Course:
Data Science for Contemporary Power Grid

Prerequisite:
ECE 433 Power System Analysis, or ECE 437 Smart Grid

Course Description:
This course introduces the principles and applications of data science in the context of modern power grids. We will cover various topics including statistical analysis, predictive analytics, data visualization, supervise/unsupervised learning, and how these techniques can be contributed to reliable, resilient, and safe power grid operations.

Learning Objectives:
By the end of this course, students will be able to apply principles and techniques of data science to analyze, interpret, visualize, and utilize complex datasets from contemporary power grids. They will develop the skills to implement statistical analysis, predictive analytics, and machine learning algorithms to address challenges in power grid operations, improving grid reliability and resilience. Moreover, students will gain an understanding of the social impact associated with applying data science in the context of power grid management. Specifically, 5 goals are set for students to achieve in this course:

1. **Analyze power grid data**: Effectively identify patterns and anomalies in the data.
2. **Predict power grid data**: Effectively estimate power grid generation, demand, and behavior.
3. **Visualize power grid data**: Effectively communicate insights and findings using data visualization techniques.
4. **Evaluate social impact**: Effectively evaluate social impact of the data science applications in power grid, including privacy, equity, and transparency in data-driven decision-making processes.

Course outline:

Week 1: Introduction to power grid fundamentals
- Overview of data science principles and applications in power grid management
- Introduction to contemporary power grid components, operations, and challenges

Week 2: Statistical analysis for power grid data
- Review of statistical concepts and methods relevant to analyzing power grid datasets
- Hands-on exercises in statistical analysis

Week 3: Data visualization techniques
- Importance of visualization in understanding and communicating power grid data insights
- Introduction to data visualization tools and techniques

Week 4: Predictive analytics: time series forecasting
- Understand time series data and its relevance to power grid forecasting
- Time series forecasting models

Week 5: Predictive analytics: machine learning basics
- Overview of machine learning concepts and algorithms
- Introduction to supervised learning algorithms and their applications in power grid forecasting

Week 6: Predictive analytics: advanced machine learning techniques

- Deep dive into advanced supervised learning techniques
- Case studies on applying advanced machine learning techniques to power grid datasets

Week 7: Unsupervised learning

- Introduction to unsupervised learning techniques such as clustering and anomaly detection
- Hands-on exercises in identifying patterns in power grid data using unsupervised learning algorithms

Week 8: Case studies in power grid data analysis

- Analysis of real-world power grid datasets
- Discussion on applying data science techniques to address specific challenges in power grid operations and management

Week 9: Social impact of Data Science in Power Grid Management

- Examination of ethical considerations and societal implications associated with data-driven decision-making in power grid management.
- Discussion on privacy, fairness, and transparency issues in power grid data analysis

Week 10: Project Presentations and Wrap-Up

- Final project presentations where students showcase their findings and insights from the project work
- Review of key concepts covered throughout the course and discussion on future directions in data science for contemporary power grid

Grading:

Homework 30%
Mid-term 30%
Project 40%