The Hong Kong Polytechnic University
Department of Applied Mathematics

Control Seminar Series

Adversarial Reinforcement Learning: A Duality-Based Approach to Solving Overlearning in Deep Monte Carlo Simulation

By

Prof. Nan Chen
The Chinese University of Hong Kong

Abstract

Recently, the deep neural network approximation, combined with Monte Carlo simulation, has demonstrated a great potential in solving high-dimensional stochastic control problems that are widely viewed as hard problems due to the curse of dimensionality. However, this approach suffers from serious overlearning when the training data is not sufficient relative to the complexity of the networks, as deep networks may construct feedback policies that are not adapted to the information flow in the training data.

We introduce the duality-based method in this talk to overcome the issue of overlearning. By relaxing the adapted requirement on control policies and incorporating the related penalty into the objective function, the new approach formulates a standard stochastic control problem as a zero-sum game between the decision maker and the adversary. Based on this formulation, we develop the adversarial deep Monte Carlo learning (ADMCL) algorithm to solve it and prove the convergence of this algorithm. Numerical experiments show that, when the size of training data set is limited, our method can effectively improve the overlearning issue encountered by the deep Monte Carlo optimization algorithm in reinforcement learning.

This talk is based on two joint works with Mengzhou Liu, Yanchu Liu, Xiang Ma, Chengli Ren, and Wei Yu.

Bibliography

Nan Chen is Professor of Systems Engineering and Engineering Management at the Chinese University of Hong Kong. His research interests include financial engineering and FinTech, Monte Carlo simulation, and applied probability. The previous research topics included credit spread modeling, stochastic differential game in convertible security pricing, Monte Carlo methods in American option pricing and the related sensitivity analysis, simulation of stochastic differential equations, and exotic option pricing under jump diffusion models. Currently, he is mainly focusing on modeling of systemic contagion and liquidity risk, complex social and financial network, and Monte Carlo method in stochastic control and learning.

He is now an associate editor of Mathematical Finance, International Review of Finance, Digital Finance and has chaired/been a member of the program committees of several international conferences on quantitative finance and Monte Carlo simulation. Prof. Chen received his Ph.D. in operations research from Columbia University in 2006, and M.S. and B.S. in probability and statistics from Peking University, Beijing, China in 2001 and 1998, respectively.

Date : 21 June 2021 (Monday)
Time : 11:00-12:00 (Hong Kong Standard Time GMT +8)
Venue : Online Talk via Zoom (Meeting ID: 949 4042 0173, Passcode: 0621)
Speaker : Prof. Nan Chen, The Chinese University of Hong Kong
Host : Dr. Xiang Yu, The Hong Kong Polytechnic University
Click to join :
https://polyu.zoom.us/j/94940420173?pwd=amlWZ3h0RmNOa1FENFgvSzdrQUUyZz09

Click to join (Zoom)

* * * ALL ARE WELCOME * * *

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