MUSC 3264: Lab Assignment 2 (Due Tuesday, March 4, by 11:59 pm)

You are going to create a function that adds echoes to an inputted audio signal and then applies amplitude modulation to the signal with echoes. Use the following instructions to create a Google Colab notebook to write and run the function.

1) The necessary libraries and audio files are already imported in cell 1

2) The following functions have been copied in cells 2 through 5 (one in each cell)
- plotAudio2()
- subplots()
- makeEchoes()
- amplitudeModulation()

3) **In cell 6: create a function called echoAM() that inputs**
- **an audio signal**
- **the audio signal's sampling rate**
- **a delay time (in seconds)**
- **a list containing the amplitude for the delays (# of delays specified by the length of the list)**
- **an amplitude modulation frequency**
- **an amplitude modulation amplitude**
- **a modulation index**

The function should
- **plot the original signal in the time domain using plotAudio2()**
- **use makeEchoes() to apply a delay according to the inputted values to the inputted signal**
- **plot the delay in the time domain using plotAudio2()**
- **use amplitudeModulation() to apply amplitude modulation according to the inputted to the delayed signal and to plot the Modulator Signal, Carrier Signal, and Product Signal as subplots in a single plot**
- **return the modified signal**

Remember the basic template for creating functions

```
In [1]:  1 def printText(string):
         2     print(string)

In [2]:  1 printText('Hello world!')
         Hello world!
```

4) The following code is in cell 7 touse librosa.load() to open avm.wav and use IPython.display.Audio() to play it

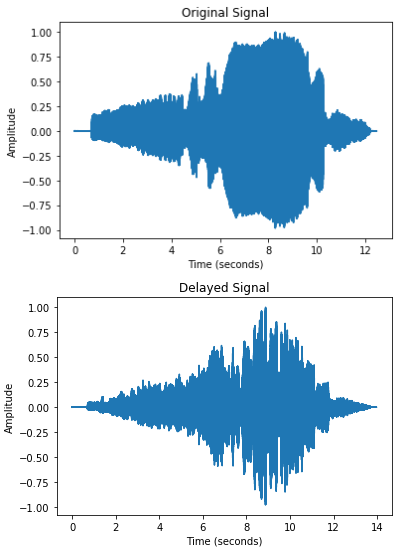
```
sig , sr = librosa.load('avm.wav')
```

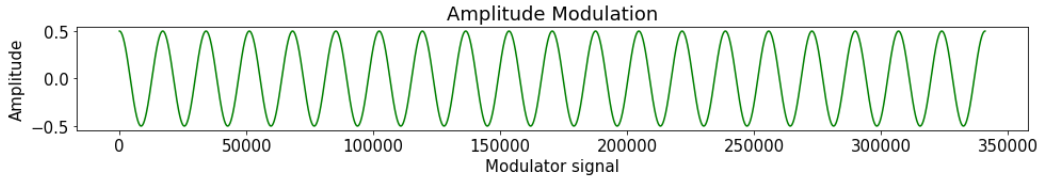
5) In cell 8: run the function with the following arguments and use IPython.display.Audio() to play the modulated signal (named modSignal1)

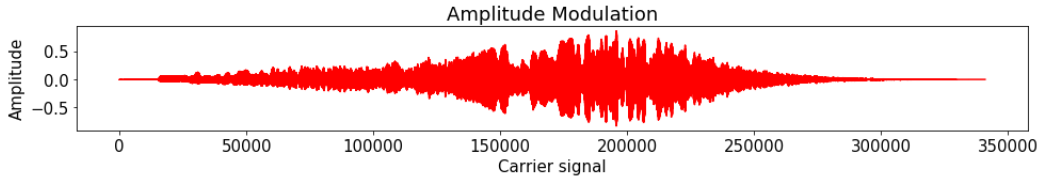
delay = 0.5
echoes = [1,1,1]
modulatorFreq = 20
modulatorAmp = 0.5
modIndex = 1

