Van Eenam Lecture Series

April 11, 13 & 14, 2022

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TITLES AND ABSTRACTS

Deep Learning Methods for Stochastic Control And Partial Differential Equations
MON., APRIL 11, 2022, 4-5PM
The numerical resolution of high-dimensional partial differential equations (PDEs) and stochastic control is a challenging problem in applied mathematics. Over the last five years, several deep neural networks-based algorithms have been proposed and have show their great efficiency for tackling these issues. In this talk, we give an introduction to this field of research, review the main results in this literature, and present some new developments, notably regarding mean-field control problems and Master equation in Wasserstein space.

Mean-Field Markov Decision Processes With Common Noise And Open-Loop Controls
WED., APRIL 13, 2022, 4-5PM
We develop an exhaustive study of Markov decision process (MDP) under mean field interaction both on states and actions in the presence of common noise, and when optimization is performed over open-loop controls on infinite horizon. Such model, called CMKV-MDP for conditional McKean-Vlasov MDP, arises and is obtained here rigorously with a rate of convergence as the asymptotic problem of N-cooperative agents controlled by a social planner/influencer that observes the environment noises but not necessarily the individual states of the agents. We highlight the crucial role of relaxed controls and randomization hypothesis for this class of models with respect to classical MDP theory. We prove the correspondence between CMKV-MDP and a general lifted MDP on the space of probability measures, and establish the dynamic programming Bellman fixed point equation satisfied by the value function, as well as the existence of epsilon-optimal randomized feedback controls. The arguments of proof involve an original measurable optimal coupling for the Wasserstein distance. This provides a procedure for learning strategies in a large population of interacting collaborative agents

Optimal Bidding Strategies for Digital Advertising With Social Interactions
THURS., APRIL 14, 2022, 5:30-6:30PM
With the emergence of new online channels and information technology, digital advertising tends to substitute more and more to traditional advertising by offering the opportunity to companies to target the consumers/users that are potentially interested by their pro\-ducts or services. We introduce a continuous time model for the study of optimal bidding strategies associated to different types of advertising, namely, commercial advertising for triggering purchases or subscriptions, and social marketing for alerting population about unhealthy behaviours (anti-drug, vaccination, road-safety campaigns). Our framework encodes users online behaviours via their web-browsing at random times, social interactions in a large population of users, and the targeted advertising auction mechanism widely used on Internet. We address the attribution problem of how to efficiently diffuse advertising information by means of digital channels in order to generate conversion. Our main results are to provide semi-explicit formulas for the optimal value and bidding policy in various contexts of commercial advertising and social marketing. We show sensitivity properties of the solution with respect to model parameters, and analyse how the different sources of digital information accessible to users including the social interactions affect the optimal bid for advertising auctions. We also study how to efficiently combine targeted advertising and non-targeted advertising mechanisms. Finally, some classes of examples with fully explicit formulas are derived.