Machine Learning Applications for AMI Data
A Hands-on Training for Practitioners – 22 PDHs

Course Description

This course is one in a series of several courses developed and offered through GridEd to enhance workforce readiness through training and education of personnel with needed skill sets at the intersection of power systems and digital systems.

This 22-hour course focuses on machine learning applications for AMI data in power systems. The topics covered in the course include smart meter background information, applications of smart meter data, data preprocessing, building machine learning and data mining models, training models to perform topology identification, calculate performance metrics and refine models. The implementation of the machine learning models to perform phase identification with AMI data using Python will be covered in this hands-on short course.

Participants will learn how to build machine learning models to perform phase identification using AMI data. They will learn how to tackle specific issues faced by utility data scientists while applying different machine learning algorithms.

Who Should Attend

This course is intended for professionals and practitioners interested in developing deep learning models for AMI data in distribution systems. Prior knowledge of Python is required, and a basic understanding of data science and deep learning are recommended. A basic familiarity with open-source libraries such as PyTorch, TensorFlow, and Scikit-Learn are also recommended but not required.

Schedule:

Week 1a: 4 hours classroom + assignment time
Week 1b: 3 hours classroom + assignment time
Week 2a: 3 hours classroom + assignment time
Week 2b: 2 hours classroom + assignment time

Location: Online - Live sessions will be recorded and available following the live web conference.

See course outline on page 2 and 3.

For more information contact Amy Feser, afeser@epri.com

Course Outline

Week	Activities
1a	***Topic*** Distribution Network Topology Identification: Phase Identification – Model Development
	Hands-on Problem Phase Connectivity Identification in Power Distribution Systems with Smart Meter Data
	Day 1 (3hrs total) – 1.5hr presentation + 1.5hr code walkthrough • Overview of Topology Identification Problem in Power Distribution Systems • Phase Identification Problem Description • Data preprocessing • Unsupervised Machine Learning Model – Dimension Reduction and Clustering • Problem setup and dataset • Assignment walk-through
	Day 2 (1hr) Assignment Q&A and discussion
	Assignment (3hrs) Build a clustering algorithm to identify phase connectivity of smart meters in power distribution system using a publicly available dataset *Complete sections of code for dimension reduction and clustering module.*
1b	***Topic*** Distribution Network Topology Identification: Phase Identification – Model Refinement & Assessment
	Hands-on Problem Refine Phase Identification Method and Assess the Performance of the Model
	Dataset: Validation and Testing dataset
	Day 1 (2hrs total) – 1 hr presentation + 1hr code walkthrough • Model enhancement with nonlinear dimension reduction and density-based clustering • Saving and loading models • Metrics assess performance • Assignment walk-through
	Day 2 (1hr) Assignment Q&A and discussion
	Assignment (2hrs) Enhance phase identification model on a test dataset and submit the code and clustering results. Compare performance with the previous clustering method and linear dimension reduction approach. *The submission file will be evaluated*

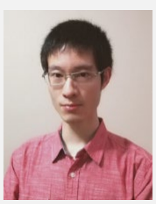
2a	***Topic*** Distribution Network Topology Identification: Phase Identification – Model Development with Supervised Machine Learning
	Hands-on Problem Phase Connectivity Identification in Power Distribution Systems with Smart Meter Data using supervised machine learning
	Day 1 (2hrs total) – 1 hr presentation + 1 hr code walkthrough • Data preprocessing • Deep neural network • Building neural network to classify smart meters with different phase connections
	Day 2 (1hr) *Assignment Q&A and discussion*
	Assignment (3hrs) Build a supervised machine learning model to perform phase identification with smart meter data.
2b	***Topic*** Distribution Network Topology Identification: Phase Identification –Assessment
	Hands-on problem Visualize performance and compute metrics to evaluate model performance
	Dataset: Validation and Testing dataset
	Day 1 (1hr) • Metrics • Visualize and log results • Assignment walk-through
	Day 2 (1hr) • Assignment walk-through
	Assignment (2hrs) Run supervised machine learning model for phase identification on a test dataset and submit the code and evaluate model performance. *The submission file will be evaluated*

<u>Meet the Instructors</u>

Dr. Nanpeng Yu received his B.S. in Electrical Engineering from Tsinghua University, Beijing, China, in 2006. Dr. Yu received his M.S. degrees in Electrical Engineering and Economics and Ph.D. degree from Iowa State University in 2010. Before joining University of California, Riverside, Dr. Yu was a senior power system planner and project manager at Southern California Edison from Jan, 2011 to July 2014.

Currently, he is an associate professor and vice chair of Electrical and Computer Engineering at the University of California, Riverside, CA. Dr. Yu is the recipient of the Regents Faculty Fellowship and Regents Faculty Development award from University of California. He received multiple best paper and prize paper awards from the IEEE Power and Energy Society General Meetings, IEEE Power and Energy Society Grand International Conference and Exposition Asia and the Second International Conference on Green Communications, Computing and Technologies.

Dr. Yu is the director of Energy, Economics, and Environment Research Center at UC Riverside. Dr. Yu is also a cooperating faculty member of department of computer science and engineering and department of Statistics. He currently serves as the chair of distribution system operation and planning subcommittee of IEEE Power and Energy Society and the chair for IEEE Power and Energy Society Working group of data-driven modeling, monitoring and control for Power Distribution Networks. Dr. Yu currently serves as the associate editor for IEEE Transactions on Smart Grid and IEEE Power Engineering Letters.



Dr. Yinglun Li received his PhD in electrical and computer engineering from University of California, Riverside. He is an expert on applications of machine learning in power systems and electricity markets, multi-armed bandit problems, and large-scale generative models involving large language models (LLMs) and latent diffusion models (LDMs). He was previously working as an applied scientist in Alexa Proactive Experience team of Amazon.com and will be joining as a senior researcher in an AI Lab in the Asian-Pacific region.

Participants will need access to an internet connection from a standard desktop/laptop computer equipped with speakers, microphone and common web browser, i.e. Internet Explorer, FireFox, Google Chrome, etc. Students will join live, synchronous web conference sessions via WebEx, with two-way voice capability through a telephone bridge.

March 2024

EPRI
3420 Hillview Avenue, Palo Alto, California 94304-1338 PO Box 10412, Palo Alto, California 94303-0813 USA 800.313.3774 650.855.2121
askepri@epri.com www.epri.com