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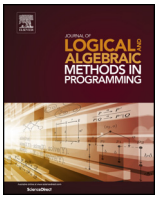

Preface to the special issue on Open Problems in Concurrency Theory

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ABSTRACT

This special issue reports on current research in the area of Concurrency Theory as well as challenges for the future in the area. They are the result of contributions to the research seminar *Open Problems in Concurrency Theory, OPCT 2017* and associated discussions.

The research seminar *Open Problems in Concurrency Theory (OPCT 2017)* took place in the Institute of Science and Technology Austria (IST Austria), from the 26th to the 29th of June, 2017. It was organised in the framework of the IFIP Working Group 1.8 and gathered 66 leading researchers on concurrency theory who contributed with 42 presentations to the seminar.

The 9 articles that are featured in this special issue highlight the research presented and discussed in such a prolific and successful event. They range from process theory and behavioural abstractions to verification and debugging techniques. More precisely, the contributions are as follows:

- In *"Ensuring liveness properties of distributed systems: Open problems"* [1], Rob van Glabbeek puts forward new ideas for the foundations of a process theory for distributed systems that ensures liveness properties without having to turn to fairness assumptions. His proposed agenda does not only include the theoretical framework, but also extends to methodology and tools.
- In *"Nested-unit Petri nets"* [2], Hubert Garavel presents an extension of Petri nets in which places can be grouped in "units" that capture sequential behaviour. By nesting units recursively, the resulting net reflects the concurrent and hierarchical structure of a system. The paper goes beyond capturing the syntactic nature of systems by reporting on the performance impact on verification tools.
- In *"Declarative debugging of concurrent Erlang programs"* [3], Rafael Caballero, Enrique Martin-Martin, Adrián Riesco, and Salvador Tamarit report on the implementation of a declarative debugger for the language Erlang. The tool interacts with the user through enquiries about particular transitions and their expected results and uses the differences with the actual program behaviour to find the function responsible of the error.
- In *"Axiomatising infinitary probabilistic weak bisimilarity of finite-state behaviours"* [4], Nick Fischer and Rob van Glabbeek present the first complete axiomatisation for probabilistic weak bisimulation on finite-state processes with unguarded

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recursion that exhibit both probabilistic and non-deterministic behaviour. In particular, the results focus on infinitary semantics, where weak transitions may abstract from an unbounded number of internal actions.

- In *"Precise subtyping for synchronous multiparty sessions"* [5], Silvia Ghilezan, Svetlana Jakšić, Jovanka Pantović, Alceste Scalas, and Nobuko Yoshida prove the soundness and completeness (i.e., preciseness) of the subtyping relation for a synchronous multiparty session calculus. They address preciseness both from an operational and a denotational viewpoint. In particular, the proof of the operational case presents a novel approach, and the proof for denotational preciseness results as a corollary.
- In *"A stable non-interleaving early operational semantics for the pi-calculus"* [6], Thomas Troels Hildebrandt, Christian Johansen, and Håkon Normann gave the first non-interleaving semantics for the pi-calculus that unfolds to the stable model of prime event structures. They also provide some correctness results showing that the new semantics is a conservative extension of the non-interleaving semantics for CCS and that it respects the standard interleaving early operational semantics of the pi-calculus. In addition, their semantics can be interpreted in terms of labelled asynchronous transition systems.
- In *"Higher-order linearisability"* [7], Andrzej S. Murawski and Nikos Tzevelekos extend linearisability — an important notion to assess correct and safe behaviour of software libraries — to the general setting of open higher-order libraries. Before their contribution, linearisation was limited only to ground types while the new framework extends to methods of arbitrary types that can be passed as arguments and returned as values.
- In *"Verification and control for probabilistic hybrid automata with finite bisimulations"* [8], Jeremy Sproston shows that for a given probabilistic hybrid automaton, the existence of (non-probabilistic) bisimulation on the probability-abstracted version lifts to the original probabilistic version. Such lifting preserves maximal probabilities of ω-regular properties, thus making verification and control problems in the subclass of probabilistic rectangular hybrid automata decidable.
- In *"On series-parallel pomset languages: Rationality, context-freeness and automata"* [9], Tobias Kappé, Paul Brunet, Bas Luttik, Alexandra Silva, and Fabio Zanasi take an important step forward to provide a Kleene-like theorem for Concurrent Kleene Algebra (CKA) with the aim to find a correspondence between the denotational and the operational view. In particular, they manage to prove the correspondence between bi-Kleene Algebra — a fragment of CKA — and the so called pomset automata.

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