

EN.520.680 Speech and Auditory Processing by
Humans and Machines
Homework 2

Due: February 22nd

1. Write a program to compute the Short-time Fourier Transform(STFT) of a signal. You can use in-built Fast Fourier Transform (FFT) programs, namely `fft()` in MATLAB and `scipy.fftpack.fft()` or `numpy.fft.fft()` in Python. Inputs to your program should be the **signal**, **window length** and **window overlap percentage** and it should return the one-sided STFT (Fourier transform of a real signal is symmetric and half of the transform carries all the information). (**Points:25**)
2. Consider the one second long signal

$$x(t) = \begin{cases} \sin(3000\pi t) & \text{for } 0 \leq t < 0.7 \\ \sin(4000\pi t) & \text{for } 0.7 \leq t < 1 \end{cases} \quad (1)$$

, where t denotes time in seconds. What sampling frequency would you recommend for this signal to avoid loss of information? (**Points:5**)

3. Sample the signal from part 2 at 16 kHz. Compute STFTs of the signal using your program from part 1 with Hamming window of lengths 15 ms, 30 ms, 60 ms and 120 ms with a 25% overlap percentage for each window length. Plot the magnitude of STFT and explain your observations in the light of the uncertainty principle. (**Points:20**)