

# 43rd International Symposium on Mathematical Foundations of Computer Science

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Edited by

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## ■ Contents

Preface	
<i>Igor Potapov, Paul Spirakis, and James Worrell</i> .....	0:xi–0:xii

### Regular Papers

Consensus Strings with Small Maximum Distance and Small Distance Sum	
<i>Laurent Bulteau and Markus L. Schmid</i> .....	1:1–1:15
Plain Stopping Time and Conditional Complexities Revisited	
<i>Mikhail Andreev, Gleb Posobin, and Alexander Shen</i> .....	2:1–2:12
Error-Tolerant Non-Adaptive Learning of a Hidden Hypergraph	
<i>Hasan Abasi</i> .....	3:1–3:15
From Expanders to Hitting Distributions and Simulation Theorems	
<i>Alexander Kozachinskiy</i> .....	4:1–4:15
Balance Problems for Integer Circuits	
<i>Titus Dose</i> .....	5:1–5:16
On Hadamard Series and Rotating $\mathbb{Q}$ -Automata	
<i>Louis-Marie Dando and Sylvain Lombardy</i> .....	6:1–6:14
One-Sided Error Communication Complexity of Gap Hamming Distance	
<i>Egor Klenin and Alexander Kozachinskiy</i> .....	7:1–7:15
Online Maximum Matching with Recourse	
<i>Spyros Angelopoulos, Christoph Dürr, and Shendan Jin</i> .....	8:1–8:15
Linking Focusing and Resolution with Selection	
<i>Guillaume Burel</i> .....	9:1–9:14
Team Semantics for the Specification and Verification of Hyperproperties	
<i>Andreas Krebs, Arne Meier, Jonni Virtema, and Martin Zimmermann</i> .....	10:1–10:16
Consistency for Counting Quantifiers	
<i>Florent R. Madelaine and Barnaby Martin</i> .....	11:1–11:13
The $b$ -Branching Problem in Digraphs	
<i>Naonori Kakimura, Naoyuki Kamiyama, and Kenjiro Takazawa</i> .....	12:1–12:15
Pairing heaps: the forward variant	
<i>Dani Dorfman, Haim Kaplan, László Kozma, and Uri Zwick</i> .....	13:1–13:14
Simultaneous Multiparty Communication Protocols for Composed Functions	
<i>Yassine Hamoudi</i> .....	14:1–14:15
Sliding Windows over Context-Free Languages	
<i>Moses Ganardi, Artur Jež, and Markus Lohrey</i> .....	15:1–15:15

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Average Case Analysis of Leaf-Centric Binary Tree Sources <i>Louisa Seelbach Benkner and Markus Lohrey</i> .....	16:1–16:15
Expressive Power, Satisfiability and Equivalence of Circuits over Nilpotent Algebras <i>Paweł M. Idziak, Piotr Kawalek, and Jacek Krzaczkowski</i> .....	17:1–17:15
Lagrange’s Theorem for Binary Squares <i>P. Madhusudan, Dirk Nowotka, Aayush Rajasekaran, and Jeffrey Shallit</i> .....	18:1–18:14
A Two-Sided Error Distributed Property Tester For Conductance <i>Hendrik Fichtenberger and Yadu Vasudev</i> .....	19:1–19:15
Graph Similarity and Approximate Isomorphism <i>Martin Grohe, Gaurav Rattan, and Gerhard J. Woeginger</i> .....	20:1–20:16
Finding Short Synchronizing Words for Prefix Codes <i>Andrew Ryzhikov and Marek Szykula</i> .....	21:1–21:14
Quantum vs. Classical Proofs and Subset Verification <i>Bill Fefferman and Shelby Kimmel</i> .....	22:1–22:23
Timed Network Games with Clocks <i>Guy Avni, Shibashis Guha, and Orna Kupferman</i> .....	23:1–23:18
Hardness Results for Consensus-Halving <i>Aris Filos-Ratsikas, Søren Kristoffer Stiil Frederiksen, Paul W. Goldberg, and Jie Zhang</i> .....	24:1–24:16
Maximum Rooted Connected Expansion <i>Ioannis Lamprou, Russell Martin, Sven Schewe, Ioannis Sigalas, and Vassilis Zissimopoulos</i> .....	25:1–25:14
Interactive Proofs with Polynomial-Time Quantum Prover for Computing the Order of Solvable Groups <i>François Le Gall, Tomoyuki Morimae, Harumichi Nishimura, and Yuki Takeuchi</i> .	26:1–26:13
On the Complexity of Team Logic and Its Two-Variable Fragment <i>Martin Lück</i> .....	27:1–27:22
A Tight Analysis of the Parallel Undecided-State Dynamics with Two Colors <i>Andrea Clementi, Mohsen Ghaffari, Luciano Gualà, Emanuele Natale, Francesco Pasquale, and Giacomo Scornavacca</i> .....	28:1–28:15
Recovering Sparse Graphs <i>Jakub Gajarský and Daniel Král’</i> .....	29:1–29:15
Average-Case Polynomial-Time Computability of Hamiltonian Dynamics <i>Akitoshi Kawamura, Holger Thies, and Martin Ziegler</i> .....	30:1–30:17
Generalized Budgeted Submodular Set Function Maximization <i>Francesco Cellinese, Gianlorenzo D’Angelo, Gianpiero Monaco, and Yllka Velaj</i> ..	31:1–31:14

