Homework 3: Filtering Audio

In this homework, you are given an audio file with the name “audio.wav”. This audio is composed of three instruments: A piano, a drum kick and a cymbal. The sound of the kick is between 0 and 500 Hz. The sound of the piano is between 500 and 4000 Hz. The sound of the cymbal is bigger than 4000 Hz. The audio.wav is sampled at 48000 Hz.

Your task is to apply three FIR filters using MATLAB to separate this audio into three audio tracks that contain each instrument separately.

- Your first filter should be a low pass with a cutoff frequency 500 Hz. This filter is going to separate the drum kick sound.
- Your second filter should be a band pass filter which allows only the frequencies between 500 Hz and 4000 Hz. This filter is going to separate the piano chords.
- Your third filter should be a high pass filter with cutoff frequency 4000 Hz. This filter is going to separate the cymbals.

You are allowed to find these filters online or from other external resources.

Note: You are not supposed to apply these filters all at once. You need the apply them to the “audio.wav” separately for each separate track.

Note: If your filter does not separate the audio perfectly, it’s okay. You can try applying it twice. It’s still possible that artifacts would remain so it is not a problem that it is not perfect.

Submission:

- Submit a single zip file YOUR_STUDENT_ID.zip.
- Provide a pdf report where you explain your work. Your report should contain:
    - Your name and your student id
    - Explain how or why you came up with each filter either by providing your own mathematical proof or citing another resource.
    - Plots of magnitude of the frequency response of each filter (similar to those in course slides).
    - An explanation why each filter does what it does by referring to the plots.
    - Waveform plots of the “audio.wav” and three separate audio tracks after filtering.
- Provide three wave files kick.wav, piano.wav, cymbal.wav that contains three audio tracks you separated.
- Provide your code.

If your submission file size exceeds the Moodle limit, please provide a download link to your submission in a text file.