Master's thesis or internship on

The role of state-space representation in multiagent reinforcement learning

Background: When multiple agents learn in the same environment and influence each other's learning process, multiple outcomes may be possible. Which outcomes are possible and how efficiently they can be learned depends on the agent's representation of the environment. A more accurate representation may make better outcomes possible but will slow down the learning efficiency. This trade-off can be addressed by making use of analogy classes: grouping specific environment states together. An important consequence of this grouping is that the game may become partially observable.

Topic: In this project, you will analyze the effect of changing state-space representations in games where the states consist of action-histories. A high-resolution representation of the action history makes highly complex strategies possible, but learning such strategies may take a long time. You will quantify this effect by analyzing the deterministic multiagent reinforcement learning dynamics for different analogy-class representations. Time permitting, we may also investigate the effect of representation choice on the intrinsic fluctuations of the learning dynamics.

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, state-space representation, analogy classes

References:
[1] Barfuss, W., & Meylahn, J. M. (2023). Intrinsic fluctuations of reinforcement learning promote cooperation. *Scientific reports*, *13*(1), 1309.
[2] Jehiel, P. (2005). Analogy-based expectation equilibrium. *Journal of Economic theory*, *123*(2), 81-104.