Contents and Abstracts of the Electronic Notes in Theoretical Computer Science Vol. 5

Selected Papers First International Workshop on Verification of Infinite State Systems, Università di Pisa, Pisa, Italy, 30–31 August, 1996

Bernhard Steffen and Didier Caucal (Guest Editors)

Preface

This volume contains a selection of papers from the First International Workshop on Verification of Infinite State Systems (Infinity’96), which took place at the University of Pisa (Italy), 30–31 August, 1996, as a satellite of CONCUR’96, the seventh International Conference on Concurrency Theory.

The aim of the workshop was to provide a forum for researchers interested in the development of mathematical techniques for the analysis of infinite state systems, a topic which has received a concerted effort within the Concurrency Theory community over the past few years. The basis of this effort has been the realization that an understanding of infinite state systems is necessary in order to have a complete picture of general process algebras, Petri nets, or other formalisms incorporating value-passing, real-time, hybrid, and/or probabilistic aspects. Its importance has grown however by the further realization that techniques which are developed for infinite state systems – particularly structural techniques – can potentially provide elegant solutions to the state-space explosion problem in the analysis of finite state systems, as well as to classical problems in language theory. Possible topics for inclusion are: decidability issues for equivalence and model checking over various classes of infinite state systems; complexity results for decidability results; connections and applications to questions in classical automata and formal language theory; and tools and case studies involving nontrivial applications of methods for the analysis of infinite state systems.

In addition to the regular sessions, Infinity featured three invited talks, given by Yoram Hirshfeld (Tel Aviv University, Israel), Thomas A. Henzinger (University of California at Berkeley, USA), and Javier Esparza (Technische Universität München, Munich, Germany).

In addition to the Editors, the Program Committee included Julian Bradfield (Edinburgh) and Faron Moller (Stockholm). We would also like to thank the referees who assisted in the selection of the regular contributions among the 24 submissions received.

Finally, warm thanks are due to Tiziana Margaria, who has provided invaluable assistance in the preparation of the text of this volume. Without her you would not hold this volume in your hands, nor could you browse it on your screen.

Yoram Hirshfeld

Bisimulation trees and the decidability of weak bisimulations

http://www.elsevier.nl/locate/entcs/volume5.html

We develop “bisimulation trees” as a means to prove decidability of weak bisimulation for restricted classes of BPP and BPA.
I. Černá, M. Křetínsky and A. Kučera

Bisimilarity is decidable in the union of normed BPA and normed BPP processes
http://www.elsevier.nl/locate/entcs/volume5.html

We compare the classes of behaviours (transition systems) which can be generated by normed BPA and normed BPP processes. We exactly classify the intersection of these two classes, i.e., the class of transition systems which can be equivalently (up to bisimilarity) described by the syntax of normed BPA and normed BPP processes. We provide such a characterization for classes of normed BPA and normed BPP processes as well. Next we show that it is decidable in polynomial time whether for a given normed BPA (or BPP) process $\Delta$ there is some normed BPP (or BPA) process $\Delta'$ such that $\Delta$ is bisimilar to $\Delta'$. Moreover, if the answer is positive then the process $\Delta'$ can be effectively constructed. Simplified versions of the algorithms mentioned above for normed BPA and normed BPP are also given. As an immediate (but important) consequence we also obtain decidability of bisimilarity in the union of normed BPA and normed BPP processes.

Pawel Paczkowski

Characterizing bisimilarity of value-passing parametrised processes
http://www.elsevier.nl/locate/entcs/volume5.html

Symbolic transition graphs of Hennessy and Lin extended with assignments are used to represent parametrised value-passing processes. Semantics appealing to the notion of state is introduced for the symbolic transition graphs and their extended version. Showing strong early bisimulation between finite symbolic transition graphs extended with assignments is reduced to solving sets of equations involving first-order state formulas.

Olaf Burkart and Yves-Marie Quemener

Model-checking of infinite graphs defined by graph grammars
http://www.elsevier.nl/locate/entcs/volume5.html

In this paper, we consider the model-checking problem for regular graphs, i.e. infinite transition graphs defined in terms of deterministic graph grammars. It turns out that an elegant adaptation of the model-checker for pushdown processes leads to an algorithm that decides whether the root of a regular graph under consideration satisfies a given formula of the alternation-free modal $\mu$-calculus. The key to the algorithm is to exploit the underlying structure of regular graphs, as well as to consider a variant of standard $\mu$-calculus semantics, called the assertion-based semantics, which allow to presume the validity of formulas at distinguished states.

Régis Crídlig

Semantic analysis of concurrent ML by abstract model-checking
http://www.elsevier.nl/locate/entcs/volume5.html

In this paper we present a new kind of semantics for concurrent ML, a popular concurrent extension of the ML functional language equipped with message-passing inter-process communication along first-class channels. This semantics is based on infinite domains of higher-dimensional
transition systems that are able to model the asynchronous execution of concurrent operations and is operational in nature. By dual abstract interpretation using folding of states and truncation of transitions finite automata can be automatically derived that represent a sound but imprecise semantics of a given program. They are used to compute static properties verified by the standard concurrent execution of the program by means of abstract model-checking of modal logic formulae.

Richard Mayr
Semantic reachability
http://www.elsevier.nl/locate/entcs/volume5.html

This paper is an approach to combine the reachability problem with semantic notions like bisimulation equivalence. It deals with questions of the following form: Is there a reachable state that is bisimulation equivalent to a given state? Here we show some decidability results for process algebras and Petri nets.

Olaf Burkart and Javier Esparza
More infinite results
http://www.elsevier.nl/locate/entcs/volume5.html

Recently, there has been a spurt of activity in concurrency theory centred on the analysis of infinite-state systems. The following two problems have been intensely investigated: (1) given two infinite-state systems, are they equal with respect to a certain equivalence notion? and (2) given an infinite-state system and a property expressed in a certain temporal logic, does the system satisfy the property? In his paper "Infinite Results", Moller (1996) surveys some of the key results on the decidability and complexity of problem (1). This paper is a survey on the results about problem (2).

Olga Kouchnarenko and Ph. Schnoebelen
A model for recursive-parallel programs
http://www.elsevier.nl/locate/entcs/volume5.html

We define a formal model for a class of recursive-parallel systems with specific invocation and synchronization primitives. This original model is infinite state but can still be analyzed successfully using the "well-structured transition systems" approach.

Monica Nesi
Mechanising a modal logic for value-passing agents in HOL
http://www.elsevier.nl/locate/entcs/volumeb.html

An extension of Hennessy–Milner logic to value-passing CCS is embedded in the HOL system. The resulting proof environment allows one to formally verify modal properties of communicating agents, which are defined over an infinite value domain.
Dilian Gurov, Sergei Berezin and B.M. Kapron

A modal μ-calculus and a proof system for value-passing processes
http://www.elsevier.nl/locate/entcs/volume5.html

A first-order modal μ-calculus is introduced as a convenient logic for reasoning about processes with value passing. For this logic we present a proof system for model checking sequential processes defined in the value-passing CCS. Soundness of the proof system is established. The use of the system is demonstrated on two small but instructive examples.