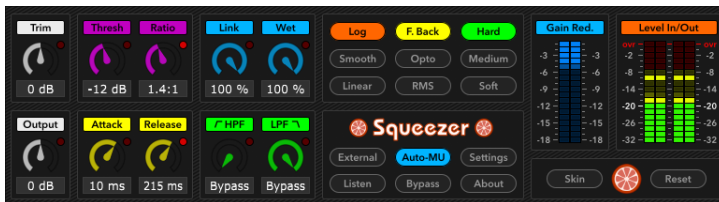


Squeezer

Flexible general-purpose audio compressor
with a touch of citrus



Last edited on 13th April 2020



This documentation by [Martin Zuther](#) is licensed under a [Creative Commons Attribution-ShareAlike 4.0 International License](#) with the exception of trademark logos.



VST is a trademark of Steinberg Media Technologies GmbH, registered in Europe and other countries.

Contents

1	About Squeezer	6
2	What is compression?	8
2.1	The Tale of the Barkeeper	8
2.2	How does a compressor work?	10
2.3	Level detector	11
2.4	Gain computer	11
2.5	Smoothing filter	12
2.5.1	Attack and release time	14
2.5.2	Curve shape	16
2.6	Gain stage	16
2.7	Advanced topics	17
2.7.1	Stereo linking	17
2.7.2	Parallel compression	17
2.7.3	Side-chain filtering	18
2.7.4	External side-chain input	18
3	Installation	20
4	Troubleshooting	21
5	Knobs	22
5.1	Unlock knobs	22

Contents

5.2	Threshold and compression ratio	23
5.3	Attack and release time	23
5.4	Input trim and output gain	24
5.5	Stereo linking and wet/dry ratio	25
5.6	Side-chain filters	25
6	Buttons	26
6.1	Release curve type	26
6.2	Detector placement	26
6.3	RMS filter	27
6.4	Detector type	27
6.5	Knee width	27
6.6	External side-chain	28
6.7	Listen to side-chain	28
6.8	Automatic make-up gain	28
6.9	Bypass compression	29
6.10	Reset button	29
6.11	Select a skin	29
6.12	View and copy settings	30
6.13	About button	30
6.14	Display license	30
7	Meters	31
7.1	Input and output level	31
7.2	Gain reduction	31
8	Final words	32
A	Build Squeezer	34
A.1	Dependencies	34
A.1.1	premake	34

Contents

A.1.2	JUCE library	35
A.1.3	Virtual Studio Technology SDK	35
A.1.4	Python	36
A.1.5	Jinja	36
A.1.6	Artistic Style	37
A.2	GNU/Linux	38
A.2.1	Environment	38
A.2.2	Build	41
A.3	Microsoft Windows	42
A.3.1	Build	42
B	licenses	43
B.1	GNU General Public License	43
B.2	Creative Commons Attribution-ShareAlike 4.0 International	58

1 About Squeezer

I wrote this compressor¹ to learn all I could about audio compression. It took me several months to gather all the specs and papers I needed and convert them into code.

Squeezer is different from all the compressors I know: its knobs are stepped to fine-tuned *preset* values, but can be changed to *continuous* values by clicking a small orange light located next to them. This allows you to find nice settings fast while not preventing optimisation of settings.

Squeezer adapts easily to many tastes and use cases:

- feed-forward & feed-back design
- linear, logarithmic & smooth release stage
- optical & FET detectors
- peak & RMS sensing
- hard, medium & soft knee
- flexible side-chain & parallel compression

¹In this manual, I will use *compression* synonymous with *downward compression*. There are other ways to reduce dynamic range, but in audio, downward compression is used almost exclusively.

About Squeezer

Squeezer has given me a deep insight into compression. But above that, it has quickly become my go-to generic compressor.

I hope that you have as much fun with Squeezer as I had when I coded it!

2 What is compression?

2.1 The Tale of the Barkeeper

Once upon a time there was a bar. Customers enjoyed their drinks and music played in the background. After a while, the barkeeper noticed that his drinks sold best when the music had a certain loudness. Unfortunately, almost every record they played had a different loudness.

So he bought a loudness meter and wrote a set of instructions for the DJ:

- 80 dB SPL** set mixer's output gain to 0 dB
- 85 dB SPL** set mixer's output gain to -5 dB
- 90 dB SPL** set mixer's output gain to -10 dB
- 95 dB SPL** set mixer's output gain to -15 dB

This worked quite well and he could finally afford to buy a shiny new bar counter. Upon which the DJ gave notice (he had always dreamt of getting a *stereo* mixer, so the new counter didn't go down too well with him).

