

# Abstract

In the last decade, intelligent agents achieved remarkable results and aroused a wide public interest, particularly in strategic board games like Chess and Go. This success can be attributed to the intensive research in the wide range of artificial intelligence and the combination of its components, where undoubtedly neural networks take an important part. On the other hand, the continuous improvement and research regarding reinforcement learning methods provided a simple but effective algorithm known as the *Monte-Carlo tree search* (MCTS). Despite its simplicity, MCTS-based approaches showed promising results and appeared more appropriate, especially in terms of domains with a vast state space. Although the main research focus of MCTS is still on strategic board games, there were also some impressive results from researches on intelligent agents for combinatorial optimization problems. Unfortunately the results base on methods, which are tailored to the specific domain and therefore cannot be applied to other problems.

This thesis focuses on the learning paradigm of an agent with the MCTS as the basis of our algorithms. Therefore, we are going to extend the MCTS-based reinforcement learning method to the general case, where our agent can operate on a wide range of domains. This concept is known as *general game playing* and presents a new research area within the artificial intelligence. It has also a strong similarity to the *black-box optimization* approach. In this context, we provide the algorithm UCT-ODU and its extension UCT-RAVE-ODU, which represents an approach of a general AI agent for combinatorial optimization problems.

This study outlines the obstacles for a MCTS-based agent in combinatorial optimization problems, identifies the requirements and clarifies the necessity of specific learning paradigms. Finally, an intensively empirical evaluation supports the validation of this approach and shows that the algorithms UCT-ODU and UCT-RAVE-ODU provide a significant improvement of the learning rate.