Lecture Notes in Computer Science

3317

Commenced Publication in 1973
Founding and Former Series Editors:
Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board

David Hutchison

Lancaster University, 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, Switzerland

John C. Mitchell

Stanford University, CA, USA

Moni Naor

Weizmann Institute of Science, Rehovot, Israel

Oscar Nierstrasz

University of Bern, Switzerland

C. Pandu Rangan

Indian Institute of Technology, Madras, India

Bernhard Steffen

University of Dortmund, Germany

Madhu Sudan

Massachusetts Institute of Technology, MA, USA

Demetri Terzopoulos

New York University, NY, USA

Doug Tygar

University of California, Berkeley, CA, USA

Moshe Y. Vardi

Rice University, Houston, TX, USA

Gerhard Weikum

Max-Planck Institute of Computer Science, Saarbruecken, Germany

Michael Domaratzki Alexander Okhotin Kai Salomaa Sheng Yu (Eds.)

Implementation and Application of Automata

9th International Conference, CIAA 2004 Kingston, Canada, July 22-24, 2004 Revised Selected Papers



Volume Editors

Michael Domaratzki Acadia University, Jodrey School of Computer Science Wolfville, Nova Scotia B4P 2R6, Canada E-mail: mike.domaratzki@acadiau.ca

Alexander Okhotin Kai Salomaa Queen's University, School of Computing Kingston, Ontario K7L 3N6, Canada E-mail: {okhotin, ksalomaa}@cs.queensu.ca

Sheng Yu University of Western Ontario, Department of Computer Science London, Ontario N6A 5B7, Canada E-mail: syu@csd.uwo.ca

Library of Congress Control Number: 2004117401

CR Subject Classification (1998): F.1.1, F.1.2, F.4.2, F.4.3, F.2

ISSN 0302-9743 ISBN 3-540-24318-6 Springer Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

Springer is a part of Springer Science+Business Media springeronline.com

© Springer-Verlag Berlin Heidelberg 2005 Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India Printed on acid-free paper SPIN: 11376019 06/3142 5 4 3 2 1 0

Preface

This volume of Lecture Notes in Computer Science contains the revised versions of the papers presented at the 9th International Conference on Implementation and Application of Automata, CIAA 2004. Also included are the extended abstracts of the posters accepted to the conference.

The conference was held at Queen's University in Kingston, Ontario, Canada on July 22–24, 2004. As for its predecessors, the theme of CIAA 2004 was the implementation of automata and grammars of all types and their application in other fields. The topics of the papers presented at the conference range from applications of automata in natural language and speech processing to protein sequencing and gene compression, and from state complexity and new algorithms for automata operations to applications of quantum finite automata.

The 25 regular papers and 14 poster papers were selected from 62 submissions to the conference. Each submitted paper was evaluated by at least three Program Committee members, with the help of external referees. Based on the referee reports, the paper "Substitutions, Trajectories and Noisy Channels" by L. Kari, S. Konstantinidis and P. Sosík was chosen as the winner of the CIAA 2004 Best Paper Award. The award is sponsored by the University of California at Santa Barbara.

The authors of the papers presented here come from the following countries and regions: Austria, Canada, Czech Republic, Finland, France, Germany, Hong Kong, Netherlands, Portugal, Russia, Slovakia, South Africa, Spain, UK, and USA.

It is a pleasure for the editors to thank the members of the Program Committee and the external referees for reviewing the papers and maintaining the high standard of the CIAA conferences. We are grateful to all the contributors to the conference, in particular to the invited speakers, for making CIAA 2004 a scientific success.

We are grateful to the conference sponsors for their generous financial support. For help with the local arrangements, we thank Nancy Barker, Michelle Crane, Lynda Moulton, Sandra Pryal and Amber Simpson. Thanks are due to the School of Computing systems group for arranging Internet access for the conference participants.

Finally, we are indebted to Ms. Christine Günther and Mrs. Anna Kramer from Springer for the efficient collaboration in producing this volume.