After an initial shock, the barkeeper was quite content. The DJ really *had* been lousy. But how to keep the impressive sales figures for his drinks?

Being an entrepreneur, the barkeeper loved challenges and connected the mixer's output to a simple amplifier. The amplifier's gain was regulated by a level sensor which in turn was connected to the amplifier's output.¹

Although the new device exactly followed the DJ's instructions (and didn't smell as bad), customers complained about a decline in sound quality. The barkeeper had invented a *wave shaping* device – gain changes were applied instantly which *distorted* its output signal.

Fortunately, the barkeeper remembered a very important thing: the DJ had often been drunk and taken his time to apply gain changes. So the barkeeper improved his device by smoothing the level sensor's output.

He could have become very rich. But he didn't realise the magnitude of his invention and continued being a happy barkeeper. Which is not the worst thing, when you come to think of it.

To this day, however, sound engineers fall silent in awe when they hear his name – the name of the barkeeper who **invented the compressor**.

¹engineers call this a negative feed-back loop

2.2 How does a compressor work?

Compressors are inherently complex sound processors. Their technology is quite simple – complexity arises from the dynamic interaction of their controls. While this is definitely a downside when you try to understand compression, it is also what allows you to use compression creatively!

A compressor is a device for reducing the dynamic range² of audio material. In its most basic form, it consists of four modules:

Level detector	measures level of audio at its input and sends it to gain computer
Gain computer	calculates difference between input level and desired output level and sends resulting <i>target</i> gain reduction to smoothing filter
Smoothing filter	smoothly adjusts <i>current</i> gain reduction in direction of <i>target</i> reduction and sends result to gain stage; the “speed” of smoothing can often be adjusted (<i>attack and release times</i>)
Gain stage	attenuates audio input by <i>current</i> gain reduction

The first three modules are also called *side-chain*. That’s because they form a sideline of processing that will only be *utilised for*, but not *heard in* the compressor’s output.

²difference between loudest and quietest signal

2.3 Level detector

As its name implies, a level detector senses the level of an audio signal. It can either detect the input wave form directly (peak sensing) or an estimate of its loudness (average sensing, usually with a RMS³ filter).

Peak sensing allows a compressor to quickly react to sudden changes in level, whereas *average sensing* detects changes over longer periods of time.

There are also two ways of connecting level detectors: vintage compressors sense the gain stage's *output* level (feedback design), leading to a very distinct “bouncing” sound. Modern compressors sense the compressor's *input* signal (feed-forward design) which often results in a more natural sound.

2.4 Gain computer

The level detector's signal is sent to a gain computer⁴ which determines the output level the signal should have. It then calculates a corresponding gain reduction (“attenuate the current input signal by 3.14 dB”). This **gain reduction constantly changes** over time.

³root mean square

⁴in the sense of *calculator* – some gain computers are entirely built from analogue circuitry!

The most common gain computer design is a *threshold* control. It sets a level below which all input passes unchanged. Levels exceeding the threshold are attenuated by a *compression ratio*, set through a second control. Higher ratios effect more compression than lower ratios.⁵

Need an example? A threshold of -20 dB FS yields a gain reduction of 0 dB (no compression) for all levels below -20 dB FS. A signal of -18 dB FS however will produce a gain reduction of 1 dB for a compression ratio of 2:1⁶ and 0.5 dB for a ratio of 4:1.

There may be a third control called *knee width*. It defines a transition zone around the threshold. In this zone, the compression ratio gradually changes from 1:1 (no compression) to the selected ratio (full compression) – quieter signals receive less compression than louder ones. This reduces distortion caused by abrupt transitions between compressed and uncompressed signal.

2.5 Smoothing filter

This was the easy part, but from now on most explanations start to fail. I'll try my best and continue anyway...

If you stopped here and let the gain computer control the gain stage directly, you'd have a wave shaping device.⁷ By

⁵a compression ratio of 1:1 effectively bypasses the compressor

⁶a ratio of 2:1 means that 2 dB on the input yields 1 dB at the output

⁷*wave shaping* is a fancy way of saying *distortion*

reacting immediately, the compressor would relentlessly change the shape of *single wave forms*. Don't get me wrong: this already *is* compression and I occasionally *do* like its sound – but it's not something you want to have on every track, let alone a full mix.

