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Preface

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This special issue of *Natural Computing* is dedicated to cellular automata and related systems. It is based on AUTOMATA 2015, the 21st International Workshop on Cellular Automata and Discrete Complex Systems. The event was organized by the Department of Mathematics and Statistics of the University of Turku, and it was held in Turku, Finland, in June 8–10, 2015. AUTOMATA 2015 continued an annual series of workshops established in 1995 as a forum for the collaboration of researchers in the field of cellular automata and related discrete complex systems.

Cellular automata are among the first nature inspired models of computation, introduced by John von Neumann and Stanislaw Ulam to study self-replication and universality. Cellular automata are physically realistic massively parallel computation models that also have versatile applications as discrete models in physics and other natural sciences. Cellular automata obey realistic constraints of locality, uniformity and parallelism which makes them an ideal model in these contexts. Other relevant properties such as time-reversibility and conservation laws can be conveniently imposed at will. In mathematics, cellular automata are studied as discrete dynamical systems in topological and symbolic dynamics.

There was an open call for papers for this special issue, which led to eight submissions. Each paper was carefully reviewed by top experts of the field. Based on the reviews, the following five papers were selected in the issue.

The first paper, *Computing the Periods of Preimages in Surjective Cellular Automata* by Luca Mariot, Alberto Leporati, Alberto Dennunzio and Enrico Formenti, investigates the pre-images of spatially periodic configurations under one-dimensional surjective cellular automata. Since the pre-images are necessarily also spatially periodic, a natural question is to study the distribution of their minimal periods. A general algorithm is provided based on the De Bruijn -graph representation of the cellular automaton. If the cellular automaton is additive and bi-permutive, an algebraic characterization is obtained based on linear recurrence sequences.

The second paper, by Martin Kutrib, Andreas Malcher and Matthias Wendlandt, is titled *Shrinking One-Way Cellular Automata*. It concerns formal language recognition by cellular automata in real time, but the standard cellular automata model is modified to allow cells to disappear during the computation. It turns out that these shrinking cellular automata can recognize in real time languages for which a standard cellular automaton needs linear time. The paper also proves an infinite hierarchy of languages based on the last time instance when a cell may disappear.

The third paper, *A Cellular Automaton for Blocking Queen Games*, is by Matthew Cook, Urban Larsson and Turlough Neary. It studies a two-dimensional cellular automaton whose space-time diagram describes the winning positions in the two-player combinatorial game known as *Blocking Wythoff Nim*. Various self-organized regions are observed in the diagram, and the authors formulate a number of interesting conjectures concerning them.

The fourth paper is by Ville Salo and Ilkka Törmä, and it is titled *Independent Finite Automata on Cayley Graphs*. In their model, multiple finiteautomata move on a colored grid, called a configuration, and communicate with each other only over bounded distances. The configuration is

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accepted if it does not contain any forbidden pattern recognized by the automata. The grid can be over any group. It turns out that if the group contains an element of infinite order then already four finite automata can define the same sets of configurations as any number of finite automata, or in fact, as arbitrary Turing machines. But if the grid is an infinite torsion group then the hierarchy based on the number of finite automata is infinite.

The fifth paper, *Activity in Boolean Networks*, is by Abhijin Adiga, Hilton Galyean, Chris J. Kuhlman, Michael Levet, Henning S. Mortveit and Sichao Wu. This article concerns discrete dynamical systems over a finite number of boolean variables on vertices of a graph. The variables are updated in parallel based on the values in the neighboring vertices. The paper studies the probability that swapping the value of a single variable in a random configuration affects the configuration one time step later. This notion of activity is introduced to measure the short-term sensitivity of the system. The exact value of activity is computed for a number of systems.

I thank the authors of all submitted papers for their contributions, and the reviewers for their insightful remarks. Finally, I thank the editor-in-chief Joost Kok for the opportunity to publish this special issue in Natural Computing.

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