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Special Issue on Machines, Computations and Universality (MCU 2015)

Preface / Editorial

The conference series *Machines, Computations and Universality* (MCU) explores computation in the setting of various discrete models, such as Turing machines, register machines, cellular automata, tile assembly systems, rewriting systems, molecular computing models and neural models, and in the setting of analog and hybrid models, including BSS machines, signal machines and quantum computing, to name a few. There is a particular, but not exclusive, emphasis given towards:

- the search for frontiers between decidability and undecidability in the various models,
- the search for the simplest universal models,
- the computational complexity of predicting the evolution of computations in the various models,
- the connection between parallelism and decidability, complexity and universality,
- universality and undecidability in continuous models of computation,
- new computing paradigms and hypercomputations.

Initiated by Maurice Margenstern, the MCU international conferences series traces its roots back to mid of 1990's, and has since been concerned with gaining a deeper understanding of computation through the study of models of general purpose computation. MCU conferences took place in Famagusta, North Cyprus (2015), Zürich, Switzerland (2013), Orléans, France (2007), Saint-Petersburg, Russia (2004), Chişinău, Moldova (2001), Metz, France (1998) and Paris, France (1995).

This special issue contains the extended versions of papers presented at the *7th international conference on Machines, Computations and Universality* (MCU 2015) held on September 9-11, 2015 in Famagusta. It was organized by the Eastern Mediterranean University. There were 12 submissions to the special issue from which 9 of them were finally accepted after a rigorous review process.

Several topics of MCU are covered by the papers in this issue:

Mazurkiewicz's trace theory is a well-established mathematical theory for concurrent computation and Petri nets. In their paper titled "Invariant structures and dependence relations", Ryszard Janicki, Jetty Kleijn, Maciej Koutny and Lukasz Mikulski investigate so-called step traces, a generalization of

traces to the case where actions could be observed as occurring simultaneously. Step traces can be represented by labeled relational structures called invariant structures, and the present paper provides effective ways of deciding whether a given invariant structure represents a step trace or not.

The next three papers are in automata theory. In "Reversible limited automata" the authors Martin Kutrib and Matthias Wendlandt consider automata that only can rewrite each tape cell on the first k visits in the cell, for some constant k. They investigate reversible computations by such k-limited automata.

In "Tinput-driven pushdown automata" an interesting extension of the input-driven (or visibly) pushdown automata is presented by Martin Kutrib, Andreas Malcher and Matthias Wendlandt, where the input goes through on a finite state transducer before the input-driven pushdown automaton starts to process it. Such tinput-driven PDA are shown to possess good closure and decidability properties.

"Tight bounds for cut-operations on deterministic finite automata" by Frank Drewes, Markus Holzer, Sebastian Jakobi and Brink van der Merwe studies the cut and the iterated cut operations on regular languages. These operations were recently introduced as an alternative to ordinary concatenation and Kleene star to model leftmost maximal string matching. The paper establishes the exact state complexity of these operations for deterministic finite automata, answering an open problem from 2011.

In the next paper, "Watson-Crick L systems and red-green Turing machines", a connection between an extension of Turing machines and a parallel bio-motivated computing paradigm is established: Erzsébet Csuhaj-Varjú, Rudolf Freund and György Vaszil prove that Watson-Crick L systems and red-green Turing machines have similar hypercomputing powers.

The next paper, "The simulation powers and limitations of higher temperature hierarchical self-assembly systems" by Jacob Hendricks, Matthew Patitz and Trent Rogers, is about another branch of DNA computing research, namely about the tiling model for self assembly. More precisely, the authors consider the so-called 2-Handed Assembly Model (2HAM) where pairs of arbitrarily large assemblies are allowed to attach to each other. The paper clarifies the concept of simulation in these systems, and it characterizes the set of pairs of temperatures such that the high temperature systems are intrinsically universal for the lower temperature systems.

Insertion-deletion systems form another computing paradigm belonging to the area of DNA computing. Sergiu Ivanov and Sergey Verlan present in "Universality and computational completeness of controlled leftist insertion-deletion systems" some universality and computational completeness results of special insertion-deletion systems.

Another new computing paradigm, the interval-valued computing is the topic of the next paper, by Benedek Nagy and Sándor Vályi. In the paper "A shift-free characterization of NP within interval-valued computing" the complexity class NP is characterized by polynomial size of computations using only product (a kind of zooming) and logical operators.

The final paper of this special issue, titled "Non-isometric contextual array grammars and the role of regular control and local selectors", is by Henning Fernau, Rudolf Freund, Rani Siromoney, and K.G. Subramanian. It considers picture languages and multidimensional grammars called non-isometric contextual array grammars. The authors extend the model using local selectors, a method for controlling how the adjoined rectangles fit to the array already generated, and show results on the role of regular control and such local selectors.

The editors warmly thank the authors of the papers and the reviewers for their work to make this special issue, with special thanks to Damian Niwiński, the editor in chief of Fundamenta Informaticae.

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