

Towards Automated Algorithm Performance Prediction Using Problem Landscape Data: A Use-Case in Single-Objective Optimization

Many real-world scenarios involve optimization problems, for example, when minimizing risks, minimizing cost, maximizing reliability, and maximizing efficiency. For this reason, evolutionary computation focuses on development of algorithms for global optimization inspired by biological evolution. These algorithms are efficient for finding good solutions to NP-hard problems for which solutions cannot be computed in analytical or semi-analytical form, or by using deterministic algorithms. Additionally, in combination with machine learning algorithms they represent powerful techniques for solving many prediction problems in industry. Benchmarking in evolutionary computation is a crucial task and is used to evaluate the performance of an algorithm against other algorithms. Existing approaches for assessing the performance of algorithms are based on a statistical comparison of the algorithms' results focusing only on the performance data. On the other side, efficient solving of an unseen optimization problem is related to appropriate selection of an optimization algorithm and its hyper-parameters. For this purpose, automated algorithm performance prediction should be performed that in most commonly-applied practices involves training a supervised ML algorithm using a set of problem landscape features. To provide more explainability in the algorithms' behaviour, we are going to present a recently proposed approach known as Deep Statistical Comparison that provides more robust results in benchmarking studies focussing only on performance data, followed by recently proposed approaches for representing the optimization problem landscape data. Finally, we are going to present different ML pipelines that are used for automated algorithm performance prediction that link the problem landscape data to the performance data by exploring the relations between the problem and the performance space. Such kinds of analysis are extremely welcome to understand the algorithm's behavior and stop treating them as a black-box, which will further allow more easily to transfer the learned academic knowledge into industry.