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Dipanwita Roy Chowdhury
Editors

Cellular Automata and Discrete Complex Systems

29th IFIP WG 1.5 International Workshop, AUTOMATA 2023
Trieste, Italy, August 30 – September 1, 2023
Proceedings

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Preface

This volume contains the papers accepted and presented at the 29th International Workshop on Cellular Automata and Discrete Complex Systems, AUTOMATA 2023, which was held in Trieste, Italy, on August 30 – September 1, 2023. The workshop was organized by the Department of Mathematics and Geosciences of the University of Trieste, and it hosted the annual meeting of the IFIP working group 1.5.

The AUTOMATA workshops began in 1995 as an established annual series of events whose main objective is to bring together researchers in the fields of cellular automata and discrete complex systems, in order to foster collaboration and sharing of recent findings on such themes. Throughout the years, the range of topics covered has steadily expanded. In this edition, the scope of discussion further broadened to include fresh areas of interest, particularly focusing on correlated models of automata and their applications to machine learning.

The current focus of AUTOMATA encompasses a wide range of aspects and features pertaining to these systems. While not exhaustive, the current topics include dynamics, topology, ergodicity, algebraic properties, algorithmic considerations, complexity analysis, emergence of properties, formal languages, symbolic dynamics, tilings, models of parallelism and distributed systems, timing schemes, synchronous and asynchronous models, phenomenological descriptions, scientific modeling, and practical applications.

AUTOMATA 2023 featured two invited talks, given respectively by Dora Giammarresi and Kévin Perrot, to whom we extend our thanks for accepting the invitation and for their very interesting presentations. The invited contributions are included in this volume.

In total, AUTOMATA 2023 received 11 full paper submissions. Each paper was reviewed in single-blind mode by at least three program committee members or external reviewers. Following the review and discussion phases, the committee decided to accept 7 papers to be included in the proceedings and presented at the workshop. One of these papers went through an additional shepherding phase, managed by a member of the program committee. We would like to thank all authors for their submissions, which contributed to a substantial part of the AUTOMATA 2023 scientific program. The workshop also featured short presentations of exploratory papers and extended abstracts, which are not included in these proceedings. We wish to thank all authors of the exploratory track as well.

This volume also includes the proceedings of the previous edition of the workshop, namely the 28th International Workshop on Cellular Automata and Discrete Complex Systems, AUTOMATA 2022. This workshop took place online on October 11–12, 2022, and it was organized by the Indian Institute of Technology Kharagpur, India. AUTOMATA 2022 received 18 submissions for the full track, out of which 3 papers were finally accepted. Each paper was reviewed in double-blind mode by at least two members of the program committee.

We are indebted to the program committees of AUTOMATA 2023 and 2022, and to the external referees for their precious help in reviewing and selecting the submitted papers. We further thank the members of the local organizing committees, namely Giulia Bernardini, Giuliamaria Menara and Gloria Pietropolli for AUTOMATA 2023, and Palash Dey and Ayan Chaudhury for AUTOMATA 2022. We are also grateful for the support by the Department of Mathematics and Geosciences and the University of Trieste. Finally, we thank the LNCS team of Springer for their help in producing this volume in time for the conference.

August 2023

Luca Manzoni
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Dipanwita Roy Chowdhury

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Sandpile Models and P-completeness

(Abstracts of Invited Talk)

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Sandpile models are number conserving cellular automata, where grains move from cell to cell according to local rules. On finite grids it has a beautiful algebraic structure with a mysterious identity element. The “complexity” of such models can be studied through the algorithmic hardness of predicting the dynamics, which is feasible in polynomial time simply by simulating the whole stabilization process of grains move. From a theoretical point of view, whether it is possible or not to do better, i.e. predict sandpiles in logarithmic time on parallel machines (PRAM), is still open. This corresponds to the complexity class NC (Nick’s Class), which is not known to be equal or differ from P (neither to be equal or differ from NP), hence there is a notion of P-completeness. We will discuss the circuit value problem (CVP, the canonical P-complete problem), its variants and connections with sandpiles. All this will be presented while playing with a sandpile simulator.

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