Listen for yourself! Load a drum track into your DAW, add the Squeezer plug-in, unlock attack and release time⁸ and set them to the lowest possible value. Make sure the compressor uses peak sensing⁹ and a high compression ratio. Now lower the threshold until you can clearly hear the wave shaping. Keep the DAW open for now.

To change *sounds* instead of *single wave forms*, the *current* gain reduction has to be slowed down and smoothly adjusted in the direction of the *target* gain reduction.

One possibility is using averaging level detectors,¹⁰ employing photo (“optical” or “opto”) cells is another.¹¹ Both solutions effectively slow down the compressor's response time, but somewhat crudely.

Play the drum track and engage the “RMS” button – the distortion vanishes. Disengage the “RMS” button and enable the “Opto” button instead – again, the distortion vanishes, but the track sounds different. You can now close the DAW.

⁸click on the orange light next to a knob so it lights up

⁹“RMS” button is not engaged

¹⁰this is *not* the reason why compressors have averaging level detectors; they let compressors react to changes in *loudness*

¹¹photo cells react to level changes in complex time-dependant ways

2.5.1 Attack and release time

With a little experimentation, it becomes clear that compressors sound best when gain reduction is increased quickly, but released much more slowly.¹² Moreover, a single smoothing “speed” could not accommodate the many different types of sound we encounter. So it makes sense to split response time into (at least) two controls:

Attack is the length of time it takes to apply roughly¹³ two-thirds of an *upward* change in gain reduction.

Release is the length of time it takes to apply roughly two-thirds of a *downward* change in gain reduction.¹⁴

With this in mind, here are the important facts that almost every explanation gets wrong:¹⁵

- compression starts **the very moment the detected level passes threshold**, it is not delayed by attack time
- compression continues **even after the detected level falls below threshold**, at least for a short while
- compression occurs **whenever current and target gain reduction differ**; this means **all of the time the detected level is above threshold** and slightly after

¹²incidentally, that is *exactly* how vintage photo cells react to changes

¹³every manufacturer defines attack and release times differently

¹⁴these definitions were shamelessly paraphrased from [Demolishing the Myths of Compression](#) by Gregory Scott, one of the few articles on compression actually worth reading; I also highly recommend working through Bob Katz’s book [Mastering Audio](#)

¹⁵for simplicity, I will elide the effects of knee width

The last list item may need some explanation. Imagine a signal above threshold.¹⁶

Whenever the signal's slope is rising, *current* gain reduction will fall below *target* gain reduction and will be smoothed using the *attack* time. Even when the slope starts to drop, *current* gain reduction may still be below *target* gain reduction and will be affected by the attack time.

If the slope keeps falling, *current* gain reduction will eventually rise above *target* gain reduction and will be smoothed according to the *release* time. This continues until the slope starts to rise again and *current* gain reduction falls below *target* gain reduction. Now, the *attack* time will once again take over.

In other words: with any real-world audio signal, compressors enter an ever-changing dynamic state as soon as the input signal passes threshold. This is what makes them so hard to explain – and I'm quite confident that it is also what makes them sound so damn good.

The good news is that you can use compressors without fully understanding this dynamic state. However, the information contained in this chapter will help you in ignoring the countless erroneous explanations out there.¹⁷

¹⁶with a compression ratio above 1:1 and below 1:∞

¹⁷they were the reason for developing Squeezer in the first place

2.5.2 Curve shape

Attack and release times can be implemented in a number of ways. Vintage compressors use simple analogue filters with *logarithmic* curves. Speed depends on the difference between *current* and *target* gain reduction – initial change is fast and slows down as the difference gets smaller.

Newer compressors often have *linear* curves – the *target* gain reduction is approached with constant speed.

In Squeezer, attack phase always has a *logarithmic* curve. The curve of its release phase can be set to *linear*, *logarithmic* or *smooth*. *Smooth* behaves like a logarithmic curve, but when an attack phase changes to release, a smooth transition between the curves prevents a sharp drop in gain reduction. This reduces yet another type of distortion exhibited by compressors.

It is hard to say which curve sounds best, as it really depends on source material and personal taste.

2.6 Gain stage

The gain stage is an amplifier that attenuates the input signal using the *current* gain reduction. There may be an additional gain control to make up for any level lost during compression (also called *make-up gain*).

That's it.

2.7 Advanced topics

2.7.1 Stereo linking

When each channel of a stereo signal is compressed separately, the stereo image may shift uncontrollably. This can be prevented by mixing the outputs of all level detectors and sending the *mixed* signal to each gain computer.