Complexity of Preimage Problems for Deterministic Finite Automata <i>Mikhail V. Berlinkov, Robert Ferens, and Marek Szykula</i> .....	32:1–32:14
The Complexity of Disjunctive Linear Diophantine Constraints <i>Manuel Bodirsky, Barnaby Martin, Marcello Mamino, and Antoine Mottet</i> .....	33:1–33:16
Give Me Some Slack: Efficient Network Measurements <i>Ran Ben Basat, Gil Einziger, and Roy Friedman</i> .....	34:1–34:16
Spanning-Tree Games <i>Dan Hefetz, Orna Kupferman, Amir Lellouche, and Gal Vardi</i> .....	35:1–35:16
Faster Exploration of Degree-Bounded Temporal Graphs <i>Thomas Erlebach and Jakob T. Spooner</i> .....	36:1–36:13
Approximating Dominating Set on Intersection Graphs of Rectangles and L-frames <i>Sayan Bandyopadhyay, Anil Maheshwari, Saeed Mehrabi, and Subhash Suri</i> .....	37:1–37:15
On Efficiently Solvable Cases of Quantum $k$ -SAT <i>Marco Aldi, Niel de Beaudrap, Sevag Gharibian, and Seyran Saeedi</i> .....	38:1–38:16
Balanced Connected Partitioning of Unweighted Grid Graphs <i>Cedric Berenger, Peter Niebert, and Kevin Perrot</i> .....	39:1–39:18
Concurrent Games and Semi-Random Determinacy <i>Stéphane Le Roux</i> .....	40:1–40:15
Low Rank Approximation of Binary Matrices: Column Subset Selection and Generalizations <i>Chen Dan, Kristoffer Arnsfelt Hansen, He Jiang, Liwei Wang, and Yuchen Zhou</i> .	41:1–41:16
Optimal Strategies in Pushdown Reachability Games <i>Arnaud Carayol and Matthew Hague</i> .....	42:1–42:14
Why are CSPs Based on Partition Schemes Computationally Hard? <i>Peter Jonsson and Victor Lagerkvist</i> .....	43:1–43:15
Directed Graph Minors and Serial-Parallel Width <i>Argyrios Deligkas and Reshef Meir</i> .....	44:1–44:14
The Complexity of Finding Small Separators in Temporal Graphs <i>Philipp Zschoche, Till Fluschnik, Hendrik Molter, and Rolf Niedermeier</i> .....	45:1–45:17
The Complexity of Transducer Synthesis from Multi-Sequential Specifications <i>Léo Exibard, Emmanuel Filiot, and Ismaël Jecker</i> .....	46:1–46:16
Pricing Problems with Buyer Preselection <i>Vittorio Bilò, Michele Flammini, Gianpiero Monaco, and Luca Moscardelli</i> .....	47:1–47:16
On Randomized Generation of Slowly Synchronizing Automata <i>Costanza Catalano and Raphaël M. Jungers</i> .....	48:1–48:16
Counting Homomorphisms to Trees Modulo a Prime <i>Andreas Göbel, J. A. Gregor Lagodzinski, and Karen Seidel</i> .....	49:1–49:13

