Analysis Seminar

Understanding Computational Limits of Random Optimization Problems via Landscape Geometry

By

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Abstract: Optimization problems with random objective functions are central in statistics and modern data science. Despite their ubiquity, finding efficient algorithms for solving these problems remains a major challenge. Interestingly, many random optimization problems share a common feature, dubbed as a statistical-computational gap: while the optimal value can be pinpointed non-constructively, all known polynomial-time algorithms find strictly sub-optimal solutions. That is, an optimal solution can only be found via a computationally expensive brute-force search.

I will discuss an emerging theoretical framework for understanding the computational limits of random optimization problems, based on the Overlap Gap Property (OGP). This is an intricate geometrical property that both identifies algorithmic thresholds as well as gives sharp algorithmic lower bounds against the best-known polynomial-time algorithms--for a wide range of random optimization problems. I will focus on two models to demonstrate the power of the OGP framework: (a) the symmetric binary perceptron, a model for classifying/storing random patterns and a random constraint satisfaction problem, widely studied in probability, computer science, and statistical physics and (b) the random number balancing problem and its planted counterpart, which is closely related to the design of randomized controlled trials. In addition to yielding sharp algorithmic lower bounds, our techniques also give rise to new toolkits for the study of statistical-computational gaps in other models, including the online setting.

Date: Wednesday, December 13, 2023
Time: 18:00-19:00, GMT+3.
Place: ZOOM

To request the event link, please send a message to goncha@fen.bilkent.edu.tr