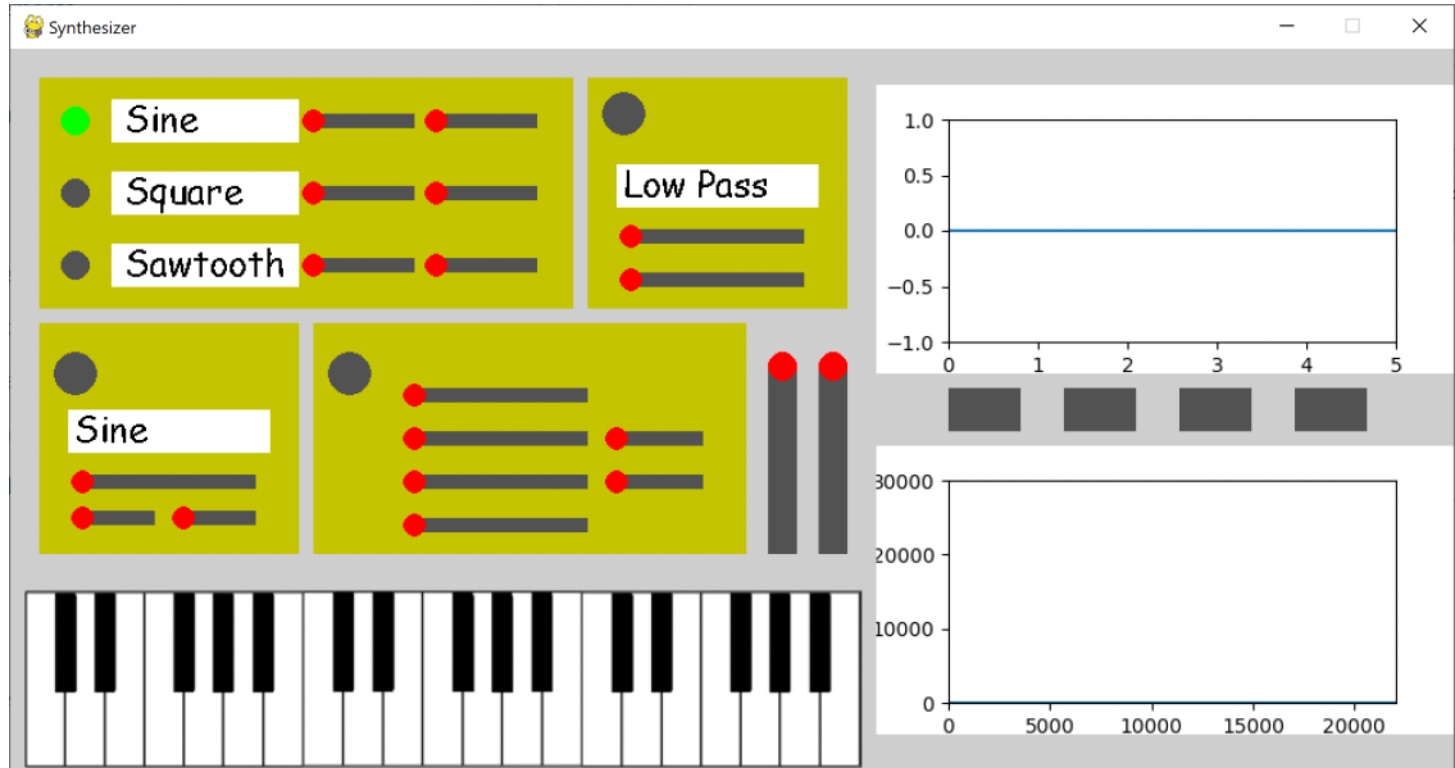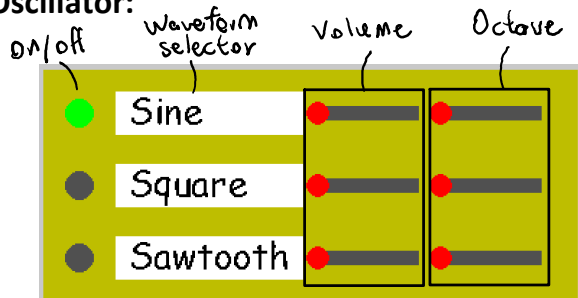# Synthesizer

