The Road from Simulated Annealing to GNNs

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Abstract

In the theory of computational complexity, the decision version of the TSP (where, given a length L, the task is to decide whether the graph has any tour shorter than L) is a classical NP-complete problem. Kirkpatrick et al. [1] proposed a Simulated Annealing (SA) routine which can generally produce good routes for the euclidean TSP while it depends on correct calibrated meta-parameters. Recently, Graph Neural Networks (GNNs) [2] have been successfully applied to a very relevant NP-Complete combinatorial problem (Boolean satisfiability problem, i.e. , SAT) [3]. Selsam et al. show that GNNs can be trained to obtain satisfactory accuracy (approximately 85%) on small instances. Prates et al. [4] extended this approach to investigate whether GNNs can be trained to solve NP-Complete problems involving numerical information (e.g. , edge weights). They designed a graph neural network for the decision version of TSP which can be trained with sets of dual examples. Given the optimal tour cost C^*, two decision instances are generated, including one decision instance with target cost x% smaller and one with target cost x% larger than C^*. The aim of our work is to figure out how GNNs can be used to predict optimal route cost of TSP and why it is more advanced than traditional approaches, like Nearest Neighbor (NN) route construction and Simulated Annealing (SA) routine.

References

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