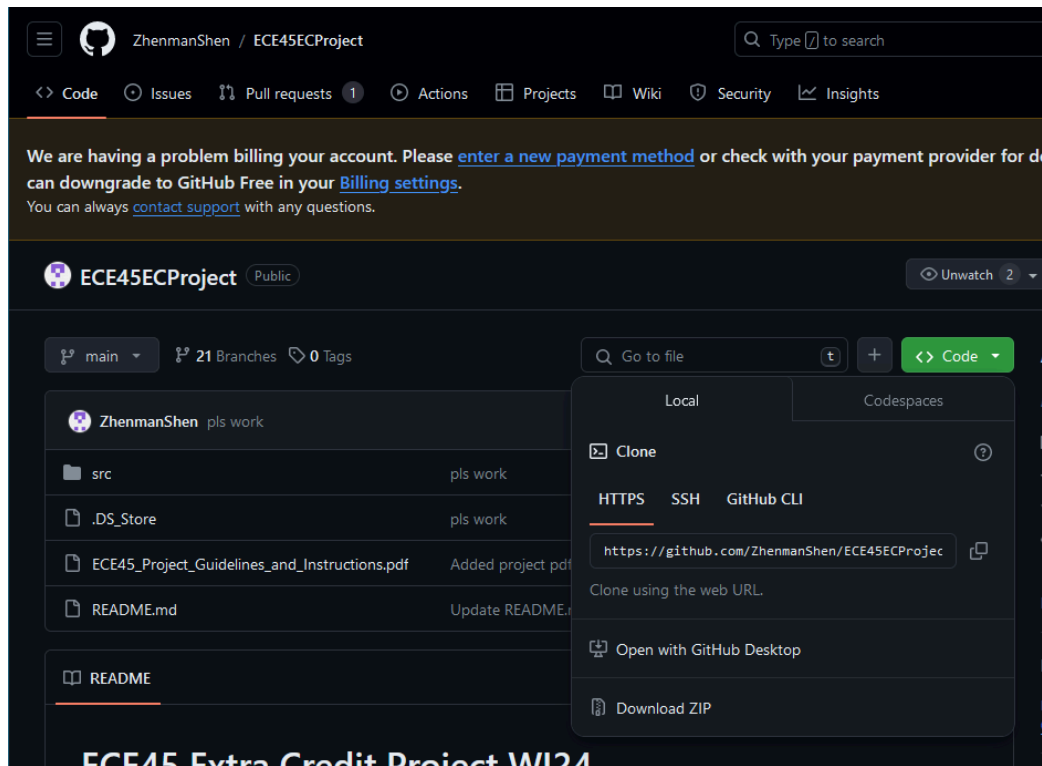# SETUP & USAGE GUIDE

a) How To Install The Synthesizer

i) Turn on the power button to your pc or device.

ii) Open the web browser, either chrome or fire fox or explorer or safari.

iii) Installing source code zip file from dropbox or [github](#).

iv) Either open Matlab online or download Matlab software if you have a subscription and set it up

v) If asked, download Audio Toolbox from MATLAB.
Link can be found here: https://www.mathworks.com/products/audio.html

vi) In the application or webapp, unzip the source file and click on the app1.mlapp, and once a new window pops up select run
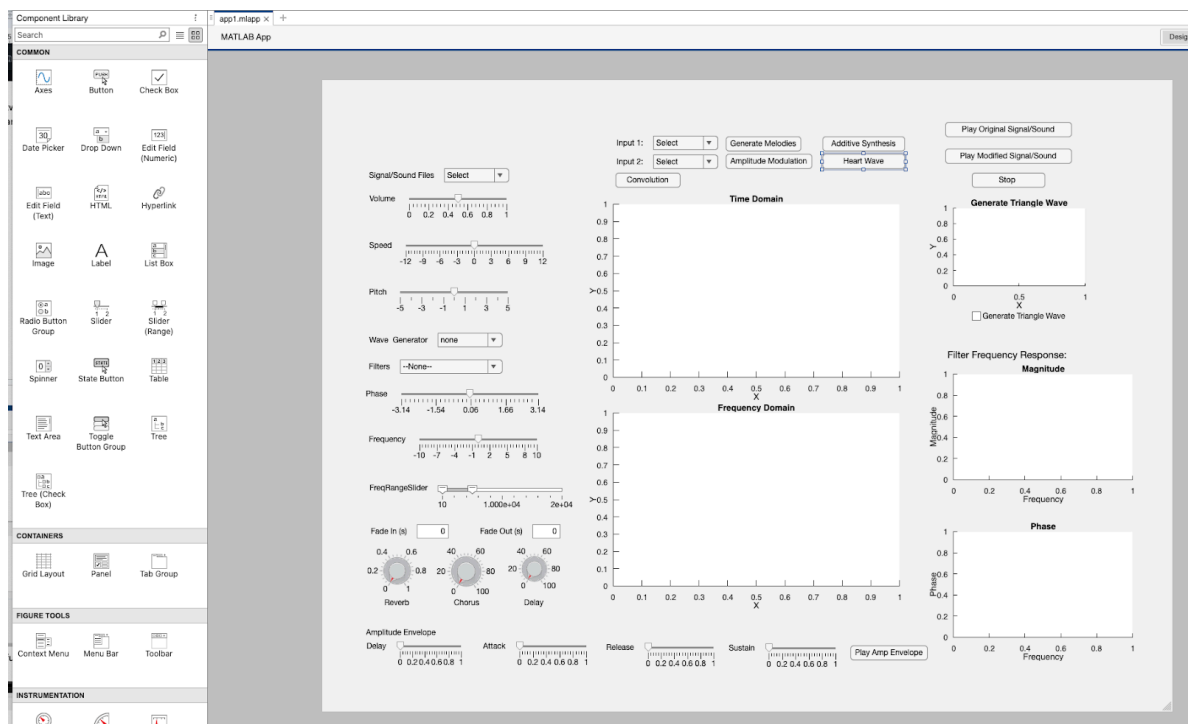
vii) Congrats! You've opened the app. I hope you have fun! Make sure to check out the basic usage guide for more info
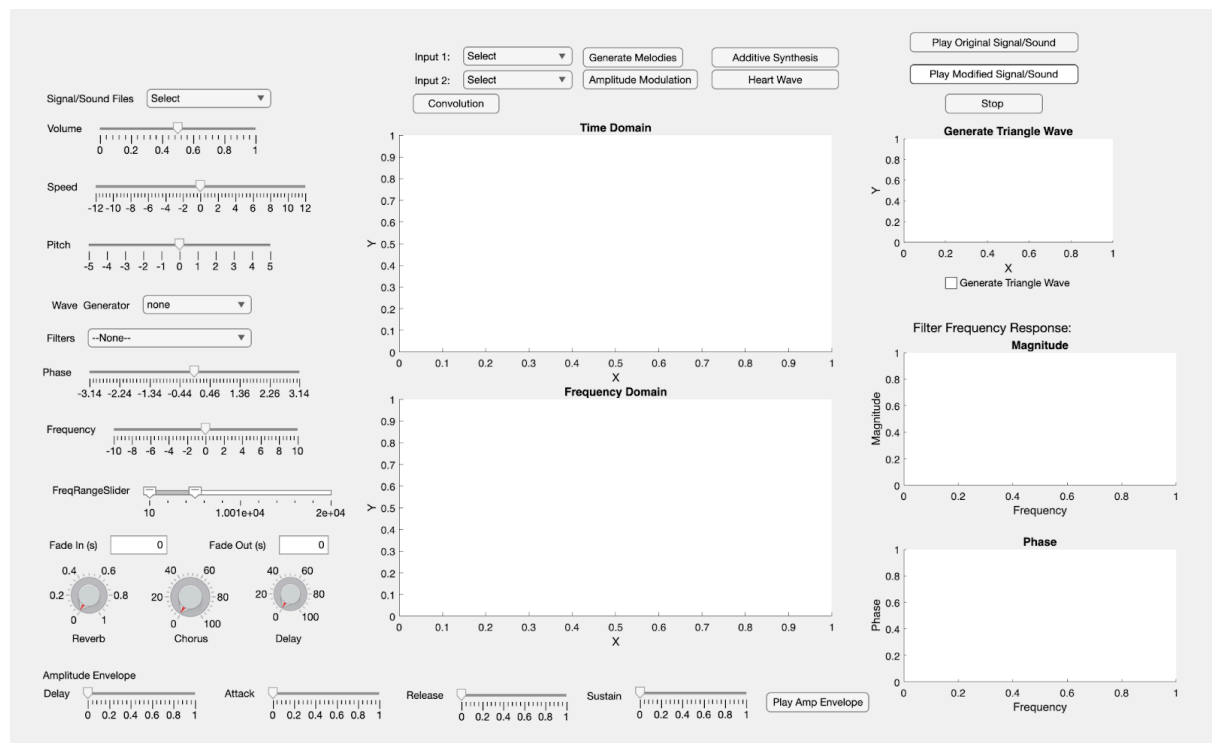
b) Basic Usage

