Complexity and Algorithmic Game Theory

Abstract:

Computational complexity provides a fruitful perspective through which to study rational behavior and to design economic systems. Indeed, computation is an integral part of economic activity as rational agents are ultimately computationally bounded, while economic systems are often complex and implemented on computational platforms such those enabled by the Internet. I will showcase important insights of complexity theory to Economics focusing on solution concepts and mechanism design.

On the first day of my lectures (Tuesday), I will talk about the complexity of Nash equilibrium and other solution concepts, the intimate relationship between equilibria and linear programming, online learning and fixed points. I will define the class PPAD and overview the proof that Nash equilibrium is PPAD-complete, concluding with approaches for overcoming this computational intractability result.

On the second day of my lectures (Wednesday), I will turn to mechanism design. I will overview classic mechanisms from Economic theory such as the Vickrey-Clarke-Groves mechanism and Myerson's auction. I will review intractability results for welfare optimization in combinatorial auctions, and describe an analytical framework for overcoming these intractability results using online learning. I will then turn to revenue maximization in multi-item settings, presenting how duality theory has lead to exciting progress on this front.