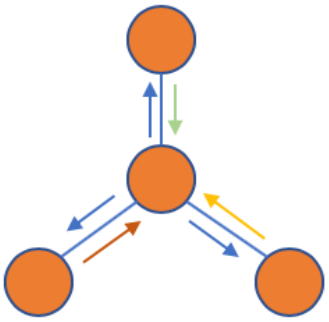
ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Distributed Computing

Prof. R. Wattenhofer

# Node and Edge Classification with Agent-based Graph Neural Networks



Lately, applying deep learning to graph-based problems has gained a lot of interest. Graph neural networks, in particular, achieved great success in knowledge graphs, reinforcement learning, chemistry, or physics simulations. These models are mostly based on the message passing framework, where nodes exchange messages over the edges and update their states based on all of the aggregated incoming messages. However, the current models generalize poorly to larger graphs and have trouble relaying long-range information over the graph. These problems have also been encountered in distributed computing and graph-based optimization problems before. Among the answers to these problems were the sub-linear randomized property testing algorithms, which allowed for probabilistic graph feature detection in time smaller than input size and ant colony optimization algorithms.

We have recently developed a model called AgentNet [Martinkus et al., 2022] based on these ideas. However the model is currently geared towards graph-level tasks such as graph classification or graph property regression. In this thesis we will extend the model to node-level tasks such as node classification or edge prediction. There is a possibility to also extend the model to optimization tasks such as the traveling salesman problem.

**Requirements:** Strong motivation, knowledge in deep learning, or a solid background in machine learning. Experience with Python and TensorFlow or PyTorch is an advantage as well as knowledge in graph theory, distributed computing and graph neural networks.

**Interested? Please contact us for more details!**

## Contact

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**References:**

## References

K. Martinkus, P. A. Papp, B. Schesch, and R. Wattenhofer. Agent-based graph neural networks. *arXiv preprint arXiv:2206.11010*, 2022.