

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

Joanna Jędrzejowicz Andrzej Szepietowski (Eds.)

Mathematical Foundations of Computer Science 2005

30th International Symposium, MFCS 2005
Gdansk, Poland, August 29 – September 2, 2005
Proceedings



Springer

Volume Editors

Joanna Jędrzejowicz
Andrzej Szepietowski
Gdansk University
Institute of Mathematics
Wita Stwosza 57, 80 952 Gdansk, Poland
E-mail: {jj, matszp}@math.univ.gda.pl

Library of Congress Control Number: 2005931473

CR Subject Classification (1998): F.1, F.2, F.3, F.4, G.2, E.1

ISSN 0302-9743
ISBN-10 3-540-28702-7 Springer Berlin Heidelberg New York
ISBN-13 978-3-540-28702-5 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: 11549345 06/3142 5 4 3 2 1 0

Preface

This volume contains the papers presented at the 30th Symposium on Mathematical Foundations of Computer Science (MFCS 2005) held in Gdansk, Poland from August 29th to September 2nd, 2005. Taking place alternately in the Czech Republic, Slovakia and Poland, this year the conference was organized by the Institute of Mathematics of Gdansk University.

From the first meeting in 1972 to this year's 30th event, the MFCS series has provided a basis for theoretical computer scientists to present their latest research results. The scope of the conference, consequently, covers all branches of theoretical computer science ranging from automata, algorithms, data structures, models of computation to complexity theory, also including artificial intelligence, computational biology, computational geometry and cryptography.

The 137 submissions from 22 countries revealed a continued strong interest in the conference as well as the high-quality research results the MFCS series stands for. The Program Committee carefully selected 62 papers for presentation at the conference complemented by 7 invited talks.

The meeting took place at a conference hotel located on Sobieszewo Island, 15 km from Gdansk, offering both a beautiful landscape with sandy beaches and forests and the possibility to explore the old Hanseatic city of Gdansk with its interesting history of over 1000 years.

Last but not least we have the pleasure to thank all the people involved in making the meeting a success: the authors for showing their interest by submitting their research results, the invited speakers for agreeing to attend the conference and for presenting their insights, the members of the Program Committee for thorough discussions during the selection process, and the referees for the effort of reading all the submissions. We would also like to thank the Organizing Committee for the excellent preparation and realization of the symposium, Springer for a smooth cooperation, and of course all the conference participants for creating an inspiring atmosphere.

June 2005

Joanna Jędrzejowicz
Andrzej Szepietowski

Organization

MFCS 2005 was organized by the Institute of Mathematics, University of Gdansk.

Program Committee

Ch. Choffrut	Paris, France
T. Coquand	Goteborg, Sweden
V. Cortier	Nancy, France
V. Geffert	Kosice, Slovakia
L.A. Hemaspaandra	Rochester, USA
M. Jantzen	Hamburg, Germany
J. Jędrzejowicz	Co-chair, Gdansk, Poland
J. Karhumäki	Turku, Finland
M. Karpinski	Bonn, Germany
R. Kralovic	Bratislava, Slovakia
J. Kratochvil	Prague, Czech Republic
M. Kubale	Gdansk, Poland
F. Moller	Swansea, UK
B. Monien	Paderborn, Germany
A.W. Mostowski	Gdansk, Poland
A. Muscholl	Paris, France
S. Radziszowski	Rochester, USA
A. Szepietowski	Co-chair, Gdansk, Poland
W. Thomas	Aachen, Germany
P. Urzyczyn	Warsaw, Poland

