0 International Public License

By exercising the Licensed Rights (defined below), You accept and agree to be bound by the terms and conditions of this Creative Commons Attribution-ShareAlike 4.0 International Public License ("Public License"). To the extent this Public License may be interpreted as a contract, You are granted the Licensed Rights in consideration of Your acceptance of these terms and conditions, and the Licensor grants You such rights in consideration of benefits the Licensor receives from making the Licensed Material available under these terms and conditions.

Section 1 -- Definitions.

a. Adapted Material means material subject to Copyright and Similar Rights that is derived from or based upon the Licensed Material and in which the Licensed Material is translated, altered, arranged, transformed, or otherwise modified in a manner requiring permission under the Copyright and Similar Rights held by the Licensor. For purposes of this Public License, where the Licensed Material is a musical work, performance, or sound recording, Adapted Material is always produced where the Licensed Material is synched in timed relation with a moving image.

b. Adapter's License means the license You apply to Your Copyright and Similar Rights in Your contributions to Adapted Material in accordance with the terms and conditions of this Public License.

c. BY-SA Compatible License means a license listed at creativecommons.org/compatiblelicenses, approved by Creative Commons as essentially the equivalent of this Public License.

d. Copyright and Similar Rights means copyright and/or similar rights closely related to copyright including, without limitation, performance, broadcast, sound recording, and Sui Generis Database Rights, without regard to how the rights are labeled or categorized. For purposes of this Public License, the rights specified in Section 2(b)(1)-(2) are not Copyright and Similar Rights.

e. Effective Technological Measures means those measures that, in the absence of proper authority, may not be circumvented under laws fulfilling obligations under Article 11 of the WIPO Copyright Treaty adopted on December 20, 1996, and/or similar international agreements.

f. Exceptions and Limitations means fair use, fair dealing, and/or any other exception or limitation to Copyright and Similar Rights that applies to Your use of the Licensed Material.

g. License Elements means the license attributes listed in the name of a Creative Commons Public License. The License Elements of this Public License are Attribution and ShareAlike.

h. Licensed Material means the artistic or literary work, database, or other material to which the Licensor applied this Public License.

i. Licensed Rights means the rights granted to You subject to the terms and conditions of this Public License, which are limited to all Copyright and Similar Rights that apply to Your use of the Licensed Material and that the Licensor has authority to license.

j. Licensor means the individual(s) or entity(ies) granting rights under this Public License.

k. Share means to provide material to the public by any means or process that requires permission under the Licensed Rights, such as reproduction, public display, public performance, distribution, dissemination, communication, or importation, and to make material

available to the public including in ways that members of the public may access the material from a place and at a time individually chosen by them.

l. Sui Generis Database Rights means rights other than copyright resulting from Directive 96/9/EC of the European Parliament and of the Council of 11 March 1996 on the legal protection of databases, as amended and/or succeeded, as well as other essentially equivalent rights anywhere in the world.

m. You means the individual or entity exercising the Licensed Rights under this Public License. Your has a corresponding meaning.

Section 2 -- Scope.

a. License grant.

1. Subject to the terms and conditions of this Public License, the Licensor hereby grants You a worldwide, royalty-free, non-sublicensable, non-exclusive, irrevocable license to exercise the Licensed Rights in the Licensed Material to:

a. reproduce and Share the Licensed Material, in whole or in part; and

b. produce, reproduce, and Share Adapted Material.

2. Exceptions and Limitations. For the avoidance of doubt, where Exceptions and Limitations apply to Your use, this Public License does not apply, and You do not need to comply with its terms and conditions.

3. Term. The term of this Public License is specified in Section 6(a).

4. Media and formats; technical modifications allowed. The Licensor authorizes You to exercise the Licensed Rights in all media and formats whether now known or hereafter created, and to make technical modifications necessary to do so. The Licensor waives and/or agrees not to assert any right or authority to forbid You from making technical modifications necessary to exercise the Licensed Rights, including technical modifications necessary to circumvent Effective Technological Measures. For purposes of this Public License, simply making modifications authorized by this Section 2(a)

(4) never produces Adapted Material.

