

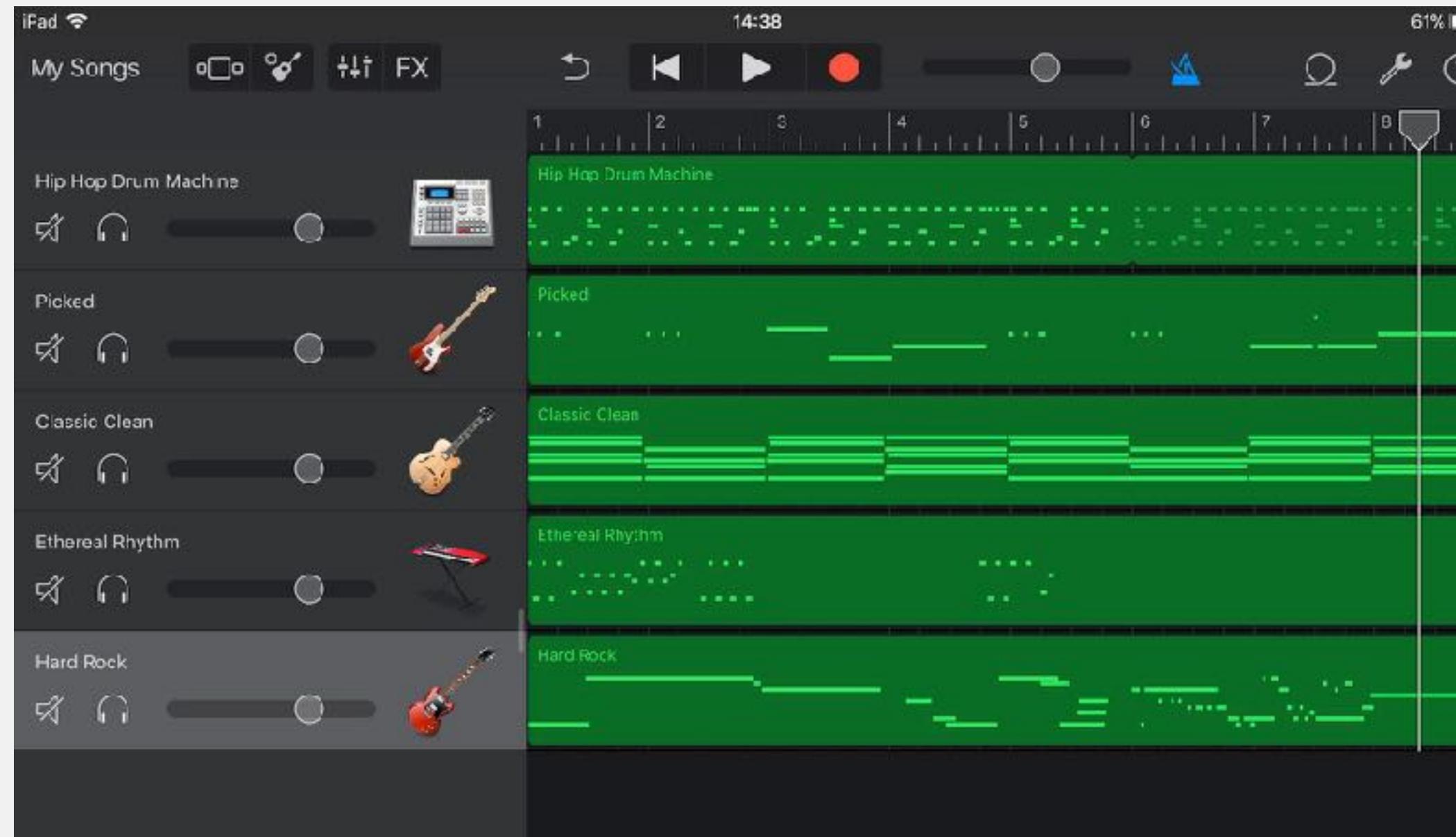
AUDIO SYNTHESIS

Intro to sound programming

Lior Ben-Gai

August 2019

Digital Audio Workstation (DAW)