Car-Sharing between Two Locations: Online Scheduling with Two Servers <i>Kelin Luo, Thomas Erlebach, and Yinfeng Xu</i> .....	50:1–50:14
The Robustness of LWPP and WPP, with an Application to Graph Reconstruction <i>Edith Hemaspaandra, Lane A. Hemaspaandra, Holger Spakowski, and Osamu Watanabe</i> .....	51:1–51:14
Shape Recognition by a Finite Automaton Robot <i>Robert Gmyr, Kristian Hinnenthal, Irina Kostitsyna, Fabian Kuhn, Dorian Rudolph, and Christian Scheideler</i> .....	52:1–52:15
Conflict Free Feedback Vertex Set: A Parameterized Dichotomy <i>Akanksha Agrawal, Pallavi Jain, Lawqueen Kanesh, Daniel Lokshtanov, and Saket Saurabh</i> .....	53:1–53:15
Largest Weight Common Subtree Embeddings with Distance Penalties <i>Andre Droschinsky, Nils M. Kriege, and Petra Mutzel</i> .....	54:1–54:15
Enumerating Minimal Transversals of Hypergraphs without Small Holes <i>Mamadou M. Kanté, Kaveh Khoshkhan, and Mozghan Pourmoradnasseri</i> .....	55:1–55:15
Collective Fast Delivery by Energy-Efficient Agents <i>Andreas Bärtzsch, Daniel Graf, and Matúš Mihalák</i> .....	56:1–56:16
Parity to Safety in Polynomial Time for Pushdown and Collapsible Pushdown Systems <i>Matthew Hague, Roland Meyer, Sebastian Muskalla, and Martin Zimmermann</i> ...	57:1–57:15
Quantum Generalizations of the Polynomial Hierarchy with Applications to QMA(2) <i>Sevag Gharibian, Miklos Santha, Jamie Sikora, Arthi Sundaram, and Justin Yirka</i>	58:1–58:16
A Subquadratic Algorithm for 3XOR <i>Martin Dietzfelbinger, Philipp Schlag, and Stefan Walzer</i> .....	59:1–59:15
Treewidth-Two Graphs as a Free Algebra <i>Christian Doczkal and Damien Pous</i> .....	60:1–60:15
On Pseudodeterministic Approximation Algorithms <i>Peter Dixon, A. Pavan, and N. V. Vinodchandran</i> .....	61:1–61:11
Testing Simon’s congruence <i>Lukas Fleischer and Manfred Kufleitner</i> .....	62:1–62:13
On the Price of Independence for Vertex Cover, Feedback Vertex Set and Odd Cycle Transversal <i>Konrad K. Dabrowski, Matthew Johnson, Giacomo Paesani, Daniël Paulusma, and Viktor Zamaraev</i> .....	63:1–63:15
Probabilistic Secret Sharing <i>Paolo D’Arco, Roberto De Prisco, Alfredo De Santis, Angel Pérez del Pozo, and Ugo Vaccaro</i> .....	64:1–64:16



