# Final work for class 20139

For ID: 314679713

The data for this project was created and stored in a text file named - proj_data.txt.
You have the task to process the data according to the following instruction.

You have to submit two files:
- A report detailing the work you did, the development of formulas and all generated plots.
  Include all explanations in this report. Do not include any code!
- The code file (*.py). All code should be in one file and should run all the tasks as singe code.
  The code should include comments about what is done in each step and explanation of the variables names.

The sampling frequency is 37500 Hz

1 - Plot tha data in time. Make sure to label the axes, use the correct units and give a title to the plot.
2 - Plot a time zoomed versios of the data in time so the shape can be seen clearly
3 - Plot the DFT of the data in three ways:
  3.1 - Use linear magnitude scale and frequency axis in Hz
  3.2 - Use dB magnitude scale and frequency axis in Hz
  3.3 - Use dB magnitude scale and frequency axis in normalized frequency (0 to 2π rad/smp)

It is known that the signal was distorted by a system with the following transfer function:

$$H(z) = \frac{(z - 1.1)}{z}$$

4 - Write the frequency response of the distorting system.
5 - Plot the frequency response of the distorting system. Use linear magnitude and normalized frequency (0 to 2π rad/smp)
6 - Separate the transfer function of the distorting system into Hap(z) and Hmin(z).
7 - Draw a pole zero map for the distorting system and for Hmin(z) and Hap(z).
8 - Plot the frequency response of Hap(z) and Hmin(z). Use linear magnitude and normalized frequency (0 to 2π rad/smp)
9 - Write the difference equation for the correction system y[n]=.
10 - Pass the signal through the correction system.
11 - Plot the output signal from the correction system in time. Start the plot after the transient response.
12 - Plot the DFT of the output signal from the correction system in two ways:
  12.1 - Use linear magnitude scale and frequency axis in Hz
  12.2 - Use dB magnitude scale and frequency axis in Hz

13 - The signal is made out of several frequencies.
  From the DFT Find the frequencies in the input signal using software
  (use the find_peaks() function from scipy with the correct threshold)
14 - Design a 200th order BPF GLP filter that will pass only the second frequency. Use a Hamming window.
  The bandwidth of the filter should be 10% of the frequency.
  Write all details for the design including how to calculate the impulse response and the window.
15 - Write expressions for the transfer function and the frequency response for the filter
16 - For the designed filter plot, the frequency response of the filter.
  Use linear magnitude and normalized frequency from 0 to 2π rad/smp
17 - Write the difference equation for the filter.
18 - Pass the input signal through the filter.
19 - Plot the filter's output signal in time.
20 - Plot the DFT of the filter's output signal. Use linear magnitude scale and frequency axis in Hz.
21 - Explain the results you got.

DONT FORGET TO UPLOAD THE REPORT AND THE CODE!
Upload the report as word or pdf file.

GOOD LUCK