369G - AUDACITY PROJECT

Audacity

1. What is it?

Audacity is a free, open source, cross-platform audio software with Digital sound processing capabilities.

It is an easy-to-use, multi-track audio editor and recorder for Windows, Mac OS X, or GNU/Linux and other operating systems.

Note: You cannot **run Audacity** on a **Chromebook** because **Audacity does** not support Chrome OS. However as Chrome OS is based on Linux it is fairly easy to install a Chrome version of Linux Ubuntu on your **Chromebook**.

2. What does it do?

Record live audio

Perform a number of audio editing and recording tasks such as making ringtones, mixing stereo tracks, transferring tapes and records to computer or CD, splitting recordings into separate tracks and more.

Nice interface to edit tracks

Audacity is good for audio editing—being able to zoom in down to the individual sample is really useful for things like cutting a loop

https://wiki.audacityteam.org/wiki/Category:Tutorial

3. Limitations

It's by far the most popular free audio editing software.

But compared to ProTools or LogicPro, much is left to be desired

Not for synthesis

Musique concrete

No MIDI, no real time editing

Routing is almost non-existent

Using anything “outside of the box” is tedious

4. Uses

Create tracks (mono, stereo, mix)

Import tracks

Export tracks

Edit Tracks

Mixing board

Generate tones, chirps (glissando), noise, silence, DTMF tones

Effects

Demo:

Starting a new project
Importing a sound file
Generating a sound file
Manipulating sound files

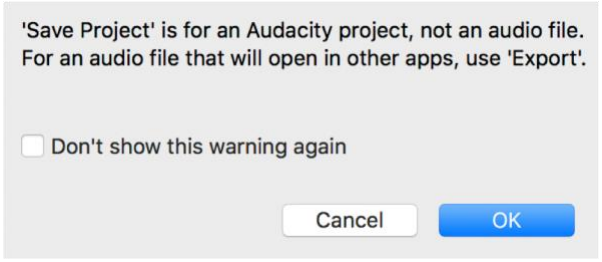
TIPS

NORMALIZE all sound files before manipulating
Save your project often in various versions
Wear high quality headphones while working and listen through speakers too

MP3: Have to download application

DSP Effects (Digital Sound Processing)

Normalize
Change pitch
Change speed (also changes frequency)
Change tempo (duration)
Reverb
Echo
Fades
Tremolo
Etc.



Tutorial

Editing an Audio File
Your First Recording
Mixing Voice with Background Music
Recording Multi-track Overdubs
Looping
Copying tapes, LPs and other media to CD or computer
Recording streaming audio playing on the computer
Splitting a recording into separate tracks
Vocal Removal and Isolation
Making Ringtones
How to import CDs
Burning Audio CDs
Exporting to iTunes
Importing from iTunes
Sample workflow for LP digitization
Sample workflow for exporting to iTunes
Recording 78rpm records
Click removal using the Spectrogram view
Recording with USB turntables and cassette decks

Helmholtz (19th century)

Timbre = quality of sound depends on: Order of harmonics
Number of harmonics Intensity of harmonics

John Cage: Composer of 20th century (1912-1992) Removes emotional aspect in his compositions (1937) All sounds are musical – 4'33''

Sound consists of: Timbre Duration
Amplitude Frequency

and: "Morphology" = Envelop ADSR (1957)

Fourier:
Periodic vibrations (however complex) can be (re)created by combining a series of simple vibrations whose frequencies are harmonically related : multiples (integers) of fundamental frequency.