Extra Space during Initialization of Succinct Data Structures and Dynamical Initializable Arrays <i>Frank Kammer and Andrej Sajenko</i> .....	65:1–65:16
Fast Entropy-Bounded String Dictionary Look-Up with Mismatches <i>Paweł Gawrychowski, Gad M. Landau, and Tatiana Starikovskaya</i> .....	66:1–66:15
New Results on Directed Edge Dominating Set <i>Rémy Belmonte, Tesshu Hanaka, Ioannis Katsikarelis, Eun Jung Kim, and Michael Lampis</i> .....	67:1–67:16
Interval-Like Graphs and Digraphs <i>Pavol Hell, Jing Huang, Ross M. McConnell, and Arash Rafiey</i> .....	68:1–68:13
Double Threshold Digraphs <i>Peter Hamburger, Ross M. McConnell, Attila Pór, Jeremy P. Spinrad, and Zhisheng Xu</i> .....	69:1–69:12
Tree Tribes and Lower Bounds for Switching Lemmas <i>Jenish C. Mehta</i> .....	70:1–70:11
Projection Theorems Using Effective Dimension <i>Neil Lutz and Donald M. Stull</i> .....	71:1–71:15
Polynomial-Time Equivalence Testing for Deterministic Fresh-Register Automata <i>Andrzej S. Murawski, Steven J. Ramsay, and Nikos Tzevelekos</i> .....	72:1–72:14
On $W[1]$ -Hardness as Evidence for Intractability <i>Ralph Christian Bottesch</i> .....	73:1–73:15
A Simple Augmentation Method for Matchings with Applications to Streaming Algorithms <i>Christian Konrad</i> .....	74:1–74:16
Reconfiguration of Graph Minors <i>Benjamin Moore, Naomi Nishimura, and Vijay Subramanya</i> .....	75:1–75:15
A Feferman-Vaught Decomposition Theorem for Weighted MSO Logic <i>Manfred Droste and Erik Paul</i> .....	76:1–76:15
Maximum Area Axis-Aligned Square Packings <i>Hugo A. Akitaya, Matthew D. Jones, David Stalfa, and Csaba D. Tóth</i> .....	77:1–77:15
Deterministically Counting Satisfying Assignments for Constant-Depth Circuits with Parity Gates, with Implications for Lower Bounds <i>Ninad Rajgopal, Rahul Santhanam, and Srikanth Srinivasan</i> .....	78:1–78:15
Results on the Dimension Spectra of Planar Lines <i>Donald M. Stull</i> .....	79:1–79:15
Tight Bounds for Deterministic $h$ -Shot Broadcast in Ad-Hoc Directed Radio Networks <i>Aris Pagourtzis and Tomasz Radzik</i> .....	80:1–80:13
Depth Two Majority Circuits for Majority and List Expanders <i>Kazuyuki Amano</i> .....	81:1–81:13

**0:x**      **Contents**

Optimization over the Boolean Hypercube via Sums of Nonnegative Circuit  
Polynomials  
*Mareike Dressler, Adam Kurpisz, and Timo de Wolff* ..... 82:1–82:17

Rainbow Vertex Coloring Bipartite Graphs and Chordal Graphs  
*Pinar Heggernes, Davis Issac, Juho Lauri, Paloma T. Lima, and  
Erik Jan van Leeuwen* ..... 83:1–83:13

Listing Subgraphs by Cartesian Decomposition  
*Alessio Conte, Roberto Grossi, Andrea Marino, Romeo Rizzi, and Luca Versari* .. 84:1–84:16

## ■ Preface

The International Symposium on Mathematical Foundations of Computer Science (MFCS conference series) is a well-established venue for presenting research papers in theoretical computer science. The broad scope of the conference encourages interactions between researchers who might not meet at more specialized venues. The first MFCS conference was organized in 1972 in Jablonna (near Warsaw, Poland). Since then, the conference traditionally moved between the Czech Republic, Slovakia, and Poland. A few years ago, the conference started traveling around Europe: in 2013 it was held in Austria, in 2014 in Hungary, in 2015 in Italy, and most recently, in 2016, the conference returned to Poland and then in 2017 was organized in Denmark. This year the conference has been visiting the United Kingdom for the first time and was organized in Liverpool.

Over 210 abstracts were submitted, of which 185 materialized as papers, of which 84 were finally accepted. The authors of the submitted papers represent nearly 40 countries. The authors first registered their papers' abstracts (by the 20th of April, 2018) and only then their content (by the 24th of April, 2018). This division in two stages has helped with the assignment of the papers to the PC members. Each paper was assigned to three PC members, who reviewed and discussed them thoroughly over a period of nearly six weeks. As the co-chairs of the program committee, we would like to express our deep gratitude to all the committee members for their hard, dedicated work. The quality of the submitted papers was very high and many good papers had to be rejected. The conference featured five invited talks, by Christel Baier (TU Dresden, Germany), Olivier Bournez (LIX, France), Herbert Edelsbrunner (IST, Austria), Leslie Ann Goldberg (University of Oxford, UK) and Christos H. Papadimitriou (Columbia University, USA):

