Assignment 5

1. FIR Basics

- Answer the following questions:
    - What are FIR filters?
    - How do they work?
    - Why do the filters have a finite impulse response?
    - Which response time do they have?
- Illustrate a basic FIR network.
- Which two methods can be used to apply FIR filter coefficients on a signal?
    - Describe the benefits and drawbacks of both methods

2. FIR filtering

- Use MATLAB to design a rectangular window based FIR filter to extract background noise from a given audio file:
    - Analyze the audio file with appropriate methods.
    - Import the audio file in MATLAB: `wavread`
    - Design the filter in MATLAB: `fdatool`
    - Filter the signal: `filter`
    - Write the output: `wavwrite`
- Change the window format from rectangular to Hamming. Which changes can be observed?
- Describe the differences between the MATLAB commands `filter` and `filtfilt`. Apply the command `filtfilt` to filter the signal.
- Repeat the procedure for the MATLAB command `fftfilt`.
- Use the Equiripple design method to create another FIR filter to extract the noise.
- Discuss the advantages and disadvantages that come with the Equiripple design method.

Home assignment: C preparation

Write a C program "filter" which reads raw sample data block-wise from a stereo WAV file. The program should be able to de-mux/de-interleave left and right channels, process the data, mux/interleave the channels again and write back the result into a new WAV file.

- CLI call: filter input.wav output.wav
- Input data should be 16-bit (signed) @ 44100Hz PCM (CD quality)
- Input stereo data is interleaved as <Left first><Right second>
- Block-size: 1024 data samples per channel (array per channel)
- Process data
    - Swap left and right channel
- Required upload
    - `filter.c`

Assignment 6

Home assignment: FIR filter implementation in C

Based on home assignment of Assignment 5 extend the C program "filter" to include a function which applies FIR coefficients on left and right channel.

The FIR coefficients should be included as a header file within `filter.c`:

```c
#include "fdacoefs.h"
```

- Dependency `fdacoefs.h`
    - `#define b_len` — Number of FIR coefficients
    - `float b[b_len]` — FIR coefficients as float array
- Required upload
    - `filter.c`
      (Modified version which includes filter function)

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