



HAL
open science

Descriptive Complexity of Formal Systems

Michal Hospodár, Galina Jirásková, Stavros Konstantinidis

► **To cite this version:**

Michal Hospodár, Galina Jirásková, Stavros Konstantinidis. Descriptive Complexity of Formal Systems: 21st IFIP WG 1.2 International Conference, DCFS 2019, Košice, Slovakia, July 17–19, 2019, Proceedings. Springer International Publishing, LNCS-11612, 2019, Lecture Notes in Computer Science, 978-3-030-23246-7. 10.1007/978-3-030-23247-4 . hal-02387282

HAL Id: hal-02387282

<https://inria.hal.science/hal-02387282>

Submitted on 29 Nov 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

Commenced Publication in 1973

Founding and Former Series Editors:

Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board Members

David Hutchison

Lancaster University, Lancaster, UK

Takeo Kanade

Carnegie Mellon University, Pittsburgh, PA, USA

Josef Kittler

University of Surrey, Guildford, UK

Jon M. Kleinberg

Cornell University, Ithaca, NY, USA

Friedemann Mattern

ETH Zurich, Zurich, Switzerland

John C. Mitchell

Stanford University, Stanford, CA, USA

Moni Naor

Weizmann Institute of Science, Rehovot, Israel

C. Pandu Rangan

Indian Institute of Technology Madras, Chennai, India

Bernhard Steffen

TU Dortmund University, Dortmund, Germany

Demetri Terzopoulos

University of California, Los Angeles, CA, USA

Doug Tygar

University of California, Berkeley, CA, USA

More information about this series at <http://www.springer.com/series/7407>

Michal Hospodár · Galina Jirásková ·
Stavros Konstantinidis (Eds.)

Desriptional Complexity of Formal Systems

21st IFIP WG 1.02 International Conference, DCFS 2019
Košice, Slovakia, July 17–19, 2019
Proceedings

Editors

Michal Hospodár
Slovak Academy of Sciences
Košice, Slovakia

Galina Jirásková
Slovak Academy of Sciences
Košice, Slovakia

Stavros Konstantinidis
Saint Mary's University
Halifax, NS, Canada

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Computer Science
ISBN 978-3-030-23246-7 ISBN 978-3-030-23247-4 (eBook)
<https://doi.org/10.1007/978-3-030-23247-4>

LNCS Sublibrary: SL1 – Theoretical Computer Science and General Issues

© IFIP International Federation for Information Processing 2019

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

This volume contains the papers presented at the 21st International Conference on Descriptive Complexity of Formal Systems (DCFS 2019) held in Košice, Slovakia, during July 17–19, 2019. It was jointly organized by the Working Group 1.02 on Descriptive Complexity of the International Federation for Information Processing (IFIP), by the Košice branch of the Mathematical Institute of the Slovak Academy of Sciences, and by the Slovak Artificial Intelligence Society.

The DCFS conference series is an international venue for the dissemination of new results related to all aspects of descriptive complexity, which is a field in computer science that deals with the costs of description of objects in various computational models, such as Turing machines, pushdown automata, finite automata, grammars, and others.

DCFS became an IFIP working conference in 2016, continuing the former Workshop on Descriptive Complexity of Formal Systems, which was a result of merging together two workshop series: Descriptive Complexity of Automata, Grammars and Related Structures (DCAGRS) and Formal Descriptions and Software Reliability (FDSR). DCAGRS was previously held in Magdeburg, Germany (1999), London, Ontario, Canada (2000), and Vienna, Austria (2001). FDSR was previously held in Paderborn, Germany (1998), Boca Raton, Florida, USA (1999), and San Jose, California, USA (2000). These workshops were merged in DCFS 2002 in London, Ontario, Canada, which is regarded as the 4th DCFS. Since 2003, DCFS has been successively held in Budapest, Hungary (2003), London, Ontario, Canada (2004), Como, Italy (2005), Las Cruces, New Mexico, USA (2006), Nový Smokovec, High Tatras, Slovakia (2007), Charlottetown, Prince Edward Island, Canada (2008), Magdeburg, Germany (2009), Saskatoon, Canada (2010), Giessen, Germany (2011), Braga, Portugal (2012), London, Ontario, Canada (2013), Turku, Finland (2014), Waterloo, Ontario, Canada (2015), Bucharest, Romania (2016), Milan, Italy (2017), and Halifax, Nova Scotia, Canada (2018).