Squeezer automatically links its channels when placed on a stereo channel. Occasionally, you may want to override this behaviour, so Squeezer lets you control the amount of stereo linking.

2.7.2 Parallel compression

So far, I have described *downward* compression. As you know, it works by bringing high-level signals down and leaving low-level signals untouched. In other words, downward compression changes – and possibly damages – the *transients*.

This may not be what you want, so *upward* compression works the other way round. Low-level signals are brought up and high-level signals are left alone. This approach has a huge problem, though – it also amplifies the noise floor! This is probably the reason why I have never seen an upward compressor in the wild ...

Parallel compression¹⁸ is similar to *upward* compression, but it preserves transients *and* leaves the noise floor alone. Here is how it works: you compress a signal (often heavily) and add some of the compressed signal to the original.

Squeezer provides a latency-compensated *wet/dry* control that allows you to apply parallel compression easily.

2.7.3 Side-chain filtering

Bass frequencies contain most of a signal's energy, so bus compression will often “pump” in the rhythm of the bass instruments.¹⁹ A filter that removes bass frequencies (*high-pass* filter) from the side-chain helps in achieving better compression results.

Squeezer also provides a *low-pass* filter to remove treble frequencies, although this is used less often. For frequency-specific compression, you can leave only desired frequencies by employing both filters simultaneously.

2.7.4 External side-chain input

Squeezer also lets you feed an external input into the side-chain. You can use this either for advanced filtering or as an

¹⁸also known as *New York compression*, but in this case, the signal is also equalised prior to compression

¹⁹in addition, music tends to contain more bass frequencies than treble as the human ear is least sensitive to bass frequencies

effect. In electronic dance music, compressor “pumping” triggered by the bass drum has become rather cliché . . .

Depending on your DAW, setting up an external side-chain can be simple or highly complicated. I cannot (and will not) help you with it, so please refer to your DAW’s manual or manufacturer. I will however provide some information to get you started.

The input channels of Squeezer’s stand-alone application and VST2 plug-in are *doubled* and divided into main inputs (first half of the channels) and side-chain inputs (second half).

The other plug-in formats are properly tagged. They notify your DAW about each channel’s role and should work without problem.

3 Installation

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

VST2 plug-ins with “no side-chain” in their name lack the external side-chain input. Use them if your DAW behaves erratically with the “regular” VST2 plug-ins.

Squeezer 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 the file Squeezer (Stereo).settings or Squeezer (Mono).settings. These files are located in ~/.config (GNU/Linux) or %appdata%\config\ (Windows).

4 Troubleshooting

My DAW acts weirdly if I insert Squeezer (VST2).

VST2 doesn't support side-chains, so I had to use a hack. It works with a few DAWs, but **FL Studio** for example outputs a mono signal if you insert a stereo instance of Squeezer.

Please use the VST2 plug-ins with “no side-chain” in their name – they disable external side-chain input. In case you need an external side-chain, please use VST3 plug-ins (VST3 officially supports side-chains).

5 Knobs

Double-click a knob to reset it to its default position. For finer control, hold the *Ctrl* key when turning a knob.

5.1 Unlock knobs

By default, Squeezer's knobs are stepped to *preset* values. I have invested a lot of time to fine-tune these values and ensure that they are useful in practice.



If you need finer control, however, every knob can be changed to *continuous* values. Just click the small orange light located in its upper right corner.

Depending on your action, Squeezer either preserves your current setting or snaps to the value closest to it.

5.2 Threshold and compression ratio

These knobs control **threshold** and compression ratio.

A **compression ratio** of 2:1 means that 1 dB on the input yields 0.5 dB at the output. Thus, a setting of 1:1 effectively disables Squeezer.



You can set this knob to values below 1:1. This transforms Squeezer into an *upward expander* – an **expansion ratio** of 0.5:1 means that 1 dB on the input yields 2 dB at the output. This allows you to *add transients* to boring and over-compressed recordings.

Note: upward expansion can massively *increase* the output level, so take care of you ears – especially when you switch from compression to expansion!

5.3 Attack and release time

Change attack and release time using these two knobs.

Attack is the length of time it takes to apply 90 % of an upward change in gain reduction.



