GridEd
The Center for Grid Engineering Education

GridEd Great with Data University Curriculum Summary

In 2018, EPRI, along with electric utility partners and five universities (Stony Brook University, University of California – Riverside, Virginia Tech, University of Texas at Austin, and Washington State University) were selected by the U.S. Department of Energy Solar Energy Technologies Office (SETO) to receive a $6 million award to launch the Grid-Ready Energy Analytics Training (GREAT) with Data initiative. The five-year project designed, developed, and delivered professional training materials to train and recruit power systems workers and university curricula for new engineers and computer scientists.

Universities were vital to the sustainable operations of GridEd due to the substantial resources required for the preparation and dissemination of training and educational materials. Additionally, the capability of universities to transfer ongoing cutting-edge research into educational programs is essential to enhancing engineers' skill sets by training them on the latest technology required to manage and operate the future grid. University participants received commitments via subcontracts with EPRI as part of GridEd. They were supported by GridEd and had roles as primary developers of the curriculum that provided early-stage delivery of the curriculum. The below listed self-paced courses were created by GridEd's Partner Universities and are available to the public at no fee.

Self-Paced Courses		
Course Title	**Description**	**Partner University**
Smart Energy in the Information Age	The course covers both techniques and applications. On the techniques side, popular techniques in machine learning, optimization, economics, and cloud computing/IoT are presented. On the application side, issues that arise in energy and sustainability are presented first, followed by recent applications of the techniques covered initially. Machine learning is used for predictions of renewable generation, electricity prices, etc; optimization is used for optimal power flow problem and energy procurement; economics is used in demand response program design; and cloud computing is used as an important component of IoT.	Stony Brook University
Big Data Systems, Algorithms and Networks	This course will cover topics include the web graph, search engines, online algorithms, and recent progress in big data systems, such as analytics, storage, resource allocation, and energy-efficient computing. There will be a combination of lectures, presentations from students, and course projects.	Stony Brook University
Cyber-Power System	This course is related to cyber infrastructure and system security of the integrated cyber and physical power system. The topics to be covered include the cyber-power system infrastructure, vulnerabilities of the integrated system, intrusion detection, data analytics, mitigation and defense, and cyber-power resiliency.	Washington State University

Electric Power Distribution Systems	In recent years, due to the Smart Grid development efforts, critical automation capabilities have been installed in distribution systems to enhance the "self-healing" capabilities. On-line monitoring and control systems enable efficient fault location and fast recovery after major outages. The trend will continue as the reliability requirement of distribution systems becomes higher to avoid catastrophic failures. This senior level course provides the fundamental principles for distribution system engineering. The theory will be supplemented by modern software tools for system planning and operation.	Washington State University
Machine Learning-based Applications for Power System Dynamics with PMU Data	This course covers the following: • Background for Phasor Measurement Units • Power System Event Detection • Graph Signal Processing-based Event Detection • Voltage Event Detection Using Optimization with Structured Sparsity-Inducing Norms • Power System Event Detection with Bidirectional Generative Adversarial Network • Power System Event Classification • Deep Neural Network-based Power System Event Classification • Classify Power System Event with a Small Number of Training Labels with Transfer Learning • Power System Dynamic Parameter Estimation • Dynamic Parameter Estimation with Physics-based Neural Ordinary Differential Equations	University of California - Riverside
Introduction to Reinforcement Learning	This course introduces reinforcement learning. The key topics to be covered include finite Markov Decision Process (MDP), dynamic programming, Monte Carlo methods, temporal-difference learning, on-policy methods, off-policy methods, policy gradient methods, safety-constrained reinforcement learning, batch-constrained reinforcement learning, and multi-agent reinforcement learning. This course will also cover the applications of reinforcement learning in smart grid.	University of California - Riverside
Fundamentals of Electric Power Distribution Systems	This course covers the fundamentals of electric power distribution system operation and planning. The U.S. power grid is evolving from a network characterized by large, centralized fossil-fueled generation plants and passive customers to a system with significant distributed energy resources and proactive customers. Therefore, it is important for researchers and power industry professionals to understand the unbalanced power distribution systems. This course also includes a few modules that covers applications of machine learning in power distribution systems.	University of California - Riverside

Cyber-Physical System Security of Power Systems	As power systems increasingly depend on information and communications technology for operation and control, cyber security is highly critical to avoid catastrophic power outages due to cyberattacks. This graduate level course on power systems under abnormal operating conditions deals with important subjects related to major power outages: power system security, cascading events and defense strategy, cyber-physical system security, power system restoration, and resilience. The new module provides important areas including Supervisory Control and Data Acquisition (SCADA) systems, modeling of a cyber-power system, and cyber security of substations.	Virginia Tech
Cyber-Physical System Security of Power Distribution Grids	This module provides the basics about cyber vulnerabilities and security for Supervisory Control and Data Acquisition (SCADA) systems, renewable energy devices, smart meters, and smart grid devices. As the distribution systems increasingly depend on information and communications technology for remote monitoring and control, it is critical to ensure cyber security of electric energy distribution systems.	Virginia Tech
Data Analytics in Power Systems	The course covers basics of machine learning and aims to introduce the tools for data-enabled modeling and inference in power systems. We will discuss the differences between first principal models and data-driven models in real-time power system operations. Classroom discussion and projects will prepare the students to understand better how to integrate data-driven and physics-based reasoning in modern power systems.	The University of Texas at Austin
Power System Engineering	The course is an introduction to power systems engineering. It focuses on the modeling and analysis of electrical power networks that interconnect generation and loads.	The University of Texas at Austin

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