Analysis and synthesis
Additive synthesis

Electronic Music:

Allows for an infinite gradation of all pitches, not just the major & minor modes of tonal system. Gives control over every aspect/component of sound

Sound: air pressure waves —> eardrum vibrates

Vibrations are transformed by the auditory nerves into impulses that brain perceives as sound

If vibrations are regular, then the sound is 'pitched'

If vibrations are not regular, then the sound is non-pitched (noise)

Frequency:
Number of vibrations/second
Cycle : single vibration
Hertz (Hz): Number of cycles per second

Amplitude: volume
Loudspeaker: distance that cone moves back & forth from neutral position
Synthesis: possible to alter the amplitude of each individual harmonic of a sound
Amplitude has its own shape that affects the envelop

Timbre: depends on partials/transients/harmonics/overtones

Duration: Electronic music can sustain sound indefinitely (non-natural).
Ex: Marimba note lasting 5 seconds

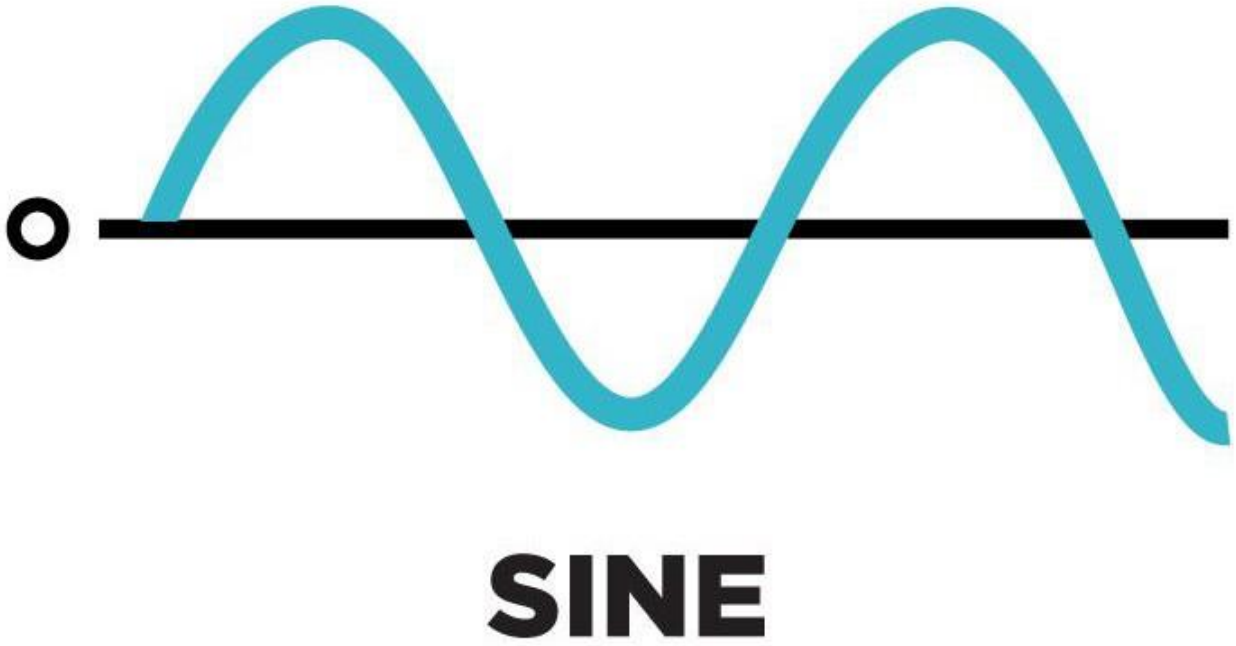
Envelop

Attack	Decay	Sustain	Release
Time to peak amplitude	Time from peak to sustain amplitude	Fixed amplitude	Time from sustain amp to 0

Waveforms:
https://www.perfectcircuit.com/signal/difference-between-waveforms

Duty Cycle: ratio b/w time above 0 amp and time below 0 amp.
Phase: In phase when identical waveforms occupy same time and space in conducting medium