i) **Select a Signal or Sound file.**

(1) Sin Wave

(2) Sad Valentine by No Vacations

(3) White Noise

(4) Mary Had a Little Lamb

(5) Ode to Joy

ii) **Apply filters and adjust audio.**

(1) Sin Wave is only for graph demonstrations. Specified ui components will be enabled to allow you to change the sin wave. These ui components are the phase and frequency slider, amplitude envelope, and wave generators.

(2) White Noise is only a graph demonstration.

(3) For Sad Valentine by No Vacations. Use the ui components that will be enabled to modify the signal. Use the slider and knob components to modify the sound. Each modification will plot their respective changes to the graphs. You can play the modified signal through the "Play Modified Signal/Sound" button.

(4) Mary Had a Little Lamb and Ode to Joy are graph/sound demos. They will plot their signal and play their respective sound but no modifications will be applied.

iii) **Play around and test all the synthesizer features!**

c) Advance Usage

i) Phase and Frequency Offset

To use the Phase and Frequency Offset, click on the Signal/Sound File and Select "Sin Wave".
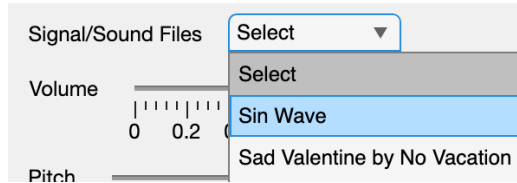
Once doing so, you will see that the graphs will be populated in time-domain, a basic sinusoidal signal.From there, please use the sliders below to modify the offset that will be applied to the signal.
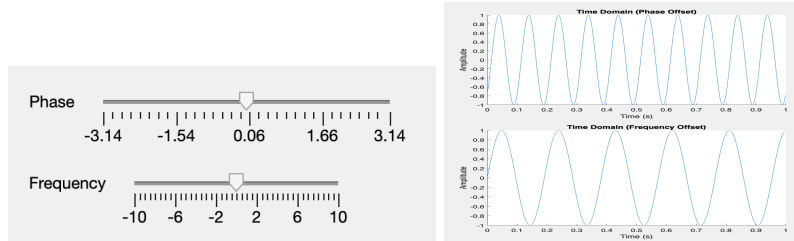
By changing the phase offset, we can see that the waveform changes relative to its original starting point. With a frequency offset, we can see how it stretches and compresses the waveform along the time axis, determining how much it oscillates.

ii) Filter: Chipmunk

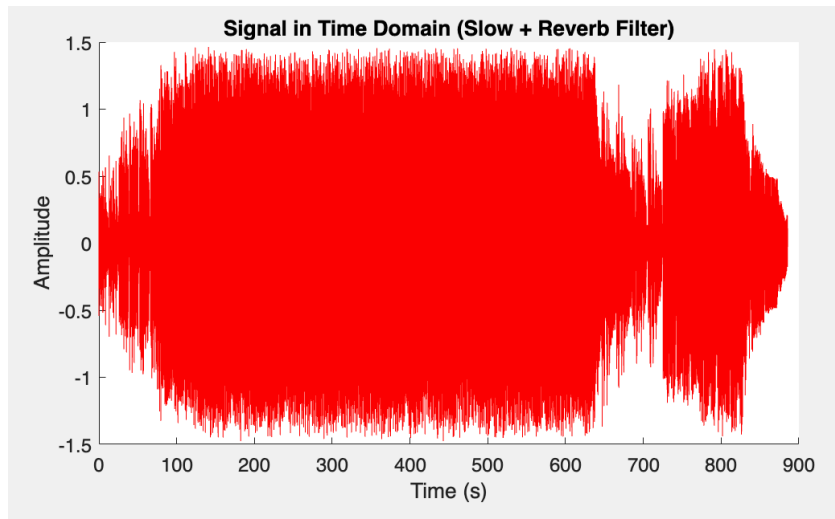Select "Sad Valentine by No Vacation" in the Signal/Sound Files.

From there, select the "Chipmunk Filter" from the Filters dropdown menu. The graphs in the middle will be repopulated with the original signal at the top and the modified signal at the bottom. Play the original and or modified sound on the right.


iii) Filter: Slow + Reverb

For the "Slow + Reverb" filter, you would do the same as the Chipmunk filter but you would select the Slow + Reverb option in the filters dropdown menu. From there, you will see the graphs being re-plotted with the original signal on top and the modified signal at the bottom.

