

Holger H. Hoos - *University of British Columbia*

Programming by Optimisation: Towards a New Paradigm for Developing High-Performance Software

Abstract: When creating software, developers frequently explore multiple ways of achieving certain tasks. Often, these alternatives are eliminated or abandoned early in the process, based on the belief that the flexibility afforded by them would be difficult or impossible to exploit later. In this talk, I challenge this view and advocate an approach that encourages developers to not only avoid premature commitment to certain design choices, but to actively develop promising alternatives for parts of a design. In this approach, dubbed Programming by Optimisation (PbO), developers specify a potentially large design space of programs that accomplish a given task, from which then versions of the program optimised for different use contexts are generated automatically; per-instance selectors and parallel portfolios of programs can be obtained from the same sources. While most of my presentation will focus on the vision of how PbO can fundamentally change the way challenging computational problems are solved in the future, I will also present examples from work done in my own group and elsewhere that clearly illustrate the viability and promise of the approach. These examples will cover substantial advances in the state of the art (often by orders of magnitude) in SAT-based software verification, planning and timetabling, as well as mixed integer programming - perhaps the most widely used approach for solving optimization problems in industry. Leveraging cutting-edge methods from machine learning and optimisation, PbO allows human experts to focus on the creative task of devising possible mechanisms for solving given problems or subproblems, while the tedious task of determining what works best in a given use context is performed automatically, substituting human labour by computation. In doing so, PbO offers an attractive way of making good use of the ever-increasing amount of computing cycles created by sustained improvements in computer hardware and cloud computing resources.

Biosketch: Holger H. Hoos is a Professor for Computer Science and a Faculty Associate at the Peter Wall Institute for Advanced Studies at the University of British Columbia (Canada); he also holds an appointment as Consulting Professor at the University of Trento (Italy). His main research interests span empirical algorithmics, artificial intelligence, bioinformatics and computer music. He is known for his work on the automated design of high-performance algorithms and on stochastic local search methods. Holger is a co-author of the book "Stochastic Local Search: Foundations and Applications", and his research has been published in numerous book chapters, journals, and at major conferences in artificial intelligence, operations research, molecular biology and computer music. Since 2009, he serves as President of the Canadian Artificial Intelligence Association (CAIAC). Currently, his group is helping UBC to produce better exam timetables, Actenum Inc. to increase production efficiency in the oil and gas industry, and IBM to improve their CPLEX optimisation software. His web page: <http://www.cs.ubc.ca/~hoos>.



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