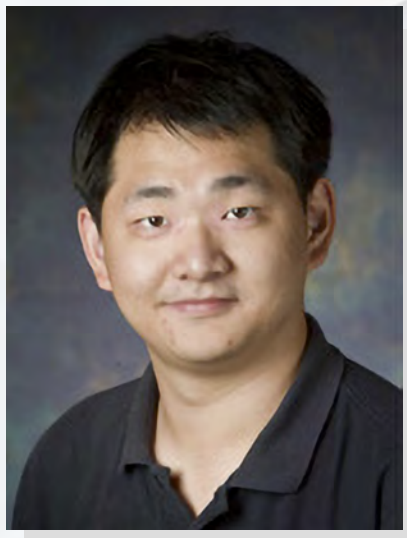
Department of Systems Engineering
香港城市大學
City University of Hong Kong

# Conjectural Online Learning in Asymmetric Information Stochastic Games



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**Seminar Link:** https://cityu.zoom.us/j/88955987491

**Abstract**
Modern socio-technical network systems powered by artificial intelligence (AI) technologies feature sophisticated interactions among humans, AI agents, and system entities. Asymmetric information stochastic games (AISG) provide principled mathematical modeling for such interactions, leading to game-theoretical mechanisms for network management. However, existing computational and learning methods in asymmetric information stochastic games (AISG) are primarily offline without adaptability to online nonstationarity, which falls short of proactive intelligence for resilient network management. To address these limitations, we propose conjectural online learning (COL), an online learning framework for generic AISGs. COL uses a forecaster-actor-critic (FAC) architecture, where the forecaster conjectures the other agents' strategies and system dynamics within a look-ahead horizon, representing the agent's subjective (mis)perception of the AISG. Based on these subjective perceptions, COL employs online rollout (actor-critic) to improve the policy. Bayesian learning is then used to calibrate the conjectures using information feedback. We establish that the conjectures produced by COL are asymptotically consistent with the information feedback in the sense of a relaxed Bayesian consistency. We deploy COL in a nonstationary IT infrastructure digital twin, which delivers online adaptable defense against advanced persistent threats compared with benchmark reinforcement learning techniques.

**About the Speaker**
Quanyan Zhu received B. Eng. in Honors Electrical Engineering from McGill University in 2006, M. A. Sc. from the University of Toronto in 2008, and Ph.D. from the University of Illinois at Urbana-Champaign (UIUC) in 2013. After stints at Princeton University, he is currently an associate professor at the Department of Electrical and Computer Engineering, New York University (NYU). He is an affiliated faculty member of the Center for Urban Science and Progress (CUSP) and Center for Cyber Security (CCS) at NYU. He is a recipient of several awards, including NSF CAREER Award and INFORMS Koopman Prize. He is an Associate Editor of IEEE Transactions on Aerospace and Electronic Systems. He currently serves as the technical committee chair on security and privacy for the IEEE Control Systems Society. His current research interests include game theory, machine learning, cyber deception, network optimization and control, cyber and physical system resilience.



*Enquiry: 3442 8422 | All are welcome*