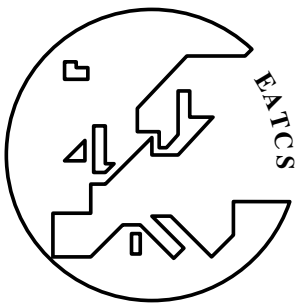
46th International Colloquium on Automata, Languages, and Programming

ICALP 2019, July 9–12, 2019, Patras, Greece

Edited by
Christel Baier
Ioannis Chatzigiannakis
Paola Flocchini
Stefano Leonardi



Editors

Christel Baier
TU Dresden, Germany
christel.baier@tu-dresden.de

Ioannis Chatzigiannakis
Sapienza University of Rome, Italy
ichatz@diag.uniroma1.it

Paola Flocchini
University of Ottawa, Canada
paola.flocchini@uottawa.ca

Stefano Leonardi
Sapienza University of Rome, Italy
leonardi@diag.uniroma1.it

ACM Classification 2012
Theory of computation

ISBN 978-3-95977-109-2

Published online and open access by
Schloss Dagstuhl – Leibniz-Zentrum für Informatik GmbH, Dagstuhl Publishing, Saarbrücken/Wadern, Germany. Online available at https://www.dagstuhl.de/dagpub/978-3-95977-109-2.

Publication date
July, 2019

Bibliographic information published by the Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at https://portal.dnb.de.

Digital Object Identifier: 10.4230/LIPIcs.ICALP.2019.0

ISBN 978-3-95977-109-2 **ISSN 1868-8969** **https://www.dagstuhl.de/lipics**

LIPIcs – Leibniz International Proceedings in Informatics

LIPIcs is a series of high-quality conference proceedings across all fields in informatics. LIPIcs volumes are published according to the principle of Open Access, i.e., they are available online and free of charge.

ISSN 1868-8969

https://www.dagstuhl.de/lipics

Contents

46th International Colloquium on Automata, Languages, and Programming (ICALP 2019).
Editors: Christel Baier, Ioannis Chatzigiannakis, Paola Flocchini, and Stefano Leonardi
Leibniz International Proceedings in Informatics
LIPICS Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany

Track B: Automata, Logic, Semantics, and Theory of Programming

Track C: Foundations of Networks and Multi-Agent Systems: Models, Algorithms and Information Management

Preface

This volume contains the papers presented at ICALP 2019, the 46th edition of the International Colloquium on Automata, Languages and Programming, held in Patras, Greece during July 8–12, 2019. ICALP is a series of annual conferences of the European Association for Theoretical Computer Science (EATCS), which first took place in 1972. This year, the ICALP program consisted of three tracks:

- Track A: Algorithms, Complexity, and Games,
- Track B: Logic, Semantics, Automata and Theory of Programming,
- Track C: Foundations of Networked Computation: Models, Algorithms, and Information Management.

In response to the call for papers, a total 490 submissions were received: 316 for track A, 103 for track B, and 71 for track C. Each submission was assigned to at least three Program Committee members, aided by many subreviewers. Out of these, the committee decided to accept 146 papers for inclusion in the scientific program: 94 papers for Track A, 31 for Track B, and 21 for Track C. The selection was made by the Program Committees based on originality, quality, and relevance to theoretical computer science. The quality of the manuscripts was very high, and many deserving papers could not be selected.

The EATCS sponsored awards for both a best paper and a best student paper for each of the three tracks, selected by the Program Committees.

The best paper awards were given to the following papers:

- Track A: Bingkai Lin. "A Simple Gap-producing Reduction for the Parameterized Set Cover Problem".
- Track B: Christof Löding and Anton Pirogov. "Determinization of Büchi Automata: Unifying the Approaches of Safra and Muller-Schupp".
- Track C: Keren Censor-Hillel and Mikaël Rabie. "Distributed Reconfiguration of Maximal Independent Sets".

The best student paper awards, for papers that are solely authored by students, were given to the following papers:

- Track A: Joran van Apeldoorn & András Gilyén. "Improvements in Quantum SDP-Solving with Applications".
- Track B: Marie Fortin. "FO = FO3 for linear orders with monotone binary relations".

