

Algorithm and Experiment Design with HeuristicLab

An Open Source Optimization Environment for Research and Education

Tutorial Outline

The proposed tutorial demonstrates how to apply and analyze metaheuristic optimization algorithms using the HeuristicLab [1] open source optimization environment. It will be shown how to parameterize and execute evolutionary algorithms to solve combinatorial optimization problems (traveling salesman, vehicle routing) as well as data analysis problems (regression, classification). The attendees will learn how to assemble different algorithms and parameter settings to a large scale optimization experiment and how to execute such experiments on multi-core or cluster systems. Furthermore, the experiment results will be compared using HeuristicLab's interactive charts for visual and statistical analysis to gain knowledge from the executed test runs. To complete the tutorial, it will be sketched briefly how HeuristicLab can be extended with further optimization problems and how custom optimization algorithms can be modeled using the graphical algorithm designer.

Additional Information

HeuristicLab [1] is an open source system for heuristic optimization that features several metaheuristic optimization algorithms (e.g., genetic algorithms, genetic programming, evolution strategies, tabu search, simulated annealing) as well as several optimization problems (e.g., traveling salesman, regression, classification, vehicle routing, knapsack, simulation-based optimization). It is developed by the research group *Heuristic and Evolutionary Algorithms Laboratory (HEAL)* [2] of the *Upper Austria University of Applied Sciences* and is based on C# and the Microsoft .NET Framework. HeuristicLab is used as development platform for several research and industry projects (for example the *Josef Res- sel Centre Heureka!* [3]) as well as for teaching metaheuristics in the study programs *Software Engineering* and *Medical- and Bioinformatics*. Over the years HeuristicLab has become more and more known within the metaheuristic optimization community and is used by researchers and lecturers at different universities. The application of HeuristicLab in multiple theoretical and practical projects has been documented in several publications (see for example [4] for a comprehensive list).

In summer 2010 version 3.3 of HeuristicLab was released under the GNU General Public License. Some of the main features of version 3.3 are:

- comfortable and feature rich graphical user interface (exemplarily shown in Figures 1 and 2)
- experiment designer to create and execute a large number of test runs
- graphical analysis and comparison of parameters and results
- graphical algorithm designer to create or modify algorithms
- plug-in based architecture which enables an easy integration of new algorithms and problems
- generic and flexible algorithm and data model
- generic interface to couple HeuristicLab with other applications
- parallel and/or distributed execution of algorithms on multi-core or cluster systems