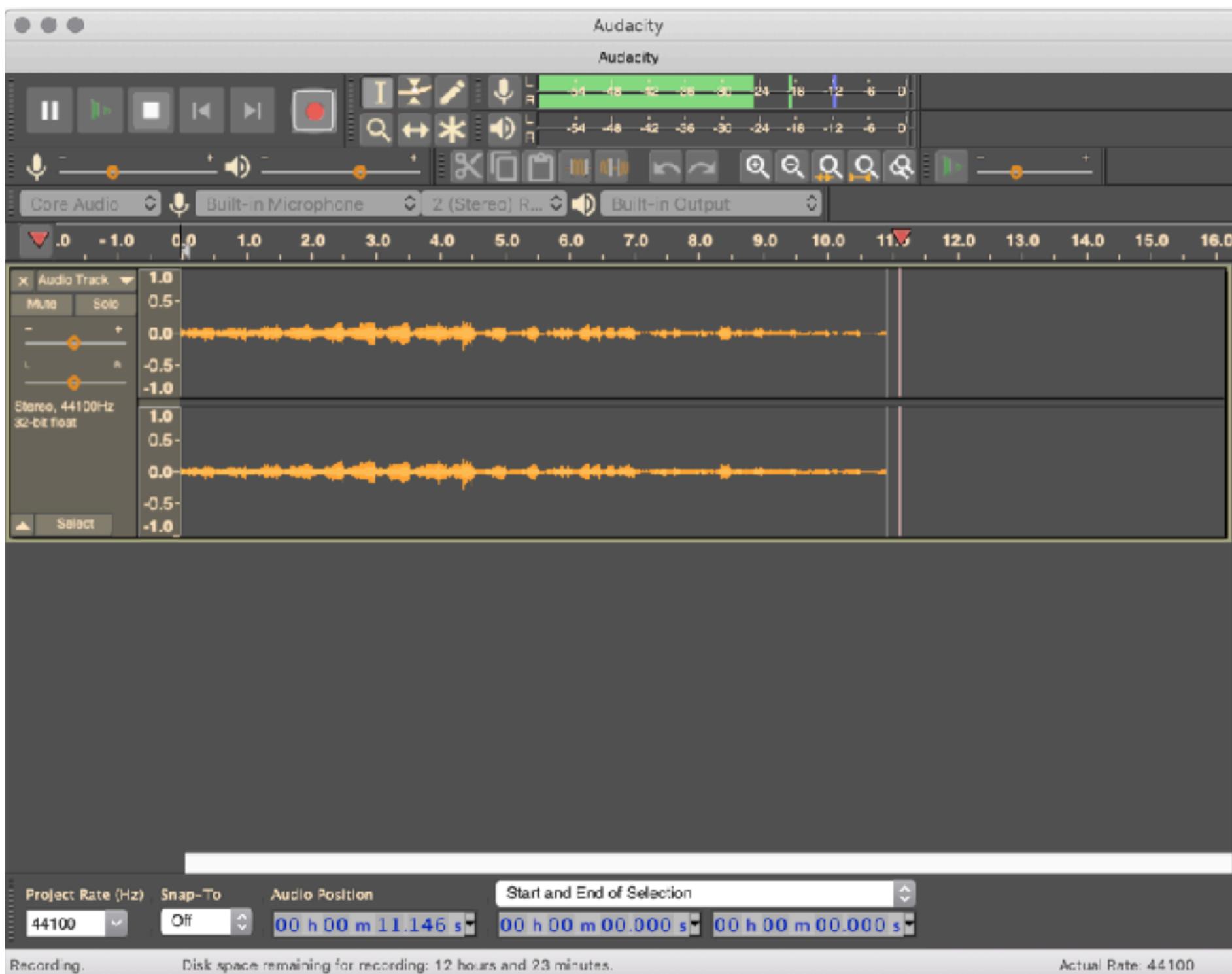


garageband

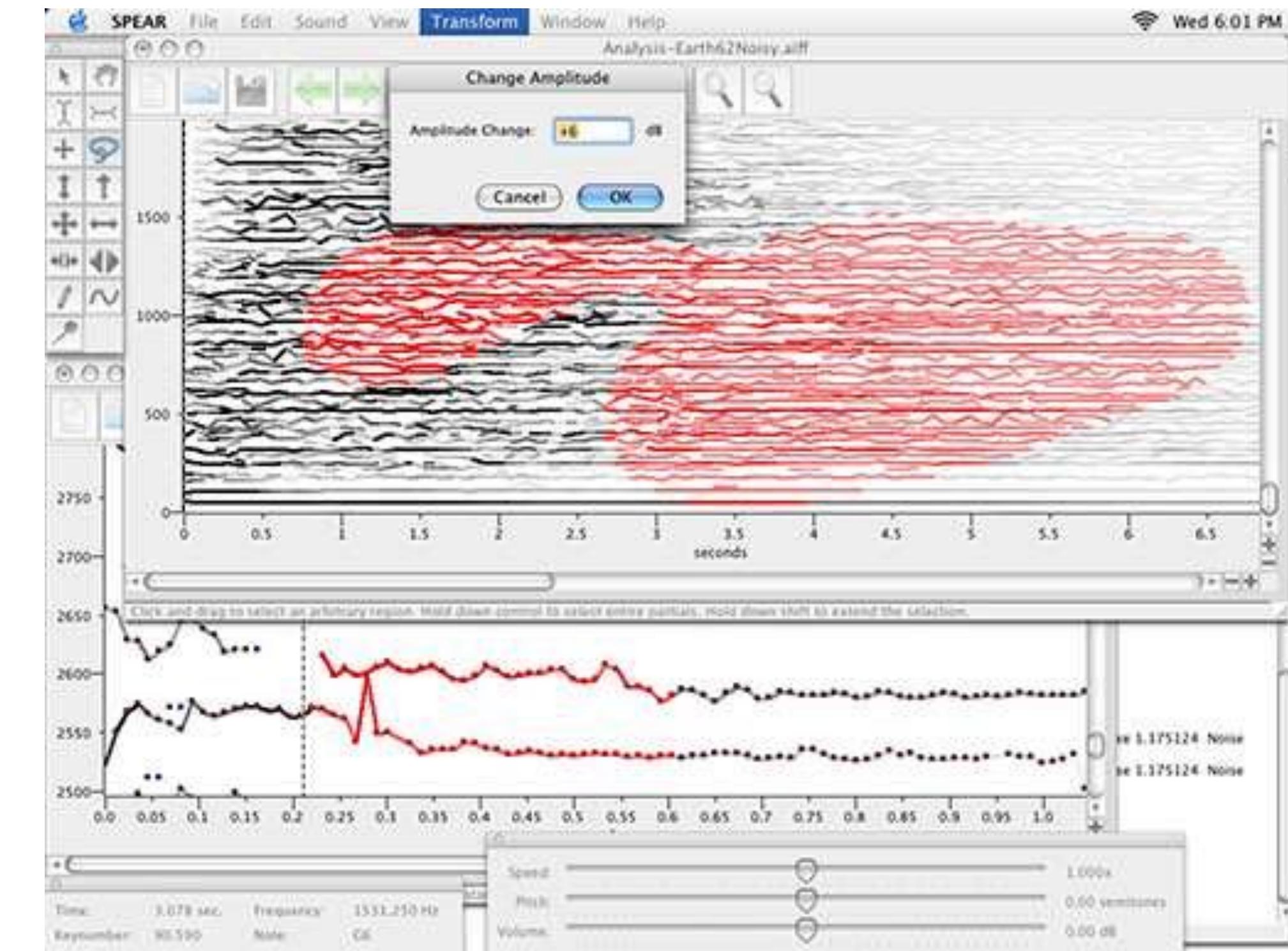


Ableton live

Sound editing / analysis



audacity

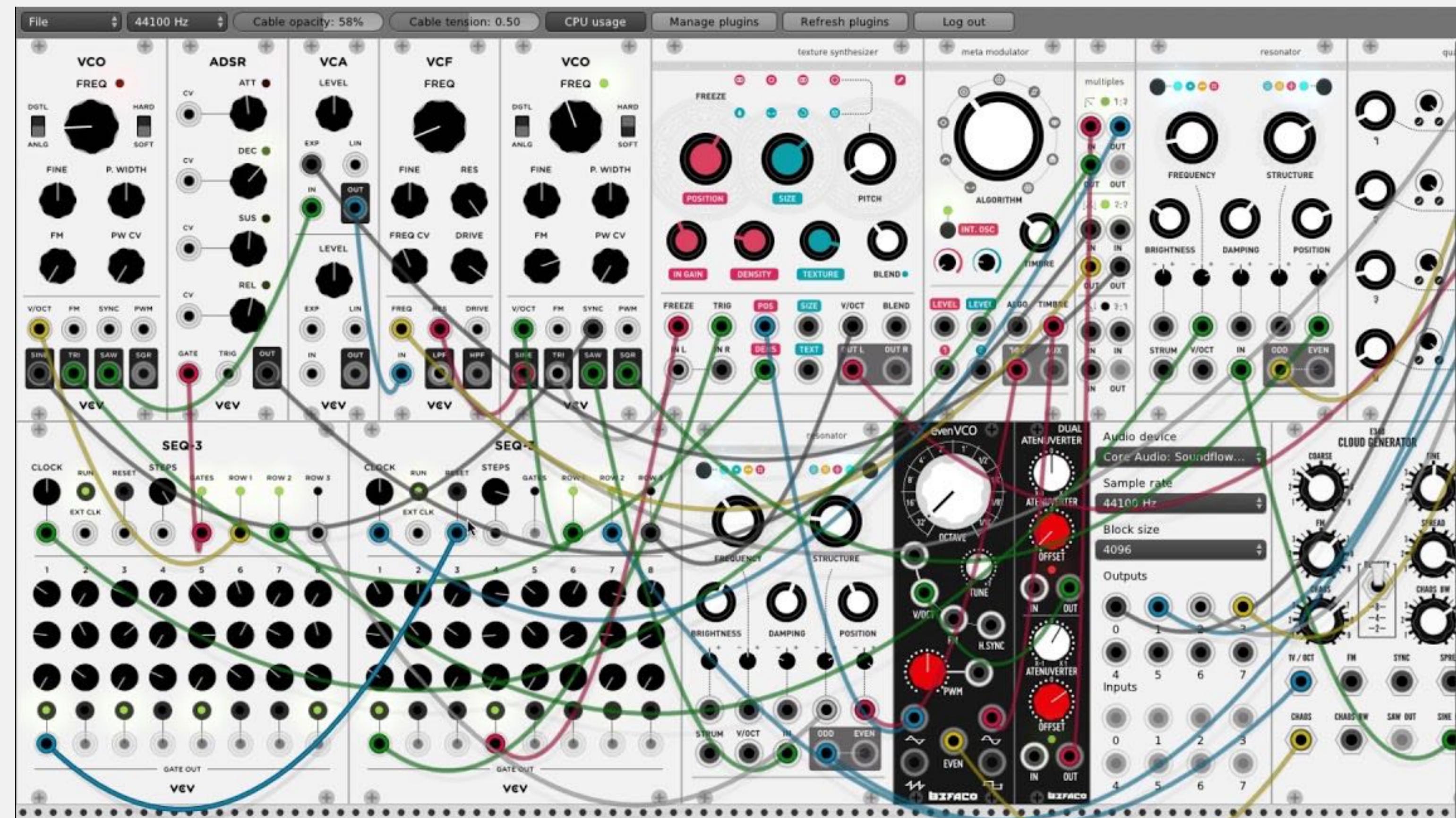


Spear



AUDIOTOOL - A web based DAW

audiotool.com

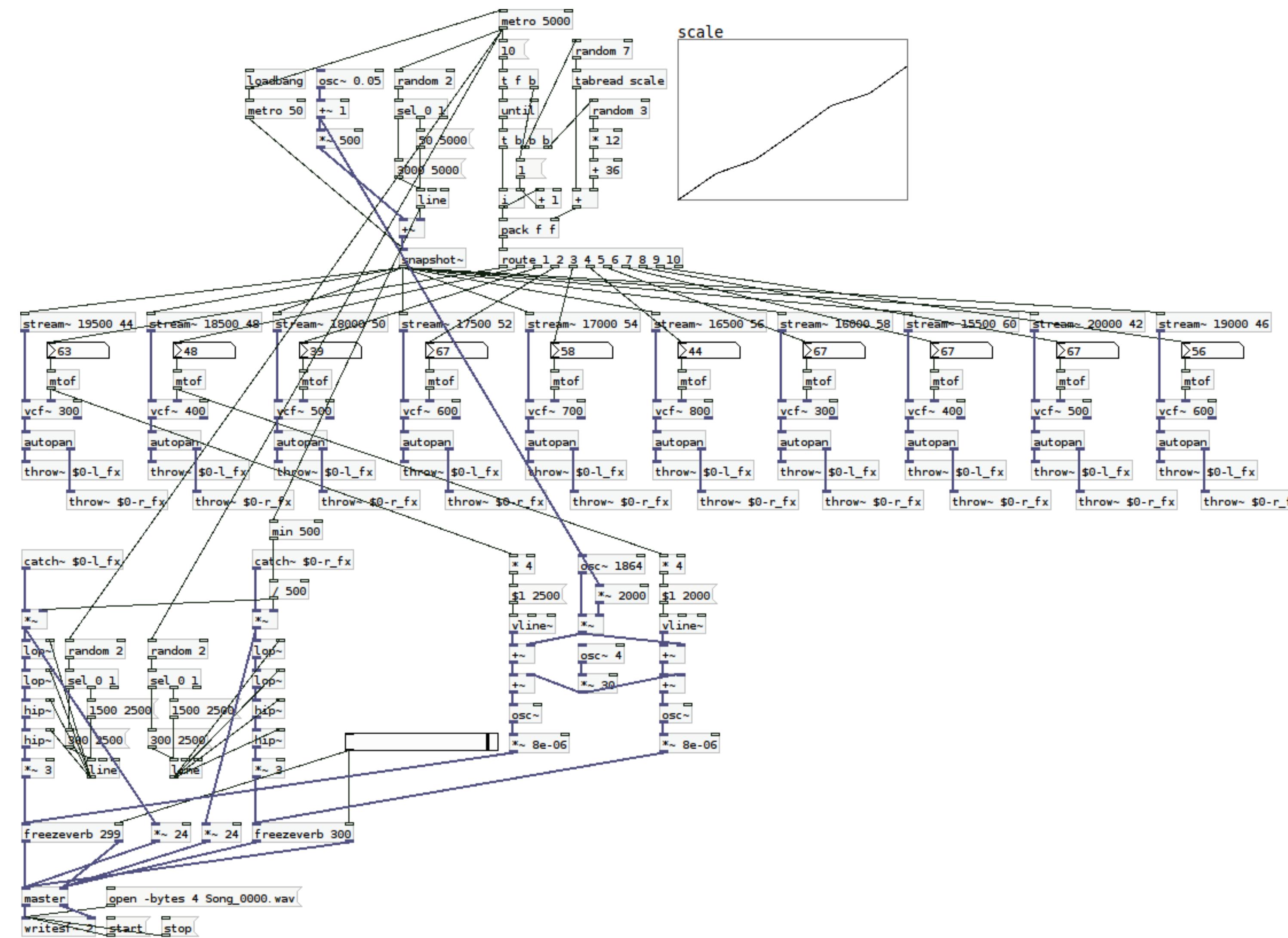


VCV rack

vcvrack.com

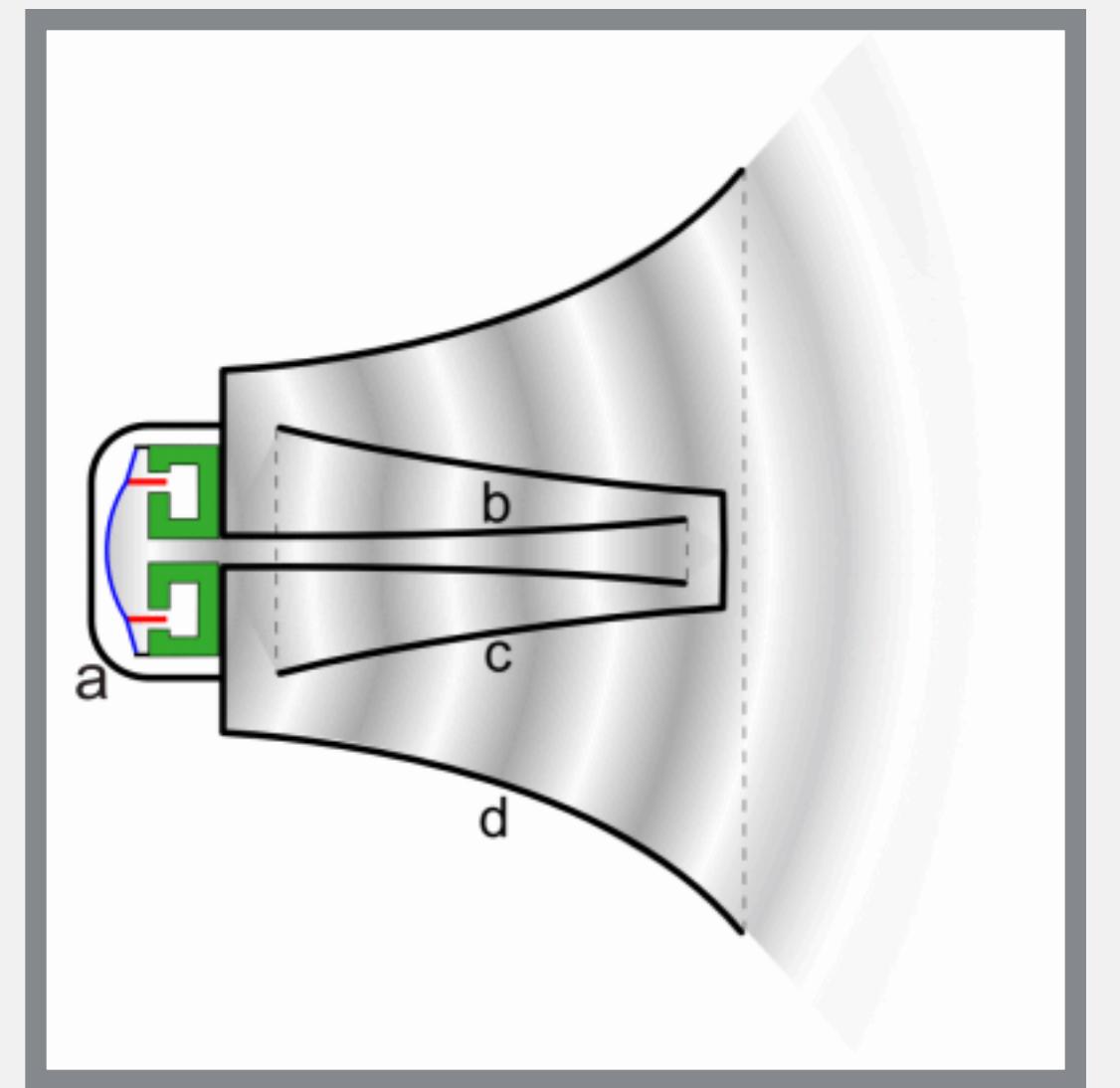
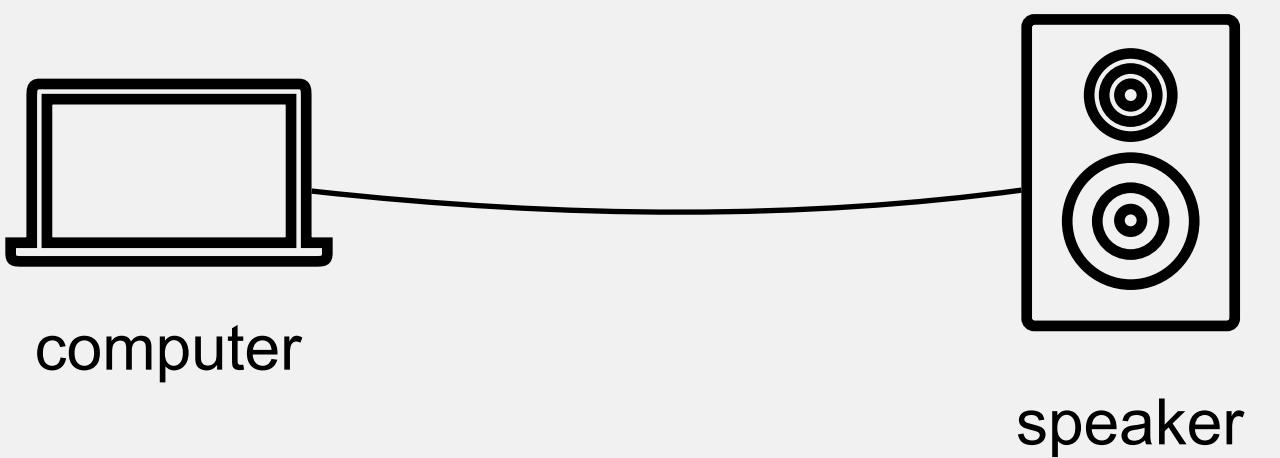
<https://www.facebook.com/groups/vcvrack/>

