First-Order Methods for Differentiable 'Nonsmooth' Convex Optimization: A Tale of Frank-Wolfe and Multiplicative-Gradient

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Talk will take place from 11:15AM - 12:05PM through Zoom.

Abstract: The remarkable success of first-order methods on huge-scale problems has mostly been in the realm of problems where the objective function or its gradient satisfy a Lipschitz property. Here we consider an important class of convex optimization problems where neither the objective nor its gradient are Lipschitz, which typically blows up on the (relative) boundary of the feasible region. Such problems appear in a wide range of applications across numerous fields, including statistical machine learning, medical imaging, experimental design, quantum physics, etc. Unfortunately, the vast majority of existing first-order methods cannot be applied to solve these problems due to their seemingly pathological behavior. In this talk we present new structures underlying these problems that lead to two new methods (the Multiplicative-Gradient method and a version of the Frank-Wolfe method) that successfully exploit these structures – both theoretically and computationally. Our theory shows that these two methods have simple and elegant computational guarantees, and our numerical experiments demonstrate the rather remarkable efficiency and efficacy of these methods in practice.

Bio: Renbo Zhao is currently a fifth-year grad student in MIT ORC. His research focuses on the theory and algorithms of continuous optimization and its intersection with applied probability, with applications in machine learning and operations research. He obtained his Master and Bachelor degrees in Math and Electrical Engineering in 2018 and 2015, respectively, both from National University of Singapore.