The topics of this volume include: finite state transducers, quantum automata theory, state complexity, syntactic complexity, subword complexity, quasi-Polish spaces, tree automata, jumping automata, pushdown automata with constant height, input-driven pushdown automata, simple semi-conditional grammars, and monotone WQOs.

There were 25 submissions from 15 different countries: Algeria, Canada, Chile, Czech Republic, France, Germany, Hungary, India, Italy, Japan, Latvia, Russia, Slovakia, South Korea, and the USA. The submission, single-blind refereeing process, and the collating of the proceedings were supported by the EasyChair conference system. Each submission was reviewed by at least three, and on average 3.1, Program Committee members.

The committee selected 18 papers for presentation at the conference, and publication in this volume. The program also included four invited talks by Rudolf Freund, Jarkko Kari, Benedek Nagy, and Giovanni Pighizzini.

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 for their valuable contributions that helped DCFS 2019 to be a scientifically successful event in a collaborative and friendly atmosphere.

We are also grateful to the editorial staff at Springer, in particular Alfred Hofmann and Anna Kramer, for their guidance and help during the process of publishing 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 local Organizing Committee: Peter Mlynářčík and Matúš Palmovský (social program), Ivana Krajňáková and Peter Gurský (financial issues), Viktor Olejár (IT support), Juraj Šebej (conference materials). Everything 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 DCFS in Vienna, Austria.

July 2019

Michal Hospodár
Galina Jirásková
Stavros Konstantinidis

Organization

Steering Committee

Cezar Câmpeanu	University of Prince Edward Island, Charlottetown, Canada
Erzsébet Csuhaj-Varjú	Eötvös Loránd University, Budapest, Hungary
Helmut Jürgensen	Western University, London, Canada
Stavros Konstantinidis	Saint Mary's University, Halifax, Canada
Martin Kutrib (Chair)	Justus Liebig University, Giessen, Germany
Giovanni Pighizzini	University of Milan, Italy
Rogério Reis	University of Porto, Portugal

Program Committee

Suna Bensch	University of Umeå, Sweden
Erzsébet Csuhaj-Varjú	Eötvös Loránd University, Budapest, Hungary
Szilárd Zsolt Fazekas	Akita University, Japan
Viliam Geffert	P.J. Šafárik University, Košice, Slovakia
Yo-Sub Han	Yonsei University, Seoul, South Korea
Kazuo Iwama	Kyoto University, Japan
Galina Jirásková	Slovak Academy of Sciences, Košice, Slovakia
Christos Kapoutsis	Carnegie Mellon University in Qatar, Doha, Qatar
Ondřej Klíma	Masaryk University, Brno, Czech Republic
Stavros Konstantinidis	Saint Mary's University, Halifax, Canada
Martin Kutrib	Justus Liebig University, Giessen, Germany
Hing Leung	New Mexico State University, Las Cruces, USA
Christof Löding	RWTH Aachen University, Germany
Tomáš Masopust	Czech Academy of Sciences, Brno, Czech Republic
Ian McQuillan	University of Saskatchewan, Saskatoon, Canada
Carlo Merghetti	University of Milan, Italy
Nelma Moreira	University of Porto, Portugal
Alexander Okhotin	St. Petersburg State University, Russia
Luca Prigioniero	University of Milan, Italy
Narad Rampersad	University of Winnipeg, Canada
Kai Salomaa	Queen's University, Kingston, Canada
Juraj Šebej	P.J. Šafárik University, Košice, Slovakia
Jeffrey Shallit	University of Waterloo, Canada
Marek Szykuła	University of Wrocław, Poland
Matthias Wendlandt	Justus Liebig University, Giessen, Germany
Lynette van Zijl	Stellenbosch University, South Africa

