

33rd International Symposium on Distributed Computing

DISC 2019, October 14–18, 2019, Budapest, Hungary

Edited by

Jukka Suomela



Editors

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■ Preface

DISC, the International Symposium on Distributed Computing, is an international forum on the theory, design, analysis, implementation and application of distributed systems and networks. DISC is organized in cooperation with the European Association for Theoretical Computer Science (EATCS).

This volume contains the papers presented at DISC 2019, the 33rd International Symposium on Distributed Computing, held on October 14–18, 2019 in Budapest, Hungary. It also includes the citations for two awards jointly sponsored by DISC and the ACM Symposium on Principles of Distributed Computing (PODC):

- The *2019 Edsger W. Dijkstra Prize in Distributed Computing*, presented at DISC 2019 to Alessandro Panconesi and Aravind Srinivasan for their paper “Randomized Distributed Edge Coloring via an Extension of the Chernoff–Hoeffding Bounds”, *SIAM Journal on Computing*, volume 26, number 2, 1997, pages 350–368.
- The *2019 Principles of Distributed Computing Doctoral Dissertation Award*, presented at PODC 2019 to Sepehr Assadi for his dissertation “Combinatorial Optimization on Massive Datasets: Streaming, Distributed, and Massively Parallel Computation”, written under the supervision of Prof. Sanjeev Khanna at the University of Pennsylvania.

In response to the call for papers, this year we received 145 regular submissions (four of them withdrawn after submission), and 13 brief submissions. All submissions were evaluated by at least three reviewers; we had a program committee with 38 members, and the committee was assisted by 171 external reviewers. For the first time in the history of DISC, we used double-blind peer review: the submissions were anonymous and the PC members and external reviewers did not see the names of the authors.

The program committee decided to accept 34 regular submissions for presentation at DISC 2019. After the selection of the regular papers, the authors of 19 regular papers were invited to submit brief versions of their work, and this way we received 12 additional brief submissions. From among the 25 brief submissions the program committee decided to accept 15 brief announcements for presentation.

The committee selected the following two papers as the co-recipients of the *DISC 2019 Best Paper Award*:

- Orr Fischer and Rotem Oshman: “A Distributed Algorithm for Directed Minimum-Weight Spanning Tree”
- Rachid Guerraoui, Petr Kuznetsov, Matteo Monti, Matej Pavlovic and Dragos-Adrian Seredinschi: “Scalable Byzantine Reliable Broadcast”.

DISC 2019 Best Review Award was presented to D. Ellis Hershkowitz.

This year we had eight workshops held in conjunction with DISC 2019. The following workshops were organized on October 14, 2019:

- ADGA: Workshop on Advances in Distributed Graph Algorithms
(chair: Mohsen Ghaffari)
- ApPLIED2019: Advanced tools, programming languages, and PLatforms for Implementing and Evaluating algorithms for Distributed systems
(chairs: Chryssis Georgiou, Yanhong Annie Liu, Miguel Matos and Elad Michael Schiller)
- BTT: Workshop on Blockchain Technology and Theory
(chairs: Ittai Abraham, Christian Cachin, Ittay Eyal, Maurice Herlihy and Maria Potop-Butucaru)

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- CELLS: Computing among Cells
(chairs: Matthias Fuegger, Adrian Kosowski, Manish Kushwaha and Thomas Nowak)

The following workshops were organized on October 18, 2019:

- DiADN: Distributed Algorithms for Dynamic Networks
(chairs: Tomasz Jurdzinski and Miguel Mosteiro)
- DCC: Workshop on Distributed Cloud Computing
(chairs: Chen Avin and Gabriel Scalosub)
- FRIDA: Formal Reasoning in Distributed Algorithms
(chairs: Swen Jacobs, Igor Konnov, Stephan Merz and Josef Widder)
- HDT: Workshop on Hardware Design and Theory
(chairs: Moti Medina and Andrey Mokhov)

I would like to thank all conference participants and everyone who contributed to DISC 2019: the authors of the submitted papers, PC members and external reviewers, keynote speakers, members of the organizing committee, workshop organizers, and members of the award committees. I would also like to thank the members of the steering committee, former chairs, our colleagues in the PODC organization and many other members of the community for their valuable assistance and suggestions, EATCS for their financial support, EasyChair administrators for help with the conference management system, and the staff at Schloss Dagstuhl – Leibniz-Zentrum für Informatik for all the hard work they did with preparing this proceedings volume.

October 2019

Jukka Suomela
DISC 2019 Program Chair

■ Symposium Organization

DISC, the International Symposium on Distributed Computing, is an annual forum for presentation of research on all aspects of distributed computing. It is organized in cooperation with the European Association for Theoretical Computer Science (EATCS). The symposium was established in 1985 as a biannual International Workshop on Distributed Algorithms on Graphs (WDAG). The scope was soon extended to cover all aspects of distributed algorithms and WDAG came to stand for International Workshop on Distributed AlGorithms, becoming an annual symposium in 1989. To reflect the expansion of its area of interest, the name was changed to DISC (International Symposium on DIStributed Computing) in 1998, opening the symposium to all aspects of distributed computing. The aim of DISC is to reflect the exciting and rapid developments in this field.

