MACHINE LEARNING FOR BRANCH AND BOUND SEARCH

presented by

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Abstract:
Branch-and-bound is probably the most widely used method in combinatorial optimization, including mixed integer programming, MAP inference and structured prediction. A lot of research work has focused on improving different components of the branch and bound method, yet often there is no systematic way to effectively make important design choices. We propose the use of machine learning to guide branch and bound search as a novel research direction in order to advance the state of the art in scalable combinatorial problem solving. As a first step, we develop a novel framework for data-driven, on-the-fly design of variable selection strategies, a key component of the branch and bound method. Using a computationally expensive but effective branching heuristic at the start of the search, the framework fits a variable ranking model based on dynamic variable features that is then applied in the remaining search exploration as a fast approximation. We show an instantiation of this framework using CPLEX, a state-of-the-art MIP solver, and evaluate performance the MIPLIB benchmark. Similarly, we show how ML can be used to drive in an informed way the use of primal heuristics. In the second part of my talk, I will also discuss my work on optimization approaches to network design for biodiversity conservation planning and for stochastic diffusion processes. While many have focused on optimizing a seed set of nodes from where to start a diffusion cascade, we instead ask the question of how to choose the network structure (add/delete nodes/edges) in order to facilitate or impede a given stochastic process that will affect the designed network. I will briefly present results for both the Independent Cascade and the Linear Threshold Models.

Bio:
Bistra Dilkina is an assistant professor in the College of Computing at Georgia Tech, and a Fellow at the Brook Byers Institute for Sustainable Systems. She received her PhD from Cornell University in 2012, and was a post-doctoral associate at the Institute for Computational Sustainability. Her research focuses on advancing the state of the art in combinatorial optimization techniques for solving real-world large-scale problems, particularly ones that arise in sustainability areas such as biodiversity conservation planning and urban planning. Her work spans discrete optimization, network design, stochastic optimization, and machine learning. Bistra has won several awards, including Best Paper of the INFORMS ENRE Section, Lockheed Inspirational Young Faculty Award, Raytheon Faculty Fellowship, and Georgia Power Professor of Excellence Award. She is also the co-director of the Data Science for Social Good (DSSG) Atlanta summer program, which partners student teams with government and nonprofit organizations to help solve some of their most difficult problems using analytics, modeling, prediction and visualization.

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