Interplays between Machine Learning and Optimization

Abstract:
Over the past two decades, machine learning has rapidly evolved and emerged as a highly influential discipline of computer science and engineering. One of the pillars of machine learning is mathematical optimization, and the connection between the two fields has been a primary focus of research. In this talk, I will present two recent works that contribute to this study, focusing on online learning—a central model in machine learning for sequential decision making and learning under uncertainty. In the first part of the talk, I will describe a foundational result concerned with the power of optimization in online learning, and give answer to the question: does there exist a generic and efficient reduction from online learning to black-box optimization? In the second part, I will discuss a recent work that employs online learning techniques to design a new efficient and adaptive preconditioned algorithm for large-scale optimization. Despite employing preconditioning, the algorithm is practical even in modern optimization scenarios such as those arising in training state-of-the-art deep neural networks. I will present the new algorithm along with its theoretical guarantees and demonstrate its performance empirically.