Course Number: EE P 555

Title: Data Science for Power Systems

Number of Credits: 4 credits

Quarter and Year: Winter 2026

Instructor: Dinuka Sahabandu (sdinuka@uw.edu)

Instructor Office Hours: Thursdays 6:30pm PT to 7:30pm PT (after class via zoom (same link as class link) and in-person)

TA: Chloe Yang

TA Office Hours: Tuesdays 1:00 pm PT to 2:00 pm PT (https://washington.zoom.us/j/2606944181)

Lecture Dates and Times: Tuesdays and Thursdays 4:30-6:20 p.m. PT

Classroom: ECE 037

The primary mode of instruction is in person. Use the following Zoom link only when work, emergencies, or other obligations make in-person attendance impossible.

Zoom: https://washington.zoom.us/j/99197729571?pwd=FdCEz7PPgpcy3JoPU5i0Liqa0nkFC3.1

Meeting ID: 991 9772 9571

Passcode: 093216

Join Class Discord: https://discord.gg/STYjWmfE

COURSE DESCRIPTION

This course provides a comprehensive exploration of data science applications in power systems. Focusing on core data science techniques, students will learn to leverage machine learning (ML) for various power system challenges, including load forecasting, fault prediction, and network state estimation. The course combines theory with practical programming assignments, enabling students to gain proficiency in ML tools and techniques specific to the energy sector. A final project will allow students to apply learned concepts to real-world data,

providing hands-on experience with popular data processing frameworks and analytics methods.

RECOMMENDED PREREQUISITES:

- Python Programming: Required for data manipulation and ML tasks.
- Linear Algebra and Statistics: Familiarity with statistical modeling and linear algebra.
- Basic Power Systems Knowledge.

LEARNING OBJECTIVES

By the end of this course, students will demonstrate the ability to:

1. Apply data science and ML techniques to power system data.
2. Implement algorithms for regression, classification, and clustering.
3. Utilize Python libraries, including NumPy, Pandas, and Scikit-learn.
4. Develop ML models for real-world power system applications.
5. Evaluate and interpret model performance for practical deployment.

LECTURE SCHEDULE

- **Week 1: Introduction to Data Science in Power Systems**
  Topics: Overview of data science applications, energy data types, course introduction.
- **Week 2: Regression Techniques**
  Topics: Linear regression, regularization, applications in load forecasting.
- **Week 3: Advanced Regression and State Estimation**
  Topics: Ridge and Lasso regression
- **Week 4: Power Flow Study and State Estimation**
  Topics: Weighted Least Squares; Kalman Filters.
- **Week 5: Classification Basics**
  Topics: Binary and multiclass classification, logistic regression.
- **Week 6: Deep Learning for Power Systems**
  Topics: Introduction to neural networks, use cases in energy systems.

- **Week 7: Unsupervised Learning – Clustering**
  Topics: Clustering for anomaly detection, k-means, applications in demand response.
- **Week 8: Optimal Operations and Control of Power Systems**
  Topics: Optimization techniques, Volt-VAR control, reinforcement learning.
- **Week 9**: **Time Series Analysis in Power Systems**
  Topics: Load and generation forecasting, anomaly detection, and seasonal patterns in power systems data.
- **Week 10**: **Generative AI Applications in Power Systems**
  Topics: Advanced forecasting using transformers (e.g., PatchTST for long-term forecasting), anomaly detection, and resilience modeling.
- **Week 11**: **Project Presentations**
  Topics: Final presentations by student teams, peer feedback, and wrap-up discussions.

COURSE MATERIALS

Textbook

- Weng, Y., Xie, L., & Rajagopal, R. (2023). Data Science and Applications for Modern Power Systems. Springer.

References

- Vyas, A. K., Balamurugan, S., Hiran, K. K., & Dhiman, H. S. (2022). Artificial Intelligence for Renewable Energy Systems. Wiley-Scrivener.
- Liu, Y. (2020). *Python Machine Learning By Example* (2nd ed.). Packt Publishing.