puredata
puredata.info



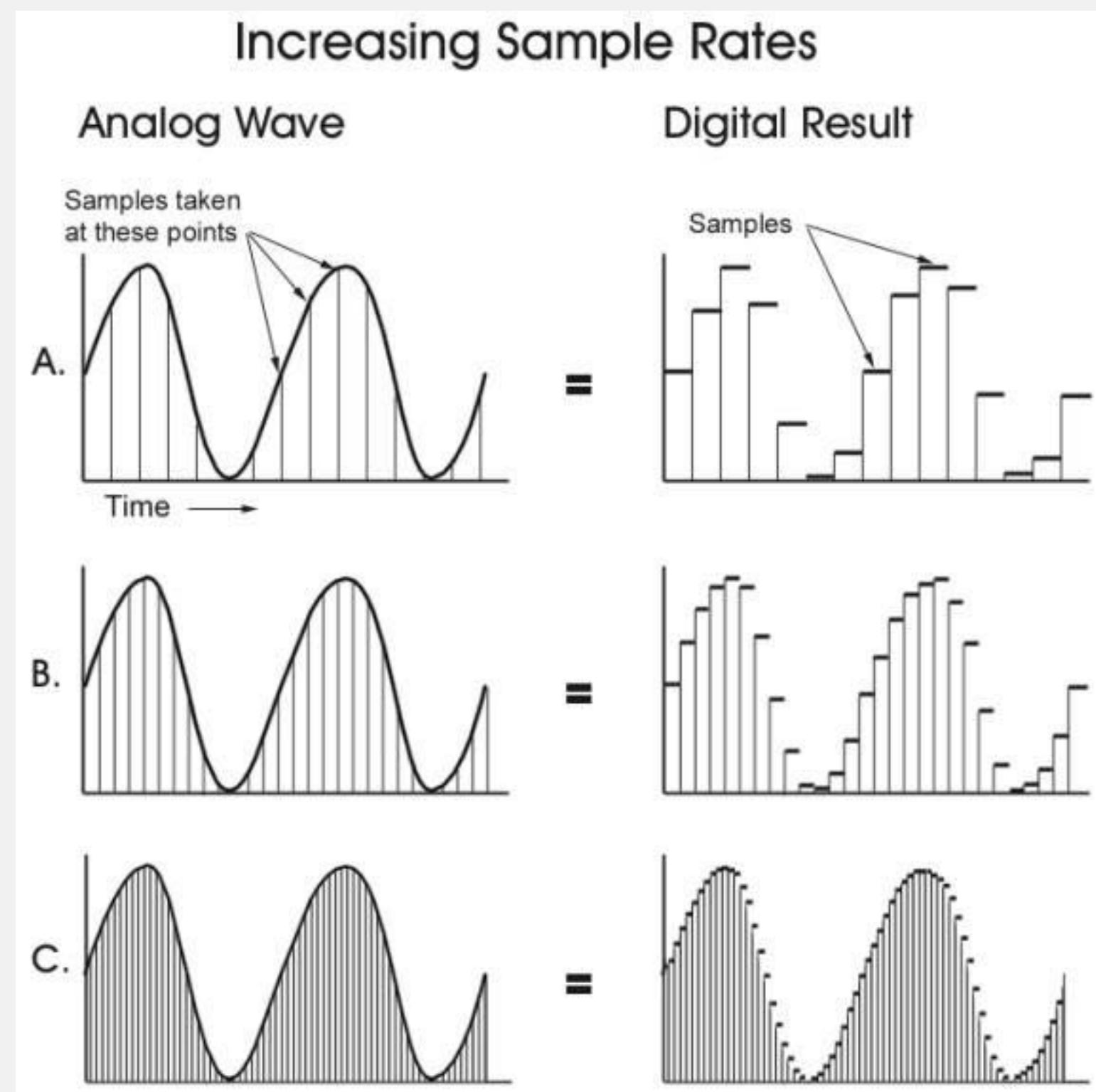
Digital Signal Processing (DSP)

Digital Audio is produced by
continuously sending electrical
signals to a speaker.
The signals vibrate the speaker cone.
Moving air towards our ears.