Apart from the contributed talks, ICALP 2019 included invited presentations by Michal Feldman, Martin Grohe, Ola Svensson, Frits Vaandrager and Mihalis Yannakakis. This volume of the proceedings contains all contributed papers presented at the conference together with the abstracts of the invited speakers.

The program of ICALP 2019 also included presentation of the EATCS Award 2019 to Thomas Henzinger, the Alonzo Church Award 2019 to Murdoch J. Gabbay and Andrew M. Pitts, the Presburger Award 2019 to Karl Bringmann and Kasper Green Larsen, and the EATCS Distinguished Dissertation Awards.

Four satellite events of ICALP were held on July 8th, 2019:

- Workshop on Theoretical Aspects of Fairness (WTAF)
- Parameterized Approximation Algorithms Workshop (PAAW)

46th International Colloquium on Automata, Languages, and Programming (ICALP 2019).
Editors: Christel Baier, Ioannis Chatzigiannakis, Paola Flocchini, and Stefano Leonardi
Leibniz International Proceedings in Informatics
LIPICS Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany

- Workshop on Algorithmic Aspects of Temporal Graphs II
- Logic and Computational Complexity Workshop (LCC 2019)

We wish to thank all authors who submitted extended abstracts for consideration, the Program Committees for their scholarly effort, and all referees who assisted the Program Committees in the evaluation process. We are also grateful to the Conference Co-Chairs Sotiris Nikoletseas and Christos Zaroliagis and all the support staff of the Organizing Committee from the University of Patras and the Computer Technology Institute & Press "Diophantus" for organizing ICALP 2019.

We are grateful for generous support from University of Patras and the Department of Computer Engineering & Informatics for their support for the conference. We also thank the Center for Perspicuous Computing CPEC (supported by CPEC - TRR 248) for their support for the travelling costs of the invited speakers.

We would like to thank Anca Muscholl for her continuous support and Paul Spirakis, the president of EATCS, for his generous advice on the organization of the conference.

July 2019

Christel Baier
Ioannis Chatzigiannakis
Paola Flocchini
Stefano Leonardi

Organization

Program Committee

Track A

Stefano Leonardi	Sapienza University of Rome, Italy, Chair
Yossi Azar	Tel-Aviv University, Israel
Aaron Bernstein	Massachusetts Institute of Technology, United States
Sayan Bhattacharya	Duke University, United States
Karl Bringmann	Max Planck Institute for Informatics, Germany
Gerth Stølting Brodal	Aarhus University, Denmark
Jaroslaw Byrka	University of Wroclaw, Poland
Parinya Chalermsook	Aalto University, Finland
Paul Duetting	London School of Economics, United Kingdom
Uriel Feige	Weizmann Institute, Israel
Claudio Gentile	Google Research, United States
Mohsen Ghaffari	ETH Zurich, Switzerland
Antoine Joux	Fondation Partenariale de l'UPMC, IMJ-PRG, France
Telikepalli Kavitha	Tata Institute of Fundamental Research, Mumbai, India
Thomas Kesselheim	University of Bonn, Germany
Michal Koucky	Czech Academy of Sciences, Czechia
Alexander Kulikov	St. Petersburg Department of Steklov Institute of Mathematics, Russia
Sophie Laplante	IRIF, Université Paris Diderot Paris 7, France
Francois Le Gall	Kyoto University, Japan
Ramanujan M. Sridharan	The University of Warwick, United Kingdom
Evangelos Markakis	Athens University of Economics and Business, Greece
Renato Paes Leme	Google, United States
Marcin Pilipczuk	Institute of Informatics, University of Warsaw, Poland
Adi Rosén	CNRS and Université Paris Diderot, France
Eva Rotenberg	Technical University of Denmark, Denmark
Rahul Santhanam	University of Oxford, United Kingdom
Alessandra Scafuro	North Carolina State University, United States
Sandeep Sen	Dept of CSE, IIT Delhi, India
Francesco Silvestri	University of Padova, Italy
Paul Spirakis	University of Liverpool and University of Patras, Greece
Leen Stougie	Centrum voor Wiskunde en Informatica (CWI), Netherlands
Chaitanya Swamy	University of Waterloo, Canada
Stefan Szeider	Vienna University of Technology, Austria
Rico Zenklusen	ETH Zurich, Switzerland

