EE 5611 – Machine Learning Applications for Wireless Communications – Spring 2019

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Text: Notes will be provided by the instructors. There is no prescribed text.

Software: Students' choice

Prerequisites: Strong background in probability and statistics. A prior course in Machine Learning and Digital Communications is expected.

Course Description: With the unprecedented access to data and computing resources, there has been an increasing interest in using machine learning tools to design various aspects of communication systems. This class will introduce how the tools of machine learning can be used to address a variety of problems in the design of wireless communication systems.

Grading: Grades will be awarded based on the student performance in Kaggle assignments, the final project and in-class presentation. The students will be expected to present a journal paper and also implement the algorithms in the same journal paper. The students can also implement any other relevant problem of their interest.

Major Topics

The course will cover both the fundamentals of machine learning and its applications to wireless networks. A high level overview of the topics covered in this course are mentioned below.

Fundamentals

- What is Machine Learning?
- When is Machine Learning useful?
- Quick overview of Supervised, Unsupervised and Reinforcement Learning
- Statistical inference and estimation
  - Kalman filters; adaptive filtering; LMS; RLS
  - Bayesian vs. Frequentist Approaches
- Supervised Learning
  - Classification
  - Neural networks and Deep Learning
- Unsupervised learning
  - Clustering
  - Autoencoders
- Reinforcement Learning
  - Markov Decision Processes
  - Q-Learning
  - Multi-armed Bandits

Applications in Wireless
- Physical layer communications
  - Use of autoencoders
  - Modulation
  - Channel coding
- Modulation / Signal classification
- Localization
- Spectrum Sensing

Note that the discussion of the applications will be interleaved with the fundamentals in order to reinforce the key foundational concepts.