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DISC 2019 acknowledges the use of the EasyChair system for handling submissions and managing the review process, and LIPIcs for producing and publishing the proceedings.

■ 2019 Edsger W. Dijkstra Prize in Distributed Computing

The Edsger W. Dijkstra Prize in Distributed Computing is awarded for outstanding papers on the principles of distributed computing, whose significance and impact on the theory or practice of distributed computing have been evident for at least a decade. It is sponsored jointly by the ACM Symposium on Principles of Distributed Computing (PODC) and the EATCS Symposium on Distributed Computing (DISC). The prize is presented annually, with the presentation taking place alternately at PODC and DISC.

The committee decided to award the 2019 Edsger W. Dijkstra Prize in Distributed Computing to

Alessandro Panconesi and Aravind Srinivasan

for their paper

**Randomized Distributed Edge Coloring via
an Extension of the Chernoff–Hoeffding Bounds,**

SIAM Journal on Computing, volume 26, number 2, 1997, pages 350–368.

A preliminary version of this paper appeared as “Fast Randomized Algorithms for Distributed Edge Coloring”, *Proceedings of the Eleventh Annual ACM Symposium Principles of Distributed Computing (PODC)*, 1992, pages 251–262.

The paper presents a simple synchronous algorithm in which processes at the nodes of an undirected network color its edges so that the edges adjacent to each node have different colors. It is randomized, using $1.6\Delta + O(\log^{1+\delta} n)$ colors and $O(\log n)$ rounds with high probability for any constant $\delta > 0$, where n is the number of nodes and Δ is the maximum degree of the nodes. This was the first nontrivial distributed algorithm for the edge coloring problem and has influenced a great deal of follow-up work. Edge coloring has applications to many other problems in distributed computing such as routing, scheduling, contention resolution, and resource allocation.

In spite of its simplicity, the analysis of their edge coloring algorithm is highly nontrivial. Chernoff–Hoeffding bounds, which assume random variables to be independent, cannot be used. Instead, they develop upper bounds for sums of negatively correlated random variables, for example, which arise when sampling without replacement. More generally, they extend Chernoff–Hoeffding bounds to certain random variables they call λ -correlated. This has directly inspired more specialized concentration inequalities. The new techniques they introduced have also been applied to the analyses of important randomized algorithms in a variety of areas including optimization, machine learning, cryptography, streaming, quantum computing, and mechanism design.

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■ 2019 Principles of Distributed Computing Doctoral Dissertation Award

The winner of the 2019 Principles of Distributed Computing Doctoral Dissertation Award is

Dr. Sepehr Assadi

for his dissertation

Combinatorial Optimization on Massive Datasets: Streaming, Distributed, and Massively Parallel Computation,

written under the supervision of Prof. Sanjeev Khanna at the University of Pennsylvania.

The thesis resolves a number of long-standing problems in the exciting and still relatively new area of sublinear computation. The area of sublinear computation focuses on design of algorithms that use sublinear space, time, or communication to solve global optimization problems on very large datasets. In addition to addressing a wide range of different problems, comprising graph optimization problems (matching, vertex cover, and connectivity), submodular optimization (set cover and maximum coverage), and resource-constrained optimization (combinatorial auctions and learning), these problems are studied in three different models of computation, namely, streaming algorithms, multiparty communication, and massively parallel computation (MPC). The thesis also reveals interesting relations between these different models, including generic algorithmic and analysis techniques that can be applied in all of them.

For many fundamental optimization problems, the thesis gives asymptotically matching algorithmic and intractability results, completely resolving several long-standing problems. This is accomplished by using a broad spectrum of mathematical methods in very detailed and intricate proofs. In addition to a wide variety of classic techniques, ranging from graph theory, combinatorics, probability, linear algebra and calculus, it also makes heavy use of communication complexity and information theory, for example.

Sepehr's dissertation work has been published in a remarkably large number of top-conference papers. It received multiple best paper awards and multiple special issue invitations, as well as two invitations to the Highlights of Algorithms (HALG) conference. Due to its contributions to the field of distributed computing and all the merits mentioned above, the award committee unanimously selected this thesis as the winner of the 2019 Principles of Distributed Computing Doctoral Dissertation Award.

The award is sponsored jointly by the ACM Symposium on Principles of Distributed Computing (PODC) and the EATCS Symposium on Distributed Computing (DISC). It is presented annually, with the presentation taking place alternately at PODC and DISC. The 2019 award was presented at PODC 2019 in Toronto, Canada.

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