# EE 260 Machine Learning and Big Data Analytics in Smart Grid Syllabus

### Course Purpose:

Penetration of advanced sensor systems such as advanced metering infrastructure (AMI) and phasor measurement units have been increasing significantly in smart grid over the past few years. By 2022, the electric utility industry will be swamped by more than 2 petabytes of data annually from smart meters alone. However, machine learning and big data analytics algorithms and applications for unlocking the potential of big data in smart grid are at an early stage of development. This graduate level course introduces various big data analytics/machine learning applications in smart grid. The lectures will not only cover basics of machine learning and big data analytics methods and tools, but also their key applications in the smart grid.

### Textbook:

### This is no official textbook for this course. Required and suggested reading materials will be posted on iLearn.

### Course Topics:

* Overview and Basic Concepts (Week 1)
  + Overview of Machine Learning/Big Data Applications in Smart Grid
  + Basic Concepts for Machine Learning and Statistical Signal Processing
* Clustering and Its Application in Smart Grid (Week 2)
  + Dimension Reduction: Linear and Nonlinear
  + Cluster Analysis: Centroid based and Density based
  + Application: Topology Identification
* Classification and Its Applications in Smart Grid (Week 3-4)
  + Decision Tree
  + Random Forest
  + Neural Networks
  + Application: Predictive Maintenance of Power System Equipment
  + Application: Phase Connectivity Identification
* Physically Inspired Data-Driven Methods (Week 5)
  + Linearized Power Flow Model
  + Application: Electricity Theft Detection
  + Application: Phase Connectivity Identification
* Regression Analysis (Week 6-7)
  + Regime Switching Models
  + Neural Networks
  + Application: Solar Generation Forecasting
  + Application: Electricity Price Forecasting
* Reinforcement Learning (Week 8-9)
  + Finite Markov Decision Process
  + Tabular Solution Methods
  + Approximate Solution Methods
  + Reinforcement Learning based Control in Power Distribution Systems

### Weekly Schedule:

* Week 1-2: Overview of Basic Concepts, Clustering and its Applications in Smart Grid.
* Week 3-4: Classification and its Applications in Smart Grid.
* Week 5: Physically Inspired Data-Driven Methods.
* Week 6-7: Regression Analysis
* Week 8-9: Reinforcement Learning
* Week 10: Final Class Presentations

### Prerequisites:

Basic concepts for power systems and smart grid; working knowledge of linear algebra and probability; and scientific computing proficiency (Python or MATLAB).

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### Grading (Percentage):

Homework Assignment – 50%

In-class Presentation – 25%

Final Project Report – 25%

### Final Project:

All students will conduct a research project on a topic related to data analytics tools used for power systems based on the student's research interest. A one-page project proposal that clearly articulates the research question to address, proposed solution techniques, and sources of data if needed, due April 22, 2019. A max six-page project final report that documents all project findings, due in the last lecture of the quarter. One in-class presentation will be scheduled for each project.