Release is the length of time it takes to apply 90 % of a downward change in gain reduction (*logarithmic* and

smooth curves). Alternatively, this is the length of time it takes gain reduction to fall by 10 dB (*linear* curve).¹

5.4 Input trim and output gain

Trim changes Squeezer's input gain without affecting its output level. *You can also think of this as attenuating threshold by the value of trim.*



Output controls output gain (also called make-up gain). There are several use cases:

- use *output gain* to match the loudness of compressed and direct signal before comparing them²
- set the threshold to a fixed value and control Squeezer *vintage style* by changing *trim* and *output gain* only
- use *trim* for gain staging to improve automatic make-up gain ([section 6.8](#))
- if Squeezer sounds well and the level of the incoming signal changes for some reason, it may be more obvious to adjust *trim* instead of *threshold*

¹often called release *rate* because the actual release *time* depends on the amount of applied gain reduction; linear release curves can sound very different from logarithmic ones

²the brain perceives a louder signal to sound better than a quieter one

5.5 Stereo linking and wet/dry ratio

Link controls the amount of stereo linking.³ 100 % enforces full linking, whereas 0 % disables linking and processes every channel independently.



Wet controls the ratio between wet (compressed) and dry (uncompressed) signal. When set to 100 %, you hear only compressed signal. A value of 50 % yields an equal mix of compressed and direct signal, and 0 % effectively bypasses Squeezer.

Mixing is latency-compensated, so you can use the wet control to employ *parallel compression*.

5.6 Side-chain filters

The side-chain is equipped with a high-pass filter and a low-pass filter. These knobs control their **cutoff frequencies**.



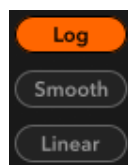
Both filters are connected in series so you can use them simultaneously to remove everything but a specific band of frequencies.

³Squeezer does not support mid/side processing

6 Buttons

6.1 Release curve type

Attack phase always has a *logarithmic* curve. Use these buttons to change the *release phase*. All options (**linear**, **logarithmic** and **smooth** curve) are detailed in [section 2.5.2](#).



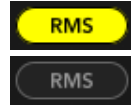
6.2 Detector placement

Engaging the **feed-back** button places the level detector at the gain stage's output. Otherwise, the detector is fed with the uncompressed input signal (**feed-forward**).



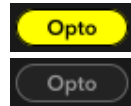
6.3 RMS filter

This button switches the detector between peak-sensing and average-sensing using an **RMS** filter (window size of 30 ms). RMS filter and the “Opto” detector type are independent – both buttons can be engaged at the same time.



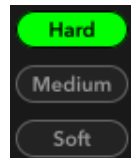
6.4 Detector type

Engage this button to switch between the linear response of a field-effect transistor (**FET**) and a photo cell emulation (**Opto**). Detector type and “RMS” filter are independent – both buttons can be engaged at the same time.



6.5 Knee width

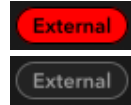
These buttons let you select the compressor’s knee width. **Hard** abruptly transitions between compressed and uncompressed signal at the threshold. **Medium** sets a knee width of 24 dB¹ and **soft** a knee width of 48 dB.



¹transition zone starts 12 dB below threshold and ends 12 dB above

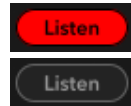
6.6 External side-chain

Use this button to feed Squeezer's side-chain with an **external** signal. For more information, please see [section 2.7.4](#).



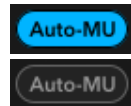
6.7 Listen to side-chain

Listen to the internal or external side-chain by clicking this button. If you have engaged the side-chain filters, you will hear the *filtered* signal.



6.8 Automatic make-up gain

When this button is engaged, Squeezer tries to counter the jumps in level caused by changing threshold and compression ratio.



Implementing **automatic make-up gain** is an exercise in compromise, so its quality depends on the incoming signal's level (among a lot of other factors). Changing input trim ([section 5.4](#)) can sometimes improve results.

6.9 Bypass compression

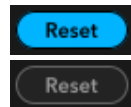
Click on this button to **bypass** Squeezer. I regard this as the most important control of any compressor, as its easy to *deteriorate* a signal by compression without noticing it.



Thus, I recommend matching the levels of compressed and uncompressed signal (see [section 5.4](#)) and comparing them by toggling the bypass button.

6.10 Reset button

A click on this button **resets** all meters. This action will also reload the current skin and re-draw everything.



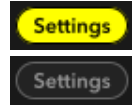
6.11 Select a skin

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



6.12 View and copy settings

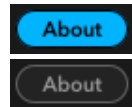
Display all of Squeezer's **settings** with a click on this button. This information is also copied to the clipboard for pasting into a text editor.



I wrote Squeezer while attending a course on compression and this feature made my life much easier.

