PhD proposal: Graph Transformers, Deep Reinforcement Learning and Combinatorial Optimization

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Recently, Deep Reinforcement Learning models have shown promising results in solving NP-hard Combinatorial Optimization problems [1]. Deep Reinforcement Learning models do not rely on problem-specific expert domain knowledge (heuristic methods) and supervised labeled data (supervised learning methods) [3]. They also are less biased.

Graph Transformers have gained popularity in the field of graph representation learning with a variety of recent publications [2].

We propose to investigate the use of Graph Transformers in Deep Reinforcement Learning for learning to solve difficult Combinatorial Optimization problems. The kind of problems we propose to try first are problems for which Neural Networks already gave good results such as the traveling salesman problem, the capacitated vehicle routing problem, the prize collecting TSP, and the orienteering problem [3].

We also propose to investigate the relations between symmetries and the architecture of the model as well as the Deep Reinforcement Learning framework. Taking symmetries into account should improve generalization.

[1] DIMES: A Differentiable Meta Solver for Combinatorial Optimization Problems. Ruizhong Qiu, Zhiqing Sun, Yiming Yang. Neurips 2022.

[2] Recipe for a General, Powerful, Scalable Graph Transformer. Ladislav Rampasek, Mikhail Galkin, Vijay Prakash Dwivedi, Anh Tuan Luu, Guy Wolf, Dominique Beaini. Neurips 2022.

[3] Sym-NCO: Leveraging Symmetricity for Neural Combinatorial Optimization. Minsu Kim, Junyoung Park, Jinkyoo Park. Neurips 2022.