Dissertation Abstract

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In November 2012 I joined the research group Artificial Intelligence of the university of Basel as a Ph.D. student, supervised by Malte Helmert. Since at the time of writing of this abstract, I have been working as a Ph.D. student for roughly three months, I can not develop an elaborated research plan of my studies, as it is not very clear to me on what area my thesis will focus yet. Therefore I cannot give a real abstract of my thesis in the following, but only write about what I did so far (both during previous studies and as a Ph.D. student so far) and which of my interests I intend to pursue during my further Ph.D. research. Although this abstract is very short, I hope that I can expose my ideas in a satisfying way so that I can possibly get the chance to participate in the doctoral consortium of this year's ICAPS. I consider the DC to be most helpful for Ph.D. students who are at the beginning of their studies rather than for students who have done research for a few years already and to whom the contents of their thesis should be very clear anyway.

Previous work

Already during my Bachelor's studies, I attended a lecture on automated planning held by Prof. Helmert and I focused on the area of artificial intelligence generally and on topics related to planning specifically since then. For example, together with two other students, we implemented optimal cost-partitioning for an abstraction heuristic in the Fast Downward planning system (Helmert 2006).

In my Bachelor's thesis (Sievers 2009), I pursued the goal of solving single-person games with the help of a classical planner. Therefore I used a transformation which translates such games that are encoded in GDl into a PDDL representation of a regular classic planning task.

During my Master's studies, I deepened my knowledge in AI in general and in planning particularly.

As a student assistant I worked on the Fast Downward planning system. My main task was the maintenance and the refactoring of existing code however. Still I was able to gain lots of insights into the state-of-the-art planning system and gain a first basic understanding of using landmarks (Hoffmann, Porteous, and Sebastia 2004) for planning (both generating them and using them as a heuristic).

During a semester project, together with another student, we implemented Pattern Databases (Culberson and Schaeffer 1998) for the Fast Downward planning system. Additionally we re-implemented the incremental PDB computation by Haslum et al. (2007) for comparison reasons. We obtained promising results compared to the best known heuristic based on abstractions, the merge-and-shrink heuristic (Nissim, Hoffmann, and Helmert 2011). Our results have been published at the SoCS 2012 (Sievers, Ortlieb, and Helmert 2012).

When deciding on topics for my Master's thesis, I deliberately did *not* choose a topic directly related to planning, as I knew that I would have plenty of opportunities of pursuing my interest in planning during my Ph.D. studies and I was interested in acquainting knowledge in some slightly different domains as well. Inspired by a work on the German card game Skat by Kupferschmid and Helmert (2006), I implemented the UCT algorithm (Kocsis and Szepesvári 2006) for another German card game called Doppelkopf, obtaining promising results encouraging future work on that topic.

Current research

Since the beginning of my Ph.D. studies I have read a lot of papers related to partial order reduction, an approach that originated in the domain of model checking and that has recently been considered for planning. An example is the so called stubborn sets method, originally introduced by Valmari (1989), which is a state-space-pruning technique. Wehrle and Helmert (2012) show that several of recently proposed planning techniques can be related to these stubborn sets. Currently we try to better understand bounded intention planning (Wolfe and Russell 2011) and to bring it in the context of other already classified methods related to stubborn sets.

A second topic which I currently deal with is a practical application of planning. In the context of an industrial project, we work on developing a software that helps planning in a warehouse logistics domain. More precisely we develop algorithms to support palletizing, i.e. automated stacking of objects onto pallets in the context of large warehouses.

Research interests and future plans

As can be seen from the work I have done so far, I am generally interested in planning. Particularly, I like working in

the context of heuristic search (especially abstraction-based heuristics and PDB heuristics, but also landmark heuristics), but I am also interested in methods based on partial order reduction. An analysis by Helmert and Röger (2008) shows that it is indeed necessary to not only search for nearly perfect heuristics, but also for approaches which help cut down the size of the state space that need to be searched by classical planners when solving planning problems.

Some of my other interests cover solving games and, even more unrelated to planning, the concepts related to game theory and their application in practically relevant problems such as auctions.

In the future I plan to continue the work done in my Master's thesis and to compare the performance of the UCT approach to other existing programs solving doppelkopf. If a chance arises where I could take part in some work related to game theory, I would enjoy to profit from this opportunity.

However I will consider such work only as a "side research" (as to have some diversification), as concerning the topic of my Ph.D. thesis, the focus of my research will very probably remain on classical planning. I hope to deepen my understanding of partial order reduction methods such as bounded intention planning in the near future and to be able to improve or generalize the ideas and insights gained there. Another pruning technique I also intend to consider is symmetry elimination.

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