Master's thesis or internship on

Modeling basins of attraction of multiagent reinforcement learning dynamics

Background: When multiple agents learn in the same environment and influence each other's learning process, multiple outcomes may be possible. The different outcomes may have vastly different consequences. For example, pricing algorithms may either learn to price competitively or to collude (drive up prices). People expressing their opinions and learning through interactions with others on social networks may reach a consensus or become polarized, leading to a rift in society. Agents making use of shared resources may learn to take care of the resources sustainably or may exploit them, leading to environmental degradation. Understanding which outcomes are likely to be learned and how algorithm design influences this likelihood is crucial for designing responsible and ethical AI.

Topic: In this project, you will analyze the basins of attraction of multiagent reinforcement learning dynamics in a deterministic learning limit and characterize the fluctuations around this limit using a van Kampen expansion. This will be done in the context of normal-form games. You will compare the basins of attraction for different policy functions to investigate how policy functions influence equilibrium selection.

This project will be conducted in collaboration with the Integrated System Modeling group of the Center for Development Research (ZEF) at the University of Bonn under the guidance of Jun.-Prof. Wolfram Barfuss. As part of the project, a research visit at Uni Bonn will be possible.

Contact: For more information, please get in touch with Janusz Meylahn (j.m.meylahn@utwente.nl)

Keywords: Multiagent reinforcement learning, basins of attraction, stochastic processes

References:

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[2] Barfuss, W., Donges, J. F., & Kurths, J. (2019). Deterministic limit of temporal difference reinforcement learning for stochastic games. *Physical Review E*, *99*(4), 043305.