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Application and Theory of Petri Nets and Concurrency: Special Issue of Selected Papers from Petri Nets 2018

Preface

This special issue is based on extended versions of the best papers presented at the 39th International Conference on Application and Theory of Petri Nets and Concurrency (Petri Nets 2018). Petri Nets 2018 was co-located with the Application of Concurrency to System Design Conference (ACSD 2018). Both were organized by the Interes Institute and Faculty of Electrical Engineering and Information Technology, Slovak University of Technology. The conference took place at the Austria Trend Hotel Bratislava, from June 24 to June 29, 2018.

In total, 33 papers were submitted to Petri Nets 2018 by authors from 19 different countries. Each paper was reviewed by three reviewers. The Program Committee (PC) selected 23 papers for presentation: 15 theory papers and 8 tool papers. The authors of the best six papers were invited to submit an extended version of their conference paper for this special issue. The selected papers contained highly innovative and very strong contributions, as was demonstrated by the unanimous support of the reviewers. Also the PC unanimously supported these invitations.

After a rigorous review process comprising two rounds of reviewing, the invited papers were accepted. Besides a subset of the original reviewers, we also invited additional reviewers to ensure the best feedback possible. We believe that the papers in this special issue are of high quality and represent the state-of-the-art in their respective fields.

The article "Analysis and Synthesis of Weighted Marked Graph Petri Nets" by Raymond Devillers and Thomas Hujsa focuses on an important subclass of persistent Petri nets, the weighted marked graphs (WMGs), also called generalised (or weighted) event (or marked) graphs or weighted T-nets. The authors provide new behavioural properties of WMGs expressed on their reachability graph, notably backward persistence and strong similarities between any two sequences sharing the same starting state and the same destination state. They also propose necessary structural conditions that must be fulfilled by a labelled transition system to be WMG-solvable. Finally, the authors propose a general synthesis method to create a WMG whose reachability graph minimally includes the specification.

The article "Operational Semantics, Interval Orders and Sequences of Antichains" by Ryszard Janicki and Maciej Koutny introduces a new general class of nets that can represent both inhibitor and activator nets — called safe nets with context arcs. The authors analyse in detail fundamental relationships between interval sequences and sequences of maximal antichains, and provide simple algorithms that transform one into another.

The article "Synthesis for Various Petri Net Classes with Union/Find" by Karsten Wolf proposes a new algorithmic approach for the synthesis of a Petri net from a transition system. It is first presented for a class of place/transition Petri nets with an incidence matrix where entries have values 0, 1, and -1 only. The algorithm employs Tarjans union/find algorithm for managing sets of vertices. It requires just $O(|V||T|)$ space where V is the set of vertices and T is the set of transition labels. Finally, the author presents ideas for adapting the method to various classes of Petri nets.

The article "Formal Properties of Petri's Cycloid Systems" by Rüdiger Valk investigates a class of Petri nets called *cycloids*. Cycloids were discovered by C.A. Petri, who used them to describe fundamental processes running in time and space. This contribution provides for the first time a formal definition together with new results concerning their structure. Cycloids are proved to be live and safe. It is shown that the minimal length of a cycle is the length of a local basic circuit, possibly decreased by an integer multiple of the number of semi-active transitions. These results make it possible to find the defining parameters of a cycloid from the static properties of the net system.

The article "Co-Finiteness and Co-Emptiness of Reachability Sets in Vector Addition Systems with States" by Petr Jančar, Jérôme Leroux and Grégoire Sutre focuses on the co-finiteness problem that asks if (for a given initial configuration) the complement of the reachability set is finite. It is the dual problem of the boundedness problem. By restricting the question, they get the co-emptiness (or universality) problem that asks if all configurations are reachable. The authors show that both the co-finiteness problem and the co-emptiness problem are exponential-space complete.

The article "Analysis and Synthesis of Weighted Marked Graph Petri Nets" by Wil M.P. van der Aalst is based on the paper that received the best paper award at Petri Nets 2018 and investigates lucency and translucency. Lucency can be defined both in terms of automata and Petri nets. A marked Petri net is *lucent* if there are no two different reachable markings enabling the same set of transitions, i.e., states are fully characterized by the transitions they enable. An event log is *translucent* if each event carries information about the set of activities that were enabled when the event occurred. This paper aims to characterize process models that are lucent, provides a discovery approach to learn process models from translucent event logs, and relates lucency and translucency.

As the above summaries illustrate, the papers provide strong theoretical contributions that help to advance the field of concurrency. Therefore, we thank the authors for extending their papers and the reviewers for their detailed reviews. We would also like to express our deepest thanks to the Organizing Committee chaired by Gabriel Juhás for the time and effort invested in organizing Petri Nets 2018. Finally, we would like to thank the publishing team at FUNDAMENTA INFORMATICAE for their support in preparing this special issue.

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