6.13 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.



6.14 Display license

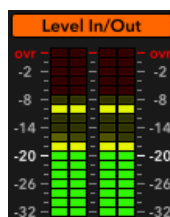
This button is located in the **about window** and does not only advertise that you are using free software licensed under the **GNU General Public License** – when clicked, it will also open the license's website in your browser ...



7 Meters

7.1 Input and output level

Squeezer's **level meters** consist of an average level meter (coloured bar) and a peak level meter (single coloured segment riding on top). The meters are divided into steps of 2 dB and exhibit a flat frequency response.

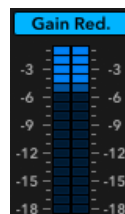


The *average* level meter reaches 99 % of the final reading in 300 ms, whereas the *peak* level meter has a rise time of one sample and a fall time of 8.67 dB/s.

7.2 Gain reduction

The **gain reduction meter** is divided into steps of 1 dB and displays *current* gain reduction. It also indirectly reflects ratio, attack and release time.

The gain reduction meter should always be in motion. If a part of the meter is always lit, consider reducing the threshold.



8 Final words

I want to express my gratitude to the **Audio Engineering Society** and to the **Rane Corporation** for their wonderful E-Libraries. This includes everybody who wrote the fine papers and notes, especially Dimitrios Giannoulis *et al.*¹ and Rick Jeffs *et al.*²

I must also thank the **beta testers** and **users of Squeezer** 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 Squeezer has been a lot of fun, it has also been a lot of work. So if you like Squeezer, why not send me a short 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 ...

¹**Giannoulis, Dimitrios; Massberg, Michael; Reiss, Joshua D.** Digital Dynamic Range Compressor Design – A Tutorial and Analysis. *JAES Volume 60 Issue 6 pp. 399-408; June 2012.*

²**Rick Jeffs; Scott Holden; Dennis Bohn.** Dynamics Processors – Technology & Application Tips. *Rane Corporation; Rane Note 155; 2005.*

Final words

Here is my email address (please remove “-nospam”):

"Martin Zuther" <code-nospam@mzuther.de>

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

A Build Squeezer

A.1 Dependencies

A.1.1 premake

Importance: required

Version: 5.0.0 (alpha13)

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/run_premake.sh` or `Builds/run_premake.bat`.

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

A.1.2 JUCE library

Importance: required

Version: 5.3.2

License: ISC and GPL v3 (among others)

Homepage: www.juce.com

Installation

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

If you want to build the LV2 plug-in, please extract the archive `distrho_lv2-xxxxxxx.tar.gz` into the same directory.

A.1.3 Virtual Studio Technology SDK

Importance: optional

Version: 2.4 / 3.6.8

License: proprietary / GPL v3

Homepage: www.steinberg.net

Installation

Just extract the archive into the directory `libraries/vst`.

A.1.4 Python

Importance: optional

Version: 3.5 (or higher)

License: Python Software Foundation License

Homepage: www.python.org

You'll only need Python if you want to change the premake file (see [section A.1.1](#)) using Jinja templates.

Installation (Windows)

You can download an installer from the website.

A.1.5 Jinja

Importance: optional

Version: 2.8 (or higher)

License: BSD

Homepage: jinja.pocoo.org

You'll only need Jinja if you want to change the premake file using templates (see [section A.1.1](#)).

A.1.6 Artistic Style

Importance: optional

Version: 2.05.1

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 Squeezer.

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.2 GNU/Linux

A.2.1 Environment

To build Squeezer 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-get 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-get update  
apt-get -y install bash-completion clang \  
    libasound2-dev libjack-jackd2-dev \  
    mesa-common-dev xorg-dev less vim  
apt-get 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 Squeezer!

A.2.2 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 build and execute

32 and 64 bit

```
./run_premake.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.3 Microsoft Windows

A.3.1 Build

After preparing the dependencies, change into the directory `build` and execute

32 and 64 bit

```
./run_premake.bat
```

Then change into the directory `Builds/windows/vs20xx`, open the project file with the corresponding version of Visual C++ 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

Licenses

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.

Licenses

"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

Licenses

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

Licenses

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

Licenses

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

Licenses

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.

Licenses

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

Licenses

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.

Licenses

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

Licenses

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.

Licenses

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.

Licenses

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

Licenses

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.

Licenses

- 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

Licenses

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.

1. 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)

Licenses

- (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

Licenses

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

Licenses

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

Licenses

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

Licenses

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

Licenses

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.