You are able to play the original and or modified sound on the right.

iv) Delay

Select "Sad Valentine by No Vacation" in the Signal/Sound Files. With delay, there will be a knob ui at the bottom left labeled "Delay" where you are able to change the values to. When doing so, the bottom graph will be re-plotted with the delay that you chose from the knob. When playing the modified signal, it will play the original sound and with some delay, will echo the delayed sound under the original sound.
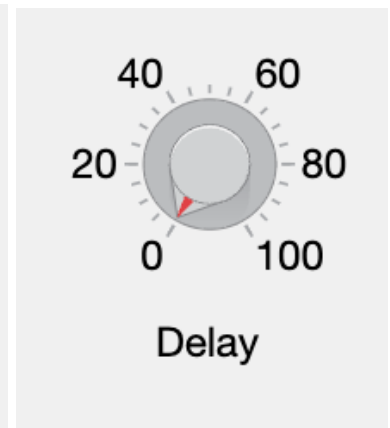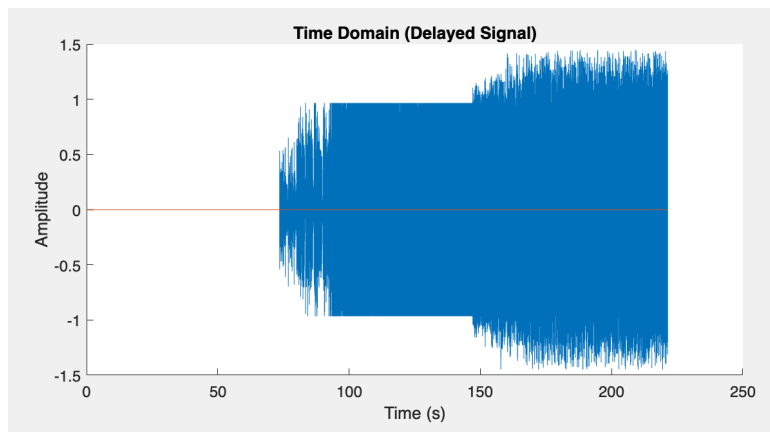

v) White Noise

Select "White Noise" in the Signal/Sound Files. A random white noise will be plotted in its time and frequency domain. It will cover frequencies of all ranges.
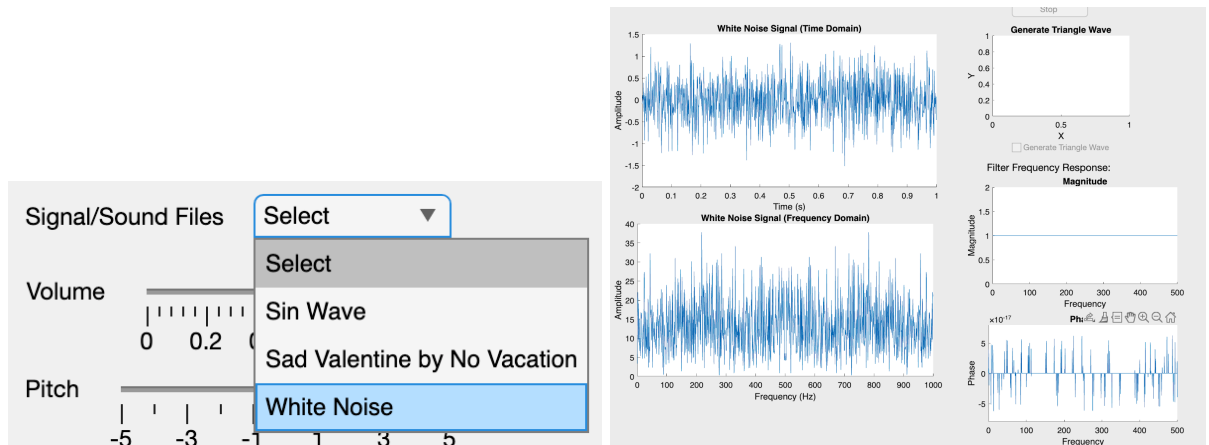
vi) Bandpass/Bandstop

Select "Sad Valentine by No Vacation" in the Signal/Sound Files. Then use the frequency range slider to get the range of frequencies to be applied. Then select either bandpass or bandstop, using the filters drop down menu. Due note that depending on the amount of frequencies you cut in the case of bandstop, or stay in the case of bandpass it would take longer for the graph in the time domain to load, as well as for the song to load. Utilizing the buttons on the right you can play the modified or unmodified file.
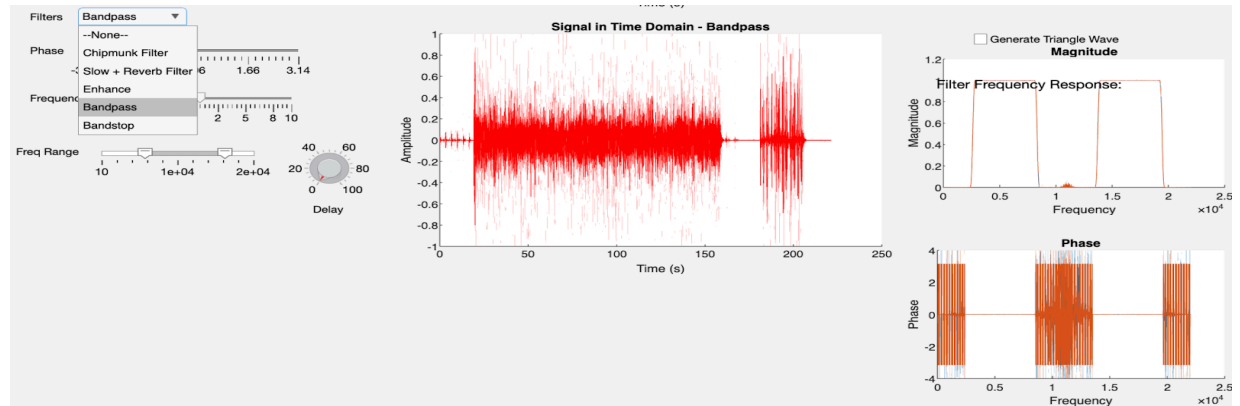

