Interactive Concept-based Search

HHAI2024 Tutorial

Amiram (Ami) Moshaiov, Tel-Aviv University

moshaiov@tauex.tau.ac.il

Abstract

In Concept-based Search (CbS) problems the term conceptual solution, or in short concept, refers to a pre-defined subset of feasible solutions, which is meaningful to the decision-makers. In such CbS problems, predefined meaningful subsets of particular solutions, i.e., predefined concepts, are explored to reach some informative results at the conceptual and the particular solution levels. Interactive CbS (I-CbS) forms a synergy between humans` tacit knowledge and cognitive abilities at the conceptual level and the search capabilities of computers at the detailed level of the particular solutions.

While not restricted to search problems that involve multiple criteria, most research on CbS and I-CbS focused on multi-objective problems and multi-criteria decision-making. In such a context, the term interactivity commonly refers to biasing the search according to interactive articulations of objective preferences. In contrast, multi-criteria I-CbS is not restricted to such a bias; interactivity in I-CbS could also be implemented with respect to preferences towards concepts and sub-concepts.

This tutorial will provide insight to the unique features of I-CbS and to its potential real-life applications. It aims to introduce the HHAI community of researchers and practitioners to past and current research on CbS and I-CbS and to provide an overview about potential future research directions concerning I-CbS.

The tutorial topics

1. Introduction: The origin of CbS, conceptual solutions and the notion of a set-based concept
2. Set-based concept evaluation versus traditional concept evaluation
3. Real-life examples of CbS and I-CbS
4. Pareto-optimality and the s-Pareto approach for optimal concept selection
5. I-CbS using the s-Pareto approach
6. The s-Pareto approach versus the relaxed concept-based Pareto approach
7. On the difference between optimal concept and satisficing concept
8. On multi-criteria CbS of satisficing concepts
9. The various types of CbS and their motivations and relations to other search types

10. Numerical difficulties of CbS
11. Methodologies for comparing multi-criteria CbS algorithms
12. Multi-criteria decision-making on set-based concepts
13. Overview on Interactive Multi-Objective Optimization (I-MOO)
14. The unique features of I-CbS as compared with I-MOO
15. Research challenges and opportunities concerning CbS and I-CbS
16. A discussion on the potential of I-CbS for HHAI

References

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Tutorial duration - Approximately 3 hours

Tutorial format - PowerPoint presentation and a discussion on the potential of I-CbS problems and solution techniques to HHAI applications.

Short bio of the organizer

Amiram (Ami) Moshaiov is a retired yet active member of the School of Mechanical Engineering and of the Sagol School of Neuroscience at Tel-Aviv University (TAU). Previously, he was a faculty member at MIT, USA. At TAU, Moshaiov heads a research group on computational intelligence. The main research areas of his group include Multi-payoff Games: Theory & Evolutionary Search of Rationalizable Strategies to such Games, Multi-objective Topology and Weight Evolution of Artificial Neural-Networks, Multi-objective Optimization & Multi-Criteria Decision-Making, Multi-Concept Optimization and Exploration, and Multi-objective Neuro-Fuzzy Inference Systems. His research group develops computational intelligence methods which are applied to problems from a wide range of application areas. Moshaiov was an Associate Editor of the IEEE Transactions on Emerging Topics in Computational Intelligence and of the Journal of Memetic Computing. In addition, he was a member of many program committees of scientific conferences, a reviewer to many scientific journals, and a member of the Management Board of the European Network of Excellence in Robotics. He is currently a member of the IEEE Task Forces on Evolutionary Deep Learning and Applications, and on Transfer Learning & Transfer Optimization.