Track B

Christel Baier	TU Dresden, Germany, Chair
Parosh Aziz Abdulla	Uppsala University, Sweden
Krishnendu Chatterjee	Institute of Science and Technology (IST), Austria
Thomas Colcombet	CNRS, France
Pedro R. D'Argenio	Universidad Nacional de Córdoba - CONICET, Argentina

Laure Daviaud	City, University of London, United Kingdom
Rocco De Nicola	IMT - School for Advanced Studies Lucca, Italy
Josee Desharnais	Laval University, Canada
Mariangiola Dezani-Ciancaglini	Dipartimento di Informatica, Università di Torino, Italy
Amina Doumane	PPS, France
Nathanaël Fijalkow	CNRS, LaBRI, University of Bordeaux, United Kingdom
Wan Fokkink	Vrije Universiteit Amsterdam, Netherlands
Christoph Haase	University of Oxford, United Kingdom
Ichiro Hasuo	National Institute of Informatics, Japan
Radha Jagadeesan	DePaul University, United States
Markus Lohrey	University of Siegen, Germany
P. Madhusudan	University of Illinois at Urbana-Champaign, United States
Radu Mardare	Aalborg University, Denmark
Matteo Mio	CNRS/ENS-Lyon, France
Mickael Randour	F.R.S.-FNRS & UMONS - Université de Mons, Belgium
Sven Schewe	University of Liverpool, United Kingdom
Lutz Schröder	Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany
Helmut Seidl	Technical University of Munich, Germany
Michał Skrzypczak	University of Warsaw, Poland
Pawel Sobocinski	University of Southampton, United Kingdom
Christine Tasson	Laboratoire IRIF - Université Paris 7, France

Track C

Paola Flocchini	University of Ottawa, Canada, Chair
Amotz Bar-Noy	City University of New York, United States
Vittorio Biló	University of Salento, Italy
Bogdan Chlebus	University of Colorado Denver, United States
Xiaotie Deng	Peking University, China
Leszek Gasieniec	University of Liverpool, United Kingdom
Olga Nikolaevna Goussevskaia	Federal University of Minas Gerais, Brazil
Magnús Halldórsson	Reykjavik University, Iceland
Tobias Harks	Augsburg University, Germany
Christos Kaklamanis	University of Patras, Greece
Ralf Klasing	CNRS and University of Bordeaux, France
Max Klimm	Humboldt Universität zu Berlin, Germany
Ravi Kumar	Google, United States
Silvio Lattanzi	Google, Switzerland
Toshimitsu Masuzawa	Osaka University, Japan
Ruta Mehta	University of Illinois at Urbana-Champaign, United States
Ariel Orda	Department of Electrical Engineering, Technion, Israel
Gopal Pandurangan	University of Houston, United States
Pino Persiano	Università degli Studi di Salerno, Italy
Maria Potop-Butucaru	UPMC Sorbonne Universités, LIP6, Paris, France
Giuseppe Prencipe	Università di Pisa, Italy
Andrea Richa	Arizona State University, United States
Nicola Santoro	Carleton University, Canada
Jukka Suomela	Aalto University, Finland
Patrick Thiran	Ecole Polytechnique Fédérale de Lausanne, Switzerland
Peter Widmayer	ETH Zurich, Switzerland, Switzerland

Organizing Committee

Efstratios Gallopoulos	University of Patras, Greece
John Garofalakis	University of Patras and CTI, Greece
Christos Kaklamanis	University of Patras and CTI, Greece
Sotiris Nikoletseas	University of Patras and CTI, Greece, Conference Co-Chair
Christos Zaroliagis	University of Patras and CTI, Greece, Conference Co-Chair

Steering Committee

Javier Esparza	TUM Munich, Germany
Leslie Ann Goldberg	Oxford University, UK
Thore Husfeldt	Lund University, Sweden and IT University of Copenhagen, Denmark
Giuseppe Italiano	Università di Roma Tor Vergata, Italy
Christos Kaklamanis	University of Patras and CTI Diophantus, Greece
Daniel Marx	Hungarian Academy of Sciences, Hungary
Emanuela Merelli	University of Camerino, Italy
Anca Muscholl	Bordeaux University, France), Steering Committee Chair
Luke Ong	Oxford University, UK
Jiří Sgall	Charles University, Prague, Czech Rep.
Paul Spirakis	University of Liverpool, UK and University of Patras, Greece

