Subject: 21AIE315

Lab Session: 04

Notes:

1. Please read the assignment notes carefully and comply to the guidelines provided.
2. Code should be checked into the GitHub and the report to TurnItIn. These details shall be provided in the Lab.
3. If you have not completed the prerequisite assignments, please complete them before starting these assignments.
4. Please use your headphone / earphones for lab experiments. Avoid using the device microphone / speakers (not to disturb others).

References:

- https://numpy.org/doc/stable/reference/routines.fft.html
- https://docs.scipy.org/doc/scipy/reference/generated/scipy.signal.spectrogram.html
- https://librosa.org/doc/main/generated/librosa.stft.html

Main Section (Mandatory):

Please use the recorded voice of yours used in last lab session.

A1. Use `numpy.fft.fft()` to transform the speech signal to its spectral domain. Please plot the amplitude part of the spectral components and observe it.

A2. Use `numpy.fft.ifft()` to inverse transform the frequency spectrum of the speech signal from frequency domain to time domain. Compare the generated time domain signal with the original signal.

A3. Perform the spectral analysis of a word present in the recorded speech. Compare the spectrum with the spectrum of the full signal.

A4. Take a rectangular window of 20 mili-second sampled at 22.5 KHz. Using FFT, analyse the spectral components.

A5. Break your speech signal into window lengths of 20 mSec intervals. Evaluate the frequency components using `numpy.fft.rfft()`. Stack these frequency components as columns in a matrix. Use heatmap plot to display the matrix. You may use `librosa.stft()` or `scipy.signal.stft()` as well to achieve this.

A6. Use `scipy.signal.spectrogram()` to plot the spectrogram of the speech signal at the same duration. Compare the plots.

Report Assignment:

1. Update your last week's report by updating the introduction, literature review sections. Please conduct literature review with the downloaded papers. The Reference section should be added / updated with the list of papers used for literature review. Please make sure to align your introduction to your project scope.
2. Add the experiments conducted on your recorded speech in Methodology section. Write the results obtained in results analysis section.
3. Summarize the outcomes of your experiments in conclusion section.