Useful Data Sources:

1. NREL Wind Integration Study, Solar Integration Study
2. PECAN Street (need to register, free with a .edu email)
3. ERCOT (Texas) load data
4. IEEE PES Subcommittee on Big Data \& Data Analytics

GRADING CRITERIA

- **Homework: 3**0% (3 assignments (every two weeks), 10% each → 30% total.)
- **Final Project:** 40% (Proposal: 5%, Presentation: 15%, Report: 20%)
- **Class Participation: 3**0% (via Canvas Quizzes and Case Study based Discussions)

COURSE POLICIES

- Please complete the homework by yourself and do not copy code from others or the internet. *Any content produced using **generative AI tools** (including, but not limited to, **ChatGPT and other GenAI models**, as well as **coding agents/assistants** such as Copilot, Cursor, CodeWhisperer, etc.) must be **clearly identified and disclosed** in your submission*. **If your homework is identical to another student's work or to any online sample code snippets, you will receive zero credit, and UW mandates that we report the incident to the College of Engineering.**
- You are encouraged to discuss homework content with your classmates offline and on the discussion boards. However, please limit your discussion to ideas and not discuss the code. Specifically, do not copy-paste any homework answers into the discussion boards.
- Students must submit homework and project materials online by the posted due date. Throughout the quarter, we will provide you with ***four late-day credits for the four homework assignments**, which you can use to submit one or more homework without a penalty*. *However, if you have used all four days, each additional late day will result in a 25% penalty in the corresponding homework.*
- Students need to submit project reports and presentations on time. **The project does not have any credit days**. Any overdue project materials will receive a zero score.

RELIGIOUS ACCOMMODATIONS

Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at

Religious Accommodations Policy (https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/).

Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form (https://registrar.washington.edu/students/religious-accommodations-request/).

ACCOMMODATIONS AND ACCESS

If you have already established accommodations with Disability Resources for Students (DRS), please communicate your approved accommodations to me at your earliest convenience so we can discuss your needs in this course. If you have not yet established services through DRS, but have a temporary health condition or permanent disability that requires accommodations (conditions include but not limited to; mental health, attention-related, learning, vision, hearing, physical or health impacts), you are welcome to contact DRS at 206-543-8924 or uwdrs@uw.edu or disability.uw.edu. DRS offers resources and coordinates reasonable accommodations for students with disabilities and/or temporary health conditions. Reasonable accommodations are established through an interactive process between the student, instructor, and DRS. It is the policy and practice of the University of Washington to create inclusive and accessible learning environments consistent with federal and state law.

ACADEMIC INTEGRITY

Engineering is a profession demanding a high level of personal honesty, integrity and responsibility. Therefore, it is essential that engineering students, in fulfillment of their academic requirements and in preparation to enter the engineering profession, adhere to the College of Engineering Statement of Principles. Any student in this course suspected of academic misconduct (e.g., cheating, plagiarism, or falsification) will be reported to the College of Engineering Dean's Office and the University's Office of Community Standards and Student Conduct to initiate the student conduct process.

TITLE IX

"UW, through numerous policies, prohibits sex- and gender-based violence and harassment, and we expect students, faculty, and staff to act professionally and respectfully in all work, learning, and research environments. For support, resources, and reporting options related to sex- and gender-based violence or harassment, visit UW Title IX's webpage (https://www.washington.edu/titleix/), specifically the Know Your Rights & Resources guide (https://www.washington.edu/titleix/files/2020/08/KYRR-guide-8-10-2020-LINKED.pdf).

If you choose to disclose information to me about sex- or gender-based violence or harassment, I will connect you (or the person who experienced the conduct) with resources and individuals who can best provide support and options. You can also access those resources directly:

- Confidential: Confidential advocates (https://www.washington.edu/sexualassault/support/advocacy/) will not share information with others unless given express permission by the person who has experienced the harm or when required by law.
- Private and/or anonymous: SafeCampus (https://www.washington.edu/safecampus/) provides consultation and support and can connect you with additional resources if you want them. You can contact SafeCampus anonymously or share limited information when you call

Please note that some senior leaders and other specified employees have been identified as "Officials Required to Report." (https://www.washington.edu/titleix/title-ix-officials-required-to-report/) If an Official Required to Report learns of possible sex- or gender-based violence or harassment, they are required to call SafeCampus and report all the details they have in order to ensure that the person who experienced harm is offered support and reporting options (https://www.washington.edu/titleix/resources/)."