Financial Sponsors

University of Patras, Greece
Center for Perspicuous Computing CPEC, Germany

Additional Reviewers

Abboud Amir
Abrahamsen Mikkel
Accattoli Beniamino
Adamczyk Marek
Aduri Pavan
Aggarwal Divesh
Agrawal Akanksha
Ahmadian Sara
Ahrens Benedikt
Ailon Nir
Ajwani Deepak
Akhremtsev Yaroslav
Akrida Eleni C.
Albert Michael
Aldridge Matthew
Allender Eric
Allouah Amine
Almagor Shaull
Alman Josh
Amanatidis Georgios
Ambainis Andris
Amy Matthew
An Hyung-Chan
Anagnostopoulos Aris
Angelidakis Haris
Annamalai Chidambram
Applebaum Benny
Arseneva Elena
Arunachalam Srinivasan
Asadpour Arash
Ashtiani Hassan
Assadi Sepehr
Atserias Albert
Augustine John
Aumüller Martin
Avin Chen
Avner Orly
Awasthi Pranjal
Aziz Haris
Babenko Maxim
Bacci Giorgio
Bacci Giovanni
Backurs Arturs
Badanidiyuru Varadaraja Ashwinkumar
Balkanski Eric
Balko Martin
Bampas Evangelos
Banik Aritra
Bansal Nikhil
Barbero Fausto
Barenbaum Pablo
Barmpalias George
Bartholdi Laurent
Barto Libor
Bartoletti Massimo
Baswana Surender
Batra Jatin
Becher Veronica
Beffara Emmanuel
Behnezhad Soheil
Beimel Amos
Belovs Aleksandrs
Ben-Amram Amir
Ben-David Shalev
Benadè Gerdus
Bera Debajyoti
Berkholz Christoph
Bertrand Nathalie
Bhagat Subhash
Bhangale Amey
Bhaskara Aditya
Bhattacharya Anup
Bhattiprolu Vijay
Bilò Davide
Bishnu Arijit
Bitansky Nir
Björklund Andreas
Blahoudek František
Bliznets Ivan
Blocq Gideon
Blondin Michael
Blumensath Achim
Bodlaender Hans L.
Bodwin Greg
Boker Udi
Bollig Benedikt
Bonchi Filippo
Boodaghians Shant
Boyle Elette
Brakensiek Joshua
Brand Cornelius
Brandt Sebastian
Brázdil Tomáš
Bredereck Robert
Broadbent Anne
Broutin Nicolas
Bruni Roberto
Bu Gewu
Buchbinder Niv
Buttkus Matthias
Cabello Sergio
Cadilhac Michaël
Canonne Clément
Capelli Florent
Caragiannis Ioannis
Carton Olivier
Cassuto Yuval
Castellan Simon
Cazaux Bastien
Ceccarello Matteo
Censor-Hillel Keren
Chailloux André
Chakrabarti Amit
Chakrabarti Shouvanik
Chakrabarty Deeparnab
Chakraborty Shantanav
Chan T-H. Hubert
Chan Timothy M.
Chang Yi-Jun
Charatonik Witold
Chatterjee Soumyottam
Chattopadhyay Eshan
Chechik Shiri
Chen Ho-Lin
Chen Lijie
Chen Yixin
Chen Yu
Chen Yu-Fang
Cheraghchi Mahdi
Chillara Suryajith
Chistikov Dmitry
Chitnis Rajesh
Chonev Ventsislav
Choudhary Keerti
Chouquet Jules
Christiani Tobias
Chuzhoy Julia
Clifford Raphael
Cohen-Addad Vincent
Coja-Oghlan Amin
Colini Baldeschi Riccardo
Corsten Jan
Cseh Ágnes
Czerwiński Wojciech
Dabrowski Konrad Kazimierz
Dal Lago Ugo
Dalmau Victor
Damian Mirela
Dani Varsha
Dartois Luc
Das Debarati
Das Syamantak
Datta Samir
Daymude Joshua
De Minati
Dehornoy Patrick
Delic Dejan
Deligkas Argyrios
Dell Holger
Deng Xiaotie
Dereniowski Dariusz
Deshpande Apoorvaa
Di Luna Giuseppe Antonio
Diakonikolas Jelena
Diaz Josep
Dickens Charlie
Doerr Benjamin
Doty David
Dou Zehao
Douéneau-Tabot Gaëtan
Doyen Laurent

