The Impact of Structure: From Optimization to Game Theory

Presented by:

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Real-world problems are often highly structured, and such structure can significantly affect their complexity. I will present different problems exhibiting a rich combinatorial structure, and I will show how to exploit it to obtain efficient solution methods. In combinatorial optimization, the structure of a problem typically translates into special polyhedral properties. I will show how to extend this polyhedral approach beyond optimization, in the context of game theory. I will define a new class of games, called Totally Unimodular (TU) Congestion Games, where the players’ strategies are binary vectors inside polyhedra with TU constraint matrices. In the symmetric case, I will show a strongly polynomial-time algorithm to (i) find a pure Nash equilibrium, and (ii) compute a socially optimal state. In the asymmetric case, I will state some negative complexity results. This algorithm subsumes the one of Fabrikant, et al. for network congestion games, and it can also be adapted to matroid congestion games, showing to be a unifying tool for different problems in algorithmic game theory.