Sunday, March 20, 2022   1:56 PM

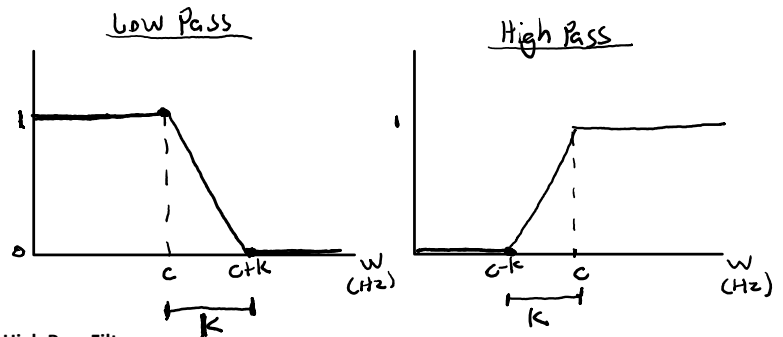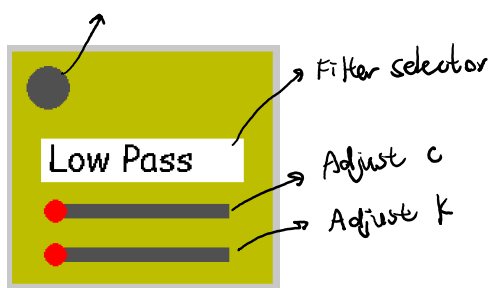## Full Application:

Oscillator:

The oscillator contains **3 types of waveforms: Sine, Square, and Sawtooth**. It allows up to three waveforms simultaneously.

- Each waveform (besides the top one) can be turned on / off individually by <u>clicking the on/off switch</u>
- Each waveform can be changed individually using the waveform selector by <u>clicking the text</u>
- Each waveform's volume contribution can be changed individually using the volume slider by <u>clicking a position on the slider (not dragging)</u>
  - Volume is initialized at 0 (left side of slider)
  - Volume slider represents the volume of each waveform, the total volume is the sum of active waveform
  - **Note: Square wave and Sawtooth wave are a lot louder than Sine wave at same volume setting**
- Each waveform is directly connected to the keyboard, playing a key on the keyboard sets the frequency of all the waveforms. The keyboard contains 3 octaves, and <u>moving the</u>

Filter: on/off

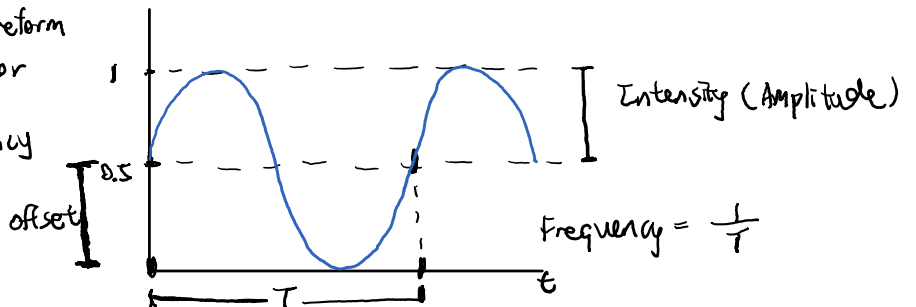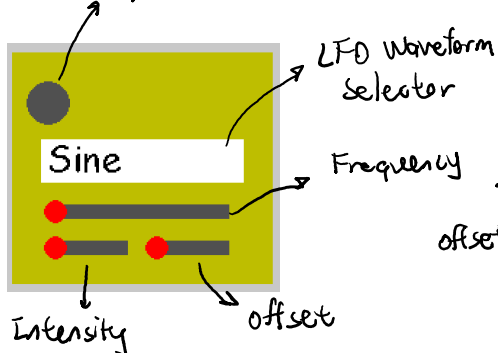Filter selector

Low Pass

Adjust c

Adjust k

Low Pass

High Pass

The Filter contains **2 types of filters: Low Pass Filter and High Pass Filter**.
- The filter can be turned on / off by clicking the on/off switch
- The type of filter can be changed using the filter selector by clicking the text
- The cut off frequency c can be adjusted with the top c-slider
- The slope of cut off line k (see above graphs for details) can be adjusted with the bottom k-slider
  - When k is 0 or close to 0, the filter is an ideal filter.

