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Michal Hospodár · Galina Jirásková (Eds.)

Implementation and Application of Automata

24th International Conference, CIAA 2019
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Editors

Michal Hospodár
Slovak Academy of Sciences
Košice, Slovakia

Galina Jirásková
Slovak Academy of Sciences
Košice, Slovakia

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Preface

This volume contains the papers presented at the 24th International Conference on Implementation and Application of Automata (CIAA 2019) organized by the Košice branch of the Mathematical Institute of the Slovak Academy of Sciences and the Slovak Artificial Intelligence Society (SAIS) in Košice, Slovakia, during July 22–25, 2019.

The CIAA conference series is a major international venue for the dissemination of new results in the implementation, application, and theory of automata. The previous 23 conferences were held in various locations all around the globe: Charlottetown (2018), Marne-la-Vallée (2017), Seoul (2016), Umeå (2015), Giessen (2014), Halifax (2013), Porto (2012), Blois (2011), Winnipeg (2010), Sydney (2009), San Francisco (2008), Prague (2007), Taipei (2006), Nice (2005), Kingston (2004), Santa Barbara (2003), Tours (2002), Pretoria (2001), London Ontario (2000), Potsdam (WIA 1999), Rouen (WIA 1998), and London Ontario (WIA 1997 and WIA 1996).

The topics of this volume include: complexity of languages and language operations, regular expressions, picture languages, jumping automata, input-driven and two-dimensional automata, tree languages and tree transducers, architecture of oritatami systems, intruder deduction problem, context-sensitive flash codes, rational relations, and algorithms for manipulating sequence binary decision diagrams.

There were 29 submissions from 20 different countries: Belgium, Canada, China, Croatia, Czech Republic, France, Germany, Hungary, India, Israel, Italy, Japan, Poland, Portugal, Russia, Slovakia, South Korea, Spain, Sweden, and the USA.

The submission, single-blind peer-review process, and the collating of the proceedings were supported by the EasyChair conference system. Each submission was reviewed by at least three Program Committee members, except for five that received two reviews.

The committee selected 17 papers for presentation at the conference and publication in this volume. The program also included five invited talks by Marián Dvorský, Christos Kapoutsis, Sebastian Maneth, Alexander Okhotin, and Helmut Seidl.

We would like to thank the Program Committee members and the external reviewers for their help in selecting the papers. We are also very grateful to all invited speakers, contributing authors, session chairs, and all the participants who made CIAA 2019 possible.

We also thank the editorial staff at Springer, in particular, Alfred Hofmann, Anna Kramer, and Christine Reiss, for their guidance and help during the publication process of this volume, and for supporting the event through publication in the LNCS series.

Last but not least, we would like to thank the conference sponsors for their financial support, and the Organizing Committee members, Peter Gurský, Ivana Krajňáková, Peter Mlynárčik, Viktor Olejár, Matúš Palmovský, and Juraj Šebej, for their help with organizing the social program, preparing conference materials, and for taking care

of the IT support as well as the financial issues of the conference. All of this was always carefully checked and slightly criticized by Jozef Jirásek to whom our sincere gratitude goes as well.

We all are looking forward to the next CIAA in Loughborough, UK.

May 2019

Michal Hospodár
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Abstracts of Invited Talks

Large Scale Sorting in Distributed Data Processing Systems

Marián Dvorský

CEAi Slovakia s.r.o., Košice, Slovakia
marian.dvorsky@gmail.com

Specialized distributed systems, such as MapReduce [3] or Spark [4] are being used to process large amounts of data. At the core of these systems is a *shuffle* operation which reorganizes the data represented as (*key*, *value*) pairs according to keys, to implement basic data transforms such as aggregations or joins. The shuffle operation can be viewed as large distributed sorting.

Fundamental research has been focused on figuring out bounds on the amount of data that needs to be shuffled, see for example [1]. This talk will focus instead on the problem of efficient shuffling itself.

For the most challenging applications the amount of data sorted exceeds the total amount of memory available in these systems, so sorting is *external*. Lower bounds on external sorting have been well studied, see for example [2]. However, less is known about optimal algorithms for large scale sorting in distributed, fault-tolerant environments.

We will discuss the problem of large scale sorting, its role in data processing systems, recent advances in implementation of sorting algorithms in real-world cloud systems, and open problems.

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Alternation in Two-Way Finite Automata

Christos A. Kapoutsis

Carnegie Mellon University in Qatar, Doha, Qatar
cak@cmu.edu

Abstract. In this talk we will overview two-way alternating finite automata (2AFAs). We will first list and reconcile the various definitions of what a 2AFA is, as they have appeared in the literature; as well as the various corresponding definitions of what it means for a 2AFA to accept its input. We will then study the computability and size complexity of 2AFAs. A large part of the latter study will involve the polynomial-size alternating hierarchy and its relation to its natural variants in terms of predicates and oracles. We will conclude with a list of open questions.

Deciding Equivalence of Tree Transducers by Means of Precise Abstract Interpretation

Helmut Seidl

Fakultät für Informatik, TU München, Germany
seidl@in.tum.de

Abstract. This presentation reviews the construction of the earliest normal form for top-down tree transducers. It will indicate how this construction allows to decide equivalence of deterministic top-down tree transducers and how it can be used to decide whether a top-down tree transducer is functional. The earliest normal form also opens up the way for decidability of equivalence for functional sequential tree-to-string transducers, as well as for deterministic macro tree transducers, at least when they are basic and separated. Interestingly, both the construction of the earliest normal form as well as its application to equivalence for the given class of macro tree transducers rely on techniques borrowed from precise abstract interpretation.

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