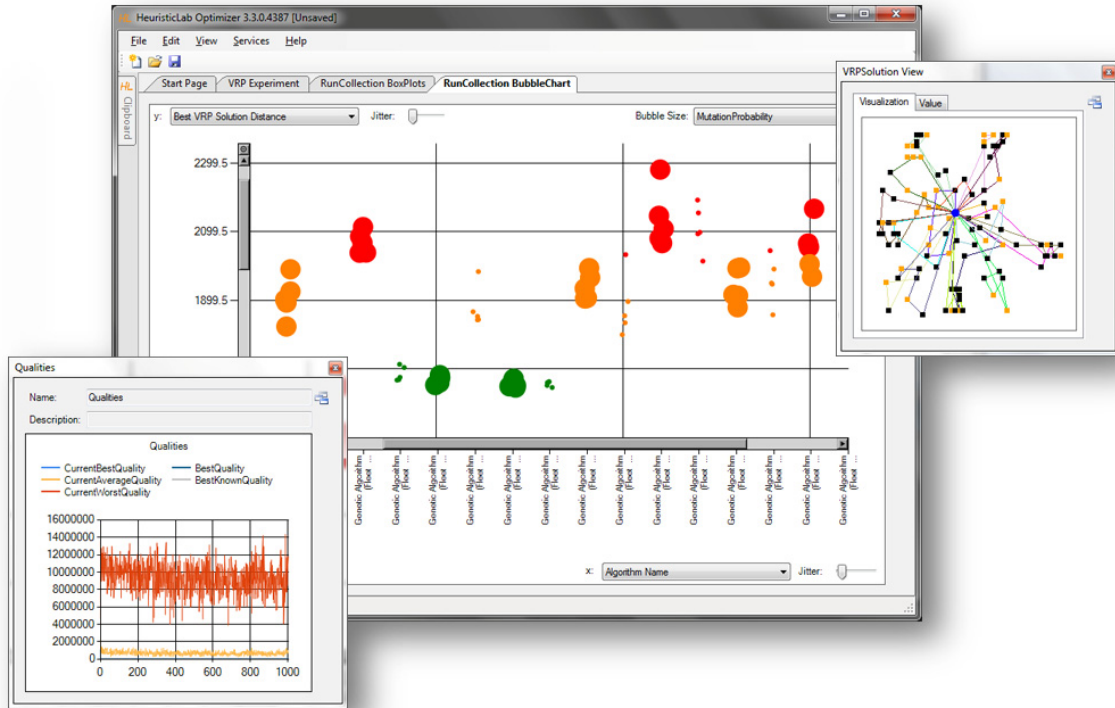


Figure 1: Screenshots of HeuristicLab 3.3 showing test run analysis bubble chart, vehicle routing solution visualization, and quality chart

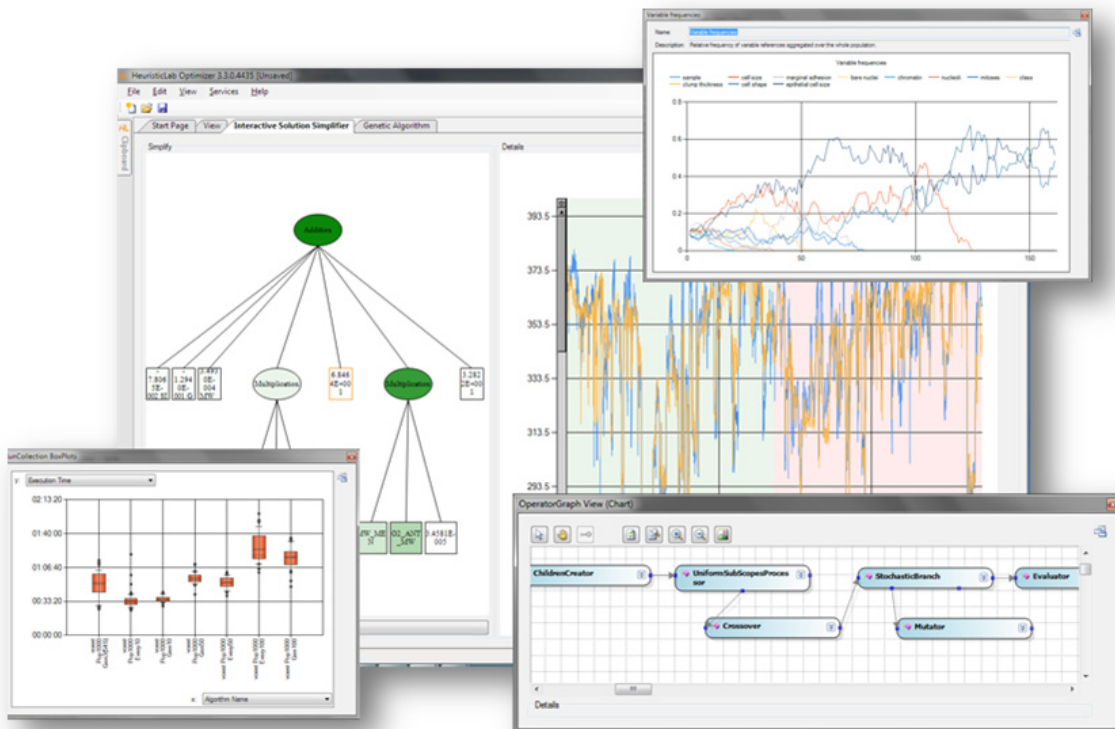


Figure 2: Screenshots of HeuristicLab 3.3 showing interactive GP solution simplifier, variable frequencies chart, test run analysis box plots, and algorithm designer

Links

- [1] <http://dev.heuristiclab.com>
- [2] <http://heal.heuristiclab.com>
- [3] <http://heureka.heuristiclab.com>
- [4] <http://research.fh-ooe.at/en/orgunit/detail/356#showpublications>

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Biography:

Stefan Wagner received his MSc in computer science in 2004 and his PhD in technical sciences in 2009, both from the Johannes Kepler University Linz, Austria. From 2005 to 2009 he worked as an associate professor for software project engineering and since 2009 as a full professor for complex software systems at the Upper Austria University of Applied Sciences, Campus Hagenberg, Austria. Dr. Wagner is one of the founders of the research group Heuristic and Evolutionary Algorithms Laboratory (HEAL) and is the project manager and head developer of the HeuristicLab optimization environment.