

Lecture Notes in Artificial Intelligence 4428

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Stefan Edelkamp Alessio Lomuscio (Eds.)

# Model Checking and Artificial Intelligence

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Revised Selected and Invited Papers

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# Preface

Exploration of very large search spaces lies at the heart of many disciplines in computer science and engineering, especially systems verification and artificial intelligence. In particular, the technique of *model checking* is used to automatically verify the properties of a system. In the model checking approach, verifying that a system  $S$  satisfies a property  $P$  is investigated by automatically checking the satisfiability of the expression  $M_S \models \phi_P$ , where  $M_S$  is a suitable model representing all evolutions of  $S$ , and  $\phi_P$  is a logical formula capturing the property  $P$  to be checked.

Model checking and artificial intelligence have enjoyed a healthy interchange of ideas over the past few years. On the one hand, model checking techniques have benefited from efficient search algorithms developed in artificial intelligence thereby increasing their efficiency, on the other, model checking techniques have been extended to deal with typical artificial intelligence formalisms, such as epistemic logics, thereby permitting the verification of systems based on artificial intelligence concepts. In addition to this, there remains a keen interest among researchers to use model checking to solve planning problems.

The forth MOCHART workshop aimed at bringing together researchers interested in the interplay of these areas. The workshop was held as a satellite workshop of ECAI 2006, the 17th biennial European conference on Artificial Intelligence. Previous workshops were held in San Francisco in 2005 (as a satellite workshop of CONCUR 2005), Acapulco in 2003 (as a satellite workshop of IJCAI 2003), and Lyon in 2002 (as a satellite workshop of ECAI 2002).

This volume includes extended versions of eight of the nine papers selected for presentation at the workshop after a selective round of reviews, as well as three further papers selected from submissions to the post-proceedings. An article based on an invited presentation to the workshop is also included. The papers are included in the order in which they were presented at the workshop.

The volume begins with the invited contribution by Bertoli et al. on a broad overview of the use of model checking techniques for safety analysis, diagnosability and synthesis in reactive systems. This is followed by an article by Alechina et al. investigating the reasoning capabilities of resource bounded agents. A contribution by Edelkamp on a variety of genetic algorithms operating on pattern databases represented via OBDDs follows.

Hoffman et al. then discuss efficient optimization methods for model checking real-time systems by introducing predicate abstraction to generate efficient heuristic search functions. Analysis for real-time systems also features in the following paper by Edelkamp and Jabber investigating the performance of secondary storage solutions for three search algorithms. Concluding in this line, Lomuscio et al. present and evaluate algorithms for model checking networks of timed-automata with clock differences against epistemic real-time specifications.

Genetic algorithms feature again in the following article where Araragi and Cho suggest a reinforcement learning technique to check liveness in reactive systems. This is followed by a paper by Pecheur and Raimondi on model checking variants of CTL supporting explicit actions via OBDDs. In the next paper, Viganò proposes a methodology based on SPIN to verify the multi-agent frameworks of e-institutions described by an ad-hoc modelling language.

In a change of topic Kurkowski et al. present a SAT-based methodology for the verification of security protocols by modelling principals via networks of communicating automata. Wijs and Lisser conclude the volume by analyzing variations of distributed beam search algorithms to find solutions to scheduling problems via model checking.

All the papers represent solid contributions to the state of the art in the interplay between artificial intelligence and model checking and provide an interesting overview of the current trends of research worldwide.

We very much enjoyed the workshop and wish to thank the authors for their excellent contributions and the program committee for their outstanding service in selecting the papers.

We conclude by thanking Springer for enthusiastically supporting the idea of publishing the post-proceedings of the event. The British Royal Association of Engineering and the Deutsche Forschungsgemeinschaft are also acknowledged for their generous support.

February 2007

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