

EPSTEIN INSTITUTE SEMINAR ISE 651

STOCHASTIC GRADIENT DESCENT WITH ADAPTIVE DATA

ABSTRACT

Stochastic gradient descent (SGD) is a powerful optimization technique, particularly useful in online learning scenarios. Its convergence analysis/effectiveness is relatively well understood under the assumption that the data samples are independent and identically distributed (iid). However, applying online learning to policy optimization problems in operations research involves a distinct challenge: the policy changes the environment and thereby affects the data used to update the policy. The adaptively generated data stream involves samples that are non-stationary, no longer independent from each other, and are affected by previous decisions. The influence of previous decisions on the environment introduces estimation bias in the gradients, which presents a potential source of instability for online learning. In this paper, we introduce simple criteria for the adaptively generated data stream to guarantee the convergence of SGD. We show that the convergence speed of SGD with adaptive data is largely similar to the classical iid setting, as long as the mixing time of the policy-induced dynamics is factored in. Our Lyapunov-function analysis allows one to translate existing stability analysis of systems studied in operations research into convergence rates for SGD, and we demonstrate this for queuing and inventory management problems. We also showcase how our result can be applied to study an actor-critic policy gradient algorithm. This is joint work with Ethan Che and Xin Tong.



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SPEAKER BIO

Jing Dong is the DeRosa Family Associate Professor of Business at the Decision, Risk, and Operations Division at Columbia Business School. Her research is at the interface of applied probability and service operations management, with a special focus on patient flow management in healthcare delivery systems. She received an NSF CAREER Award in 2020. She currently serves on the editorial boards of Operations Research, Mathematics of Operations Research, Management Science, Manufacturing and Service Operations Management, and Operations Research Letters. She received her Ph.D. in Operations Research from Columbia University. Before joining Columbia Business School, she was on the faculty of Northwestern University.



TUESDAY, MARCH 5, 2024 | 3:30 PM – 4:50 PM
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