Sine Wave: no harmonics except fundamental. A bit like flute, but less rich



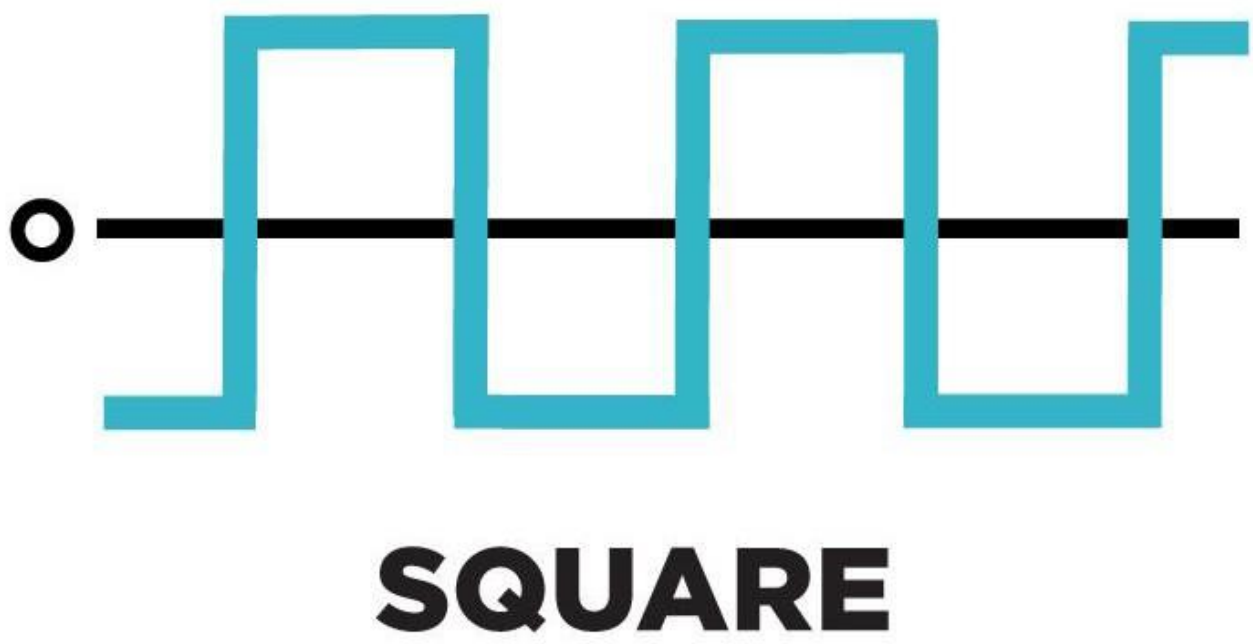
DEFINITION: A sine wave sounds like it looks: smooth and clean. It is sound at its most basic. The sound of a sine wave is only made up of one thing, something known as the fundamental. No partials to be seen! Try whistling one note or imagine the sound of a tuning fork. Those are both approximations of what sine waves sound like, though real-life sine waves are rare.

TRY IT YOURSELF: If you're looking to create a smooth sub bass sound that doesn't interfere with the bassline you are writing, then deploy a sine wave to create a beautiful deep tone.

DID YOU KNOW? Every other waveform can be created by adding up a series of sine waves.

Square Wave: Odd harmonics only, special kind of pulse wave with duty cycle of ½. Amplitudes jumps instantaneously from apex to base. Clear resonant sound.

Duty cycle of pulse wave is 1/3 above 0



DEFINITION: Remember how a sine wave is only made up of one thing, the fundamental? Not the square wave. A square wave sounds richer and buzzier. It also looks different. These are both because in addition to the fundamental, the square wave also contains **harmonics**. A harmonic is a kind of partial tone which is a whole multiple of a fundamental frequency. In a square wave, these harmonics occur in whole odd-number multiples of the fundamental frequency. The harmonics, combined with the fundamental, give this wave a square shape.