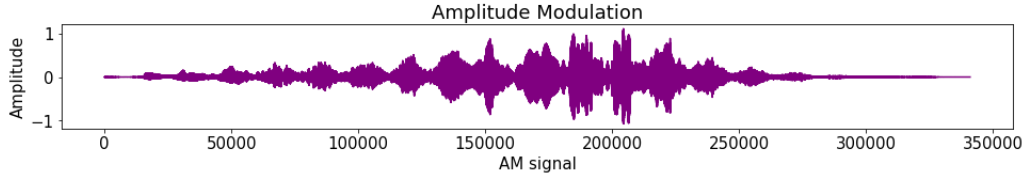
modSignal1 = echoAM(sig,sr,delay,echoes,modulatorFreq,modulatorAmp,modIndex)

This should generate the following plots







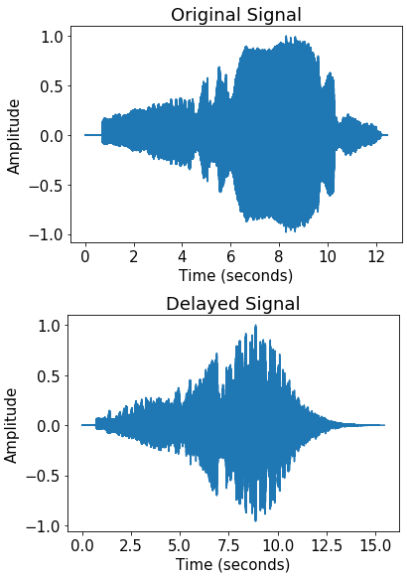


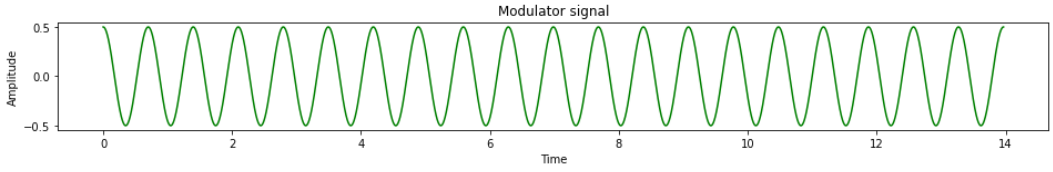
6) In cell 9: run the function with the following arguments and use IPython.display.Audio() to play the modulated signal (named modSignal2)

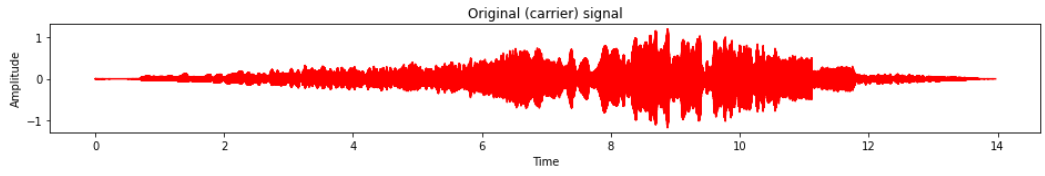
delay = 0.5
echoes = [1,0.5,0.25,0.125,0.0625,0.03125]
modulatorFreq = 20
modulatorAmp = 0.5
modIndex = 1

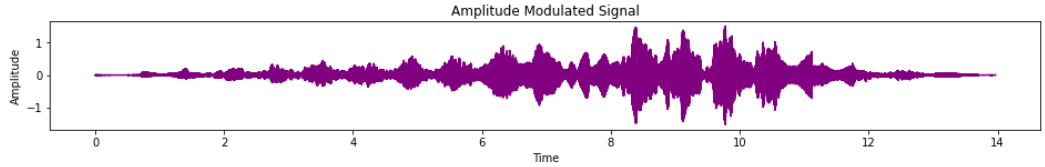
modSignal2 = echoAM(sig,sr,delay,echoes,modulatorFreq,modulatorAmp,modIndex)

