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Title: Understanding the Empirical Hardness of NP-Complete Problems

Abstract:

In this project, we focus on the work of empirical hardness models (EHMs) that, given a new problem instance, estimate the runtime of an algorithm in low-order polynomial time. Using the uniform-random 3-SAT problem as an example, the construction process of EHM, based on the analysis of instance structure followed by machine learning regression method, is described. Consequently, in an attempt to build a conditional model for further improvement of the runtime prediction accuracy, a decision tree based approach to obtain satisfiability status is introduced. The idea of hardness model is extended for other problems, such as, combinatorial auction winner determination problem (WDP), Mixed integer programming (MIP), and the traveling salesman problem (TSP). Moreover, EHM is used to predict the runtime of previously untested algorithm designs on previously unseen instances, in the context of highly parameterized algorithms that span a large space of possible algorithm designs.

Reference:

Leyton-Brown K, Hoos HH, Hutter F, Xu L. Understanding the empirical hardness of NP-complete problems. Communications of the ACM. 2014; 57(5):98-107.