September 2004

M. Domaratzki A. Okhotin K. Salomaa S. Yu

Organization

Invited Speakers

Oscar H. Ibarra University of California, Santa Barbara, USA

Jeffrey O. Shallit University of Waterloo, Canada

Program Committee

B. Boigelot Université de Liege, BelgiumJ. Brzozowski University of Waterloo, Canada

C. Câmpeanu University of Prince Edward Island, Canada

J.-M. Champarnaud Université de Rouen, France

J. Gruska Masaryk University, Czech Republic

T. Harju University of Turku, Finland

M. Holzer Technische Universität München, Germany

J. Hromkovič ETH Zürich, Switzerland

O. Ibarra University of California, Santa Barbara, USA

M. Ito Kyoto Sangyo University, Japan

T. Jiang University of California, Riverside, USA

J. Karhumäki
 L. Karttunen
 Vniversity of Turku, Finland
 Palo Alto Research Center, USA
 N. Klarlund
 Bell Labs, New Jersey, USA

W. Kuich Technische Universität Wien, Austria
C. Martín-Vide Rovira i Virgili University, Spain
D. Maurel Université de Tours, France

M. Mohri Courant Institute of Mathematical Sciences, USA

F. Neven Limburgs Universitair Centrum, Belgium

Gh. Păun Romanian Academy, Romania

J.-E. Pin
B. Ravikumar
G. Rozenberg
CNRS and Université Paris 7, France
Sonoma State University, USA
Leiden University, The Netherlands,

and University of Colorado, Boulder, USA

K. SalomaaQueen's University, Canada, co-chairK. SutnerCarnegie Mellon University, USA

W. Thomas RWTH Aachen, Germany

B. Watson Technische Universiteit Eindhoven, The Netherlands,

and University of Pretoria, South Africa

D. Wood Hong Kong University of Science and Technology,

Hong Kong, China

H.-C. Yen National Taiwan University, Taiwan

S. Yu University of Western Ontario, Canada, co-chair

Organizing Committee

M. DomaratzkiA. OkhotinAcadia University, CanadaQueen's University, Canada

K. Salomaa Queen's University, Canada, chair

Sponsors

- School of Computing, Queen's University
- Office of Research Services, Queen's University
- Communications and Information Technology Ontario (CITO)
- European Association for Theoretical Computer Science (EATCS)

Additional Referees

Abdullah Arslan
Geert Jan Bex
Béatrice Bouchou
Cristian S. Calude
Ivana Černá
Christian Choffrut
Fabien Coulon
Zhe Dang
Stéphane Demri
Michael Domaratzki
Horváth Géza
Peter Habermehl
Maia Hoeberechts

Jarkko Kari
Satoshi Kobayashi
Mojmír Kretínský
Antonín Kučera
Michal Kunc
Joachim Kupke
Sylvain Lombardy
Wim Martens
Alexandru Mateescu
Giancarlo Mauri
Ian McQuillan
Koji Nakano
Gonzalo Navarro

Dirk Nowotka
Alexander Okhotin
Friedrich Otto
Michael Palis
Andrei Păun
Mathieu Raffinot
Philipp Rohde
Nicolae Santean
Sebastian Seibert
Benjamin Steinberg
Stijn van Summeren
Mikhail V. Volkov







Table of Contents

Invited Papers

Automata-Theoretic Techniques for Analyzing Infinite-State Systems Oscar H. Ibarra	1
Enumerating Regular Expressions and Their Languages Jonathan Lee, Jeffrey Shallit	2
Contributed Papers	
A General Weighted Grammar Library Cyril Allauzen, Mehryar Mohri, Brian Roark	23
On the Complexity of Hopcroft's State Minimization Algorithm Jean Berstel, Olivier Carton	35
Implementation of Catalytic P Systems Aneta Binder, Rudolf Freund, Georg Lojka, Marion Oswald	45
Code Selection by Tree Series Transducers Björn Borchardt	57
Some Non-semi-decidability Problems for Linear and Deterministic Context-Free Languages Henning Bordihn, Markus Holzer, Martin Kutrib	68
Brute Force Determinization of NFAs by Means of State Covers Jean-Marc Champarnaud, Fabien Coulon, Thomas Paranthoën	80
Computing the Follow Automaton of an Expression Jean-Marc Champarnaud, Florent Nicart, Djelloul Ziadi	90
Viral Gene Compression: Complexity and Verification Mark Daley, Ian McQuillan	102
Concatenation State Machines and Simple Functions Wojciech Debski, Wojciech Fraczak	113
FIRE Station: An Environment for Manipulating Finite Automata and Regular Expression Views Michiel Frishert, Loek Cleophas, Bruce W. Watson	125