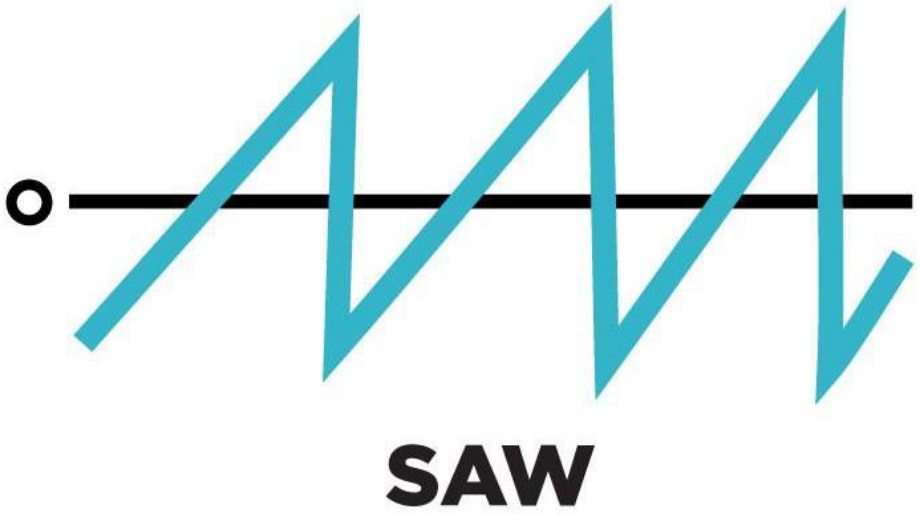
TRY IT YOURSELF: Square waves can make aggressive, crunchy kick drums.

Triangle Wave: Only odd harmonics; a bit like muted horn. Amplitudes fall off in odd integer ratios.

DEFINITION: A triangle wave contains the same odd harmonics as a square wave. Unlike a square wave, they taper off as they get further away from the fundamental, giving it its shape. It looks like an angular sine wave, and it sounds somewhere in between a square wave and a sine wave. It's not as buzzy as a square but not as smooth as a sine wave. It sounds clearer, maybe even brighter than a sine wave. Think of a recorder, or a breathily-played flute—that sounds similar to a triangle wave.

TRY IT YOURSELF: A triangle wave can be edited to make a great lead melody line.

Sawtooth Wave: contains all harmonics; a bit like reeds and strings
Amplitude of each subsequent harmonic decreases exponentially



DEFINITION: Also called a saw wave, a sawtooth wave is much more jagged and, well, looks like a saw. It is the buzziest sounding of them all, sounding even harsher than a square wave, and that's because it's the richest in terms of harmonics. This means it can be a really great choice for when you're working with subtractive synthesis, which is when you construct a sound by filtering out frequencies, rather than adding them on.

Think of the sound of a bow dragging across a violin. There's science to explain it! The friction between the bow and the string pulls the string in one direction (the saw's ramp) until it snaps back (the saw's flyback) and repeats, giving the slightly buzzy sound to a violin.

TRY IT YOURSELF: Use several saws slightly detuned to create a phasing, supersaw sound!

While other waveforms certainly exist, these four are the primary foundation for the sound of most analog synthesizers. Whether working with a keyboards, modular, or even software, these shapes are likely to be there at the core of your synthesizer's voice.

If you are curious about some of the other weird forms an oscillator can take, be sure to check out our **Learning Synthesis** series—the article on **Oscillators** in particular will be of interest!

DSP

White Noise: all waveforms combined, hiss.
(Pink: 18Hz to 10000, **Blue:** 10000Hz to 22000**)**

Reverberation: sum total of all reflections –> distance of listener to sound source, and type of surface in room/environment.
Length of reverb: from start of sound to 60dB below original amplitude

Echo: A more spaced reverb (repetitions at least 50ms apart)

Delay: from tape composition practice. Refeeding same length of tape to be re-recorded (loss of quality)

Loop: Locked groove (no loss of sound quality)

Envelop can be adjusted

Voltage Control (1960-1985)
Made possible by the invention of the transistor
Analog Synthesis much easier with Voltage Controlled Synthesis
VCO Oscillator
VCA Amplitude (amplifier)
ENV Envelop
VCF Filter
LFO

