Research Training Group 2126

ALGORITHMIC OPTIMIZATION

Autumn School 2021

Optimization and Market Design

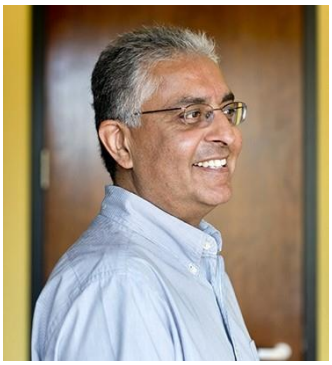
October 4—October 7, 2021

Speakers

Moshe Babaioff is a Senior Principal Researcher at Microsoft Research (Israel). He has joined Microsoft Research as a Researcher in the Silicon Valley lab at 2007. Prior to joining Microsoft Research, he was a post-doctoral scholar at the University of California, Berkeley. He received his PhD in Computer Science from the Hebrew University in Jerusalem. His research interest includes subjects on the border of Computer Science Theory, Game Theory, and Microeconomic Theory. In particular, he is interested in the theoretical foundations of Economics and Computation (EC). Moshe has served as Program co-Chair of ACM-EC 2017 and as General Chair of ACM-EC 2014.

Martin Bichler is full Professor at the Department of Computer Science of the Technical University of Munich (TUM). Martin received his MSc degree from the Technical University of Vienna, and his Ph. D. as well as his Habilitation from the Vienna University of Economics and Business. He was a research fellow at UC Berkeley and a research staff member at the IBM T. J. Watson Research Center, Yorktown Heights, New York. Currently, he is president of the INFORMS Section on Auctions and Market Design, a principal investigator of the DFG-funded research training group AdONE and a DFG Koselleck project. Besides, he is Associate Dean at the TUM Department of Computer Science and Advisory Board member of the TUM Institute for Advanced Study.

Garrett van Ryzin is a Distinguished Scientist at Amazon in the Supply Chain Optimization Technologies (SCOT) group. Before joining Amazon, he was a Distinguished Scientist and Head of Marketplace Lab at Lyft, working on pricing and market design. Prior to Lyft, Garrett was Head of Marketplace Optimization Advanced Development at Uber. Garrett was also a Professor of Decision Risk and Operations at Columbia University and subsequently Professor of Operations, Technology and Information Management at Cornell Tech. Garrett received a bachelor's degree in Electrical Engineering from Columbia University, and holds a master's degree in Electrical Engineering and Computer Science and Ph.D. in Operations Research from MIT.



Rakesh Vohra is the George A. Weiss and Lydia Bravo Weiss University Professor of Economics as well as Electrical and Systems Engineering and Co-Director of the Warren Center for Network & Data Sciences at the University of Pennsylvania. His research interests are in mechanism design and game theory and their applications.

Schedule

Program: Monday, October 4, 2021

Trier Time CEST/UTC+2	EDT UCT-4	Click here for ZOOM Meeting link
15:00 – 15:30	09:00— 09:30	**Opening Remarks** *Volker Schulz, Speaker, RTG ALOP* *Sven de Vries, Organizer*
15:30 – 17:00	09:30—11:00	**Rakesh Vohra, "Allocating Indivisible Goods (1)," lecture**
17:00 – 17:30	*11:00—11:30*	*Virtual Coffee Break*
17:30 – 19:00	11:30—13:00	**Rakesh Vohra, "Allocating Indivisible Goods (2)," lecture**
19:00 – 20:00	*13:00—14:00*	*Lunch*
20:00 – 21:30	14:00—15:30	**Exercise Session "Allocating Indivisible Goods" Option 1**

Allocating Indivisible Goods

Rakesh Vohra
University of Pennsylvania

Markets do not emerge full born from the head of Hera. They arise organically but don't scale without institutions that support property rights and resolve disputes. They evolve, but not always according to the needs of all participants but to those who have the power to influence its rules. Markets can and do fail to deliver outcomes that are efficient. Neo-classical Economics traces the source of market failure to externalities. It also tells us that the externality needs to be `priced in' to eliminate failure. This is more easily said than done and the question of exactly how is the fundamental challenge that market design sets for itself.

My three sessions will be organized around the three basic obstacles to the existence of theorems that tells us whether markets deliver efficient outcomes: indivisibility, non-convexity in preferences and the absence of a frictionless medium of exchange. Under what conditions can we extend the positive results about market outcomes to these settings? When this is impossible, what compromises among the attributes of market outcomes are achievable?

Program: Tuesday, October 5, 2021

Trier Time CEST/UTC+2	EDT UCT-4	
13:00 – 14:30	07:00 – 08:30	**alternate Exercise Session "Allocating Indivisible Goods" Option 2**
15:30 – 17:00	09:30—11:00	**Moshe Babaioff, "How to maximize profit when selling multiple items?" lecture**
17:00 – 17:30	*11:00—11:30*	*Virtual Coffee Break*
17:30 – 19:00	11:30—13:00	**Moshe Babaioff, "How to maximize profit when selling multiple items?" lecture**
19:00 – 20:00	*13:00—14:00*	*Lunch*
20:00 – 21:30	14:00—15:30	**Exercise Session "How to maximize profit when selling multiple items?" Option 1**

How to maximize profit when selling multiple items?

