Online Training Course on Machine Learning, Agent-based Systems, and Optimization in Power and Energy

This online training course is divided in two parts: Machine Learning and Agent-based Systems in Power and Energy, and Evolutionary Optimization Methods and Applications in Power and Energy. The first part will be presented by Professor Zita Vale (Full Professor at ISEP/P.Porto), Professor Carlos Ramos (Full Professor at ISEP/P.Porto), Dr. Tiago Pinto (Invited Professor at ISEP/P.Porto), and Dr. Pedro Faria (Invited Professor at ISEP/P.Porto) considering their work developed under MAS-Society project. The second part will be presented by Dr. João Soares, Dr. Pedro Faria (Invited Professor at ISEP/P.Porto), and Dr. Fernando Lezama, considering their work developed under CENERGETIC, and COLORS projects. This training course is online and free of charge. The participants who attend will receive certification.

Abstract:

This training course covers machine learning, agent-based systems, and evolutionary optimization methods in power and energy systems.

In this context, in Part I, regards a general overview of machine learning methods and the application of multi-agent systems for simulation and emulation in power and energy. Then, Part I, demonstrates two particular cases using machine learning and multi-agent systems, considering electricity market negotiations, and energy management in a farm microgrid.

The Part II, of this training course, regards optimization techniques in the scope of smart grid paradigms. The optimization techniques consist of heuristic and metaheuristic approaches, including evolutionary algorithms. Then, it will be demonstrated a practical experimentation and case studies in smart grid optimizations.

In this training course, each part consists of case studies and practical experimentation as examples of applications of machine learning, agent-based systems, and optimization in power and energy systems.

Part I: 14:00 – 16:45 (WEST) Friday 03-Jul-2020

Part II: 17:00 – 19:15 (WEST) Friday 03-Jul-2020

Free but mandatory registration: here.

Program

Duration	Topic	Speaker
Part I – Machine Learning and Agent-based Systems in Power and Energy		
5 minutes	Tutorial Introduction	Zita Vale
40 minutes	Machine learning methods: a general overview	Carlos Ramos
40 minutes	Multi-Agent Simulation and Emulation in Power and Energy	Zita Vale
30 minutes	Machine learning methodologies and strategic behaviour in electricity market negotiations	Tiago Pinto
30 minutes	Multi-agent based real-time infrastructure for energy: modelling and simulation of a farm microgrid	Pedro Faria
20 minutes	Open discussion and closing remarks	Zita Vale, Carlos Ramos, Tiago Pinto, and Pedro Faria
Part II – Evolutionary Optimization Methods and Applications in Power and Energy		
5 minutes	Tutorial Introduction	João Soares
40 minutes	Metaheuristics methods and basics of evolutionary techniques for optimization algorithm	João Soares
40 minutes	Handling specific heuristics and adaptations of complex optimization program in the context of smart grids	Fernando Lezama
30 minutes	Practical experimentation and case studies in smart grids optimizations	Pedro Faria
20 minutes	Open discussion and closing remarks	João Soares, Pedro Faria, and Fernando Lezama

Speakers

1. Zita Vale

She is full professor at the Polytechnic Institute of Porto and the director of the Research Group on Intelligent Engineering and Computing for Advanced Innovation and Development (GECAD). She received her diploma in Electrical Engineering in 1986 and her PhD in 1993, both from University of Porto. Zita Vale works in the area of Power and Energy Systems, with special interest in the application of Artificial Intelligence techniques. She has been involved in more than 50 funded projects related to the development and use of Knowledge-Based systems, Multi-Agent systems, Genetic Algorithms, Neural networks, Particle Swarm Intelligence, Constraint Logic Programming and Data Mining. Energy resources management, distributed generation, demand response and electric vehicles are important topics of her research in the current projects. The main application fields of these projects comprise: (1) Smart Grids, accommodating an intensive use of Renewable Energy Sources, Distributed Energy Resources (DER) and Distributed Generation (DG). She addresses the management of energy resources, the impact of DER on electrical networks, the negotiation of DER in electricity markets, demand response, storage, energy management in buildings, and electrical vehicles, including the ones with gridable capability (V2G); (2) Electricity markets, addressing contracts, prices and tariffs, decision-support for market participants, aggregation, ancillary services, and wholesale and local market simulation; and (3) Control Centre applications, namely intelligent alarm processing, intelligent interfaces and intelligent tutors. Zita published over 800 works, including more than 100 papers in international scientific journals, and more than 500 papers in international scientific conferences. She has surprised 17 PhD concluded thesis and is currently supervising 8 PhD students. She has also supervised 45 MSc concluded theses and is currently supervising 10 MSc thesis.