Signal Modulation:
FM
AM
Ring Modulation

Guidelines: Compose a 2 to 3 -minute piece using Audacity

Create an **imaginary** soundscape-

Do not try to reproduce the style of popular ‘songs’ or any traditional forms of composition as you know it

- The project will involve learning essential concepts, terminology, and basic skills of audio software with multi-tracks and DSP capabilities.
- EX: Choice of basic material: Audacity or Rack generated waveforms only to be manipulated through DSP and developed into a meaningful musical composition.
- Number and type of tracks (mono, stereo, or mix)
- An essential component of the project will be learning to use new tools for compositional goals (controlling simultaneously multiple musical processes such as using delays, reverberation, exporting sound-files from the computer) and tasting some aspect of the modern/contemporary musical aesthetics.
- Rubrics:
  - Project submitted on time (via Sakai) : 50% (more details to come)
  - Meaningful manipulation of sound files: 25%
  - Imagination and innovative aesthetics: 25%

- Listen/watch this piece by Ligeti:

https://www.youtube.com/watch?v=71hNl_skTZQ

COMPOSITION

Based on process:

from slow to fast // fast to slow
from low to high // high to low
from sad/angry to happy <--> (chord/scale choice)
from soft to loud <-->
from tense to relaxed
from complex (many components/layers) to simple<-->
from consonant to dissonant <-->
from distant to near (amount of reverb?)
from left to right (panning)

Based on contrast:

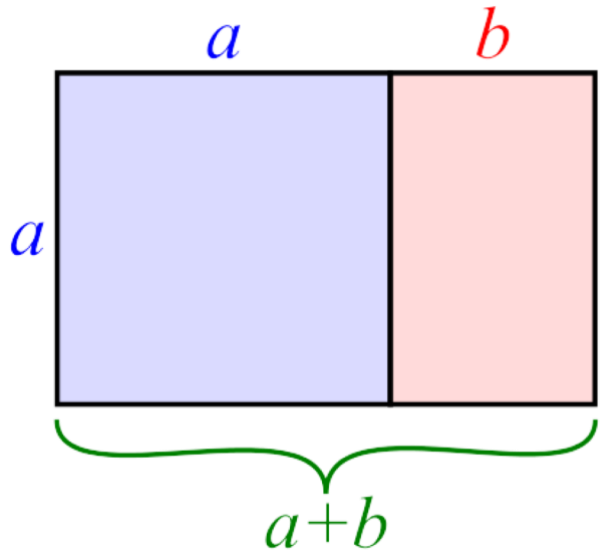
slow – fast
low – high
angry – happy)
soft – loud
tense – relaxed
complex – simple
consonant – dissonant
distant – near
left – right

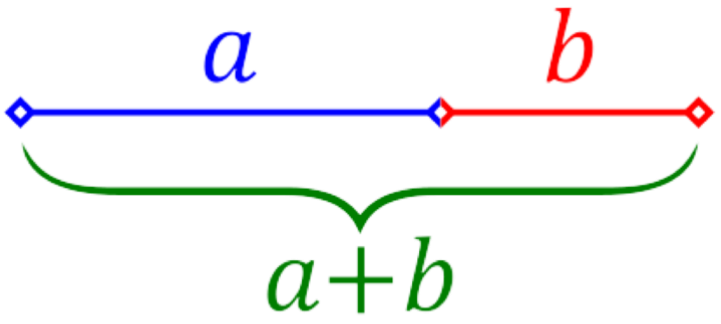
Classical Development in Composition & Typical Proportion/timing for a 2-minute piece

Contrast of two ideas: 60 seconds
Increase of tension: 14 seconds
Climax (higher louder faster): golden ratio (.618) at 74.2 seconds
Release of tension with shorten repeat of main idea

Proportions within composition:

Two quantities are in the **golden ratio** if their ratio is the same as the ratio of their sum to the larger of the two quantities.





$a+b$ is to a as a is to b

- Two quantities are in the **golden ratio** if their ratio is the same as the ratio of their sum to the larger of the two quantities.
- Also Fibonacci series.