Organizing Committee

A. Brekiewicz
T. Dzido
H. Furmanczyk
M. Nadolska
J. Neumann
P. Zyliński

Referees

M. Agnew	G. Andrejkova	A. Beygelzimer
R. Amadio	R. Bartak	F. Blanchard
P. Anderson	J. Berstel	S. Blazy

VIII Organization

Y. Bleischwitz	S. Froeschle	G. Kliewer
J. Blömer	H. Furmańczyk	M. Koehler
L. Boasson	R.S. Gaborski	P. Kolman
H.J. Böckenhauer	M. Gairing	V. Koubek
M. Bojańczyk	J. Gajdosikova	M.Y. Kovalyov
B. Borchert	A. Gambin	D. Kowalski
T. Borzyszkowski	C. Gavoille	R. Kralovic
A.M. Borzyszkowski	V. Geffert	E. Kranakis
O. Bournez	K. Giaro	J. Kratochvil
V. Brattka	Ch. Glasser	D. Kratsch
P. Bürgisser	A. Gomolińska	A. Krebs
Z. Butler	J. Goubault-Larrecq	S. Kremer
P. Campadelli	P. Grabner	M. Kubale
R. Canosa	E. Graedel	A. Kucera
D. Catalano	S. Grothklags	M. Kudlek
D. Caucal	F. Hüffner	M. Kunc
K. Cechlarova	A. Habel	M. Kutylowski
B. Chlebus	V. Halava	J.M. Kwon
M. Chrobak	M.M. Halldorsson	G. Lakemeyer
R. Clifford	D. Harel	W. Lamersdorf
J. Cohen	T. Harju	S. Laplante
R. Cole	M. Hauptmann	M. Latteux
T. Coquand	F. Heine	M. Lehmann
V. Cortier	P. Hell	S. Lietsch
B. Courcelle	L.A. Hemaspaandra	Ch. Löding
F. Cucker	E. Hemaspaandra	S. Lombardy
E. Czeizler	C. de la Higuera	U. Lorenz
R. Dabrow	M. Hirvensalo	T. Luecking
S. Demri	P. Hlineny	J. Mairesse
D. Deng	Ch. Homan	D. Makowiec
R. Downey	J. Honkala	M. Malafiejski
M. Droste	P. Hřřyer	A. Malinowski
R. Durikovic	L. Istonova	J. Marciniac
Ch. Durr	A. Jakoby	N. Markey
J. Dvorakova	A. Janiak	J. Matousek
R. Elsässer	J. Jędrzejowicz	A. May
D. Eppstein	A. Jez	B. McKay
T. Erlebach	G. Jiraskova	J. Meakin
G. Exoo	A. Kaminsky	D. Meister
P. Faliszewski	M. Kanazawa	J. Messner
R. Feldmann	J. Karhumäki	H. Meyerhenke
J. Fiala	J. Kari	K. Michael
L. Fousse	J. Karkkainen	M. Milkowska
S. Fratani	M. Karpinski	A. Miller
R. Freivalds	M. Kaufmann	P. Mlynarcik

F. Moller	F. Ruskey	J. Tarhio
B. Monien	W. Rytter	G. Tel
L. Moss	Z. Sadowski	L. Tendera
A.W. Mostowski	J. Sakarovitch	W. Thomas
A. Muscholl	P. Sankowski	E. Thomé
A. Nadolski	M. Sauerhoff	S. Tison
B. Neumann	S. Schamberger	J. Toran
R. Niedermeier	Ch. Schindelhauer	E. Torng
A. Okhotin	U.P. Schroeder	S. Travers
L. Olsen	Ch. Schwarzweiler	R. Tripathi
J. Oravec	L. Segoufin	T. Truderung
P. Orponen	S. Seibert	M. Turuani
F. Otto	O. Serre	J. Tyszkiewicz
L. Pacholski	J. Sgall	P. Urzyczyn
P. Pačzkowski	J. Simon	M. Van Wie
I. Paenke	J. Skurczyński	D. Vilenchik
D. Pardubská	Cz. Smutnicki	B. Vöcking
A. Pavan	J. Sobecki	K. Volbert
H. Petersen	Ch. Sohler	M. Volkov
I. Petre	R. Somla	K. Voß
M. Piotrów	G. Stachowiak	T. Walen
K. Piwakowski	L. Staiger	I. Walukiewicz
T. Plachetka	H. Stamer	G. Weiss
W. Plandowski	K. Stencel	A. Woclaw
S. Radziszowski	F. Sur	A. Wojna
S. Ranise	A. Szabari	Y. Yao
M. Ren	B. Szepietowski	S. Zemke
H. Roeglin	A. Szepietowski	M. Zhong
D. Rossin	T. Tantau	P. Żyliński

Previous MFCS

1972 Jablonna (Poland)	1990 Banská Bystrica (Czechoslovakia)
1973 Strbske Pleso (Czechoslovakia)	1991 Kazimierz Dolny (Poland)
1974 Jadwisin (Poland)	1992 Prague (Czechoslovakia)
1975 Mariánske Lázně (Czechoslovakia)	1993 Gdansk (Poland)
1976 Gdansk (Poland)	1994 Kosice (Slovakia)
1977 Tatranska Lomnica (Czechoslovakia)	1995 Prague (Czech Republic)
1978 Zakopane (Poland)	1996 Krakow (Poland)
1979 Olomouc (Czechoslovakia)	1997 Bratislava (Slovakia)
1980 Rydzyna (Poland)	1998 Brno (Czech Republic)
1981 Strbske Pleso (Czechoslovakia)	1999 Szklarska Poreba (Poland)
	2000 Bratislava (Slovakia)

