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Introduction to the Special Issue on Knowledge Engineering Tools and Techniques for Automated Planning and Scheduling Systems

Competitions are frequently fostering and speeding-up development in a given area. Since 1998, the biannual International Planning Competition (IPC) has been organized with the goal to promote planning technology. Indeed, this competition is very successful — it led to rapid development of planning techniques, established a common language for communicating the dynamics of domain models (PDDL) and helped in the validation and scrutiny of planning algorithms. However, the scope of IPC is limited to planning algorithms while omitting the other aspects of solving planning problems, for example design of domain models and gathering application knowledge which is crucial for efficiency of planning systems. Consequently, the contribution of IPC to solving real-life problems is limited. No matter how efficient or powerful Planning and Scheduling (P&S) engines are, they are only as good as the application knowledge that they use. If the P&S domain model is flawed, the resulting P&S application will be flawed. These ideas stood behind the new International Competition on Knowledge Engineering for Planning and Scheduling (ICKEPS). The first ICKEPS was collocated with the ICAPS 2005 conference in Monterey, U.S.A. and seven systems participated in the competition. Their authors have been invited to extend the description of their systems into a journal form and submit to this Special Issue. From these submissions, three papers have been selected to form this special issue on knowledge engineering tools and techniques for automated planning and scheduling. Not coincidentally, two of these selected papers represent the systems that won the first Competition on Knowledge Engineering for Planning and Scheduling, namely GIPO and ARMS.

The first paper of this issue describes system GIPO (Graphical Interface for Planning with Objects) — the winner of 'general tools' track of ICKEPS 2005. The authors explain the object centric view standing behind GIPO and provide an overview of the GIPO environment and its components. GIPO has been used for some time for teaching planning techniques by assisting users in the formulation of planning domains, providing tools for both the static and dynamic validation of planning domains and providing an interface to various planning systems. These features are illustrated in this paper using a simple but non-trivial Dock Worker Robots example.

The second paper presents the winner of 'specific tools' track of ICKEPS 2005 — an automatic knowledge engineering tool for learning action models in AI planning (ARMS). This tool uses a set of known plans to learn the preconditions and effects of the action within the plans. The main difference from similar tools is that ARMS does not require specification of intermediate states between the actions but it gathers knowledge on statistical distribution of sets of actions that is encoded as a weighted SAT problem and then solved using a MAXSAT solver. In this paper, the authors describe the encoding of the problem as a weighted SAT formula and provide some experimental evidence that this method indeed provides satisfactory results.

The last paper describes the system PLTOOL that stands in between the abovementioned categories. It is an integrated environment that helps users to interact with a set of machine-learning techniques and planners. One component of this environment, HAMLET for learning control rules for planners, participated in the competition in the track 'specific tools'. Nevertheless, the paper goes beyond the description of HAMLET. The authors describe PLTOOL — a knowledge-engineering framework for mixed-initiative generation of efficient and good planning knowledge. In addition to system description, this paper provides extensive experimental results comparing efficiency of machine-learning techniques used in PLTOOL.

The first KE competition raised a high interest in the planning community and this special issue represents the cream of the crop of this competition. We, as the organizers of the first ICKEPS and guest editors of this special issue, hope that future KE competitions will encourage the development of tools across the whole KE area, as IPC did in the area of planning algorithms. At the time of writing, the next KE competition is already under preparation to be held during ICAPS 2007.

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Guest Editors