Math
Architecture
Book
Design
Art
Music
Nature

Goals:
The first point is to learn that technology has a lot to offer musically, and is not a mere imitation or replacement of acoustic instruments which bear "acoustical" or physical limitations.
We will explore ways of moving across the border of the acoustic world through the creation of sounds expanding the acoustic vocabulary (imagine for instance the sound of a cello morphing into the sound of a flute, or a sound stretched 50 times its length; this sound could be the friction of a bow on a string). We will also explore the world of sounds *beyond* the acoustic realm by creating *new* non-acoustic sounds, sounds that could not exist in our physical environment. The second point is to teach students how to free the imagination inside them. They will achieve this goal through the completion of this composition project (with presentation of projects during last class if feasible)

Benefits to students:
Students will benefit from the class in many ways.
Students will be able to use their knowledge of the material for a composition project.
Electronic music has been around for about 70 years (the first electronic music studio was built in 1951, in Cologne), and is therefore a part of music history. As such, the style and period deserves as much attention from music historians than any other music era.

Intellectual implications:
The acceleration of computing power allows real time interaction between synthesis and sound treatment, thus upsetting traditional processes between both techniques, as well as questioning the validity of the electro-acoustic “classic form” (instrument + tape), and its aesthetics. This implies an evolution of artistic thought. Recent technological developments such as automatic performers’ followers, virtual scores, motion and speech followers, and algorithmic improvisation represent at the same time a reflection *and* an anticipation of new composition rules and concepts.

Audacity Project Rubrics: Due April 28 at 11:59pm via Sakai – Save the files with your name and title before submitting

Craftsmanship 20 17 Superior quality in every aspect of project	16 14 Excellent quality most of the time, minor problems	13 11 Overall good quality but a few lapses.	10 6 Some basic compositional skills, but lack of craft	5 1 Attempt made but serious errors or minimal
Diversity of techniques 20 17 Shows proficiency in all required manipulations (pitch shift, time shift, using cut and paste, creating rhythms, harmonies, melodic lines, and multiple tracks (12-16)	16 14 Shows proficiency in almost all DSP forms and uses multiple tracks (9-12)	13 11 Shows proficiency in some DSP, but does not use others) Uses a good number of tracks (6- 8)	10 6 Shows craft in only a few forms of DSP and less than 6 tracks	5 1 Uses only one form of DSP and 3 tracks or less
Diversity of material 10 9 Combination of varied soundwaves sources (sine, square, sawtooth)	8 7 Good combination of materials from only 2 categories (for example vocal and drums)	6 5 At least two categories, but not enough variety within the categories	4 3 One category only with good variety	2 1 One category and almost no variety
Inventiveness/sophistication 10 9 High level of sophistication and inventiveness (panning, registers, filters, echoes, reverb)	8 7 Good level of sophistication and inventiveness	6 5 Some degree of sophistication and/or inventiveness	4 3 Does not show sufficient inventiveness or sophistication	2 1 Lack of inventiveness or sophistication
Ability to complete 30 25 Shows ability to complete project on time	24 20 Project is less than 24 hours late	19 14 Project is less than 48 hours late	13 8 Project is less than 72 hours late	7 1 Project submitted 72 hours late, but within a week of original deadline
Form/Development 10 9 Composition shows control of formal design and developmental skills. Homogeneity and contrast are well balanced all the time	8 7 Composition shows control of formal design, but developmental skills still needs work. Good balance between consistency and contrast	6 5 Some deficiencies in form and development but shows balance between homogeneity and contrast.	4 3 Few attempts to use formal design or develop materials, lack of balance in the overall design.	2 1 Does not attempt to develop material. No contrast at all, or complete lack of homogeneity.

Submit the links using WeTransfer 1. The folder containing the tracks, sound files, and all manipulations
2. A stereo file .mp3 or .aiff or .wav

TOTAL: