43rd International Symposium on Mathematical Foundations of Computer Science

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Edited by
Igor Potapov
Paul Spirakis
James Worrell

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Editors

Igor Potapov
Department of Computer Science
University of Liverpool
Potapov@liverpool.ac.uk

Paul Spirakis
Department of Computer Science
University of Liverpool
P.Spirakis@liverpool.ac.uk

James Worrell
Department of Computer Science
University of Oxford
jbw@cs.ox.ac.uk

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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)m 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 or 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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