vii) Enhance

Select "Sad Valentine by No Vacation" in the Signal/Sound Files. Then use the frequency range slider to get the range of frequencies to be applied. Then select enhance, using the filters drop down menu, then use the volume knob to adjust how much you want to enhance the selected frequencies. Due note that depending on the amount of frequencies you choose, it will take a long time to load in whether it be the graph or the song. Utilizing the buttons on the right you can play the modified or unmodified file.
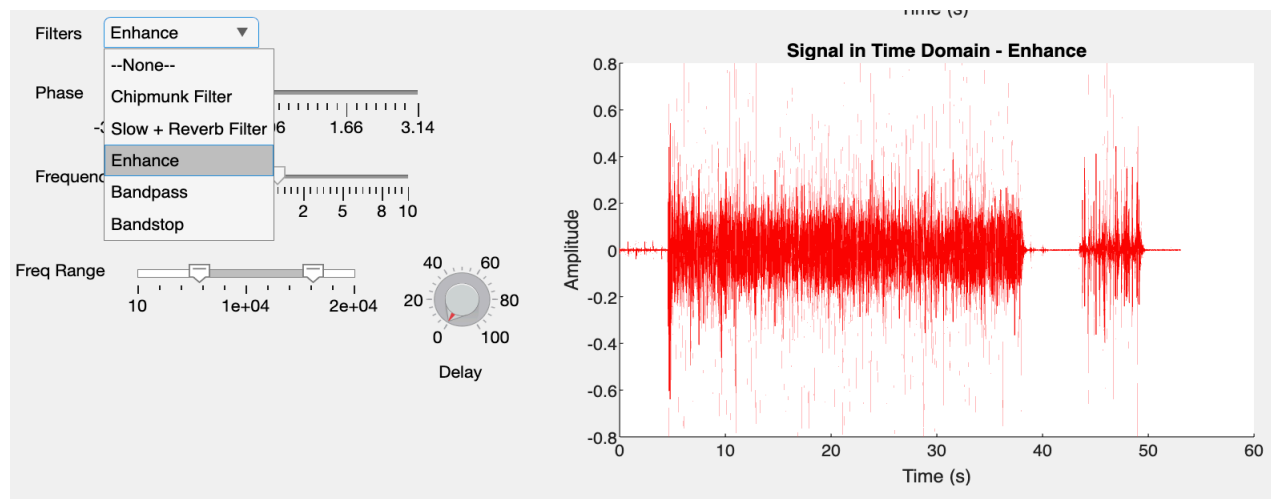

viii) Speed

Select an audio of your choice from the drop down menu. Then use the speed slider to either increase or decrease the speed and pitch of the function. A value of 2 would increase the frequency of the audio by 11.25%, while conversely -2 would decrease it by 11.25%
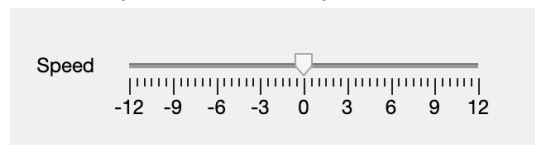

ix) Flanger

Select "Sad Valentine by No Vacation" in the Signal/Sound Files. A graph will then be populated in time-domain. Then select "Flanger" in the Filters. It will create a flanging effect to the sound file, as shown in the graph below.

You are able to play the original and or modified sound on the right.
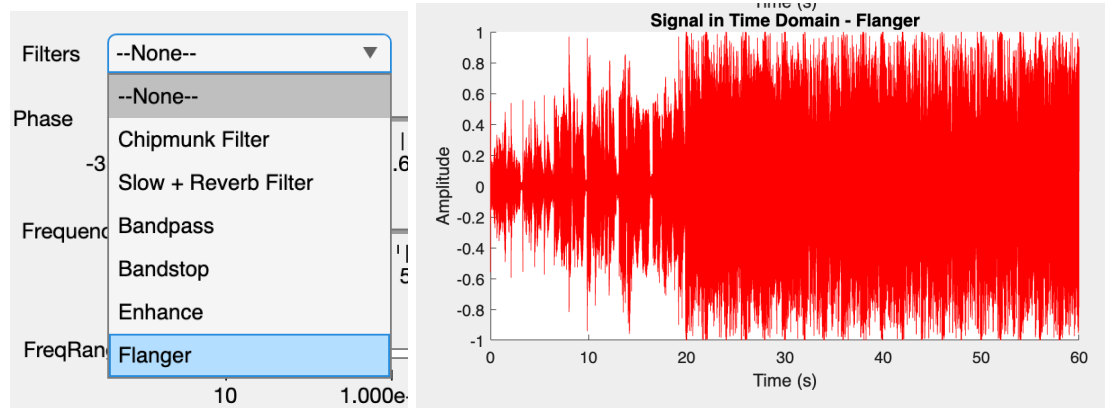
x) Reverb (Yash Joshi)

Select an audio of your choice from the drop down menu. A graph will then be populated in time-domain. Then select "Reverb" in the Filters. It will create a reverb effect to the sound file, as shown in the graph below. You can adjust the amount of reverb using the knob below.
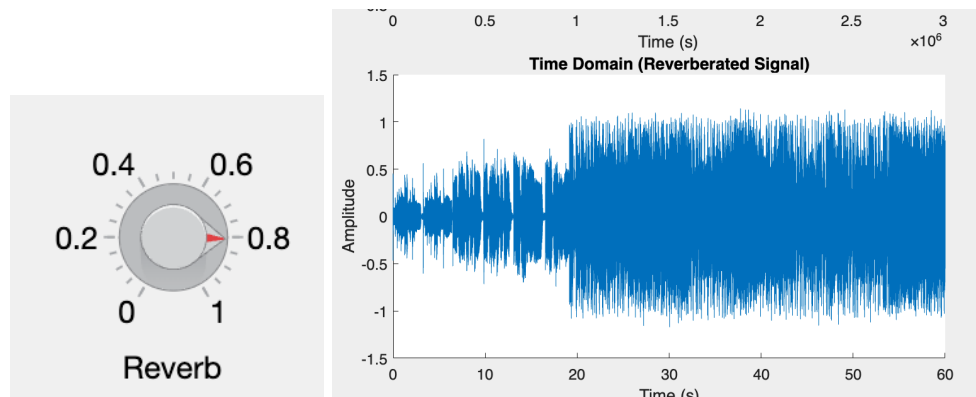

xi) Amplitude Envelope

Select Sin Wave and change the following sliders to modify the Amplitude Envelope. Click on "Play Amp Envelope" to plot the graphs and play the modified sound.
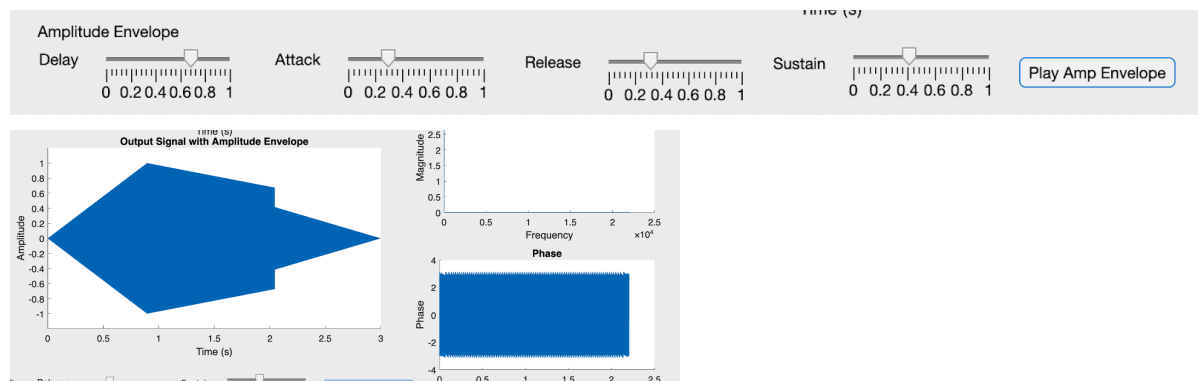

