Assignment 3

EE698V – Machine Learning for Signal Processing

Submit your 3 rendered **ipynb** files and 1 **pdf** file at:
https://forms.gle/gRuj4XnegwyoB8T49

Q1.

Use python to generate the plots for this question. Put together your plots in a pdf file (copy from ipynb). Plots should be labelled properly.

A fan is rotating with a constant angular velocity, $\omega_0 = 2\pi(R+2)$ radians/s, where R is the last digit of your roll number. You are measuring the angle of the fan, $\theta(t) = \omega_0 t; \theta(t) \in [0,2\pi)$, with respect to time t, sampled at a frequency Fs=128Hz for a duration of 1s.

a. **Plot** the angle $\theta[n]$ w.r.t. n
b. Split the set of data samples $(n, \theta[n])$ into (mutually exclusive and exhaustive) training set S_{train} and test set S_{test}, randomly. The size of training set, $|S_{train}| = 10$. **Plot** the training samples $(n, \theta[n]);\ n \in S_{train}$. Set np.random.seed(R+2), where R is defined above.
c. Consider a model $y = \sum_{m=0}^{M} w_m n^m$; $w_m \in \mathbb{R}$. Find the optimal weights for $M = 5,11,20$, using least squares solution. **Plot** $(n, \theta[n])$ and $(n, y[n])$ for training samples, as well as test samples. These graphs will look like the ones shown in slide no. 8 of lecture 7 (linear regression). So, you will get 3×2 plots. Save the code in **LS.ipynb** and plots in **plots.pdf**
d. Re-do part c with gradient descent. **Plot** $(n, \theta[n])$ and $(n, y[n])$ for training samples, as well as test samples. These graphs will look like the ones shown in slide no. 8 of lecture 7 (linear regression). So, you will get 3×2 plots. Save the code in **GD.ipynb** and plots in **plots.pdf**
e. Re-do part c with LASSO (section 3.1.4 of PRML book). Take $M = 10$. **Plot** the reconstruction error E_D w.r.t. λ. Also, plot the values of weights $\boldsymbol{w}$ w.r.t. λ. Vary λ in a range 0 to a value when half the weights become 0. Save the code in **LASSO.ipynb** and plots in **plots.pdf**

Note: in case your algorithm has stability problems, print different values to debug it. You will need to do something smart to make it stable.