### **Christel Baier - On energy conditions and stochastic shortest path problems for Markov Decision Processes**

*Abstract: Markov decision processes (MDP) are widely used to formalize algorithmic problems where the task is to find a policy for traversing a weighted probabilistic graph structure in a somehow optimal way. Examples are the stochastic shortest-path problem where the goal is to minimize the expected accumulated weight until reaching a target or decision problems for MDPs with energy constraints that, e.g., aims to ensure that almost surely a target will be reached while the accumulated weight ("energy") meets a given bound. The talk will discuss solutions for such and related problems for MDPs with integer weights. These rely on a new classification of so-called end components of MDPs according to their limiting behavior with respect to the accumulated weights. This classification will be used to show that the stochastic shortest path problem is solvable in polynomial time for arbitrary finite-state MDPs, generalizing previous results for sub-classes of MDPs. Furthermore, it will be used to provide algorithms for deciding the existence of a policy ensuring that a weight-bounded (repeated) reachability condition holds almost surely or with positive probability, and the analogous problems for universal rather than existential quantification over policies.*

### **Olivier Bournez - Descriptive Mathematics and Computer Science with Polynomial Ordinary Differential Equations**

*Abstract: We will see that many continuous and discrete concepts from mathematics and computer science can be presented using ordinary differential equations. Basically, we will start from the following observation: if you know what 0, 1, -1 are, as well as what an*

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addition and a multiplication are, and if you remember what an ordinary differential equation is, then you can define and program many concepts from Mathematics and Computer Science. In particular we will present/rediscover descriptive complexity, computability and complexity using polynomial ordinary differential equations only. A title for this talk could also be "Programming with Ordinary Differential Equations", as these questions also relate to analog models of computations, and in particular to the 1941 General Purpose Analog Computer of Claude Shannon. In some way, we are rediscovering the forgotten art of their programming, and we are only starting to understand the true power of these very old models.

#### **Herbert Edelsbrunner - Tri-partition of a simplicial complex**

*Abstract:* We prove that for every simplicial complex,  $K$ , and every dimension,  $p$ , there is a partition of the  $p$ -simplices into a maximal  $p$ -tree, a maximal  $p$ -cotree, and the remaining  $p$ -simplices defining the  $p$ -th homology of  $K$ . Given a monotonic order of the simplices, this tri-partition is unique and can be computed by matrix reduction. Collecting the sets over all monotonic orders, we get matroids over the set of  $p$ -simplices (Joint work with Katharina Oelsboeck).

#### **Leslie Ann Goldberg - Computational Complexity and the Independence Polynomial**

*Abstract:* The independence polynomial is one of the most well-studied graph polynomials, arising in combinatorics and computer science. It is also known in statistical physics as the "partition function of the hard-core model". After describing the polynomial, I will tell you something about the complexity of approximating this polynomial, including the now-classical breakthrough results of Weitz and Sly, incursions into the complex plane by Harvey, Srivastava, and Vondrák and by Patel and Regts and finally more recent work using tools from complex analysis by Peters and Regts and also in joint work with Bezakova, Galanis, and Stefankovic.

#### **Christos H. Papadimitriou - A computer scientist thinks about the Brain**

*Abstract:* How does the Brain give rise to the Mind? How do neurons and synapses, molecules and genes, evolution and development, give rise to behavior and cognition, language and intelligence? Despite lightning progress in recording and molecular technology and a deluge of experimental data, we do not seem to get closer to an answer. This is a talk about admiring and appreciating the problem, and proposing a new approach based on a recognized but little studied intermediate level of Brain computation carried out by the synchronous firing of large and highly interconnected sets of neurons called assemblies. We show that assemblies give rise to a novel computational system, and we speculate that they may instrument higher cognitive functions, such as language and math.

We would like to thank them deeply for their contributions and their time. This is the third time that the MFCS proceedings are published in the Dagstuhl/LIPIcs series. We would like to particularly thank Marc Herbstritt and the LIPIcs team for all the help and support. We believe that the cooperation between MFCS and Dagstuhl/LIPIcs in the future will continue to be as seamless and fruitful as ours.

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