xii) Pitch

Select "Sad Valentine by No Vacation" in the Signal/Sound Files. Once doing so, you will see that the graphs will be populated in time-domain, a complicated wave which is about 200 seconds long. From there, please use the sliders below to modify the pitch that will be applied to the signal. You can then play the modified signal.
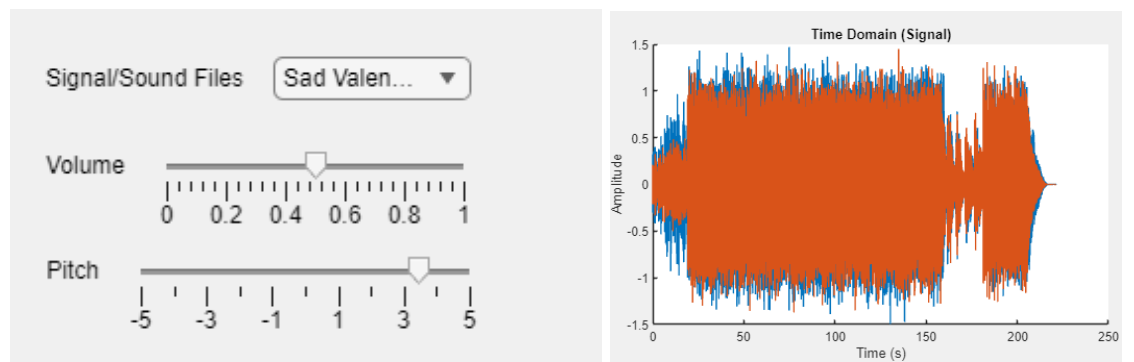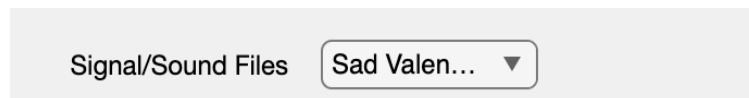
xiii) Convolution

Select the two options from the drop down menu that you want as your inputting signal (input 1 and input 2). Then press "Convolution" and the output signal will be displayed in the time domain.
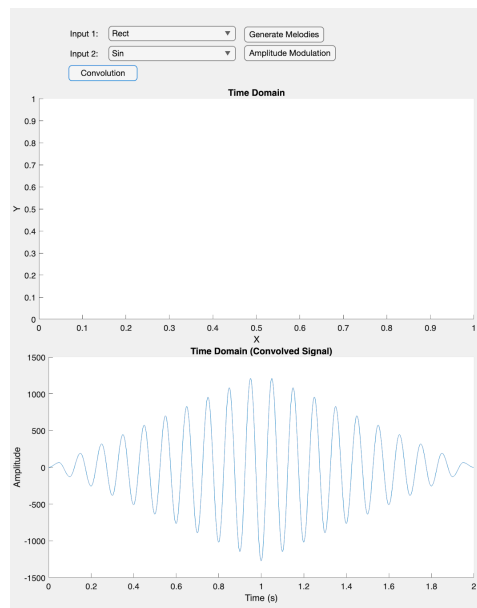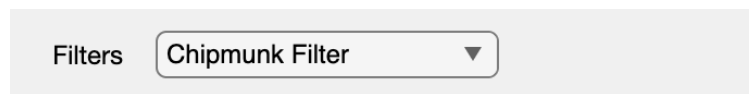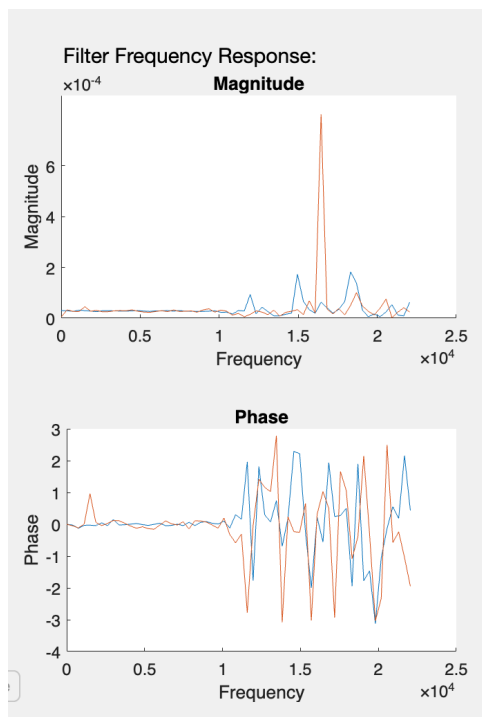

xiv) Frequency Response Graph

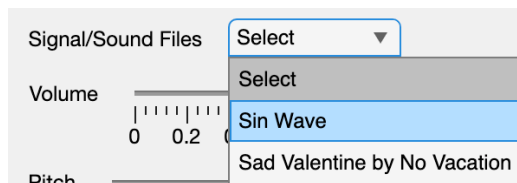Select a signal/ sound file.

Then, select a filter.

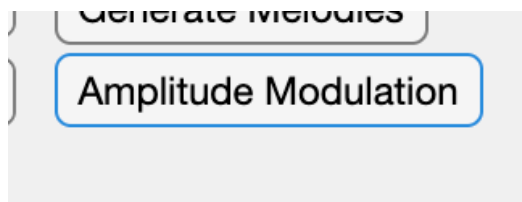Wait a moment, the frequency response graphs should be updated!

Filter Frequency Response:
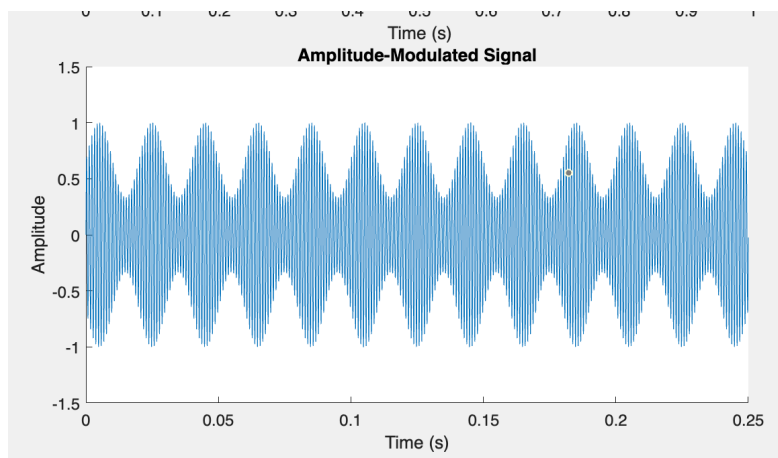
xv) AM Modulation

Select "Sin Wave" from the Signal Files Drop down menu.