Additional Reviewers

Bednárová, Zuzana
Beier, Simon
Berglund, Martin
Björklund, Johanna
Brecht de, Matthew
Davies, Sylvie
Gazdag, Zsolt
Guillon, Bruno
Holzer, Markus
Keeler, Chris
Khadiev, Kamil
Křivka, Zbyněk
Loff, Bruno

Malcher, Andreas
Mika, Maksymilian
Pauly, Arno
Pighizzini, Giovanni
Sin'Ya, Ryoma
Szabari, Alexander
Villagra, Marcos
Vyalyi, Mikhail N.
Weihrauch, Klaus
Winter, Sarah
Yamakami, Tomoyuki
Young, Joshua

Invited Speakers

Rudolf Freund
Jarkko Kari
Benedek Nagy
Giovanni Pighizzini

TU Wien, Austria
University of Turku, Finland
Eastern Mediterranean University, Famagusta, Cyprus
University of Milan, Italy

Sponsors

City of Košice
Slovak Society for Computer Science



Contents

A General Framework for Sequential Grammars with Control Mechanisms.	1
<i>Rudolf Freund</i>	
Low-Complexity Tilings of the Plane	35
<i>Jarkko Kari</i>	
Union-Freeness, Deterministic Union-Freeness and Union-Complexity.	46
<i>Benedek Nagy</i>	
Limited Automata: Properties, Complexity and Variants.	57
<i>Giovanni Pighizzini</i>	
Nondeterministic Right One-Way Jumping Finite Automata (Extended Abstract)	74
<i>Simon Beier and Markus Holzer</i>	
State Complexity of Single-Word Pattern Matching in Regular Languages . . .	86
<i>Janusz A. Brzozowski, Sylvie Davies, and Abhishek Madan</i>	
Square, Power, Positive Closure, and Complementation on Star-Free Languages	98
<i>Sylvie Davies and Michal Hospodár</i>	
Descriptive Complexity of Matrix Simple Semi-conditional Grammars	111
<i>Henning Fernau, Lakshmanan Kuppusamy, and Indhumathi Raman</i>	
Regulated Tree Automata.	124
<i>Henning Fernau and Martin Vu</i>	
Generalized de Bruijn Words and the State Complexity of Conjugate Sets . . .	137
<i>Daniel Gabric, Štěpán Holub, and Jeffrey Shallit</i>	
The Syntactic Complexity of Semi-flower Languages	147
<i>Kitti Gelle and Szabolcs Iván</i>	
Limited Nondeterminism of Input-Driven Pushdown Automata: Decidability and Complexity	158
<i>Yo-Sub Han, Sang-Ki Ko, and Kai Salomaa</i>	
Computability on Quasi-Polish Spaces.	171
<i>Mathieu Hoyrup, Cristóbal Rojas, Victor Selivanov, and Donald M. Stull</i>	

NFA-to-DFA Trade-Off for Regular Operations 184
Galina Jirásková and Ivana Krajňáková

State Complexity of Simple Splicing 197
Lila Kari and Timothy Ng

Nondeterminism Growth and State Complexity. 210
Chris Keeler and Kai Salomaa

Descriptive Complexity of Iterated Uniform Finite-State Transducers 223
*Martin Kutrib, Andreas Malcher, Carlo Mereghetti,
and Beatrice Palano*

On Classes of Regular Languages Related to Monotone WQOs 235
Mizuhito Ogawa and Victor Selivanov

State Complexity of GF(2)-Concatenation and GF(2)-Inverse
on Unary Languages 248
Alexander Okhotin and Elizaveta Sazhneva

Pushdown Automata and Constant Height: Decidability and Bounds 260
Giovanni Pighizzini and Luca Prigioniero

On the Decidability of Finding a Positive ILP-Instance in a Regular Set
of ILP-Instances 272
Petra Wolf

How Does Adiabatic Quantum Computation Fit into Quantum
Automata Theory?. 285
Tomoyuki Yamakami

Author Index 299