Scheduling algorithms in wireless networking using machine learning

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Carrier-sense multiple access (CSMA)-type random access algorithms and their variants such as the queue-length based CSMA (Q-CSMA) [1] are widely adopted in ad hoc wireless networking community. Their performance with respect to various metrics, such as throughput, delay have been studied in the literature under different sets of assumptions. Some of these link scheduling algorithms or medium access control (MAC) algorithms have been shown to possess good theoretical guarantees such as throughput-optimality. However, there is a need for scheduling algorithms that optimize a combination of two or more performance metrics. An example would be to optimize delay while keeping the queue lengths below a pre-specified threshold. The objective of this master thesis is to design scheduling algorithms to enhance the performance of wireless multi-hop networks based on machine learning techniques. A possible approach to solve this problem in a decentralised fashion is to formulate a suitable decentralised partially observable Markov decision process (Dec-POMDP). Since solving a Dec-POMDP is computationally infeasible for large state spaces, an important aspect of the master thesis will be to devise an approximate solution method for the associated Dec-POMDP tailored to the wireless multi-hop networking set-up.

The thesis will be co-supervised by Robin Klose from Secure Mobile Networking Lab, department of Computer Science, Technische Universität Darmstadt. The candidate will get an opportunity to test his/her ideas on full-stack simulation environments.

Good programming skills are a prerequisite. The candidate is expected to be familiar with Markov chains. Willingness to learn some machine learning topics as and when required is also necessary for this project.

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References

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[2] M. Abu Alsheikh, D. T. Hoang, D. Niyato, H. P. Tan, S. Lin, *Markov Decision Processes With Applications in Wireless Sensor Networks: A Survey*, IEEE Communications Surveys Tutorials, 10.1109/COMST.2015.2420686, 2015.