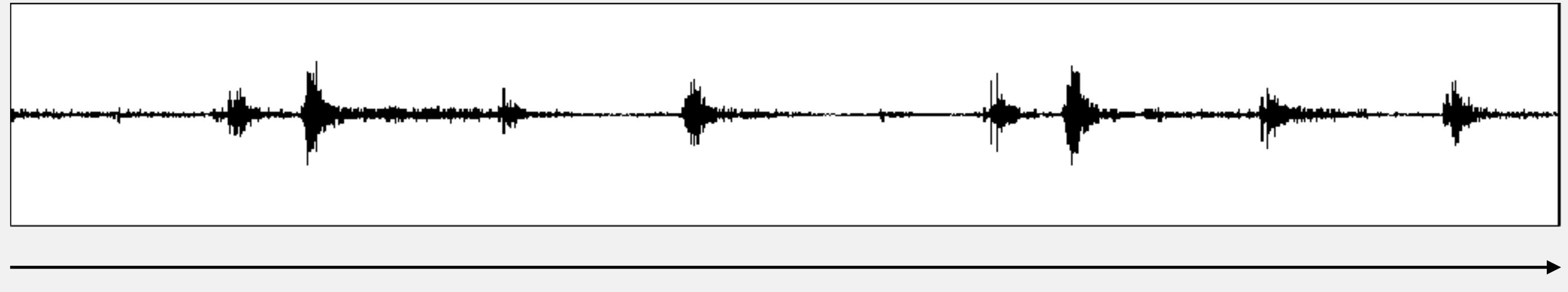


https://en.wikipedia.org/wiki/Digital_audio

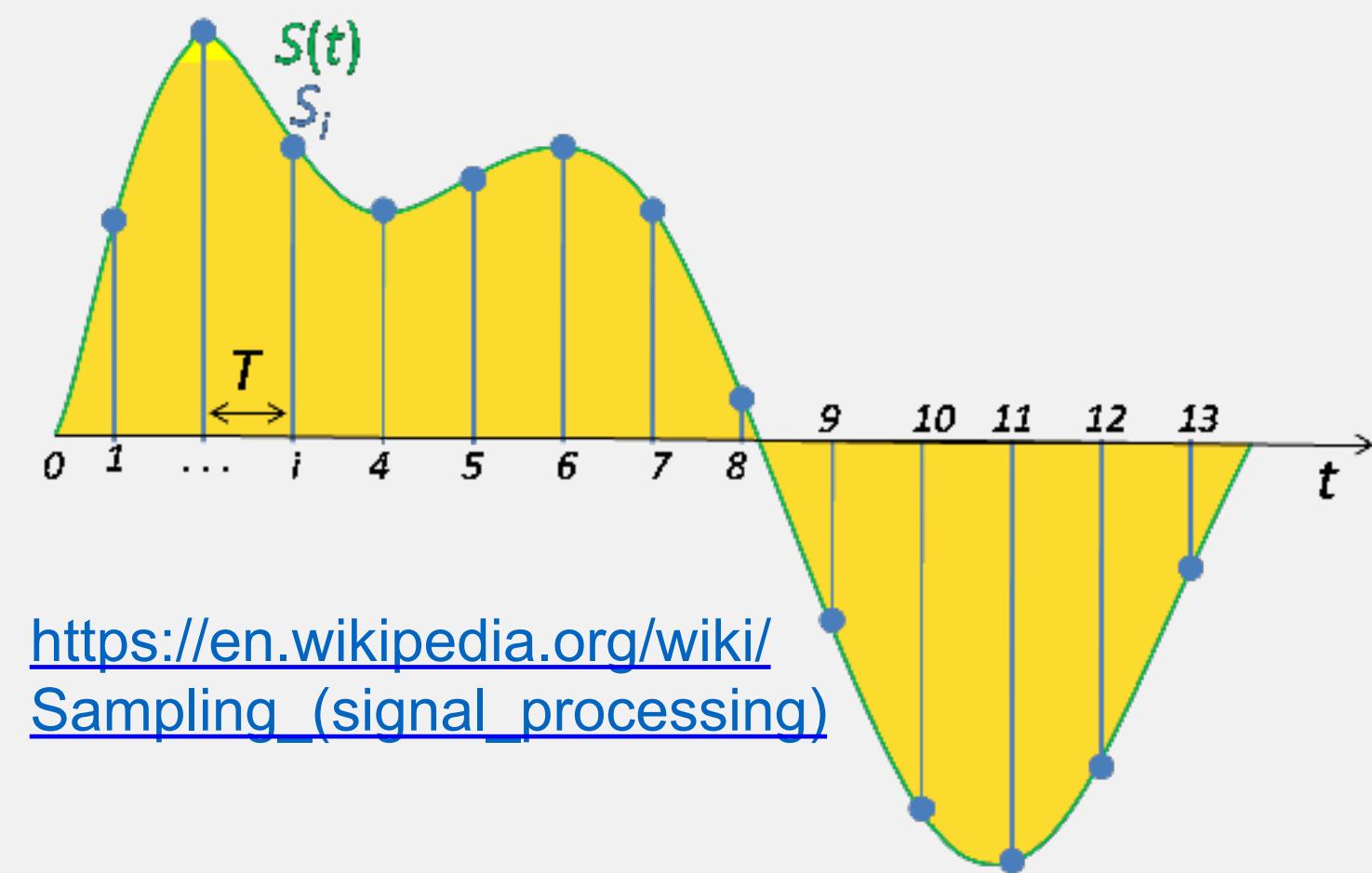
Sample rate



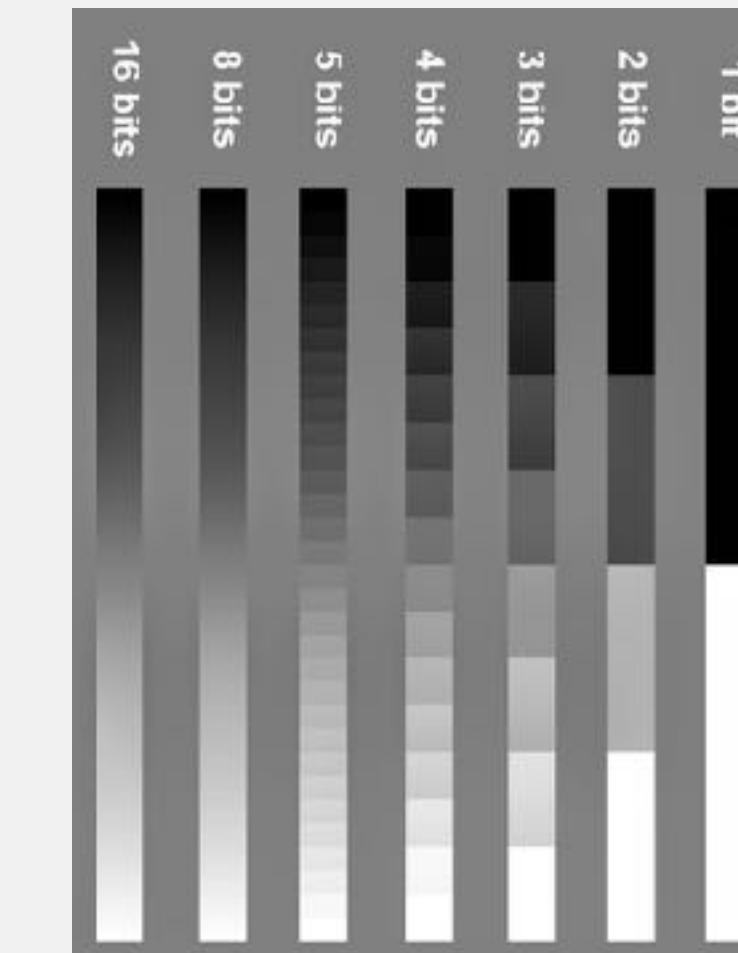
<https://www.izotope.com/en/blog/music-production/digital-audio-basics-sample-rate-and-bit-depth.html>



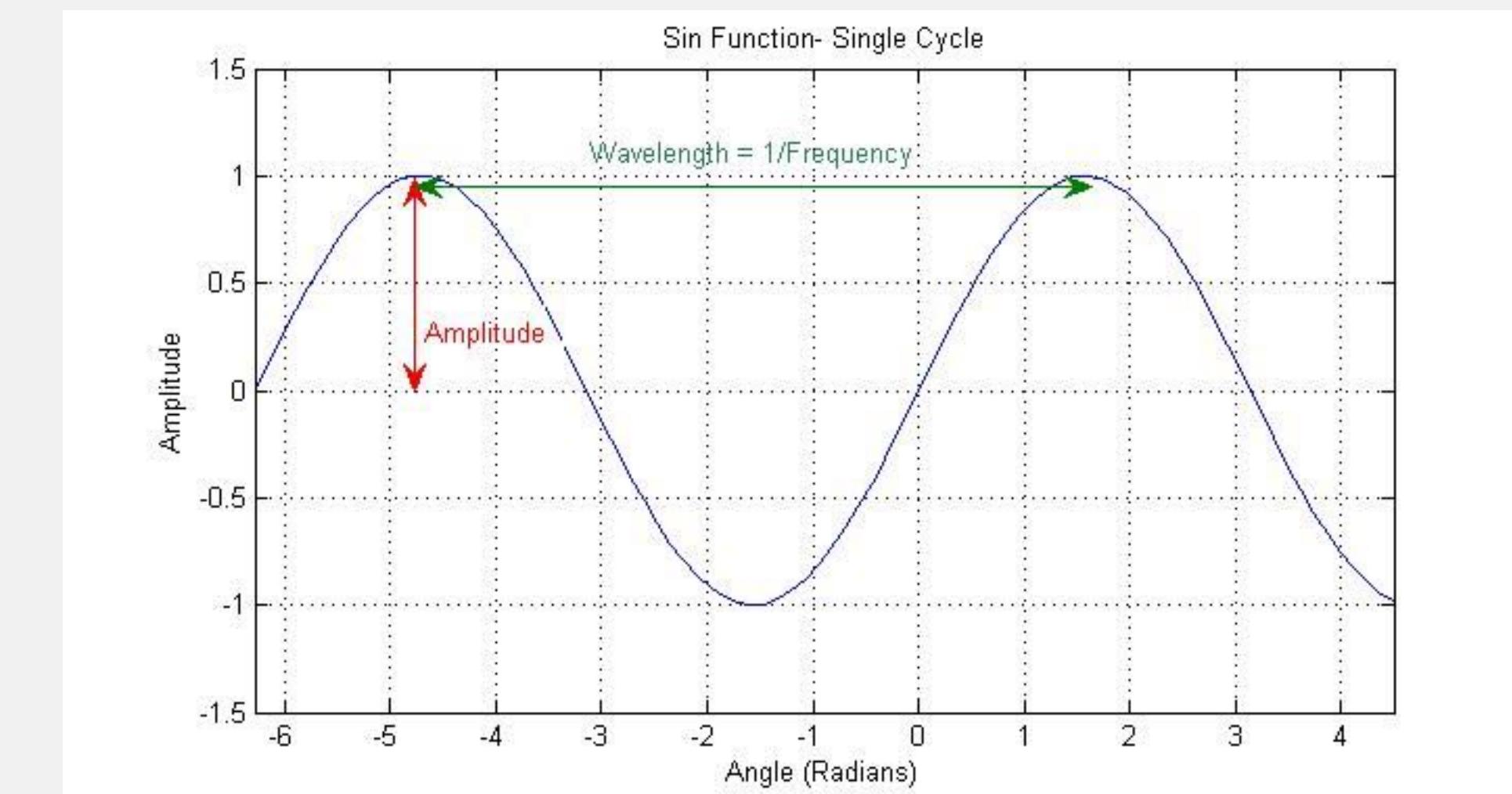
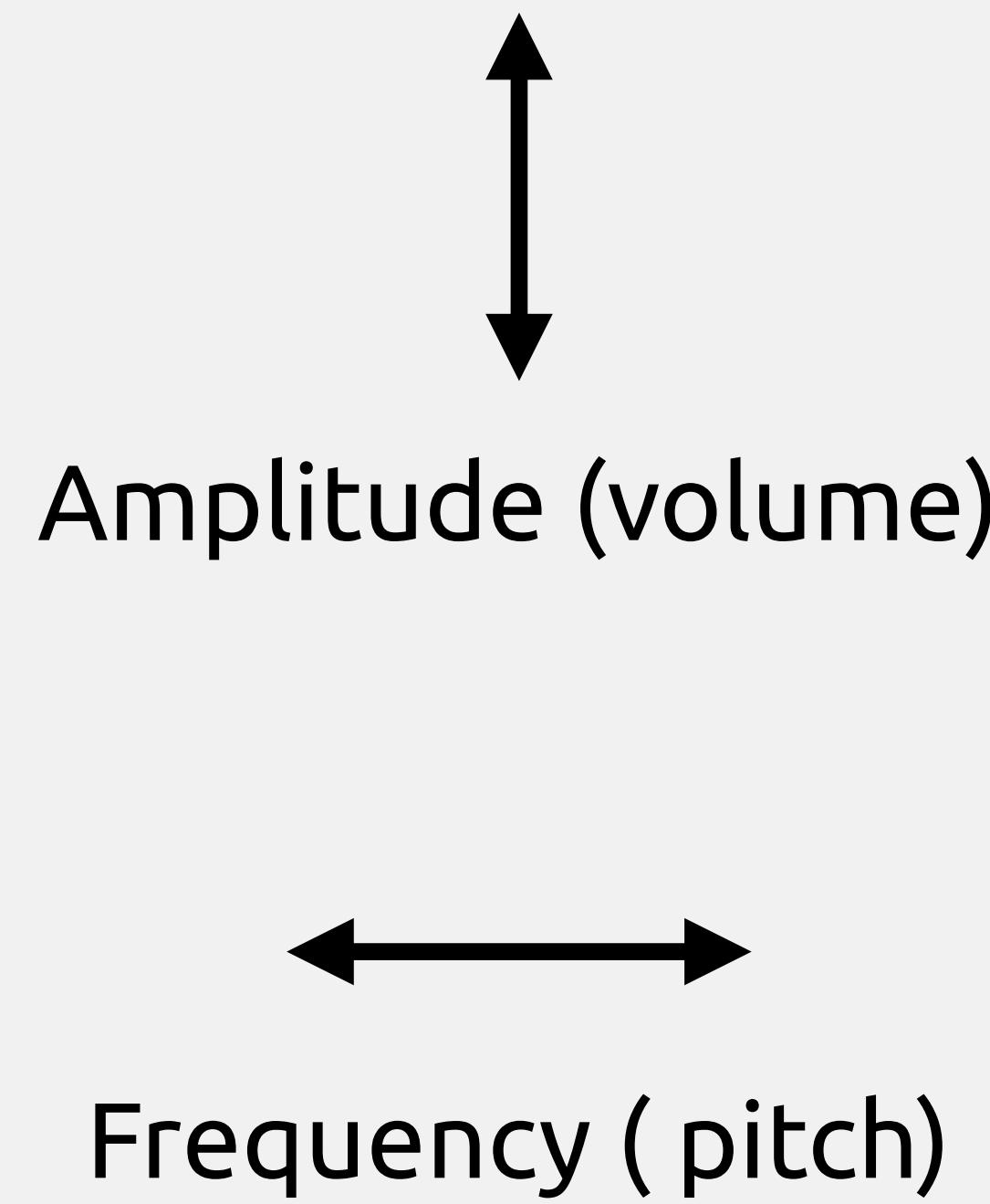
44,100 samples per second (44,100 Hz) is a common sample rate.



