Some Surprising Regularities in the Behaviour of Stochastic Local Search

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This abstract gives a brief overview of our work presented in [3]. Our approach for characterising the run-time behaviour of stochastic local search (SLS) algorithms is based on a novel and adequate empirical methodology for evaluating SLS algorithms first used in [1] and presented in more detail in [2]: Instead of collecting simple statistics averaged over a large number of runs and large sets of instances, we are estimating and functionally characterising *run-time distributions* on single instances. The data thus obtained provides the basis for formulating hypotheses on the behaviour of SLS algorithms on problem distributions and across several domains. These hypotheses are then tested using standard statistical methodology like parameter estimation methods and goodness-of-fit tests.

Using this methodology, we obtain some novel and surprisingly general empirical results concerning the run-time behavior of the most popular SLS algorithms for SAT and CSP. Our main result establishes that *on hard instances from a variety of randomised problem classes (Random-3-SAT at the phase transition) as well as encoded problems from other domains (like blocks world planning or graph colouring), the run-time behavior of some of the most powerful SLS algorithms for both SAT and CSP can be characterised by exponential distributions.* This result has a number of significant implications, the most interesting of which might be the fact that *SLS algorithms displaying this type of behaviour can be easily parallelised with optimal speedup, or, equivalently, their performance cannot be improved by using restart.* As another consequence, the search performed by these algorithms can be interpreted as random picking in a dramatically reduced search-space. Therefore, besides the practical implications of our findings, these also suggest a new interpretation of the behaviour of SLS algorithms and raise a number of interesting questions.

For details, we refer the interested reader to the full paper [3], which is available at `http://aida.intellektik.informatik.tu-darmstadt.de/ kipr/1998`.

References

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2. H.H. Hoos and T. Stützle. Evaluating Las Vegas Algorithms — Pitfalls and Remedies. *Proc. of UAI'98*, 1998.
3. H.H. Hoos and T. Stützle. A Characterisation of the Run-time Behaviour of Stochastic Local Search. *Tech. Report AIDA-98-01, Darmstadt University of Technology*, 1998.