ALEXANDRIA UNIVERSITY
Faculty of Science

Faculty of Science

Department of Mathematics and Computer Science

Using Neural Networks for solving some combinatorial optimization problems

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Abstract

The thesis applies Neural Networks in solving combinatorial optimization problems. The Knapsack problem is a well-know Combinatorial Optimization problem and is the backbone of many real-world decision problems. A neural heuristic solver for the Knapsack problem is introduced in the thesis. The solver is inspired by mechanisms and strategies used by both algorithmic solvers and humans. The solver neural model is based on sequence-to-sequence models, with a module that allow the solver to access its all previous outputs. The neural network model is trained and tested on synthetic datasets that represent a variety of instance types with different complexities.

The model was able to generalize some instances, in which there exists a correlation between items values and weights, also the capacity of the sack has a role in learning useful representations for each item in an instance and for the instance itself. These results crave for more insights and experiments on how neural networks designed with a bias for a combinatorial optimization problem can learn to solve it.

Although the "NeuroKnapsack" solver is not competent with other solvers, the results in this thesis are insights for how the connection between combinatorial optimization, machine learning, and cognitive science could serve a great purpose in operation research field.