Push the "Amplitude Modulation" button near the top of the graph to generate an amplitude-modified wave.
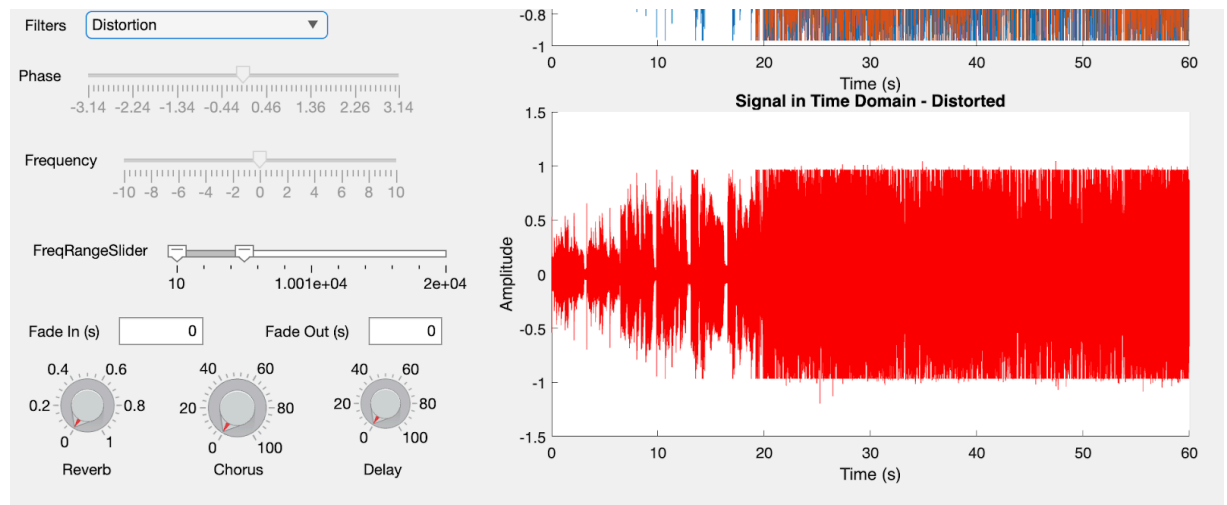

The Amplitude-Modulated Signal will be generated below.

xvi) Distortion Filter

Select "Sad Valentine by No Vacation" in the Signal/Sound Files. After that click the filter drop-down menu and select the "Distortion" filter. Then the filter will be automatically applied and you can hear the distortion if you click play modified sound.


xvii)   Muffled Filter

Select "Sad Valentine by No Vacation" in the Signal/Sound Files. After that click the filter drop-down menu and select the "Muffled" filter. Then the filter will be automatically applied and you can hear the muffled signal if you click play modified sound.
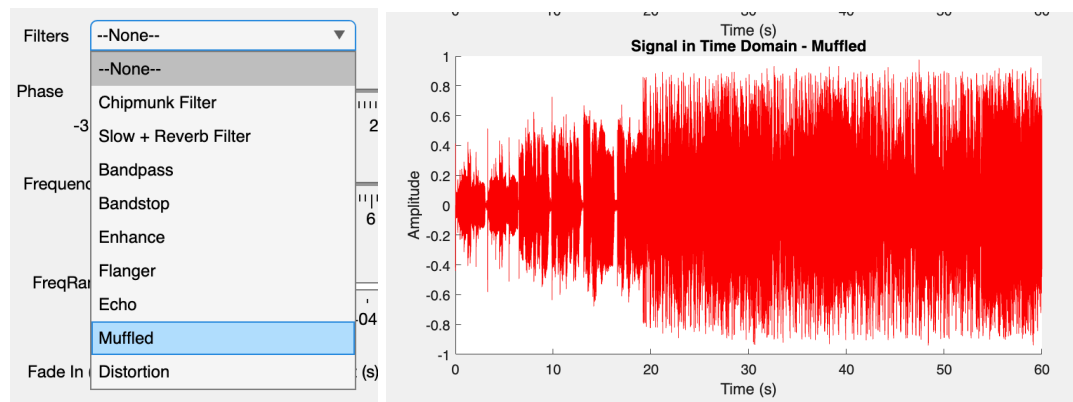

xviii)   Chorus

For the chorus functionality, if we choose a sample signal or sound file like "Sad Valentine", the method will copy a specific segment and create multiple delayed and modulated copies of it (with each turn of the knob being 10 times more), then mixing these copies with the original signal. This process introduces variations in timing and pitch, simulating the effect of multiple performers or instruments playing the same part with slight timing and pitch differences.
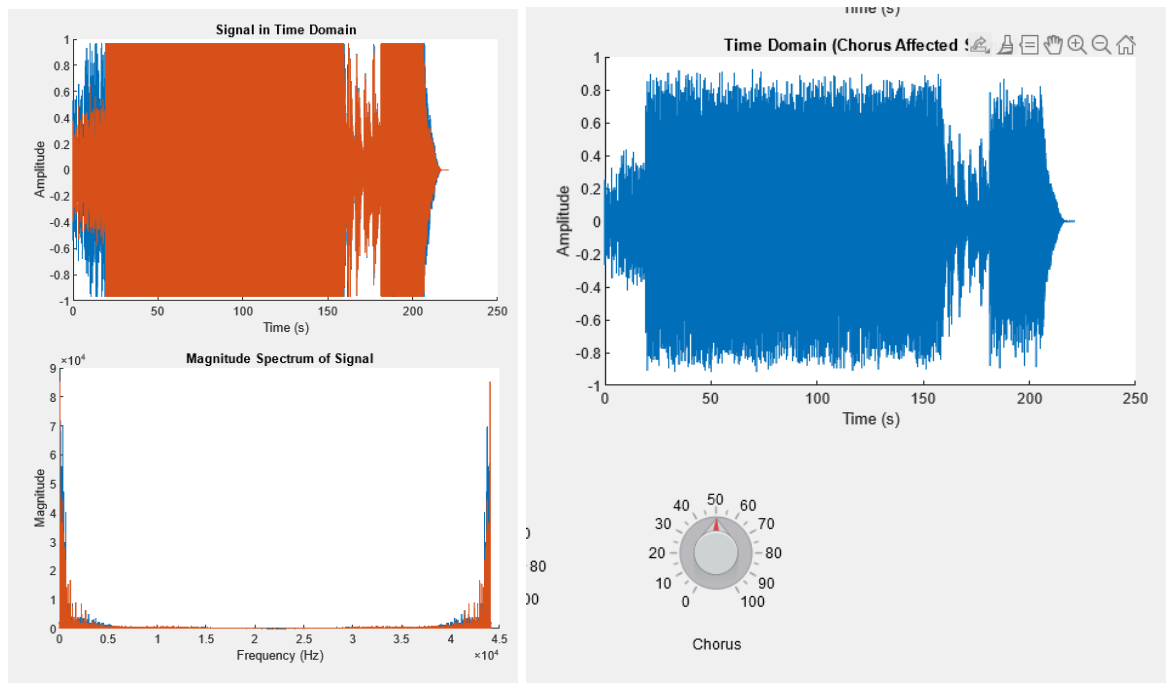
xix) Heartbeat Wave

