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Online Decision Making with Non-Convex Local and Convex Global Constraints

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Abstract

Motivated by recent progress on online linear programming (OLP), we study the online decision making problem (ODMP) as a natural generalization of OLP. In ODMP, a single decision maker undertakes a sequence of irrevocable decisions in a serial fashion. At each time step, the decision maker makes a locally feasible decision based on information available up to that point, without knowledge of the future. The objective is to maximize the total reward accumulated over time while satisfying some global constraints which are called goal constraints. ODMP has a strong modeling power, allowing discrete and nonlinear local constraints and general convex global constraints (beyond packing and covering). To handle discreteness and nonlinearity in solving ODMP, we propose a Fenchel dual-based online algorithm. At each time step, the proposed algorithm requires solving a potentially nonconvex optimization problem over the local feasible set and a convex optimization problem over the goal set. Under certain stochastic input models, we show that the algorithm achieves sublinear constraint violation in meeting the long-term goals, and sublinear competitive difference in expected reward with respect to the optimal offline decisions.

About the Speaker

Rui Chen is currently a postdoctoral associate at Cornell Tech and Cornell University School of ORIE. He received his Ph.D. degree in Industrial and Systems Engineering from the University of Wisconsin-Madison (UW-Madison) in 2021. Prior to that, he received a B.S. degree in Statistics from Nanjing University in 2017 and a M.S. degree in Computer Sciences from UW-Madison in 2020. Rui's research focuses on optimization challenges in data-driven decision making, especially those involving discreteness and uncertainty. In particular, he is interested in cutting planes, decomposition methods, approximation algorithms and computational complexity for optimization problems arising from various applications in data science and logistics.

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