SOE 16: Evolutionary Game Theory and Networks (joint SOE/DY/BP)

Time: Thursday 15:00–16:00 Location: GÖR 226

SOE 16.1 Thu 15:00 GÖR 226

Game-theoretic stability and meaning of communities in networks — •Armin Pournaki, Felix Gaisbauer, Eckehard Olbrich, and Sven Banisch — Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany

Community detection is a widely used tool for observing modular structures in networks. A large variety of algorithms exist - each with their own advantages - for finding these structures based on modularity optimisation, graph-spectral methods or stochastic block modeling, to name a few.
The talk aims to provide an interpretation of such communities in relation to game-theoretic modeling. We investigate the stability of given partitions by considering coordination games on networks. In this context, we ask how many communities different network configurations support and if there are structural patterns enabling the emergence or disappearance of communities. We relate the findings to empirical data on social networks.

SOE 16.2 Thu 15:15 GÖR 226

Quantum Game Theory for Power-, Heat- and Traffic- Networks — •Matthias Hanauske[1,2], Markus Schlott[1], Alexander Kies[1], Fabian Hofmann[1], and Horst Stöcker[1,2] — [1]Frankfurt Institute for Advanced Studies — [2]Institut für Theoretische Physik, Frankfurt, Germany

Energy networks for the combined electricity, heating and transportation sectors transform towards renewable energy sources. The electric power networks depend particularly sensitively on the decisions of various stakeholders of these complex networks. Our game-theoretical approach for the entire sector-coupled energy system for Europe depends on country-specifc socialogical, political and economical decisions. Last, not least, the success of this strategy depends on the behaviour of the population, the carbon dioxide consumers. The focus of this work is on the impact of social pressure for the behavior of the individual consumers. Classical Evolutionary Game Theory, simulations of spatial games and Evolutionary Quantum Game theory are used to study the dynamics of the transformation process towards a carbon neutral society.

SOE 16.3 Thu 15:30 GÖR 226

Reinforcement learning dynamics in the infinite memory limit — •Wolfram Barfuss — Max Planck Institute for Mathematics in the Sciences, Leipzig

Reinforcement learning algorithms have been shown to converge to the classic replicator dynamics of evolutionary game theory, which describe the evolutionary process in the limit of an infinite population. However, it is not clear how to interpret these dynamics from the perspective of a learning agent. In this work we propose a data-inefficient batch-learning algorithm for temporal difference Q learning and show that it converges to a recently proposed deterministic limit of temporal difference reinforcement learning. In a second step, we state a data-efficient learning algorithm, that uses a form of experience replay, and show that it retains core features of the batch learning algorithm. Thus, we propose an agent-interpretation for the learning dynamics: What is the infinite population limit of evolutionary dynamics is the infinite memory limit of learning dynamics.

SOE 16.4 Thu 15:45 GÖR 226

Degenerated mirror strategies extort extortioners — Haowei Shi[1,2], Sergey Sosnovskiy[1], Florian Ellsässer[1], Gregory Wheeler[3], and •Jan Nagler[1] — [1]Deep Dynamics Group and Centre for Human and Machine Intelligence, Frankfurt School of Finance and Management, Frankfurt, Germany — [2]School of International Economics, China Foreign Affairs University, Beijing, China — [3]Centre for Human and Machine Intelligence, Frankfurt School of Finance and Management, Frankfurt, Germany

In iterated games the payoff a player receives in a given round depends on the player's own action and the action of his opponent. Thus, it came as a surprise when Press and Dyson in [PNAS 109:10409 (2012)] introduced so-called extortion zero-determinant (extZD) strategies that - independently of the opponent's strategy - ensure an equal or higher expected payoff. Here, we introduce degenerated mirror strategies that, with a trembling hand that may accidentally take unintended actions, extort any extZD strategy, thereby persistently receiving a higher expected payoff than extortioners. We also show that degenerated mirror strategies outperform the most successful traditional strategies and do well against adaptive strategies. In particular, we demonstrate that they perform equal to or better than a memory-n player that may use the past n actions to determine her next move, where n may be arbitrarily large. Nevertheless, degenerated mirror strategies may be generous when mirroring cooperative strategies.