For the heart wave functionality when you select the heart wave dropdown section, there will be an ECG graph and waveform that will show a pop-up followed by a heartbeat sound playing in the background. This mimics an ECG wave and sounds similar/closely related to the ECG machines seen in medical settings.
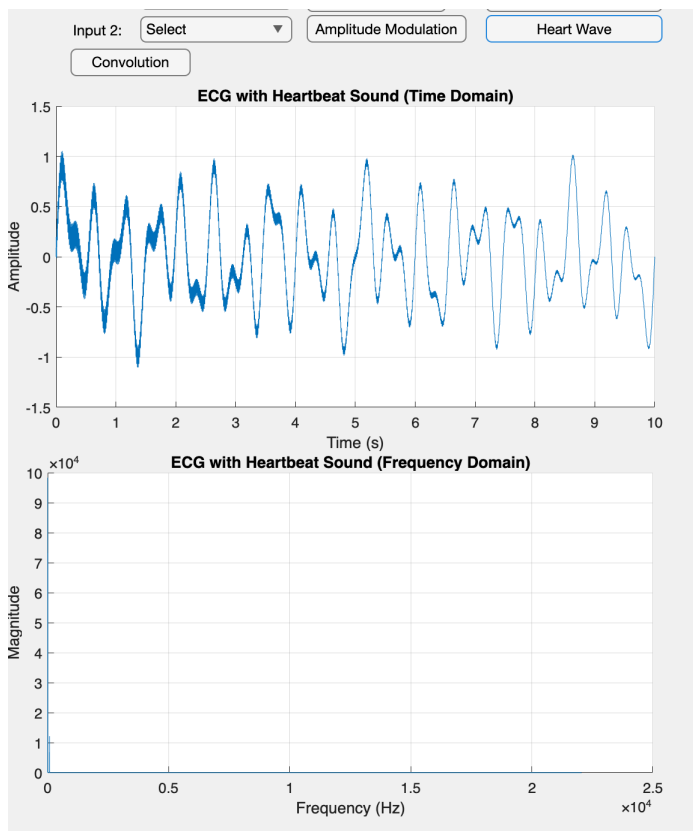

xx) Additive Synthesis

The additive synthesis functionality allows the user to combine sound waves. Click on additive synthesis, and adjust the frequency and phase sliders to vary the sound produced. This has the potential to create beautiful sounds by combination. Play around with it, and have fun!

Additive Synthesis
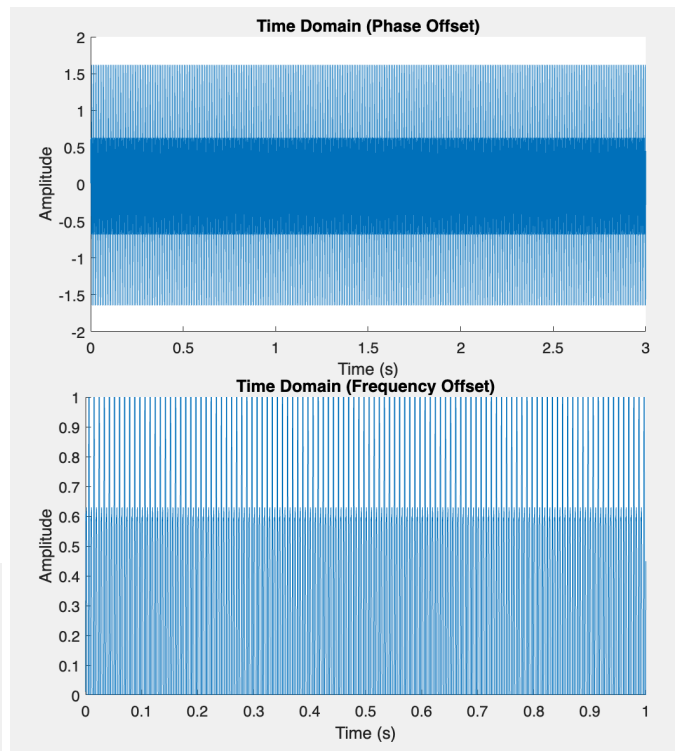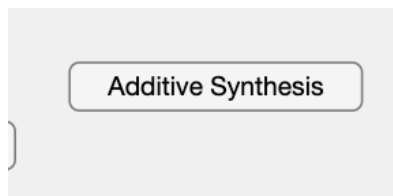
xxi)   Triangle Waveform

Click on the "Generate triangle wave" will show up the wave from the graph.Note that not all audio will appear, this test only limits the amp to 150-220 hz.
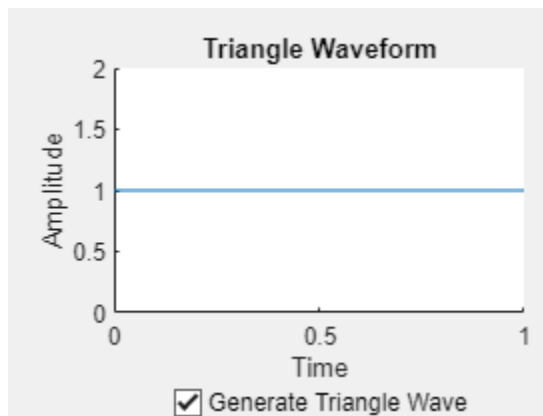
xxii)   Volume

