ECE 5530/6530 Digital Signal Processing
Matlab Exercise 1

Submission guidelines (READ CAREFULLY)

- All submissions must be done using Canvas.
- The submission should contain a single zip file which contains the report (html) and code (matlab files).
- Scanned hand written submissions will be accepted; however, it is the student's responsibility to ensure that the answers are easily legible. Otherwise, you may lose points.
- MATLAB code should be submitted as part of the code (zip) file. A brief description of the code and how to run it should be included in the html report.
- If a question asks for plots, these should be generated by MATLAB (not handdrawn) and included in the html report.
- For late policy refer to syllabus.
- Unless otherwise specified, all MATLAB exercise questions refer to the dataset described below. We will indicate questions which use other data explicitly with the text **Other dataset**.

Introduction - For several MATLAB coding exercises, we will be working with a wrist accelerometer dataset to get familiarity with signal processing operations such as filtering, examining the spectrum of a signal, Fast Fourier Transform, etc. The ultimate goal of this dataset is human activity recognition. Some of our exercises will be unrelated to this task to gain familiarity with signal processing while other exercises will be steps towards this task. The dataset can be found at

`https://archive.ics.uci.edu/ml/datasets/Dataset+for+ADL+Recognition+with+Wrist-worn+Accelerometer`

Citation - Analysis of human behavior recognition algorithms based on acceleration data, Bruno, B. et al., IEEE Int Conf on Robotics and Automation (ICRA).

About the data: The data is a collection of labeled accelerometer data (using a single wrist-worn tri-axial accelerometer) to study simple human activities of daily living (ADL). There are 14 different activities performed by 17 volunteers. Each record of a file reports the acceleration along the X, Y, Z axis of the accelerometer. A detailed description about the data and the different activities can be found from the website given above. We will use this data to learn some useful signal processing concepts.

Module 1 - Introduction to Discrete-Time Signals

1. Download the data from

   `https://archive.ics.uci.edu/ml/datasets/Dataset+for+ADL+Recognition+with+Wrist-worn+Accelerometer`

   Please use the file `Accelerometer-2011-03-24-10-24-39-climb_stairs-f1.txt` in the `Climb_Stairs` directory.

2. Load the data from the text file into 3 vectors x, y, and z corresponding to the acceleration along the different axis.

3. Convert the coded data $[x, y, z]$ values to real values. The acceleration data recorded in the dataset are coded according to the following equation, $real\_val = -1.5g + 3g\dfrac{coded\_val}{63}$, where $g = 9.8m/s^2$. Plot the x, y, z components of the signal before and after the conversion. (*40 points*)

4. Generate a cosine signal $c = \cos(2\pi f t)$ with frequency $f = 30$Hz defined in the time interval $t = [-0.5,\ 0.5]s$. Sample the signal using sampling frequencies $f_{s_1} = 80$Hz, $f_{s_2} = 60$Hz, $f_{s_3} = 30$Hz. Plot the sampled signals and comment as necessary (is there aliasing? etc) (*30 points*)

5. Generate a cosine signal $c = \cos(2\pi f t)$ with frequency $f = 30$Hz defined in the time interval $t = [-0.5,\ 0.5]s$. Let us sample this using a sampling frequency f_s, where $f_s = 32$Hz. Combine this cosine signal with the x component of the mapped signal from Part 3 as $x_c = x + c$. Plot this signal x_c. (*30 points*).