Drineas Petros
Drmota Michael
Duan Ran
Dudycz Szymon
Dujmovic Vida
Dulek Yfke
Dyer Martin
Earl Roberson David
Efraimidis Pavlos
Efthymiou Charilaos
Elder Murray
Emek Yuval
Ene Alina
Eppstein David
Epstein Leah
Erlebach Thomas
Evald Jacob
Faenza Yuri
Fahrbach Matthew
Fakcharoenphol Jittat
Fanelli Angelo
Faonio Antonio
Farhadi Alireza
Feier Cristina
Feldman Michal
Feldman Moran
Felsner Stefan
Ferraioli Diodato
Fervari Raul
Figueira Santiago
Filmus Yuval
Fineman Jeremy
Fischer Carsten
Fischer Manuela
Fogarty Seth
Forster Sebastian
Fortin Marie
Fortnow Lance
Fox Kyle
Freksen Casper Benjamin
Friggstad Zachary
Fulla Peter
Furber Robert
Gadekar Ameet
Gagie Travis
Galanis Andreas
Galesi Nicola
Galletta Lillo
Gálvez Waldo
Gamlath Buddhima
Ganardi Moses
Gańczorz Michał
Ganguly Sumit
Garg Deepak
Garg Mohit
Gawrychowski Pawel
Ghica Dan
Ghorbal Khalil
Ghosh Arijit
Gimbert Hugo
Gmyr Robert
Gogacz Tomasz
Goharshady Amir Kafshadr
Goldberg Leslie Ann
Göller Stefan
Golovnev Alexander
Gopi Sivakanth
Goranci Gramoz
Gouleakis Themis
Grandoni Fabrizio
Green Larsen Kasper
Grenet Bruno
Grochow Joshua
Grohe Martin
Grossi Roberto
Gualà Luciano
Gudmundsson Joachim
Guerrieri Giulio
Guillon Pierre
Guo Heng
Gupta Anupam
Gupta Manoj
Gur Tom
Habermehl Peter
Hagerup Torben
Hamoudi Yassine
Hampson Christopher
Hanzlik Lucjan
Haque Abida
Harris David
Harsha Prahladh
Harvey Nick
Hatami Hamed
Heindel Tobias
Hendrian Diptarama
Hernández Vélez César
Hirahara Shuichi
Hirai Hiroshi
Hirvonen Åsa
Hirvonen Juho
Hitchcock John
Hoefer Martin
Hoeksma Ruben
Hofman Piotr
Holland Joshua
Holm Jacob
Horne Ross
Hosseini Kaave
Hoyrup Mathieu
Hsu Justin
Huang Chien-Chung
Hubáček Pavel
Huisman Marieke
Hunkenschröder Christoph
Husfeldt Thore
Ilcinkas David
Im Sungjin
Ismaili Anisse
Istrate Gabriel
Ivanyos Gabor
Ivkin Nikita
Jaiswal Ragesh
Jansen Klaus
Jayram T.S.
Jeandel Emmanuel
Jerrum Mark
Jeż Artur
Jeż Łukasz
Jiamjitrak Wanchote
Jiang Shaofeng
Jindal Gorav
Jordan Charles
Kalaitzis Christos
Kamali Shahin
Kamath Akshay
Kamma Lior
Kammer Frank
Kanj Iyad
Kannan Sampath
Kapralov Michael
Karczmarz Adam
Karpov Nikolai
Karrenbauer Andreas
Karthik C. S.
Katoen Joost-Pieter
Kawamura Akitoshi
Kazda Alexandr
Kelk Steven
Kempa Dominik
Khan Arindam
Khanna Sanjeev
Kiefer Stefan
Kim Eunjung
Kincaid Zachary
Kjos-Hanssen Bjørn
Klin Bartek
Klonowski Marek
Kobayashi Koji M.
Koivisto Mikko
Kokainis Martins
Kolesnichenko Ignat
Kolla Alexandra
Kollias Kostas
König Barbara
Konrad Christian
Kopelowitz Tsvi
Korhonen Janne H.
Korman Amos
Kothapalli Kishore
Kothari Robin
Koutecky Martin
Kowalik Łukasz
Kowalski Darek
Kozik Marcin
Kozma Laszlo
Kragl Bernhard
Král Karel