After selecting the sound file, use the volume slider to change the volume of the signal. The number you select will be the new amplitude of the signal. The higher the amplitude, the higher the volume. After choosing your desired volume, hit the "Play Modified Signal/Sound" button and the volume will be different. You can also look at the signal in the time domain graph which reflects the new amplitude.
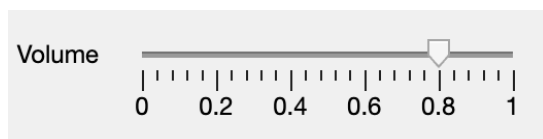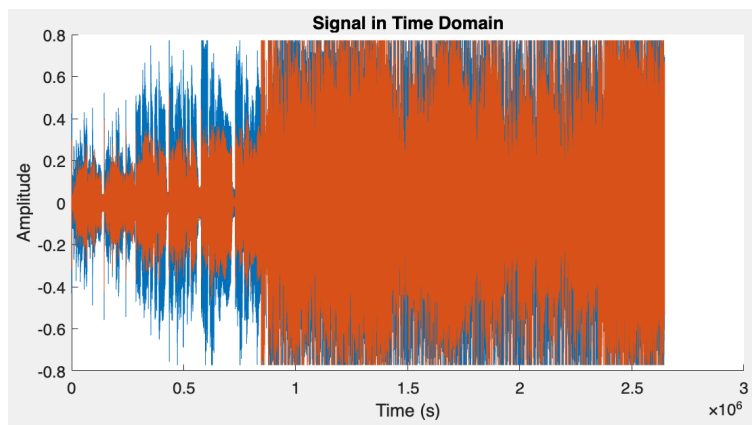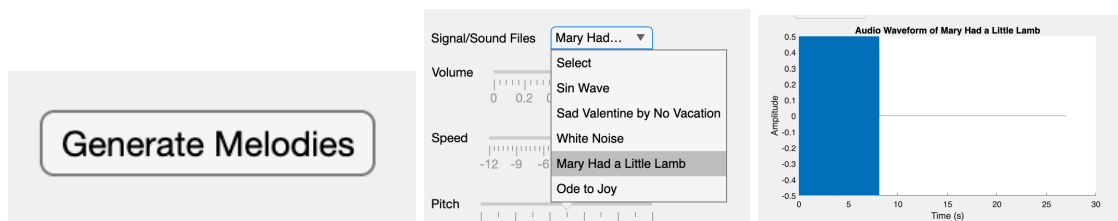
**xxiii) Generate Melodies to "Mary Had a Little Lamb" and "Ode to Joy"**

Click on the "Generate Melodies'' button in the top middle of the application. This will generate melodies to Mary Had a Little Lamb and Ode to Joy. Both of which will play.

In addition, you can check the plot for these melodies by selecting the dropdown menu for Signal/Sound Files to the selected melodies.


xxiv) Audio Fade In/Out

For the fade-in functionality, we can input a number (in seconds) into the fade-in textbox. The program will apply a quadratic fade-in to the signal upon pressing "enter." The edited audio will play in the background, and a time domain graph showing the audio with fade-in applied to it will be displayed. As we can see here, for an extreme example with audio wave of 60 seconds, the quadratic scaling of the wave amplitude is stretched for the entire duration.
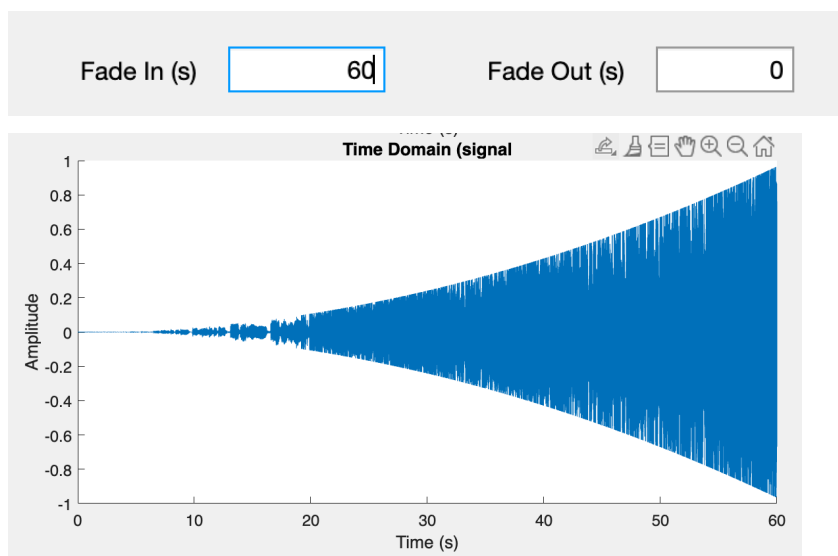
Using the fade-out functionality is the same as using fade-in. It just applies a quadratic fade-out Effect to the audio signal. An extreme example where the fade-out effect is applied for the entire duration is showed below.
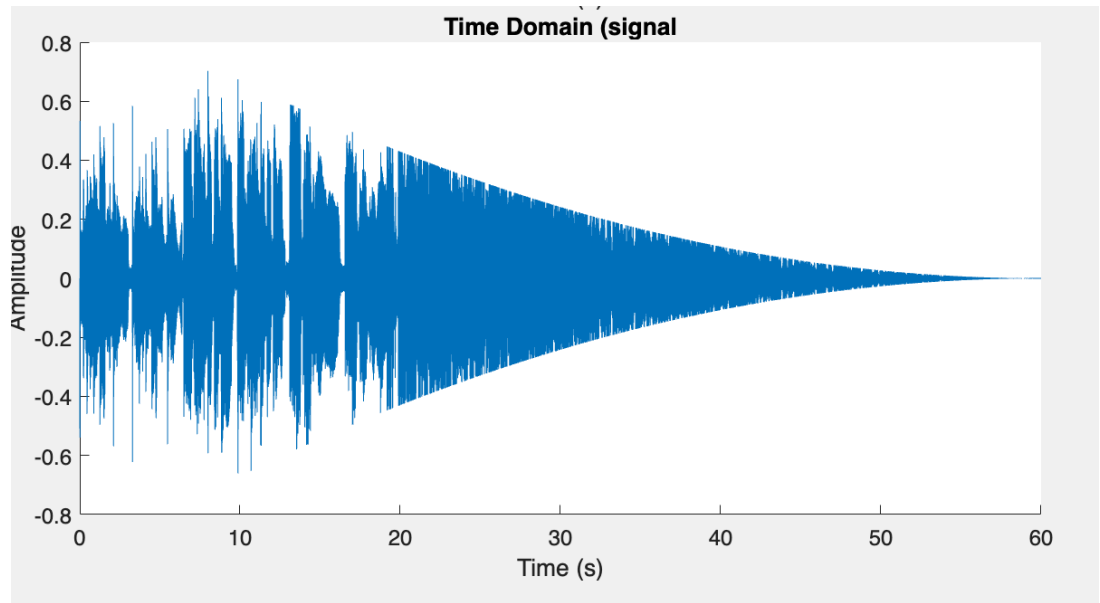
In the event that the user inputs a value larger than the duration of the audio signal, we simply set the fade length to the duration of the audio. If the event inputs a negative value, we do not edit the signal at all.

xxv)   **Echo**

Select "Sad Valentine by No Vacation" in the Signal/Sound Files. After that click the filter drop-down menu and select the "echo" filter. Then the filter will be automatically applied and you can hear the echo if you click play modified sound.