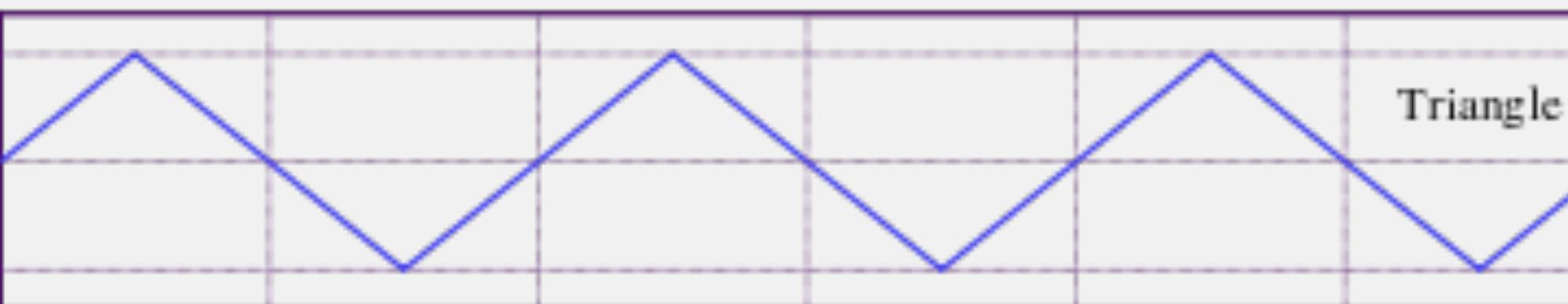
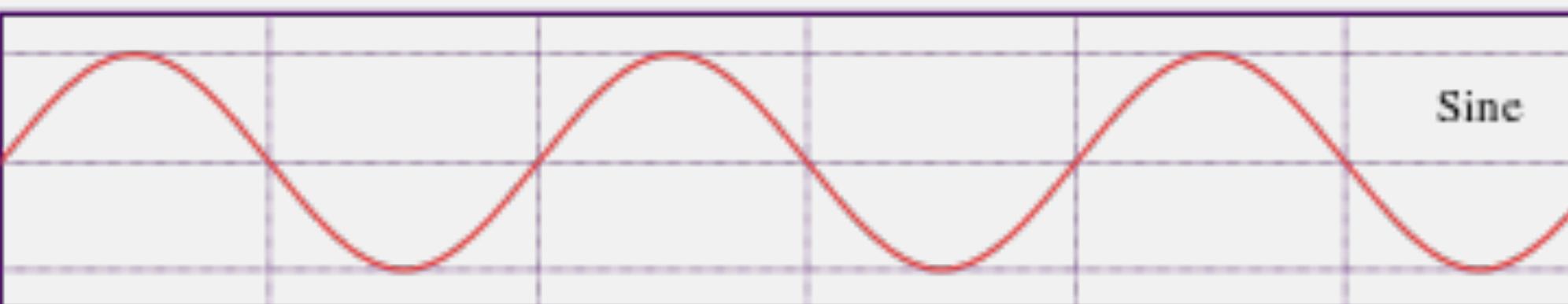
[https://en.wikipedia.org/wiki/Sampling_\(signal_processing\)](https://en.wikipedia.org/wiki/Sampling_(signal_processing))