This should generate the following plots







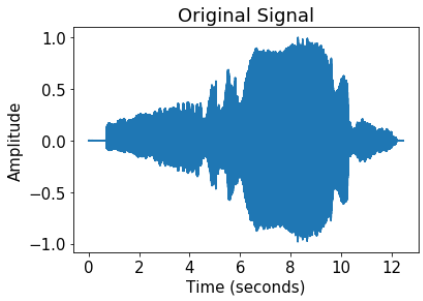


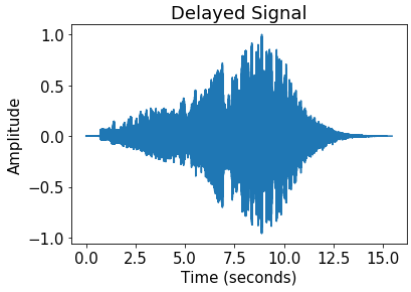
7) In cell 10: run the function with the following arguments and use IPython.display.Audio() to play the modulated signal (named modSignal3)

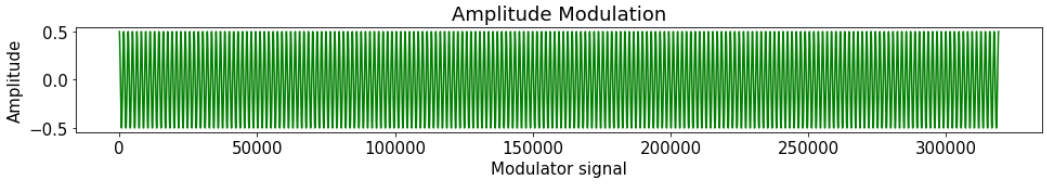
delay = 0.5
echoes = [1,1,1,1]
modulatorFreq = 200
modulatorAmp = 0.5
modIndex = 0.5

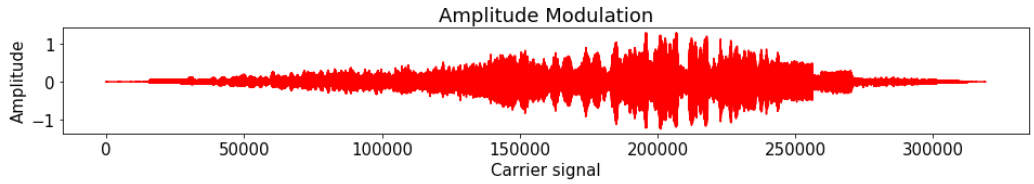
modSignal3 = echoAM(sig,sr,delay,echoes,modulatorFreq,modulatorAmp,modIndex)

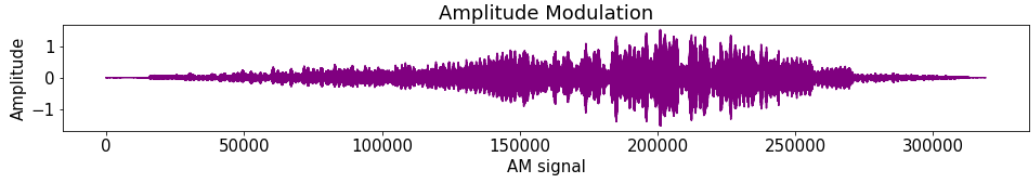
This should generate the following plots









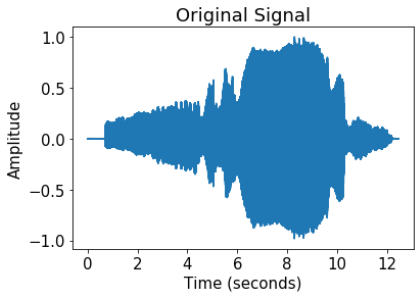


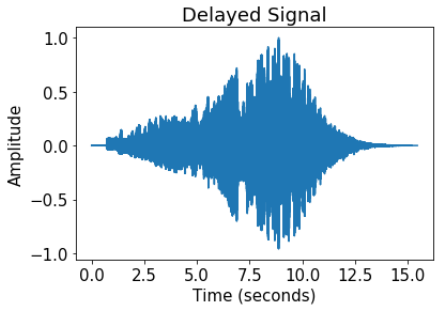
8) In cell 11: run the function with the following arguments and use IPython.display.Audio() to play the modulated signal (named modSignal4)

