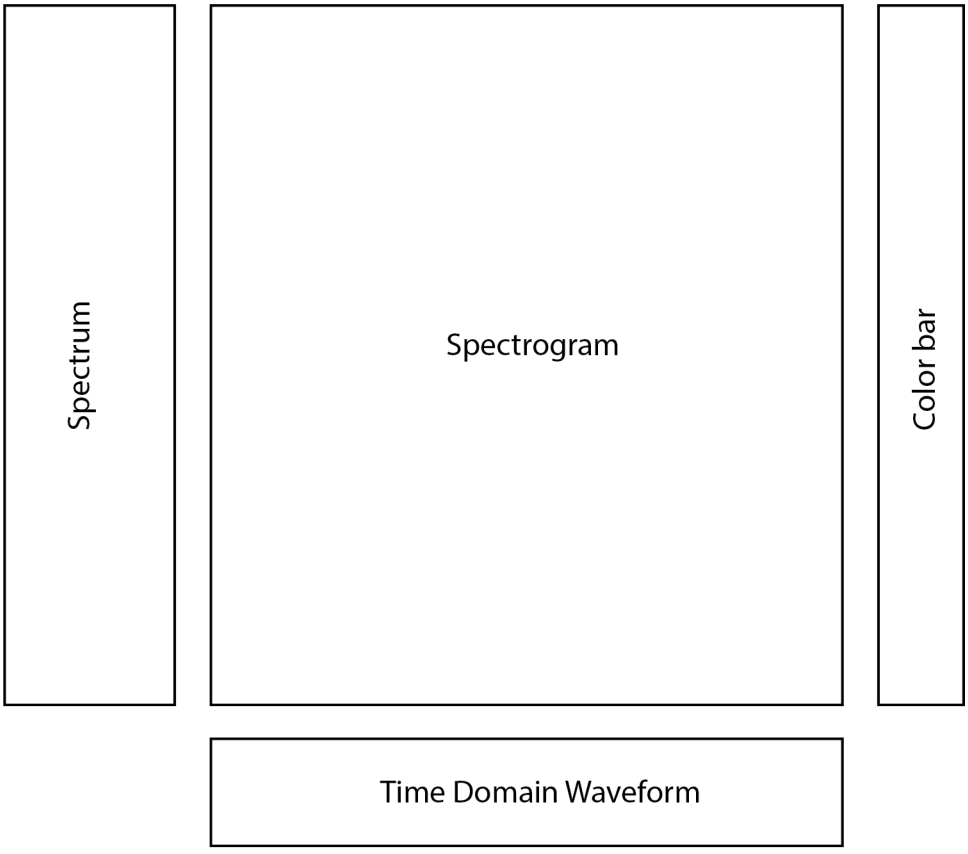
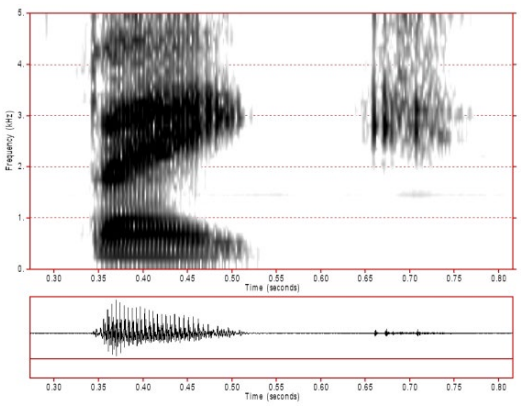
Homework #1

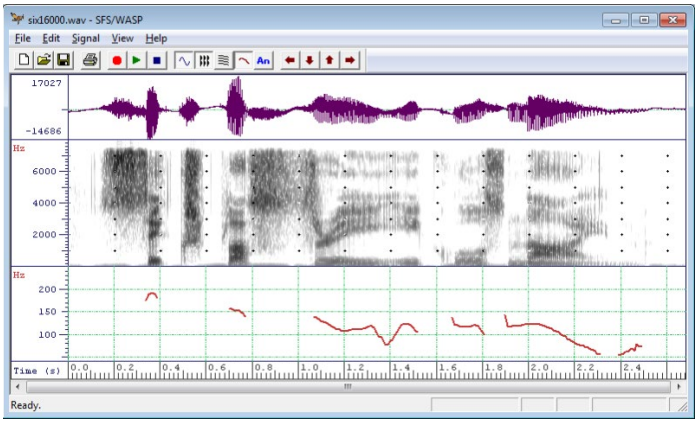
EELE 578
Assignment Date: 9/9/2022
Due Date: 9/19/2022

1. Record yourself speaking and save the speech recording as a .wav file.
   a. You can use MATLAB to record audio and read/write audio files, e.g. see:
      i. https://www.mathworks.com/help/matlab/import_export/record-and-play-audio.html
      ii. https://www.mathworks.com/help/matlab/ref/audioread.html
   b. You can read one of the sentences contained in the document TIMIT_sentences.txt (found in the HW01 directory on D2L). These sentences were created by phoneticians to contain a good mix of phonemes.
2. Write your own spectrogram function that has the layout shown below

