Wherever relevant, use $\alpha = 1 + \text{mod}(x, 3)$, where x is the last three digits of your registration number. Wherever relevant, plot signals with normalised axes, with an appropriate resolution for time and with appropriate labels and legends.

Problem 1. (Plotting signal spectra)

1. Write a function to plot the magnitude spectrum of a signal using the FFT function. You are supplied with the recordings of four different instruments (piano, trumpet,violin and flute). Find the frequency value (in Hz) corresponding to fundamental harmonic (the peak) of the four different recordings *piano*α*.wav*, *trumpet*α*.wav*,*violin*α*.wav* and *flute*α*.wav*. Tabulate this in your report. Use the FFT algorithm and plot magnitude (in dB scale) versus frequency (Hz).
2. Find β for the *flute*α*.wav* which is closest to your *piano*α*.wav* in terms of the fundamental frequency.

Problem 2. (Whistling keylock)

1. Record a 3 second snippet of you whistling. This is going to be the reference to the keylock.
2. Plot the spectrum and find the fundamental frequency using peak picking.
3. *Design a keylock*: Write a function to record 3 second audio clips that output "ACCESS GRANTED" when the fundamental frequency of the recorded audio matches with the fundamental frequency of the reference within a 5% error, and "ACCESS DENIED" otherwise.
4. Provide test cases of pass and fail. Include the spectral plots in the report.

Problem 3. (Simultaneous time and frequency representations)
Plot the spectrum of *Opera.wav*. How do you capture the temporal variations of the spectrum? The *.wav* file has around 22000 samples. Try plotting the spectrum for every 2000 samples (separately) and compare the figures (around 10 figures). Do you see the difference in the location of the dominant peaks in each figure? Comment on it.

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