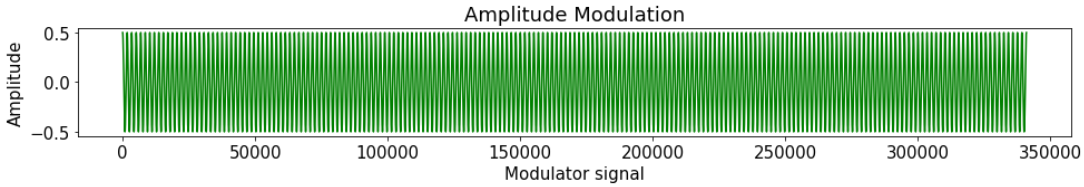
echoes = [1,0.5,0.25,0.125,0.0625,0.03125]
delay = 0.5
modulatorFreq = 200
modulatorAmp = 0.5
modIndex = 0.5

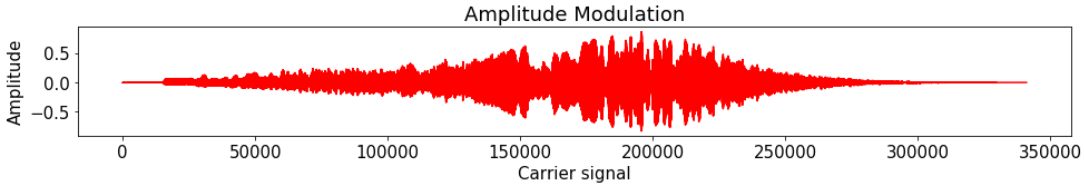
modSignal4 = echoAM(sig,sr,delay,echoes,modulatorFreq,modulatorAmp,modIndex)

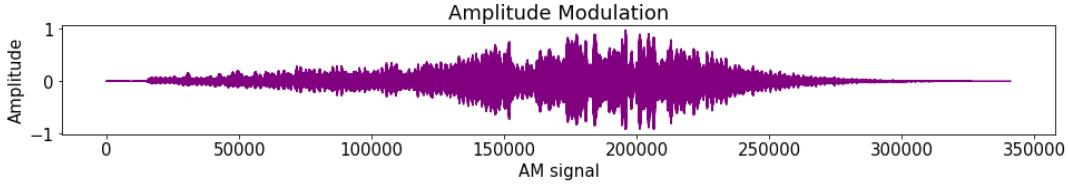
This should generate the following plots











9) In cells 12 and 13 run the function twice more, using your own settings for the inputted variables. *You can also run the function with other audio files if you like.*

10) Keep the file name as labAssignment2 and sync to your GitHub repository, then submit a link to the file on Blackboard

Workflow suggestion

Rather than writing the entire function in Step 3 (Cell 6) all at once. I recommend writing it stages. To do so, you'll also have to complete Steps 4 and 5 (Cells 7 and 8) and make modified calls to the echoAM function (see below).

Plot original signal
- echoAM(sig,sr)

Create a delayed signal
- echoAM(sig,sr,delay,echoes)

Plot delayed signal
- echoAM(sig,sr,delay,echoes)

Create amplitude modulated signal
- echoAM(sig,sr,delay,echoes,modulatorFreq,modulatorAmp,modIndex)

Return modified signal
- modSignal1 = echoAM(sig,sr,delay,echoes,modulatorFreq,modulatorAmp,modIndex)

The following image gives you an overview of the signal flow in the echoAM function