Finding Finite Automata That Certify Termination of String Rewriting Alfons Geser, Dieter Hofbauer, Johannes Waldmann, Hans Zantema	134
Linear Encoding Scheme for Weighted Finite Automata Mathieu Giraud, Dominique Lavenier	146
The Generalization of Generalized Automata: Expression Automata Yo-Sub Han, Derick Wood	156
An Automata Approach to Match Gapped Sequence Tags Against Protein Database Yonghua Han, Bin Ma, Kaizhong Zhang	167
State Complexity of Concatenation and Complementation of Regular Languages Jozef Jirásek, Galina Jirásková, Alexander Szabari	178
Minimal Unambiguous ε NFA Sebastian John	190
Substitutions, Trajectories and Noisy Channels Lila Kari, Stavros Konstantinidis, Petr Sosík	202
State Complexity and the Monoid of Transformations of a Finite Set Bryan Krawetz, John Lawrence, Jeffrey Shallit	213
An Application of Quantum Finite Automata to Interactive Proof Systems Harumichi Nishimura, Tomoyuki Yamakami	225
Time and Space Efficient Algorithms for Constrained Sequence Alignment Z.S. Peng, H.F. Ting	237
Stochastic Context-Free Graph Grammars for Glycoprotein Modelling Baozhen Shan	247
Parametric Weighted Finite Automata for Figure Drawing German Tischler	259
Regional Finite-State Error Repair Manuel Vilares, Juan Otero, Jorge Graña	269

Approximating Dependency Grammars Through Intersection of Regular Languages Anssi Yli-Jyrä	281
On the Equivalence-Checking Problem for a Model of Programs Related with Multi-tape Automata Vladimir Zakharov, Ivan Zakharyaschev	293
Poster Papers	
Tight Bounds for NFA to DFCA Transformations for Binary Alphabets Cezar Câmpeanu, Andrei Păun	306
Simulating the Process of Gene Assembly in Ciliates Liliana Cojocaru	308
A BDD-Like Implementation of an Automata Package Jean-Michel Couvreur	310
Approximation to the Smallest Regular Expression for a Given Regular Language Manuel Delgado, José Morais	312
Algebraic Hierarchical Decomposition of Finite State Automata: Comparison of Implementations for Krohn-Rhodes Theory Attila Egri-Nagy, Chrystopher L. Nehaniv	315
Does Hausdorff Dimension Measure Texture Complexity? Mark G. Eramian, Matthew Drotar	317
Combining Regular Expressions with (Near-)Optimal Brzozowski Automata Michiel Frishert, Bruce W. Watson	319
From Automata to Semilinear Sets: A Logical Solution for Sets $\mathcal{L}(\mathcal{C}, \mathcal{P})$ Denis Lugiez	321
Myhill-Nerode Theorem for Sequential Transducers over Unique GCD-Monoids	200
Andreas Maletti	323
Minimalizations of NFA Using the Universal Automaton Libor Polák	325

XII Table of Contents

Two-Dimensional Pattern Matching by Two-Dimensional Online	
Tessellation Automata	
Tomáš Polcar, Bořivoj Melichar	327
Size Reduction of Multitape Automata	
Hellis Tamm, Matti Nykänen, Esko Ukkonen	329
Testability of Oracle Automata	
Gaoyan Xie, Cheng Li, Zhe Dang	331
Magic Numbers for Symmetric Difference NFAs	
Lynette van Zijl	333
Author Index	995
Author muex	999