2. Carlos Ramos

Carlos Ramos is a professor and researcher at ISEP/IPP. He holds a PhD in Electrical and Computer Engineering from the Faculdade de Engenharia of the University of Porto. He was founder and first Director of the Research Group on Intelligent Engineering and Computing for Advanced Innovation and Development (GECAD), having participated in more than 50 R&D projects, of which he coordinated about half. Carlos Ramos has more than 450 scientific publications, 70 of which in international scientific journals. He supervised more than 13 PhD theses already completed and another 21 Master's theses. He worked in several domains of Artificial Intelligence and Robotics, such as robotic manipulators, computer vision, sensors, multi-agent systems, automatic planning, machine learning, knowledge-based systems, decision support systems, affective computing and Ambient Intelligence (AmI), having devoted more attention to the latter area in the last decade. One of his articles (C. Ramos, JC Augusto and D. Shapiro, Ambient Intelligence — the Next Step for Artificial Intelligence, IEEE Intelligent Systems, vol. 23, no. 2, pp. 15-18, March-April 2008) is one of the most cited in the field of AmI (in the last 10 years, and with more than 350 citations, this is the 3rd most cited article by AmI and the 4th most cited article in the magazine IEEE Intelligent Systems). He has a history of major international and national Information and Communication Technologies projects in the fields of smart homes and buildings. Part of this work was developed and applied in the European project

SEAS (ITEA 3 - 12004). SEAS was distinguished with the Excellence Award in the area of systems and software services, due in large part to the demonstrator developed by GECAD.

3. Tiago Pinto

He works in the area of Artificial Intelligence (AI), with special interest in the fields of adaptive machine learning and automated negotiation. He has been working in the application of AI techniques to the study of electricity markets since 2008, specifically in the decision support of negotiating agents. Tiago Pinto has been involved in the organization of multiple International congresses and conferences, namely: 18th EPIA Conference on Artificial Intelligence, Porto, Portugal, September, 2017; PAAMS 2017 (15th International Conference on Practical Applications of Agents and Multi-Agent Systems), Porto, Portugal, June 2017; PAACB 2017 (11th International Conference on Practical Applications of Computational Biology \& Bioinformatics), Porto, Portugal, June 2017; GIIS 2016 (Global Information Infrastructure and Networking Symposium), October 2016, Porto, Portugal; 27th International Conference on Database and Expert Systems Applications (DEXA 2016), September 5-8, 2016, Porto, Portugal; SUComS 2015 (6th International Conference on Security-enriched Urban Computing and Smart Grids), June 21-23, 2015, Porto, Portugal; IEA/AIE 2011 (Twenty-fourth International Conference on Industrial, Engineering and Other Applications of Applied Intelligent Systems), 29 June – 1 July, 2011, Syracuse, U.S.A; Summer School on Neural Networks in Classification, Regression and Data Mining, July 12-16, 2010, Porto, Portugal; ISCIES 2009. He has been also involved in the organization of several workshops and special sessions.

4. Pedro Faria

Pedro Faria works in the field of power systems with focus on energy markets, smart grids, and demand response. The current work includes renewable-based distributed generation, energy storage, and electric vehicles. In these fields, optimization, clustering, and classification methods have been applied to real and simulated environment problems. Those include methods based on artificial intelligence, namely meta-heuristics and data-mining. He has been developing business models for the modelling, aggregation, and remuneration of consumers participating in electricity markets and in demand response programs. He has also worked in real-time simulation of power and energy systems, namely using the OPAL-RT platform and Hardware in the Loop (HIL) technics.

Pedro Faria participated in a significative number of national and international research projects contributing with models and their implementation, testing, demonstration and piloting. He has several scientific management and coordination responsibilities in those projects, being namely the leader of work packages and tasks in international projects and the GECAD leader of one national project. Pedro Faria is author of 1 patent and of more than 130 scientific papers.

5. Joao Soares

João Soares has a BSc in computer science (2008) and a master’s degree in Electrical Engineering (2011) in Portugal, namely from Polytechnic of Porto. He attained his PhD degree in

Electrical and Computer Engineering (2017) at UTAD university. He currently conducts researcher at GECAD – Research Group on Intelligent Engineering and Computing for Advanced Innovation and Development in the School of Engineering of the Polytechnic of Porto and has been recently an invited professor at Ecole Centrale De Lille in the L2EP. He coordinates two projects in the field of energy resource management in smart grids and smart buildings with application of computational intelligence techniques. His research interests include optimization in power and energy systems, including heuristic, hybrid and classical optimization. He published more than 100 publications in this field and his works have been cited over 2000 times (H-index 23 in google scholar).

6. Fernando Lezama

Fernando Lezama received an M.Sc. degree (with Honors) in Electronic Engineering - Telecommunication (2011), and a Ph.D. in Information Technologies and Communications (2014) both from the Monterrey Institute of Technology and Higher Education (ITESM), Mexico. Currently (since August 2017), he is a researcher at GECAD/IPP, where he contributes to the development of CI applications in the context of different national and international projects, such as H2020 DOMINOES, and FCT COLORS and MAS-SOCIETY. He has been the author and co-author of several articles in the field of intelligent systems and energy, including venues such as PSCC, WCCI, and ISAP, and Journals such as IEEE Communication Letters, IEEE Transactions on Power Systems, and Elsevier Swarm and Evolutionary Computation. He is also Chair (since July 2019) of the IEEE Task Force on Computational Intelligence in the Energy Domain, and a member of the IEEE PES working group on Modern Heuristic Optimization. Besides, Fernando Lezama has acted as guest editor in journals such as Complexity from Hindawi/Wiley and Energies from MDPI, and is continuously promoting the use of CI in the energy domain through the organization of international competitions and special sessions in international conferences.

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