X Organization

1984 Prague (Czechoslovakia)

1986 Bratislava (Czechoslovakia)

1988 Karlovy Vary (Czechoslovakia)

1989 Porabka-Kozubnik (Poland)

2001 Marianske Lazne (Czech Republic)

2002 Warsaw (Poland)

2003 Bratislava (Slovakia)

2004 Prague (Czech Republic)

Table of Contents

Invited Lectures

Page Migration in Dynamic Networks <i>Marcin Bienkowski, Friedhelm Meyer auf der Heide</i>	1
Knot Theory, Jones Polynomial and Quantum Computing <i>Rūsiņš Freivalds</i>	15
Interactive Algorithms 2005 <i>Yuri Gurevich</i>	26
Some Computational Issues in Membrane Computing <i>Oscar H. Ibarra</i>	39
The Generalization of Dirac's Theorem for Hypergraphs <i>Endre Szemerédi, Andrzej Ruciński, Vojtěch Rödl</i>	52
On the Communication Complexity of Co-linearity Problems <i>Andrew C. Yao</i>	57
An Invitation to Play <i>Wiesław Zielonka</i>	58

Papers

The Complexity of Satisfiability Problems: Refining Schaefer's Theorem <i>Eric Allender, Michael Bauland, Neil Immerman, Henning Schnoor, Heribert Vollmer</i>	71
On the Number of Random Digits Required in MonteCarlo Integration of Definable Functions <i>César L. Alonso, José L. Montaña, Luis M. Pardo</i>	83
Pure Nash Equilibria in Games with a Large Number of Actions <i>Carme Àlvarez, Joaquim Gabarró, Maria Serna</i>	95
On the Complexity of Depth-2 Circuits with Threshold Gates <i>Kazuyuki Amano, Akira Maruoka</i>	107

Isomorphic Implication <i>Michael Bauland, Edith Hemaspaandra</i>	119
Abstract Numeration Systems and Tilings <i>Valérie Berthé, Michel Rigo</i>	131
Adversarial Queueing Model for Continuous Network Dynamics <i>María J. Blesa, Daniel Calzada, Antonio Fernández, Luis López, Andrés L. Martínez, Agustín Santos, Maria Serna</i>	144
Coloring Sparse Random k -Colorable Graphs in Polynomial Expected Time <i>Julia Böttcher</i>	156
Regular Sets of Higher-Order Pushdown Stacks <i>Arnaud Carayol</i>	168
Linearly Bounded Infinite Graphs <i>Arnaud Carayol, Antoine Meyer</i>	180
Basic Properties for Sand Automata <i>J. Cervelle, E. Formenti, B. Masson</i>	192
A Bridge Between the Asynchronous Message Passing Model and Local Computations in Graphs <i>Jérémie Chalopin, Yves Métivier</i>	212
Reconstructing an Ultrametric Galled Phylogenetic Network from a Distance Matrix <i>Ho-Leung Chan, Jesper Jansson, Tak-Wah Lam, Siu-Ming Yiu</i>	224
New Resource Augmentation Analysis of the Total Stretch of SRPT and SJF in Multiprocessor Scheduling <i>Wun-Tat Chan, Tak-Wah Lam, Kin-Shing Liu, Prudence W.H. Wong</i>	236
Approximating Polygonal Objects by Deformable Smooth Surfaces <i>Ho-lun Cheng, Tony Tan</i>	248
Basis of Solutions for a System of Linear Inequalities in Integers: Computation and Applications <i>D. Chubarov, A. Voronkov</i>	260
Asynchronous Deterministic Rendezvous in Graphs <i>Gianluca De Marco, Luisa Gargano, Evangelos Kranakis, Danny Krizanc, Andrzej Pelc, Ugo Vaccaro</i>	271

Zeta-Dimension <i>David Doty, Xiaoyang Gu, Jack H. Lutz, Elvira Mayordomo, Philippe Moser</i>	283
Online Interval Coloring with Packing Constraints <i>Leah Epstein, Meital Levy</i>	295
Separating the Notions of Self- and Autoreducibility <i>Piotr Faliszewski, Mitsunori Ogihara</i>	308
Fully Asynchronous Behavior of Double-Quiescent Elementary Cellular Automata <i>Nazim Fatès, Michel Morvan, Nicolas Schabanel, Éric Thierry</i>	316
Finding Exact and Maximum Occurrences of Protein Complexes in Protein-Protein Interaction Graphs <i>Guillaume Fertin, Romeo Rizzi, Stéphane Vialette</i>	328
Matrix and Graph Orders Derived from Locally Constrained Graph Homomorphisms <i>Jiří Fiala, Daniël Paulusma, Jan Arne Telle</i>	340
Packing Weighted Rectangles into a Square <i>Aleksei V. Fishkin, Olga Gerber, Klaus Jansen, Roberto Solis-Oba</i>	352
Nondeterministic Graph Searching: From Pathwidth to Treewidth <i>Fedor V. Fomin, Pierre Fraigniaud, Nicolas Nisse</i>	364
Goals in the Propositional Horn [∇] Language Are Monotone Boolean Circuits <i>J. Gaintzarain, M. Hermo, M. Navarro</i>	376
Autoreducibility, Mitoticity, and Immunity <i>Christian Glaßer, Mitsunori Ogihara, A. Pavan, Alan L. Selman, Liyu Zhang</i>	387
Canonical Disjoint NP-Pairs of Propositional Proof Systems <i>Christian Glaßer, Alan L. Selman, Liyu Zhang</i>	399
Complexity of DNF and Isomorphism of Monotone Formulas <i>Judy Goldsmith, Matthias Hagen, Martin Mundhenk</i>	410
The Expressive Power of Two-Variable Least Fixed-Point Logics <i>Martin Grohe, Stephan Kreutzer, Nicole Schweikardt</i>	422

