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Machine Learning and Optimization: Introduction to the Special Issue

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In this second installment of the two-part special issue on optimization and machine learning, we include the following set of papers. The first collection of special issue papers appeared in the Spring 2019 issue.

1. Identifying Exceptional Responders in Randomized Trials: An Optimization Approach

Dimitris Bertsimas, Nikita Korolko, Alexander M. Weinstein

In randomized clinical trials, there may be a benefit to identifying subgroups of the study population for which a treatment was exceptionally effective or ineffective. This paper presents an efficient mixed-integer optimization formulation that can directly find an interpretable subset with maximum (or minimum) average treatment effect. Dimitris is a professor at the Massachusetts Institute of Technology's (MIT's) Sloan School of Management. Nikita and Alex were doctoral students of Dimitris's at MIT's Operations Research Center.

2. A Stochastic Trust Region Algorithm Based on Careful Step Normalization

Frank E. Curtis, Katya Scheinberg, Rui Shi

The paper is part of a broader investigation into the design of new optimization methods for deep learning. The paper aims to design new methods that effectively deal with challenges related to nonconvexity, which is an inherent issue in training deep neural networks. The article sets the stage for future developments on advanced second-order algorithms for machine-learning applications. Frank and Katya are associate professor and professor, respectively, at the Industrial and Systems Engineering Department at Lehigh University. Rui was a doctoral student of Frank and Katya's at Lehigh University.

3. Learning a Mixture of Gaussians via Mixed-Integer Optimization

Hari Bandi, Dimitris Bertsimas, Rahul Mazumder

This article is part of a broader investigation to understand the degree to which modern optimization methods like mixed-integer optimization can lead to improved performance compared with statistical approaches for classical problems in machine learning and statistics. The article applies mixed-integer optimization to learn the parameters of a mixture of Gaussians. Dimitris and Rahul are professor and associate professor, respectively, at MIT's Sloan School of Management. Hari is a doctoral student of Dimitris and Rahul's at MIT's Operations Research Center.

4. A Practical Price Optimization Approach for Omnichannel Retailing

Pavithra Harsha, Shivaram Subramanian, Markus Ettl

Omnichannel analytics include cross-channel demand and supply-side interactions in retail. This paper focuses on nonperishable product pricing with a censored data omnichannel demand estimation component. The paper develops an end-to-end solution, and this was commercialized as a part of IBM's Omnichannel Merchandising Solutions. The authors were part of the analytical team that developed the pricing solution for the clients they engaged with at IBM. Pavithra is a research staff member at the IBM Thomas J. Watson Research Center in New York. Shivaram is a senior engineer at the IBM Thomas J. Watson Research Center in New York, and Markus is a senior manager for the supply chain and logistics group at IBM Research in New York.

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