Kranakis Evangelos
Kraska Artur
Kretinsky Jan
Krokhin Andrei
Krysta Piotr
Kučera Antonín
Kufleitner Manfred
Kulkarni Janardhan
Kulkarni Pooja
Kulkarni Rucha
Kumar Amit
Künnemann Marvin
Kuperberg Denis
Kurpisz Adam
Kyng Rasmus
Laarhoven Thijs
Łącki Jakub
Laekhanukit Bundit
Lagerqvist Victor
Lamprou Ioannis
Lange Julien
Lanvin Victor
Lasota Sławomir
Laurent Monique
Lauria Massimo
Lazic Ranko
Lee David
Lee Euiwoong
Lehtinen Karoliina
Lengler Johannes
Lenzner Pascal
Leroux Jérôme
Leucci Stefano
Levy Jordi
Lewandowski Mateusz
Lhote Nathan
Li Jason
Li Shi
Li Yi
Lianeas Thanasis
Lin Bingkai
Lin Huijia
Liu Chih-Hung
Liu Yang
Livanos Vasilis
Löding Christof
Loff Bruno
Lohrey Markus
Lonsing Florian
Loreti Michele
Lovett Shachar
Lu Yuxuan
Lutz Jack H.
Mahadev Urmila
Mai Tung
Makarychev Konstantin
Makriyannis Nikolaos
Malyshev Dmitriy
Mamageishvili Akaki
Maneth Sebastian
Mansfield Shane
Manuel Amaldev
Manurangsi Pasin
Marcinkowski Jan
Marino Andrea
Markey Nicolas
Markou Euripides
Martin Barnaby
Martini Simone
Masařík Tomáš
Maslov Dmitri
Masopust Tomas
Mastrolilli Monaldo
Mathieu Claire
Mauras Simon
Mazowiecki Filip
McCauley Samuel
McGregor Andrew
Mehlhorn Kurt
Mehraban Saeed
Meirom Eli
Melissourgos Themistoklis
Merker Martin
Merkle Wolfgang
Mertzios George
Mery Daniel
Meyer Ulrich
Michail Othon
Michielini Vincent
Mihalák Matúš
Mikulas Szabolcs
Milovanov Alexey
Miltzow Till
Misra Neeldhara
Misra Pranabendu
Mitrovic Slobodan
Mitsou Valia
Mnich Matthias
Molla Anisur Rahaman
Molter Hendrik
Mömke Tobias
Monaco Gianpiero
Monien Burkhard
Montanaro Ashley
Morimae Tomoyuki
Moscardelli Luca
Moses Jr. William K.
Mottet Antoine
Mucha Marcin
Murlak Filip
Musco Cameron
Muzi Irene
Nagarajan Viswanath
Nandy Subhas
Naranayan Anand Kumar
Nederlof Jesper
Nelson Jelani
Neumann Stefan
Nies Andre
Nikoletseas Sotiris
Nolin Alexandre
Norman Gethin
Nusser André
O'Donnell Ryan
Ochremiak Joanna
Odor Gergely
Ohlmann Pierre
Okhotin Alexander
Okudono Takamasa
Oliveira Igor Carboni
Olivetti Dennis
Olver Neil
Omri Eran
Onak Krzysztof
Otachi Yota
Otop Jan
Oualhadj Youssouf
Paat Joseph
Padberg Julia
Padovani Luca
Padro Carles
Pagano Miguel
Pagh Rasmus
Pajak Dominik
Paluch Katarzyna
Pananjady Ashwin
Pandurangan Chandrasekharan
Panigrahi Debmalya
Panolan Fahad
Paperman Charles
Parikh Rohit
Parotsidis Nikos
Parter Merav
Parys Paweł
Paschos Vangelis
Patel Viresh
Patt-Shamir Boaz
Paul Christophe
Paulusma Daniel
Paz Ami
Pedersen Mathias Ruggaard
Penelle Vincent
Penna Paolo
Peressotti Marco
Perkins Will
Peters Kirstin
Petrisan Daniela
Petrucciani Tommaso
Piedeleu Robin
Pilipczuk Michał
Pinsker Michael
Pisanti Nadia
Pissis Solon
Place Thomas
Platzer André
Podolskii Vladimir
Popa Alexandru