LFO: On/off

LFO waveform selector

Sine

Frequency

Intensity

offset

offset

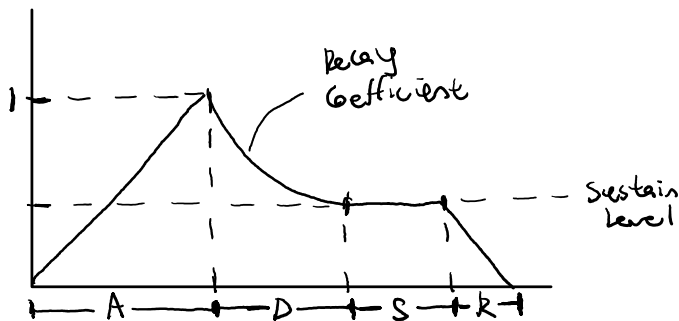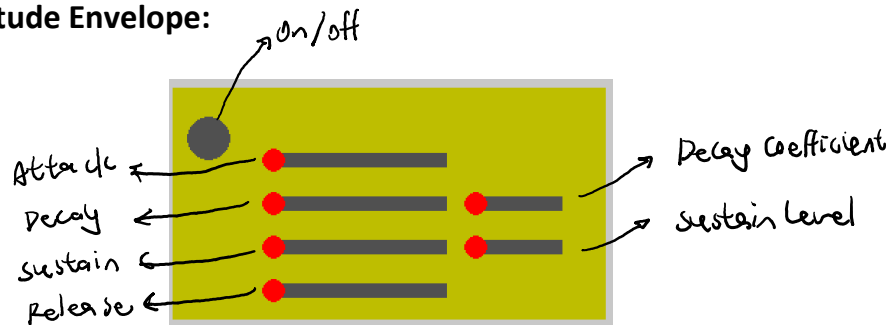Intensity (Amplitude)

$Frequency = \frac{1}{T}$

The LFO contains **3 types of waveforms: Sine, Square, and Sawtooth**. It modifies the amplitude of the sound wave based on the waveform.
- The LFO can be turned on / off by clicking the on/off switch