Bit depth is the resolution on the Y axis



common wave patterns

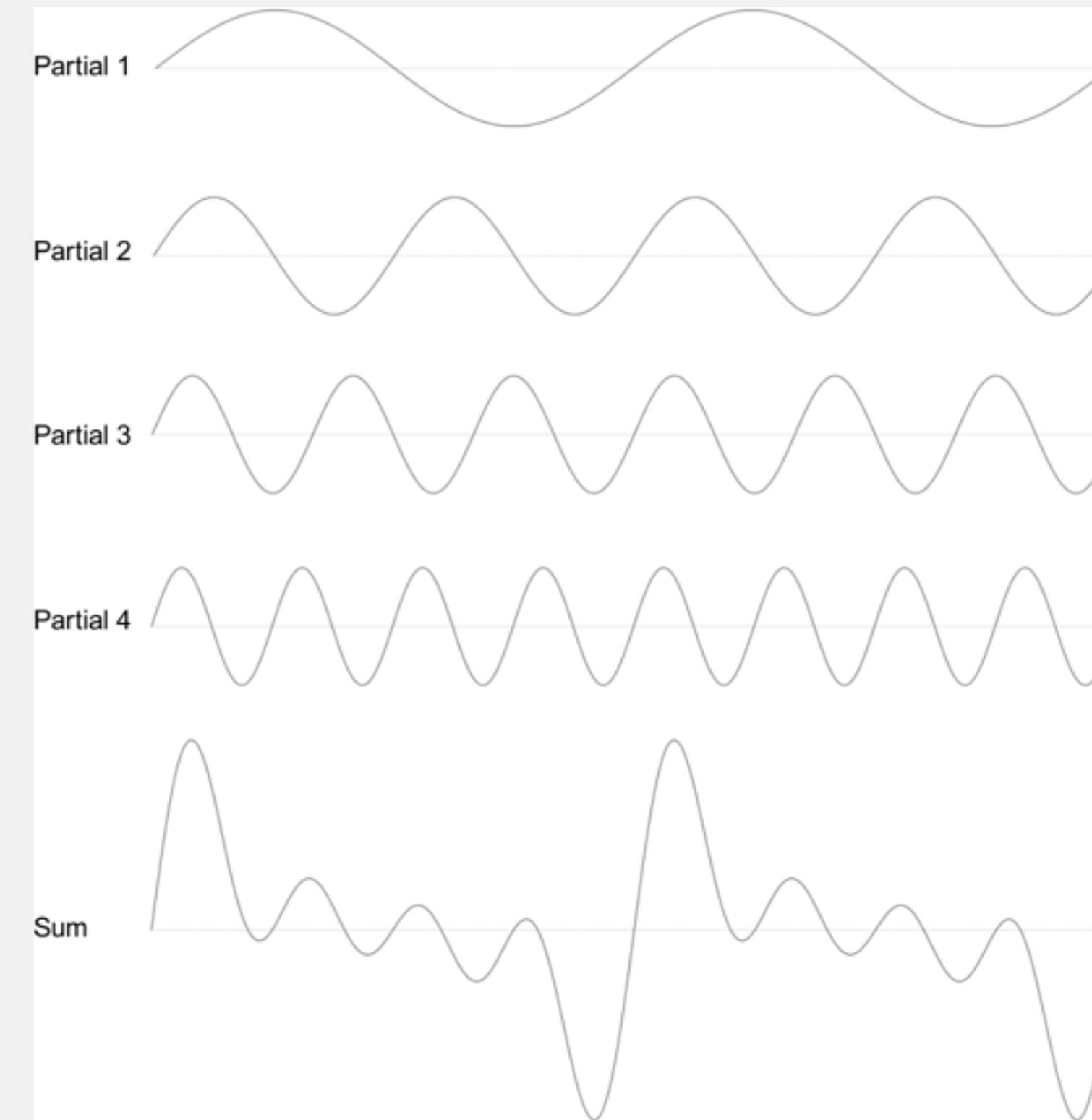


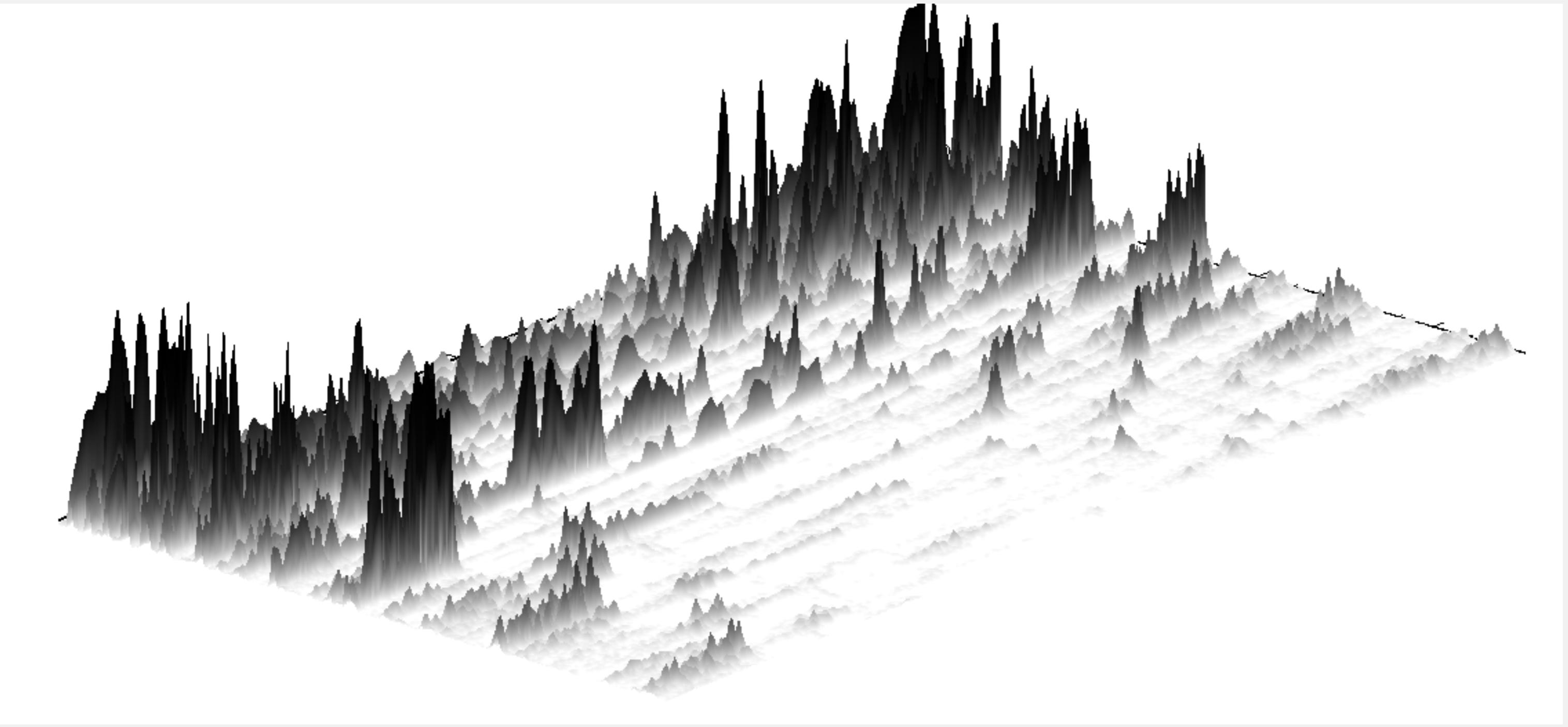
Additive synthesis

Producing a compound waveform by adding together a number of waves

https://en.wikipedia.org/wiki/Additive_synthesis

<http://floss.booktype.pro/csound/a-additive-synthesis/>

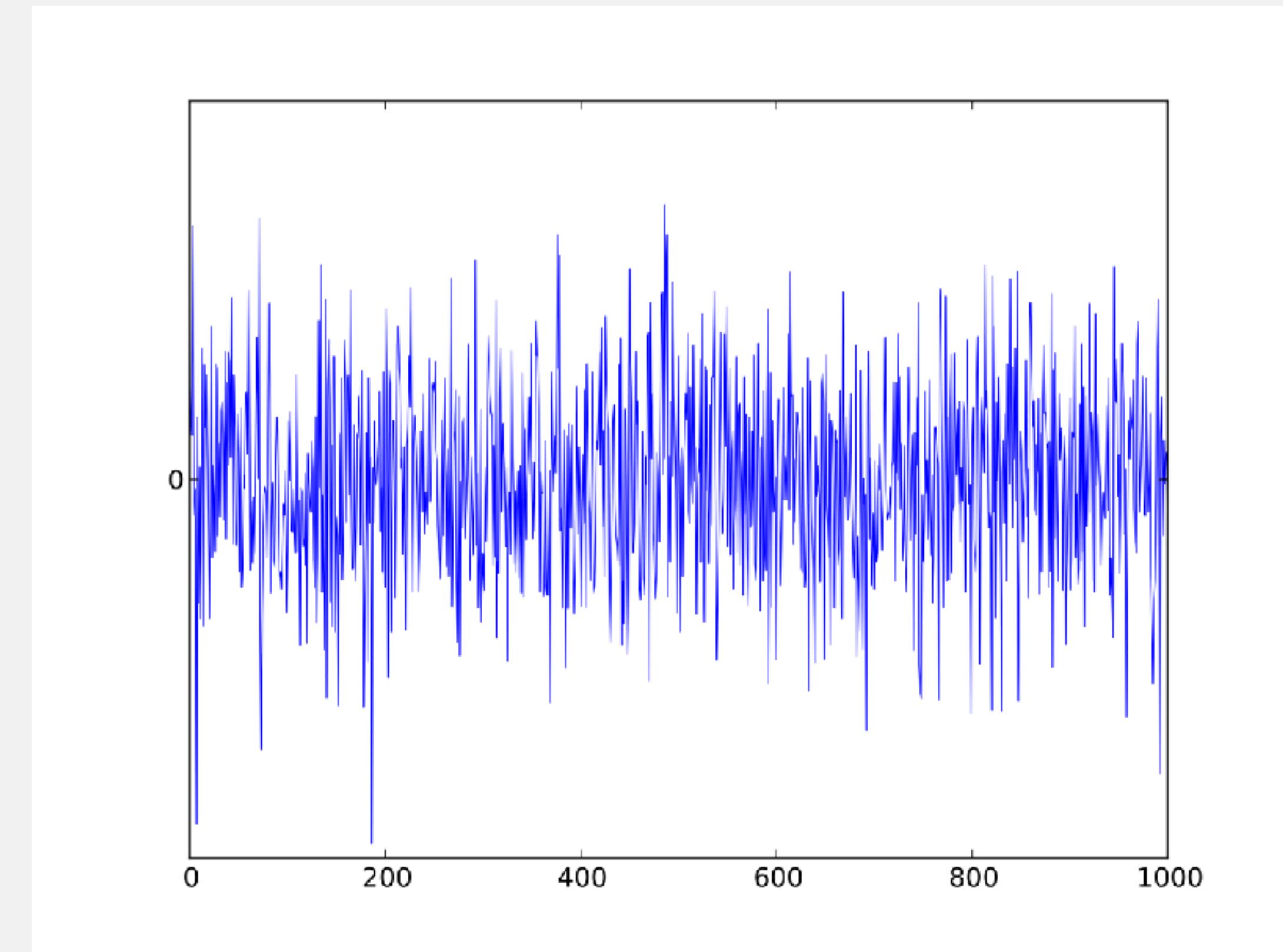




Subtractive synthesis

Producing a compound waveform by
filtering a "rich" wave.

https://en.wikipedia.org/wiki/Subtractive_synthesis



White noise

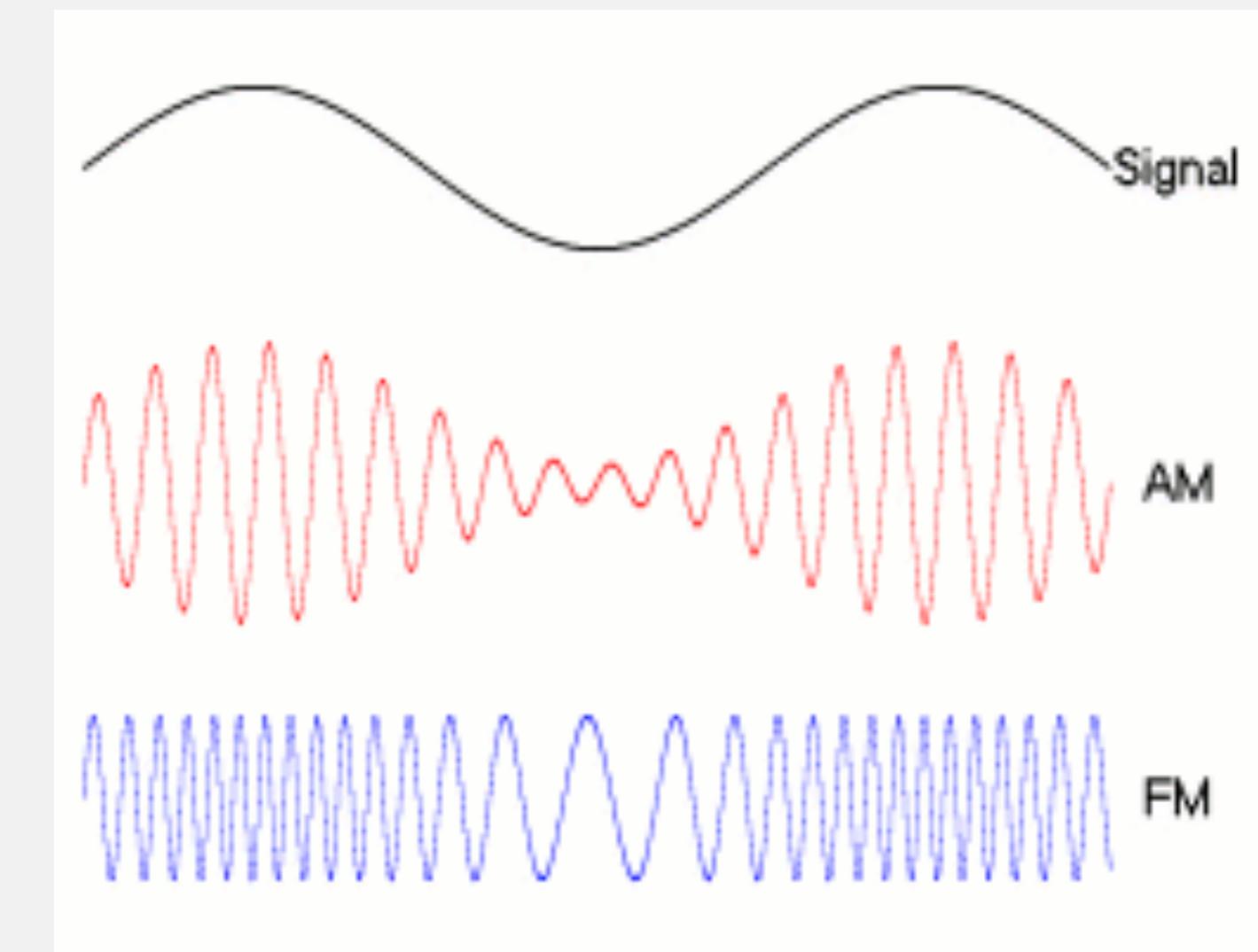
A random collection of samples

https://en.wikipedia.org/wiki/White_noise

Frequency Modulation (fm synthesis)

Changing (modulating) the properties (frequency or amplitude) of one signal (carrier) with one of more other signals (modulators)

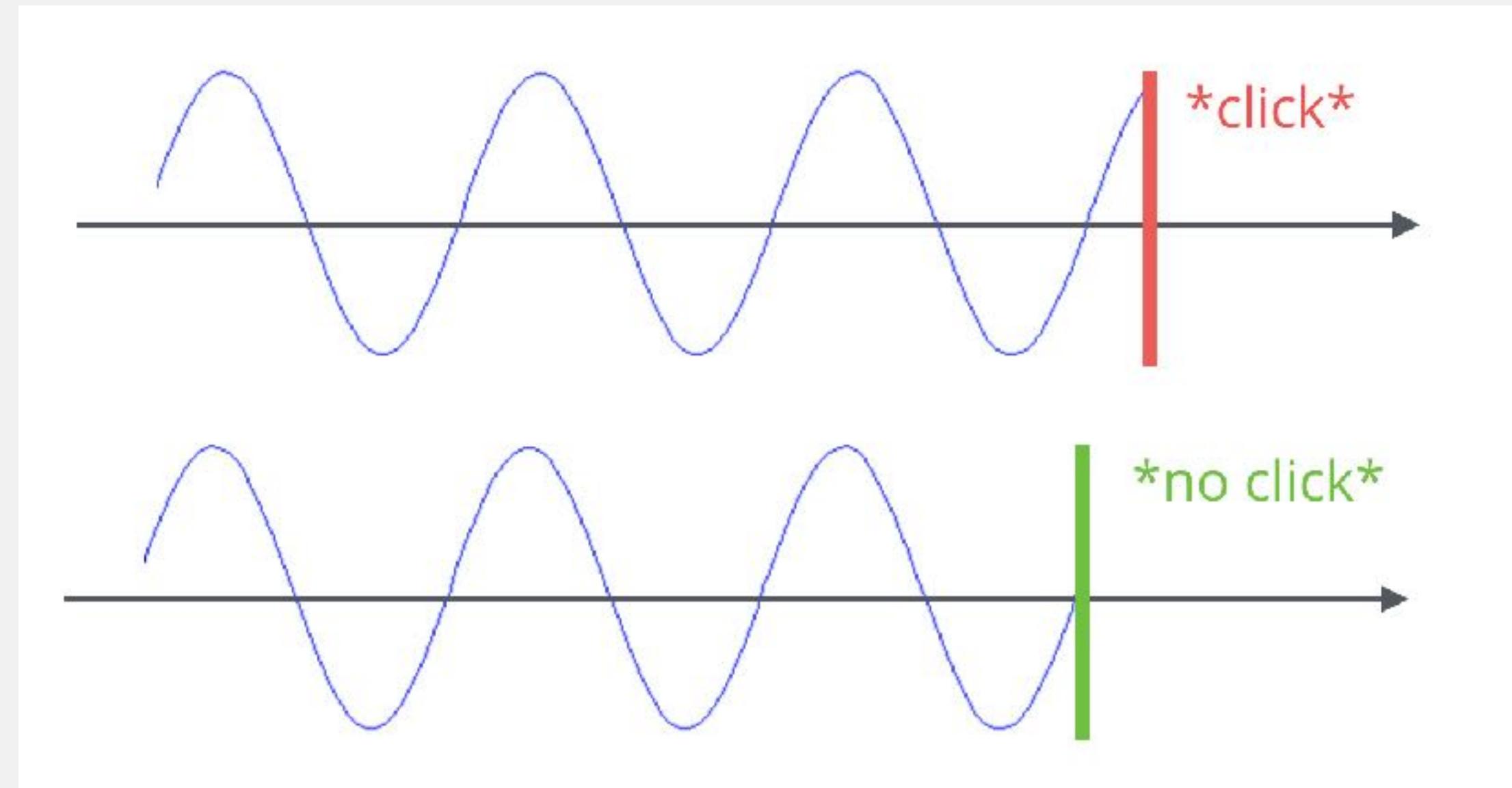
https://en.wikipedia.org/wiki/Frequency_modulation