5. Downstream recipients.

   a. Offer from the Licensor -- Licensed Material. Every recipient of the Licensed Material automatically receives an offer from the Licensor to exercise the Licensed Rights under the terms and conditions of this Public License.

   b. Additional offer from the Licensor -- Adapted Material. Every recipient of Adapted Material from You automatically receives an offer from the Licensor to exercise the Licensed Rights in the Adapted Material under the conditions of the Adapter's License You apply.

   c. No downstream restrictions. You may not offer or impose any additional or different terms or conditions on, or apply any Effective Technological Measures to, the Licensed Material if doing so restricts exercise of the Licensed Rights by any recipient of the Licensed Material.

6. No endorsement. Nothing in this Public License constitutes or may be construed as permission to assert or imply that You are, or that Your use of the Licensed Material is, connected with, or sponsored, endorsed, or granted official status by, the Licensor or others designated to receive attribution as provided in Section 3(a)(1)(A)(i).

b. Other rights.

1. Moral rights, such as the right of integrity, are not licensed under this Public License, nor are publicity, privacy, and/or other similar personality rights; however, to the extent possible, the Licensor waives and/or agrees not to assert any such rights held by the Licensor to the limited extent necessary to allow You to exercise the Licensed Rights, but not otherwise.

2. Patent and trademark rights are not licensed under this Public License.

3. To the extent possible, the Licensor waives any right to collect royalties from You for the exercise of the Licensed Rights, whether directly or through a collecting society

under any voluntary or waivable statutory or compulsory licensing scheme. In all other cases the Licensor expressly reserves any right to collect such royalties.

Section 3 -- License Conditions.

Your exercise of the Licensed Rights is expressly made subject to the following conditions.

a. Attribution.

1. If You Share the Licensed Material (including in modified form), You must:

a. retain the following if it is supplied by the Licensor with the Licensed Material:

i. identification of the creator(s) of the Licensed Material and any others designated to receive attribution, in any reasonable manner requested by the Licensor (including by pseudonym if designated);

ii. a copyright notice;

iii. a notice that refers to this Public License;

iv. a notice that refers to the disclaimer of warranties;

v. a URI or hyperlink to the Licensed Material to the extent reasonably practicable;

b. indicate if You modified the Licensed Material and retain an indication of any previous modifications; and

c. indicate the Licensed Material is licensed under this Public License, and include the text of, or the URI or hyperlink to, this Public License.

2. You may satisfy the conditions in Section 3(a)(1) in any reasonable manner based on the medium, means, and context in which You Share the Licensed Material. For example, it may be reasonable to satisfy the conditions by providing a URI or hyperlink to a resource that includes the required

information.

3. If requested by the Licensor, You must remove any of the information required by Section 3(a)(1)(A) to the extent reasonably practicable.

b. ShareAlike.

In addition to the conditions in Section 3(a), if You Share Adapted Material You produce, the following conditions also apply.

1. The Adapter's License You apply must be a Creative Commons license with the same License Elements, this version or later, or a BY-SA Compatible License.

2. You must include the text of, or the URI or hyperlink to, the Adapter's License You apply. You may satisfy this condition in any reasonable manner based on the medium, means, and context in which You Share Adapted Material.

3. You may not offer or impose any additional or different terms or conditions on, or apply any Effective Technological Measures to, Adapted Material that restrict exercise of the rights granted under the Adapter's License You apply.

Section 4 -- Sui Generis Database Rights.

Where the Licensed Rights include Sui Generis Database Rights that apply to Your use of the Licensed Material:

a. for the avoidance of doubt, Section 2(a)(1) grants You the right to extract, reuse, reproduce, and Share all or a substantial portion of the contents of the database;

b. if You include all or a substantial portion of the database contents in a database in which You have Sui Generis Database Rights, then the database in which You have Sui Generis Database Rights (but not its individual contents) is Adapted Material,

including for purposes of Section 3(b); and

c. You must comply with the conditions in Section 3(a) if You Share all or a substantial portion of the contents of the database.

For the avoidance of doubt, this Section 4 supplements and does not replace Your obligations under this Public License where the Licensed

Rights include other Copyright and Similar Rights.

Section 5 -- Disclaimer of Warranties and Limitation of Liability.

a. UNLESS OTHERWISE SEPARATELY UNDERTAKEN BY THE LICENSOR, TO THE EXTENT POSSIBLE, THE LICENSOR OFFERS THE LICENSED MATERIAL AS-IS AND AS-AVAILABLE, AND MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND CONCERNING THE LICENSED MATERIAL, WHETHER EXPRESS, IMPLIED, STATUTORY, OR OTHER. THIS INCLUDES, WITHOUT LIMITATION, WARRANTIES OF TITLE, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NON-INFRINGEMENT, ABSENCE OF LATENT OR OTHER DEFECTS, ACCURACY, OR THE PRESENCE OR ABSENCE OF ERRORS, WHETHER OR NOT KNOWN OR DISCOVERABLE. WHERE DISCLAIMERS OF WARRANTIES ARE NOT ALLOWED IN FULL OR IN PART, THIS DISCLAIMER MAY NOT APPLY TO YOU.

b. TO THE EXTENT POSSIBLE, IN NO EVENT WILL THE LICENSOR BE LIABLE TO YOU ON ANY LEGAL THEORY (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE) OR OTHERWISE FOR ANY DIRECT, SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL, PUNITIVE, EXEMPLARY, OR OTHER LOSSES, COSTS, EXPENSES, OR DAMAGES ARISING OUT OF THIS PUBLIC LICENSE OR USE OF THE LICENSED MATERIAL, EVEN IF THE LICENSOR HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH LOSSES, COSTS, EXPENSES, OR DAMAGES. WHERE A LIMITATION OF LIABILITY IS NOT ALLOWED IN FULL OR IN PART, THIS LIMITATION MAY NOT APPLY TO YOU.

c. The disclaimer of warranties and limitation of liability provided above shall be interpreted in a manner that, to the extent possible, most closely approximates an absolute disclaimer and waiver of all liability.

Section 6 -- Term and Termination.

a. This Public License applies for the term of the Copyright and Similar Rights licensed here. However, if You fail to comply with this Public License, then Your rights under this Public License terminate automatically.

b. Where Your right to use the Licensed Material has terminated under Section 6(a), it reinstates:

    1. automatically as of the date the violation is cured, provided it is cured within 30 days of Your discovery of the violation; or

2. upon express reinstatement by the Licensor.

For the avoidance of doubt, this Section 6(b) does not affect any right the Licensor may have to seek remedies for Your violations of this Public License.

c. For the avoidance of doubt, the Licensor may also offer the Licensed Material under separate terms or conditions or stop distributing the Licensed Material at any time; however, doing so will not terminate this Public License.

d. Sections 1, 5, 6, 7, and 8 survive termination of this Public License.

Section 7 -- Other Terms and Conditions.

a. The Licensor shall not be bound by any additional or different terms or conditions communicated by You unless expressly agreed.

b. Any arrangements, understandings, or agreements regarding the Licensed Material not stated herein are separate from and independent of the terms and conditions of this Public License.

Section 8 -- Interpretation.

a. For the avoidance of doubt, this Public License does not, and shall not be interpreted to, reduce, limit, restrict, or impose conditions on any use of the Licensed Material that could lawfully be made without permission under this Public License.

b. To the extent possible, if any provision of this Public License is deemed unenforceable, it shall be automatically reformed to the minimum extent necessary to make it enforceable. If the provision cannot be reformed, it shall be severed from this Public License without affecting the enforceability of the remaining terms and conditions.

c. No term or condition of this Public License will be waived and no failure to comply consented to unless expressly agreed to by the Licensor.

d. Nothing in this Public License constitutes or may be interpreted as a limitation upon, or waiver of, any privileges and immunities that apply to the Licensor or You, including from the legal

processes of any jurisdiction or authority.

==========

Creative Commons is not a party to its public
licenses. Notwithstanding, Creative Commons may elect to apply one of its public licenses to material it publishes and in those instances will be considered the \Licensor." The text of the Creative Commons public licenses is dedicated to the public domain under the CC0 Public Domain Dedication. Except for the limited purpose of indicating that material is shared under a Creative Commons public license or as otherwise permitted by the Creative Commons policies published at creativecommons.org/policies, Creative Commons does not authorize the use of the trademark "Creative Commons" or any other trademark or logo of Creative Commons without its prior written consent including, without limitation, in connection with any unauthorized modifications to any of its public licenses or any other arrangements, understandings, or agreements concerning use of licensed material. For the avoidance of doubt, this paragraph does not form part of the public licenses.

Creative Commons may be contacted at creativecommons.org.