- The type of waveform can be changed using the LFO waveform selector by clicking the text
- The frequency of the selected waveform can be adjusted using the frequency slider by clicking on a position on the bar (leftmost = 1 Hz, rightmost = 120 Hz)
- The intensity or amplitude of the selected waveform can be adjusted using the intensity slider by clicking on a position on the bar (leftmost = 0, rightmost = 1)
- The offset of the selected waveform can be adjusted using the offset slider by clicking on a position on the bar (leftmost = 0, rightmost = 1)
- **Note: When intensity and offset combination result in negative values in the wave, it is fixed at 0**
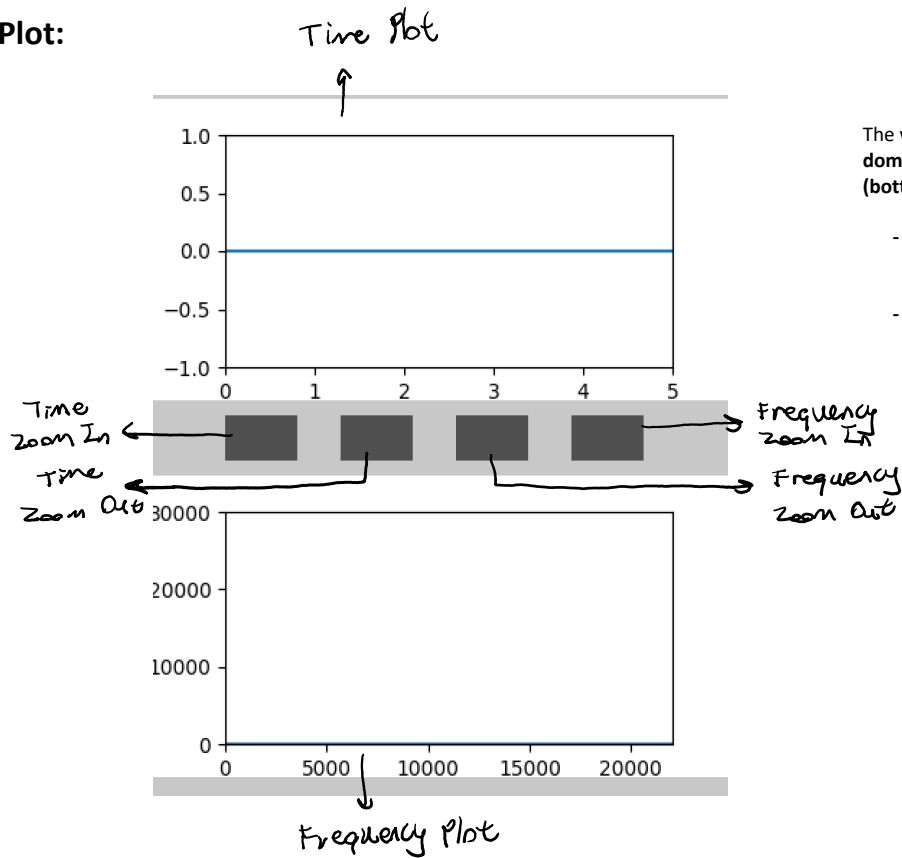
Amplitude Envelope:

The Amplitude Envelope contains **four stages: attack, decay, release, and sustain**. These four stages forms an envelope that controls the amplitude of the sound wave.
- The Amplitude Envelope can be turned on / off by clicking the on/off switch
- The **percentage** of duration of each stage is adjusted using the respective slider.
  - When all sliders are at 0 (leftmost position), the wave is a constant 0
  - When all sliders are at about the same position, the full duration of the note is shared equally across the 4 stages (A = D = S = R as shown on graph).
  - Can have one stage dominates the full duration, skip certain stages, etc
  - **Note: Attack stage always goes up to 1, decay always decreases to sustain level, sustain always keeps constant at sustain level, and release always decrease to 0, regardless of the individual duration of the stages**
- Can adjust the sustain level using the sustain level slider (leftmost = 0, rightmost = 1)
- Can adjust the form of decay using the decay coefficient slider (leftmost = more curvy, rightmost = more linear)

Plot:

Time Plot
↑

The wave played is displayed in **both time domain (top plot) and frequency domain (bottom plot)**.

- Use the left 2 buttons to zoom in on the time axis on the time plot

- Use the right 2 buttons to zoom in on the frequency axis on the frequency plot

Time Zoom In

Time Zoom Out

Frequency Zoom In
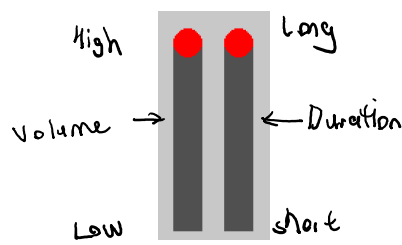
Frequency Zoom Out

Frequency Plot

Keyboard

The Keyboard tells the Oscillator to play at the frequency of the note (can be adjusted through the octave slider).
- <u>Click a note on the keyboard to play it</u> based on the settings of the synthesizer
- The plots are updated when a wave is played
- Up to **four notes can be played simultaneously** if another note is clicked before the previous notes are finished
- **Note: this synthesizer only plays the white note, black notes are not implemented**

Miscellaneous

Volume Slider: Controls the System Volume

Miscellaneous

High

Long

Volume →

← Duration

Low

short

Volume Slider: Controls the System Volume
(top is high volume, bottom is low volume)

Duration Slider: Controls the duration of notes played
(top is long, bottom is short. Range: 0 - 5 seconds)