Clicks

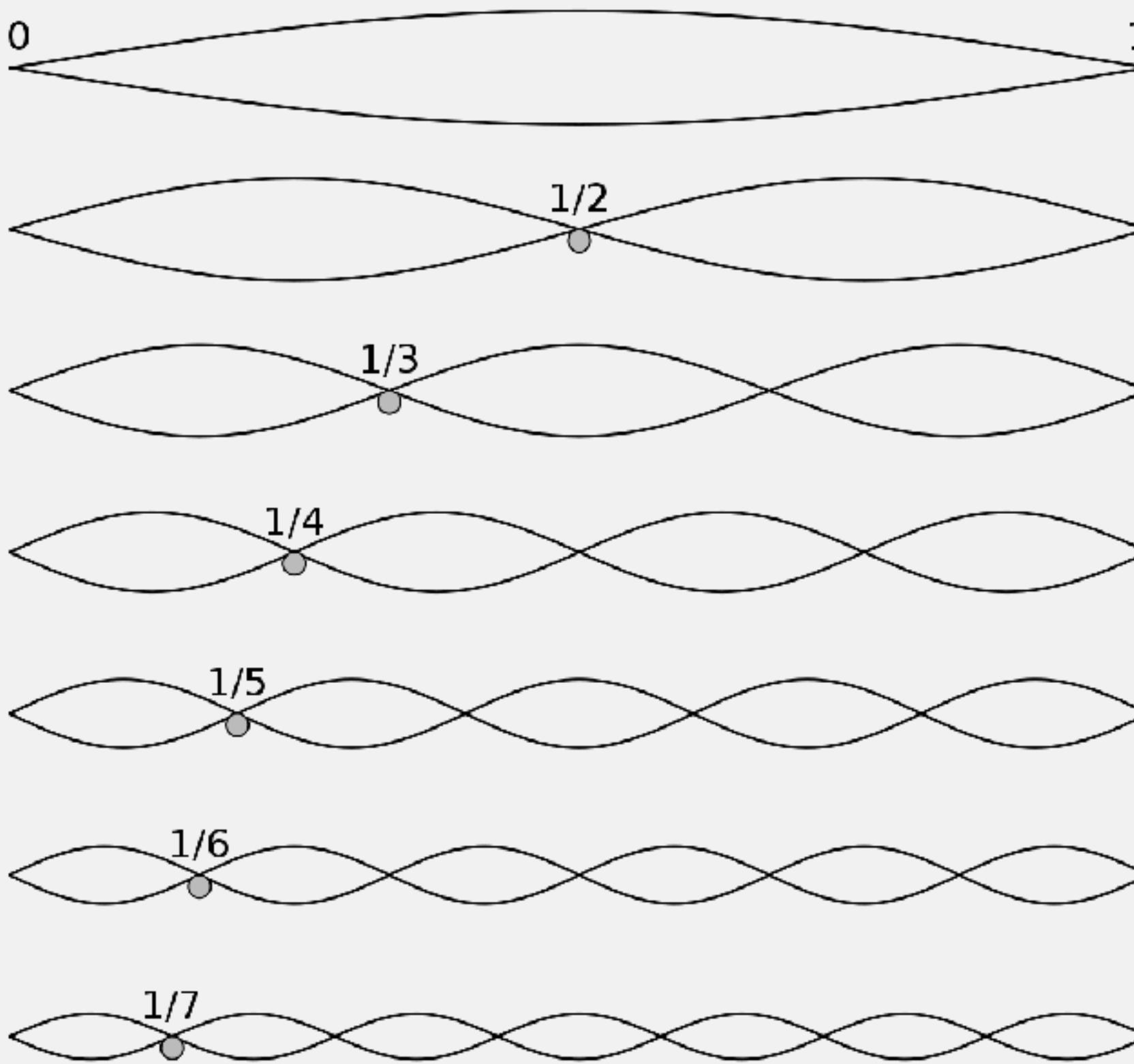
clicks are an unwanted side effect in digital audio.

It occurs when there are sharp changes between samples - often when **periodic** waves do not complete a full phase.

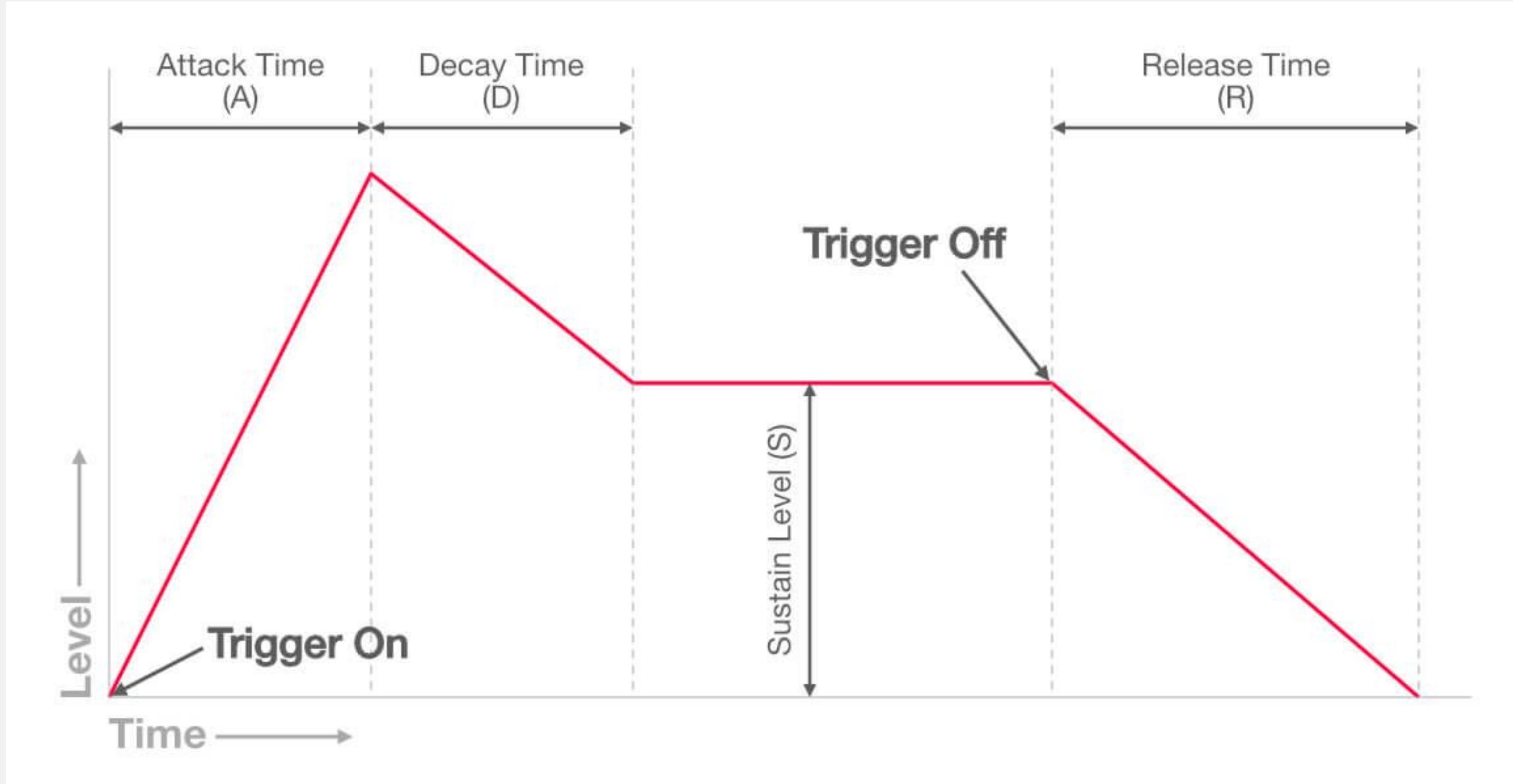


<https://marcgg.com/blog/2016/11/01/javascript-audio/>

Harmony



A **harmonic series** is the sequence of sounds^[1]—pure tones, represented by sinusoidal waves—in which the frequency^[2] of each sound is an **integer** multiple of the fundamental, the lowest frequency.^[3]



ADSR envelope

Algorithmic composition

The process of creating music via predefined rules

https://en.wikipedia.org/wiki/Algorithmic_composition

<http://www.algorithmiccomposer.com/>



<https://www.youtube.com/watch?v=o68sG69ADNA>

Live Coding

Programming music (or visuals)
as a live performance.



<https://toplap.org/>

```
;; Andrew Sorensen 2008 - andrew@soreso.com.au

(define *scale* (append (pc:scale #'_melton) '(E)))

(define bones dur)
  (lambda (beat)
    (for-each (lambda (p time)
      (play inst p (cos* 60 30 3) dur 0))
      (pc:make-chord 59 63 2 (pc:diatonic 0 1 4
                                             2 3 5 6)))
    (callback (*metro* (<- beat (* .5 dur))) 'bones (<- beat dur)))))

(bones (*metro* 'get-beat 4))

(define trps
  (lambda (beat trp plist)
    (play trp (+ 00 (car plist)) (cos* 30 10 (random (quote (1/3 1/2 1/4))) (car plist)) 0)
    (callback (*metro* (<- beat (* .5 (cdr plist)))) 'trps (<- beat (cdr plist))
              trp
              (if (null? (cdr plist))
```

