The Fifth International Competition on Knowledge Engineering for Planning and Scheduling: Summary and Trends

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Abstract

We review the 2016 International Competition on Knowledge Engineering for Planning and Scheduling (ICKEPS), the fifth in a series of competitions started in 2005. ICKEPS series focuses on promoting the importance of knowledge engineering methods and tools for automated Planning and Scheduling systems.

Introduction

The International Competition on Knowledge Engineering for Planning and Scheduling has been running since 2005 as a biennial event promoting the development and importance of the use of knowledge engineering methods and techniques within this area. The aim of the competition series is to foster developments in the knowledge-based and domain modelling aspects of Automated Planning, to accelerate knowledge engineering research, to encourage the creation and sharing of prototype tools and software platforms that promise more rapid, accessible, and effective ways to construct reliable and efficient Automated Planning systems.

ICKEPS 2016 aimed specifically (i) to provide an interesting opportunity for researchers and students to experience the challenges of knowledge engineering (ii) to motivate the planning community to create and improve tools and techniques for supporting the main design phases of a planning domain model; (iii) to provide new interesting and challenging models that can be used for testing the performance of state-of-the-art planning engines. In order to achieve the mentioned aims, ICKEPS 2016 focused on on-site modelling of challenging scenarios, performed by small teams.

This article summarises the ICKEPS held in 2016. More information about the competition, including complete scenario descriptions, can be found on the ICKEPS 2016 website.[1]

Format and Participants

ICKEPS 2016 format included two main stages:

1. On-site modelling;
2. Demonstration.

During the on-site modelling stage, each team received a set of scenarios description and had to exploit the available time for generating the corresponding models. Four scenarios were provided: two of them –"Star trek, rescue of Levaq", and "Roundabout"– requiring temporal constraints, while the other two –"RPG" and "Match-three, Harry!"– requiring classical reasoning, only. Participants were free to select the scenarios to tackle, and had no restrictions on the number and type of tools that can be used. The only constraints were on the available time –six hours were given– and on the maximum size of teams: at most four members.

[1] http://ickeps2016.wordpress.com/

The day after the on-site modelling, each team had to present, in a 10-minute demonstration, the aspects of the knowledge engineering process they exploited for encoding the scenarios. Specifically, teams were expected to discuss: the division of work among team members, the tools used, key decisions taken during the encoding, and the issues they faced.

Teams were then ranked by a board of judges, which included the following members: Minh Do (NASA, USA), Simone Fratini (ESA, Germany), Ron Petrick (Heriot-Watt University, UK), Patricia Riddle (University of Auckland, New Zealand), and David Smith (NASA, USA). The evaluation process is described in the corresponding section below. Noteworthy, judges were presented during the demonstrations session, and had the opportunity to ask questions and discuss relevant aspects of the knowledge engineering process the teams followed.

ICKEPS 2016 had two tracks: the *PDDL track*, where teams had to generate PDDL models using up to PDDL features introduced in version 3.1, and the *Open track*, where teams can encode models in any other language. However, for the open track, participants were required to provide also a planner able to deal with the selected language. 16 people, divided into six teams, took part in the competition. One team entered the open track, while the remaining five decided to participate in the PDDL track.

Participants were from institutions from Australia, Brazil, Canada, USA, Japan, and United Kingdom. The level of expertise of participants covered various academic ranks, i.e., PhD students, lecturers, research fellows and professors. One team was composed by experts from industry, only.

Evaluation

The board of judges evaluated each team by considering two main aspects: the exploited knowledge engineering process and the quality of the generated models.

The knowledge engineering process was assessed once for each team, regardless of the number of scenarios the team was able to encode. Three main criteria were taken into account: *team-working*, *method* and *tools*. *Team-working* focused on the degree of cooperation and effective collaboration among team members. In terms of the *method*, effectiveness and systematicity of the knowledge engineering process were assessed. Finally, the innovation and originality of exploited *tools*, and their actual usefulness (i.e., the support their use provided to the process) were evaluated.

In order to assess the quality of the generated models, the organisers provided the judges with the models the teams had submitted along with quantitative and qualitative information about these models. Qualitative information included evaluations about: *correctness*, i.e., if all the requirements were correctly handled; *readability*, i.e., how easy it was to read and understand the model; *generality*, i.e., if the domain model can be re-used on different problem instances; and *originality*, where the use of innovative ways for modelling element or interactions was evaluated. Quantitative information included the following statistics: number of types, number of predicates, number of operators, total number of lines, and the average (maximum) number of parameters, effects and preconditions per operator. Moreover, in the PDDL track, the runtime and quality of solutions generated by 10 well-known planners (5 classical and 5 temporal) were provided to judges. For teams participating in the open track, the corresponding performance of the planner(s) submitted by the participants were provided to judges.

According to the aims of the competition, emphasis was given to good practice in knowledge engineering, with particular regards to the degree of cooperation between the members of each team. For this reason the judges used a 0–100 scale, where up to 45 points could be awarded for the knowledge engineering process, and the remaining 55 points could be assigned according to the number and quality of generated models, as follows: Star Trek, the rescue of Levaq (up to 20 points); Roundabout (up to 15 points); Match-three, Harry! (up to 10 points); and RPG (up to 10 points).

Results

The board of judges, beside acknowledging the efforts of all the competitors, decided to give the following honourable mentions:

- **Innovative Methodology Award**: Emre Savas and Michael Cashmore. This team generated a complete domain transition graph for the RPG scenario by hand, analysed the graph to remove "bad" states and transitions, and then created a compact and elegant model for the domain.
- **Dilithium Crystal Award**: Sara Bernardini, Maria Fox, and Chiara Piacentini. This team was the only one to produce a working model that correctly captures most of the requirements of the Star Trek scenario, which was the most difficult domain in the competition.

The board of judges awarded as **Overall Winner** the team composed by Nir Lipovetzky and Christian Muise. This team demonstrated a great ability to quickly develop high quality models in multiple scenarios, while utilizing, and at the same time enhancing, model development tools for PDDL.

Given the positive feedback from competitors and judges, we believe that ICKEPS 2016 was a success. It is therefore envisaged that future ICKEPS will exploit a similar format.

Take-on Message

We have observed that the generated models showed significant differences, even on easier scenarios, where, for instance, the number of operators ranged from two to seven, with remarkable impact on readability and generality. The impact on different planning approaches has to be assessed, in order to advance the state-of-the-art of knowledge engineering.

Worryingly, ICKEPS also highlighted two main issues. Firstly, most teams did not use any tools (except text editors), and thus relied only on their expertise. Secondly, existing tools do not effectively support cooperation: to cope with the growing complexity of planning applications, planning experts have to cooperate and coordinate the knowledge engineering process. Finally, the number of participants of ICKEPS is still not very large, especially when compared with the latest edition of the International Planning Competition (Vallati et al. 2015): this suggests that the planning community underestimates the importance of knowledge engineering, despite of its enormous impact on applicability of domain-independent planning in real-world scenarios.

References

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Short Bio

Lukáš Chrpa is a research fellow at University of Huddersfield. His main research interests are in the area of AI planning, Machine Learning and Knowledge Engineering. He was a co-organiser of the 2014 edition of the International Planning Competition (IPC).

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