EE698A- MACHINE LEARNING FOR SIGNAL PROCESSING

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Topics covered so far:

- Importance of Signal Processing and its Application in our regular life
- What is machine learning and why are we using it now?
- Quantization of signals
- Fourier Transform and its properties
- Short Term Fourier Transform and analysis
- Identifying necessary features of data
- Precision, Recall and their specific applications
- Confusion Matrix
- Mathematical representation of data
- Linear models for Classification and Regression
  - Gradient Descent
  - Challenges with regression like overshooting
  - Regularization to accommodate overshooting
    - L1 Regularization
    - L2 Regularization
    - Ridge Regression
    - LASSO
    - Min norm regularization
- Neural Networks and its methodology
- Optimization methods
  - Validation dataset for hyperparameters
  - Bias
  - Momentum Method
  - Rmsprop
  - Random initialization and Normalization of dataset
  - Stochastic Gradient Descent
  - Introducing noise
  - Dropouts
- Online and Offline learning and their differences
- Introduction to Probability and Probability Models
  - Bayes' theorem
  - Expectation in probability
    - Maximum Likelihood Estimation
    - MAP
  - Probability Models
  - Sampling in Probability Models
  - Comparing two probability distribution functions
    - Cohen's Kappa
- Clustering and grouping
  - K-means Clustering also called Hard assignment
  - Gaussian Mixture Models
    - Introduction to Latent variables
    - Application and utility of Auxiliary functions
    - Jensen's Inequality for logarithmic and other concave functions
    - Expectation Maximization algorithm
- Loss functions and analysis
  - Entropy
  - Cross Entropy
  - KL Divergence
- Dimensionality Reduction using PCA
- Matrix factorization
  - Non-Negative Matrix Factorization
    - For dimensionality reduction
    - For reconstruction
    - For in painting
    - For separating Sources
    - For classification
  - PLCA
    - Probabilistic Version of NMF with latent variable and Auxiliary functions
- Convolutional Neural Networks
- RNNs
- Hidden Markov Models (HMMs)
  - Continuous and discrete latent variables