Dissertation abstract

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Since March 2013 I am a Ph.D. candidate at the University of Basel under the supervision of Prof. Dr. Malte Helmert. In the following paragraphs I will outline my previous work in the field of automatic planning and the topics I would like to work on during my thesis.

Previous research

I have completed my Bachelor and Master of Science studies at the University of Freiburg in Germany. Already during my B.Sc. studies I have focused on the field of automatic planning and subsequently also wrote my bachelor's thesis on this subject.

During my M.Sc. studies I was a student assistant at the artificial intelligence faculty and helped develop and maintain the Fast Downward planning system (Helmert 2006). We competed in the International Planning Competition in 2011 and the teams I was a part of won the Deterministic Sequential Optimization track (Helmert et al. 2011) and were the runner-ups in the Deterministic Sequential Satisficing (Helmert et al. 2011) and Learning track (Fawcett et al. 2011b). Additionally, we submitted two other planners that did not perform as well as their competitors (Domshlak et al. 2011; Fawcett et al. 2011a).

For ICAPS 2011 I submitted a paper to the KEPS workshop (Seipp and Helmert 2011) and co-authored a submission to the HDIP workshop (Fawcett et al. 2011c). The former is based on my B.Sc. thesis focusing on the reformulation of planning tasks by merging finite-domain variables. The latter talks about how we can use automatic parameter configuration tools like ParamILS (Hutter et al. 2009) to learn a good configuration for specific planning domains.

In 2012 we submitted a paper explaining how we can learn good configurations separately for multiple planning domains and combine them in a portfolio planner that performs even better on unseen domains than LAMA-2011, the winner of the IPC 2011 Deterministic Sequential Satisficing track (Seipp et al. 2012).

In my master's thesis I introduced Cartesian abstractions for classical planning tasks (Seipp 2012). This allowed me to adapt the concept of counter-example guided abstraction refinement (CEGAR) developed in the model checking commuunity to the classical planning setting. Our paper about the same topic was accepted for this year's ICAPS conference (Seipp and Helmert 2013).

Research interests

The main topic of my thesis will be **abstraction heuristics** for classical planning and combinatorial search. I enjoyed working on the subject in my master's thesis and hope I can pursue some of the ideas further during my Ph.D. studies.

To this end, I will search for ways to make the **CEGAR** approach for classical planning work faster and thus more competitive. I already started working on using additive CEGAR abstractions with very promising results. Additionally, I would like to find other abstraction algorithms and look at ways to combine abstractions with landmark detection methods. Later, I will try to apply some of the abstraction heuristics developed for classical planning to other search problems.

While traditionally the search and heuristic part of a planner are strictly separated, in our work on CEGAR we found that the formalism allows us to easily detect and fix heuristic errors during search. I think this **online learning** approach bears some potential, because it might help us overcome the limitations of A^*.

A further research area that I would like to investigate is that of **planner portfolios**. It is accepted knowledge that no planning algorithm dominates all others on all planning domains. Therefore, running a portfolio of a multitude of planners seems beneficial. I am interested in looking for ways of searching suitable planners or planner configurations and ways of combining them. For satisficing planning we have shown that simply running all planners sequentially works best (Seipp et al. 2012), but this might not be the case for optimal planning or for a greater number of planners in the portfolio. Additionally, I would like to experiment with algorithms that select the next planner in the portfolio adaptively based on the performance of the planners that have already been run.

A closely related problem is **planner selection**. Choosing the right planner for a given problem is a difficult task, because the features that can be extracted typically have very little predictive power for a planner's performance. Nonetheless, I want to try to find new **feature extraction** methods, because I think being able to select a good planner automatically could be helpful for bridging the gap between research and application.

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