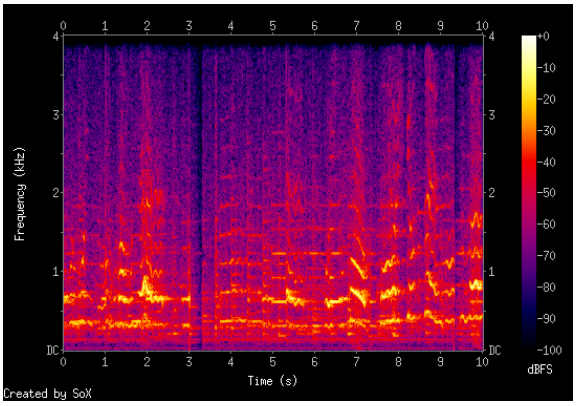


a. The time domain waveform should align with the spectrogram as shown in these examples:

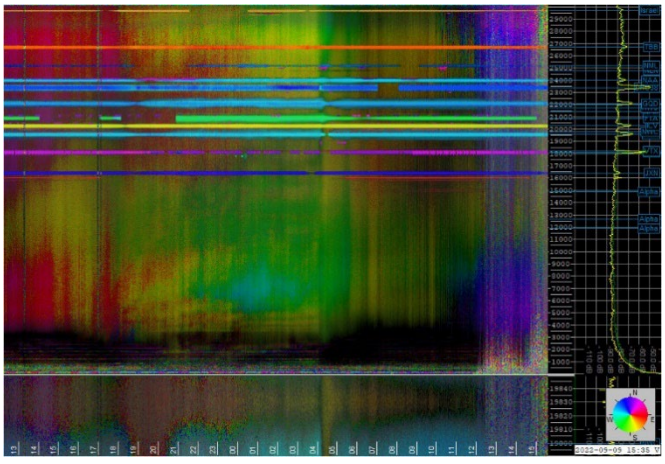




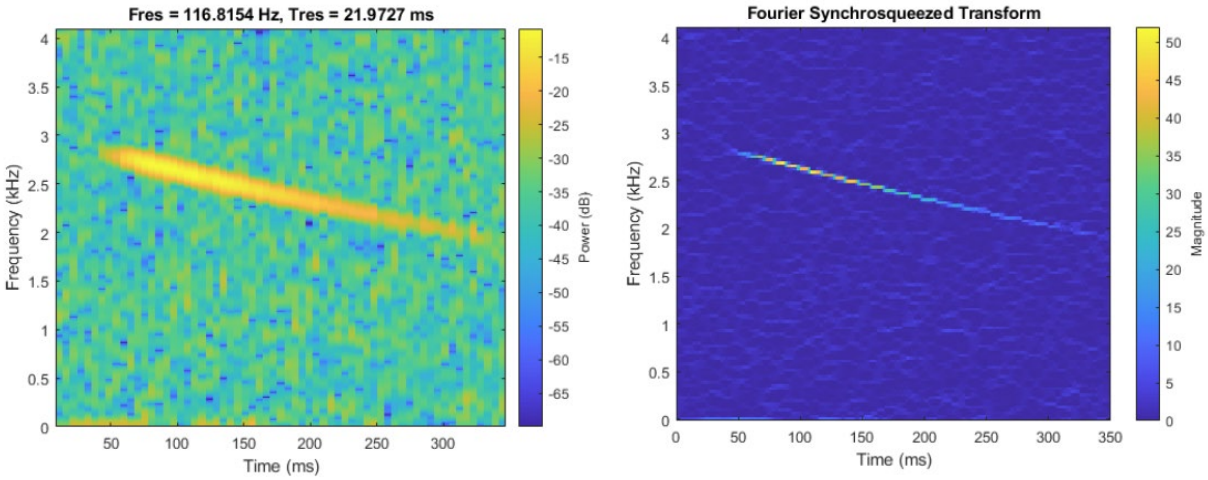
b. The color bar should be on the right where the magnitude (over all values shown in the spectrogram) has been normalized to 0 dB as the maximum value.



c. The spectrum on the left should just show the cumulative spectrum shown in the spectrogram. The example below has the spectrum on the right.



d. There will be a lot of parameters to specify for the spectrogram, so create a data structure that gets passed to your spectrogram function.
e. You can use Matlab's FFT function.
f. Have an option to use Matlab's Fourier synchrosqueezed transform, fsst, in place of the FFT, i.e. see:
    i. https://www.mathworks.com/help/signal/ug/practical-introduction-to-time-frequency-analysis.html
    ii. https://www.mathworks.com/help/signal/ref/fsst.html



g. Be able to zoom into the spectrogram. Specify time and frequency ranges in data structure. Ideally (not required) you could draw a zoom box in the spectrogram.
h. Be able to specify the FFT window type (rectangular, hanning, etc.) and amount of overlap of the FFT windows in the data structure.

3. Make comparison plots of your spectrogram and Matlab's
    a. spectrogram
    b. pspectrum (power spectrum)
    c. wvd (Wigner-Ville distribution)
4. Show both wide-band and narrow-band examples using your spectrogram function. When you give examples, document what your data structure values are.

Deliverables

Upload to D2L the following:

1. Your spectrogram code
2. A document that describes your code and contains the example plots with appropriate descriptions. What sentence did you use, plot settings, etc.