Andrew Sorensen
<https://vimeo.com/2503188>

Film essay about his work
<https://vimeo.com/9790850>

p5.Sound

Web Audio API

<https://www.w3.org/TR/webaudio/>

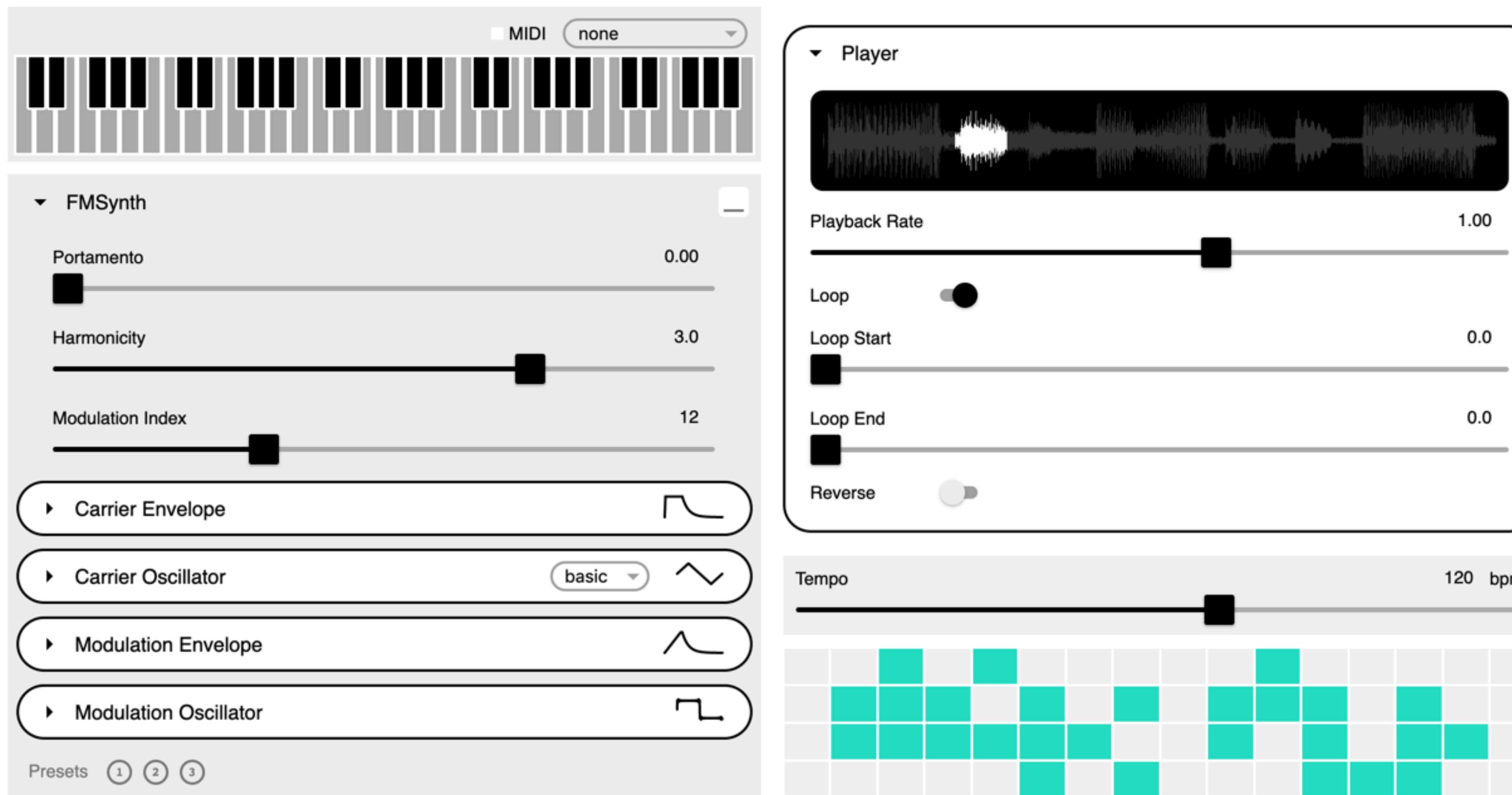
https://developer.mozilla.org/en-US/docs/Web/API/Web_Audio_API



Home	p5.sound library
Download	p5.sound extends p5 with Web Audio functionality including audio input, playback, analysis and synthesis.
Start	
Reference	
Libraries	p5.SoundFile : Load and play sound files. p5.Amplitude : Get the current volume of a sound.
Learn	p5.AudioIn : Get sound from an input source, typically a computer microphone.
Examples	p5.FFT : Analyze the frequency of sound. Returns results from the frequency spectrum or time domain (waveform).
Books	p5.Oscillator : Generate Sine, Triangle, Square and Sawtooth waveforms. Base class of p5.Noise and p5.Pulse .
Community	p5.Envelope : An Envelope is a series of fades over time. Often used to control an object's output gain level as an "ADSR Envelope" (Attack, Decay, Sustain, Release). Can also modulate other parameters.
Forum	p5.Delay : A delay effect with parameters for feedback, delayTime, and lowpass filter.
GitHub	p5.Filter : Filter the frequency range of a sound.
Twitter	p5.Reverb : Add reverb to a sound by specifying duration and decay. p5.Convolver : Extends p5.Reverb to simulate the sound of real physical spaces through convolution. p5.SoundRecorder : Record sound for playback / save the .wav file. p5.Phrase , p5.Part and p5.Score : Compose musical sequences.

p5.sound is on [GitHub](#). Download the latest version [here](#).

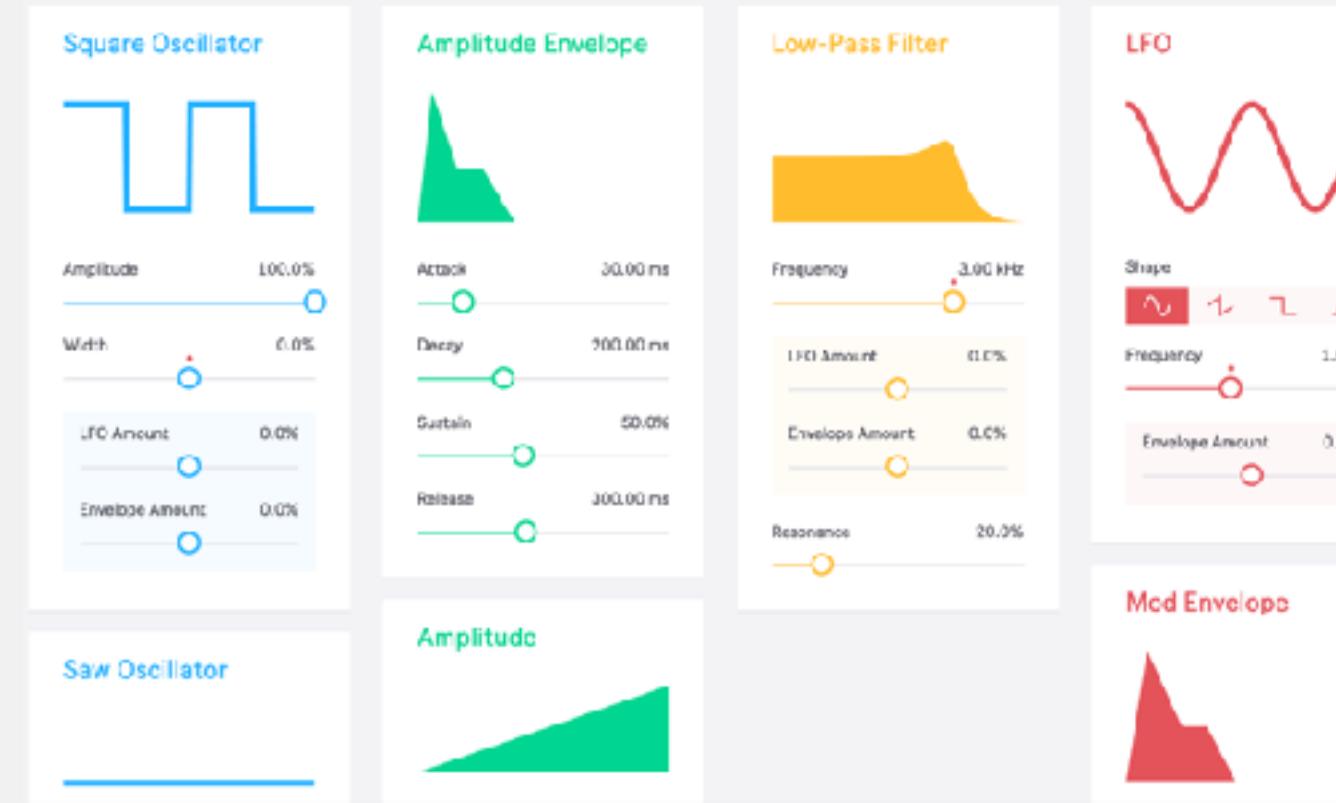
<https://p5js.org/reference/#/libraries/p5.sound>



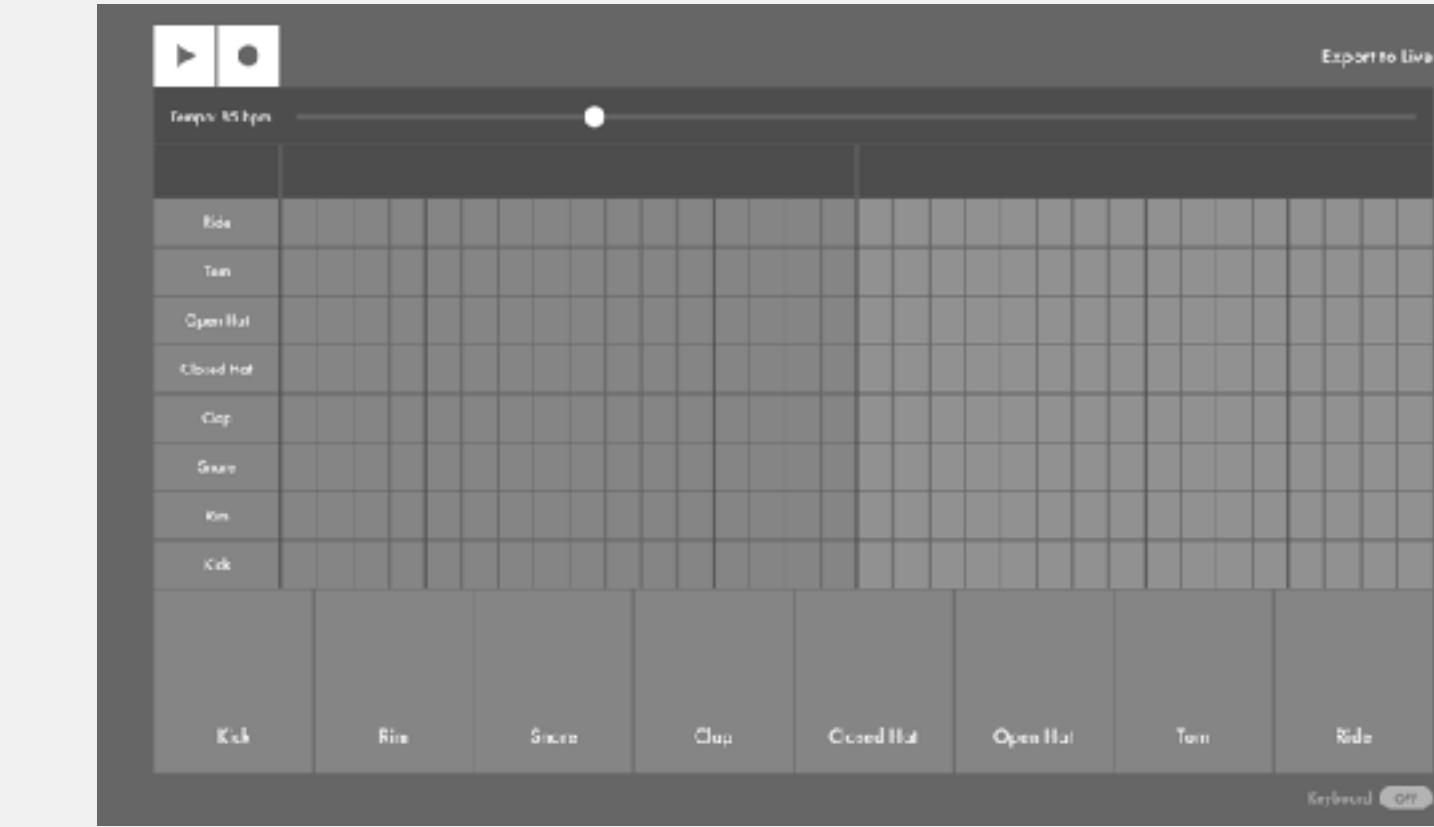
tone.js

<https://tonejs.github.io/>

Online playgrounds by Ableton



<https://learningsynths.ableton.com/playground>



<https://learningmusic.ableton.com/>