



Thesis (B.Sc. / M.Sc.)

Deep Reinforcement Learning for Multi-Agent Systems

Reinforcement Learning, RL, is an area of machine learning which has proven to be quite successful in sequential decision making [1]. Deep RL extends RL by using a deep neural network where the ground breaking work was done by developing algorithms such as DQN [2] to achieve human like behaviour for a machine (the agent). Use of Monte Carlo Tree Search in combination with neural networks has also led to an improvement in the performance and reduction in the complexity of the problem AlphaGo [3]. Deep RL for multiple agents is still a relatively new direction and already has some really exciting results [4].

In this project the student will implement current Deep RL algorithms for different multi agent system applications and then try to enhance the performance by improving the existing algorithms. One such application could be a queueing network with large number of schedulers trying to access the same queues for processing their tasks. Another application could be to assess how cooperation between different agents can increase their individual performance, especially if the resources are limited and there are some non cooperative agents present as well. The students can also come up with their own application and ideas in this direction.

Some of the following may help during your thesis:

- Basic knowledge of Deep RL and MAS
- Experience with Python and PyTorch

For further information, please contact Anam Tahir.

References

- [1] Richard S Sutton and Andrew G Barto. *Reinforcement learning: An introduction*. MIT press, 2018.
- [2] Volodymyr Mnih, Koray Kavukcuoglu, David Silver, Andrei A Rusu, Joel Veness, Marc G Bellemare, Alex Graves, Martin Riedmiller, Andreas K Fidjeland, Georg Ostrovski, et al. Human-level control through deep reinforcement learning. *nature*, 518(7540):529–533, 2015.
- [3] David Silver, Aja Huang, Chris J Maddison, Arthur Guez, Laurent Sifre, George Van Den Driessche, Julian Schrittwieser, Ioannis Antonoglou, Veda Panneershelvam, Marc Lanctot, et al. Mastering the game of go with deep neural networks and tree search. *nature*, 529(7587):484–489, 2016.
- [4] Thanh Thi Nguyen, Ngoc Duy Nguyen, and Saeid Nahavandi. Deep reinforcement learning for multiagent systems: A review of challenges, solutions, and applications. *IEEE transactions on cybernetics*, 2020.

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