Moshe Babaioff
Senior Principal Researcher, Microsoft

A seller of goods often does not know how much the buyer would be willing to pay for each of her goods. How should she therefore sell her items when aiming to maximize profit?

When there is only one item for sale, there is a simple deterministic mechanism that maximizes the seller's profit, but in contrast, recent results show that profit-maximizing mechanisms for selling multiple items are very complex, must use lotteries, and moreover, might have to present infinitely many lotteries for the buyer to choose from. Thus, exact optimization seems very problematic. The talk will present a simple deterministic mechanism whose profit is not significantly degraded compared to the complex profit-maximizing optimal mechanism. This highlight the usefulness of approximate optimization. The talk will also survey several other results regarding the complexity of mechanisms that are almost optimal, and regarding optimal deterministic mechanisms.

The talk is based on several papers, joint with Yannai Gonczarowski, Nicole Immorlica, Brendan Lucier, Noam Nisan, Aviad Rubinstein and Matthew Weinberg.

Program: Wednesday, October 6, 2021

Trier Time CEST/UTC+2	EDT UCT-4	
13:00 – 14:30	07:00 – 08:30	**alternate Exercise Session "How to maximize profit when selling multiple items?" Option 2**
15:30 – 17:00	09:30—11:00	**Rakesh Vohra, "Allocating Indivisible Goods (3)," lecture**
17:00 – 17:30	*11:00—11:30*	*Virtual Coffee Break*
17:30 – 19:00	11:30—13:00	**Garrett van Ryzin, "Minimum Earnings Regulation and the Stability of the Marketplace," lecture**
19:00 – 20:00	*13:00—14:00*	*Lunch*
20:00	14:00	**BYOWine and cheese** **Poster Session** **Pub Quiz** Gather Town Link PW: OMD

Minimum Earnings Regulation and the Stability of Marketplaces

Garrett van Ryzin
Distinguished Scientist amazon

We build a model to study the implications of utilization-based minimum earning regulations of the kind enacted by New York City (and recently Seattle) for its ride-hailing providers. We identify the precise conditions under which a utilization-based minimum earnings rule causes marketplace instability, where stability is defined as the ability of platforms to keep wages bounded while maintaining the current flexible (free-entry) work model. We also calibrate our model using publicly available data, showing the limited power of the law to increase earnings within an open marketplace. We argue that affected ride-hailing companies might respond to the law by reducing driver flexibility.

[This is joint work with Arash Asadpour and Ilan Lobel.]

Published Paper: SSRN-id3502607

Program: Thursday, October 7, 2021

Please note the new times

Trier Time CEST/UTC+2	EDT UCT-4	
15:00 – 16:30	09:00—10:30	**Martin Bichler, "Equilibrium Computation in Markets (1)," lecture**
16:30 – 17:00	*10:30—11:00*	*Virtual Coffee Break*
17:00 – 18:30	11:00—12:30	**Martin Bichler, "Equilibrium Computation in Markets (2)," lecture**
18:30 – 19:00	12:30 – 13:00	**Poster Award and Closing Remarks**
19:00 – 20:00	*13:00—14:00*	*Lunch*
20:00 – 21:30	14:00—15:30	**Exercise Session "Equilibrium Computation in Markets"**

Equilibrium Computation in Markets

Martin Bichler
Technical University of Munich

This course covers equilibrium computation with a focus on market equilibria. The first part discusses larger markets where we assume bidders to be price takers. We look at the standard notion of competitive equilibrium in markets with payoff-maximizing participants. In simple assignment markets, where each buyer is interested in at most one object, we find market mechanisms that are individually rational, incentive-compatible, budget-balanced, and efficient. The allocation problem in such markets is convex and the competitive equilibrium prices follow from the duals of the allocation problem. Next, we analyze non-convex markets where we need richer pricing functions and competitive equilibria might not always exist. We look at a real-world example and how prices were computed on this market. Finally, we relax the assumption of pure payoff-maximizers and show that budget constraints lead to intractable problems higher up in the polynomial hierarchy. In the second part of the class, we look at small markets with strategic decision makers who can influence price. We explore Bayesian Nash equilibrium bidding strategies in simple single-object and multi-object markets. Such equilibria can be modeled as systems of partial differential equations and for most markets no closed form solution is known for the equilibrium bid function. We discuss an equilibrium learning method based on simultaneous gradient ascent that is able to numerically compute Bayesian Nash equilibria for symmetric auction markets and beyond.

We gratefully acknowledge the support of the