Languages Representable by Vertex-Labeled Graphs <i>Igor Grunsky, Oleksiy Kurganskyy, Igor Potapov</i>	435
On the Complexity of Mixed Discriminants and Related Problems <i>Leonid Gurvits</i>	447
Two Logical Hierarchies of Optimization Problems over the Real Numbers <i>Uffe Flarup Hansen, Klaus Meer</i>	459
Algebras as Knowledge Structures <i>Bernhard Heinemann</i>	471
Combining Self-reducibility and Partial Information Algorithms <i>André Hernich, Arfst Nickelsen</i>	483
Complexity Bounds for Regular Games <i>Paul Hunter, Anuj Dawar</i>	495
Basic Mereology with Equivalence Relations <i>Ryszard Janicki</i>	507
Online and Dynamic Recognition of Squarefree Strings <i>Jesper Jansson, Zeshan Peng</i>	520
Shrinking Restarting Automata <i>Tomasz Jurdziński, Friedrich Otto</i>	532
Removing Bidirectionality from Nondeterministic Finite Automata <i>Christos Kapoutsis</i>	544
Generating All Minimal Integral Solutions to Monotone \wedge, \vee -Systems of Linear, Transversal and Polymatroid Inequalities <i>L. Khachiyan, E. Boros, K. Elbassioni, V. Gurvich</i>	556
On the Parameterized Complexity of Exact Satisfiability Problems <i>Joachim Kneis, Daniel Mölle, Stefan Richter, Peter Rossmanith</i>	568
Approximating Reversal Distance for Strings with Bounded Number of Duplicates <i>Petr Kolman</i>	580
Random Databases and Threshold for Monotone Non-recursive Datalog <i>Konstantin Korovin, Andrei Voronkov</i>	591

An Asymptotically Optimal Linear-Time Algorithm for Locally Consistent Constraint Satisfaction Problems <i>Daniel Král', Ondřej Pangrác</i>	603
Greedy Approximation via Duality for Packing, Combinatorial Auctions and Routing <i>Piotr Krysta</i>	615
Tight Approximability Results for the Maximum Solution Equation Problem over \mathbf{Z}_p <i>Fredrik Kuivinen</i>	628
The Complexity of Model Checking Higher Order Fixpoint Logic <i>Martin Lange, Rafał Somla</i>	640
An Efficient Algorithm for Computing Optimal Discrete Voltage Schedules <i>Minming Li, Frances F. Yao</i>	652
Inverse Monoids: Decidability and Complexity of Algebraic Questions <i>Markus Lohrey, Nicole Ondrusch</i>	664
Dimension Is Compression <i>María López-Valdés, Elvira Mayordomo</i>	676
Concurrent Automata vs. Asynchronous Systems <i>Rémi Morin</i>	686
Completeness and Degeneracy in Information Dynamics of Cellular Automata <i>Hidenosuke Nishio</i>	699
Strict Language Inequalities and Their Decision Problems <i>Alexander Okhotin</i>	708
Event Structures for the Collective Tokens Philosophy of Inhibitor Nets <i>G. Michele Pinna</i>	720
An Exact 2.9416^n Algorithm for the Three Domatic Number Problem <i>Tobias Riege, Jörg Rothe</i>	733
D-Width: A More Natural Measure for Directed Tree Width <i>Mohammad Ali Safari</i>	745
On Beta-Shifts Having Arithmetical Languages <i>Jakob Grue Simonsen</i>	757

A BDD-Representation for the Logic of Equality and Uninterpreted Functions <i>Jaco van de Pol, Olga Tveretina</i>	769
On Small Hard Leaf Languages <i>Falk Unger</i>	781
Explicit Inapproximability Bounds for the Shortest Superstring Problem <i>Virginia Vassilevska</i>	793
Stratified Boolean Grammars <i>Michał Wrona</i>	801
Author Index	813