Potapov Igor
Potechin Aaron
Pouly Amaury
Pous Damien
Pradic Pierre
Prakash Anupam
Pratap Rameshwar
Praveen M.
Probst Maximilian
Pruekprasert Sasinee
Pudlak Pavel
Puppis Gabriele
Purohit Manish
Qiao Youming
Quatmann Tim
Rabie Mikaël
Radhakrishnan Jaikumar
Radzik Tomasz
Rafiey Arash
Raghvendra Sharath
Raichel Benjamin
Raman Rajiv
Raman Venkatesh
Rampersad Narad
Raptopoulos Christoforos
Raskin Jean-Francois
Rasmussen Peter Michael Reichstein
Rathke Julian
Ravi R
Rawitz Dror
Ray Saurabh
Ray Chaudhury Bhaskar
Raymond Jean-Florent
Razgon Igor
Reiter Fabian
Riba Colin
Ricciotti Wilmer
Robinson Peter
Rodaro Emanuele
Roditty Liam
Rogers Ryan
Rojas Cristobal
Romashchenko Andrei
Romero Orth Miguel
Ron Dana
Rosa-Velardo Fernando
Rösner Clemens
Rossmanith Peter
Rote Günter
Roth Marc
Rothvoss Thomas
Roy Arnab
Roytman Alan
Rubin Natan
Rubinstein Aviad
Rzążewski Paweł
Saberi Amin
Sachdeva Sushant
Sadakane Kunihiko
Saivasan Prakash
Sajenko Andrej
Sala Pietro
Sandeep R.B.
Sanders Peter
Sanita Laura
Santos de Lima Murilo
Saranurak Thatchaphol
Saurabh Saket
Savani Rahul
Sawa Zdeněk
Schewior Kevin
Schmid Andreas
Schmid Laura
Schmidt Paweł
Schmitz Sylvain
Schmude Janusz
Schneider Jon
Schöpp Ulrich
Schwartz Roy
Schwiegelshohn Chris
Sebastien Labbe
Seddighin Saeed
Seeber Jens
Segoufin Luc
Selivanova Svetlana
Sen Sandeep
Serna Maria
Serrano Llerena Yamilet R.
Seshadhri C.
Seto Kazuhisa
Sgall Jiří
Sgouritsa Alkmini
Shahrasbi Amirbehshad
Shallit Jeffrey
Shalom Mordechai
Shayeghi Ala
Shen Alexander
Shi Jonathan
Shirmohammadi Masha
Siala Mohamed
Sickert Salomon
Sidford Aaron
Sidiropoulos Anastasios
Siebertz Sebastian
Sikora Jamie
Simon Hans
Simonov Kirill
Sitters Rene
Sivan Balasubramanian
Skopalik Alexander
Skretas George
Smal Alexander
Sokolov Dmitry
Sokolova Ana
Solomon Shay
Sorge Manuel
Sornat Krzysztof
Soto José A.
Spoerhase Joachim
Srinathan Kannan
Srinivasan Srikanth
Srivastava Piyush
Stachowiak Grzesiek
Stamatiou Yannis
Starikovskaya Tatiana
Starnberger Martin
Staton Sam
Stefanesco Léo
Stein Clifford
Sudo Yuichi
Sun Yihan
Sundaram Aarthi
Suresh Ananda Theertha
Syed Mohammad Meesum
T. Vasconcelos Vasco
Talbot Jean-Marc
Talebanfard Navid
Talmon Nimrod
Tamaki Suguru
Tamo Itzhak
Tamuz Omer
Tang Zhihao Gavin
Tavenas Sébastien
Teng Yifeng
Tesson Pascal
Thapen Neil
Thapper Johan
Thoma Daniel
Tini Simone
Tönnis Andreas
Tonoyan Tigran
Torres Vieira Hugo
Toth Csaba
Totzke Patrick
Touitou Noam
Traub Vera
Tribastone Mirco
Tsai Ming-Hsien
Tsakalidis Konstantinos
Tsikiridis Artem
Tulsiani Madhur
Turan Gyorgy
Turrini Andrea
Tzameret Iddo
Uitto Jara
Umboh Seeun William
Uniyal Sumedha
Urabe Natsuki
Uramoto Takeo
Uznański Przemysław
Vaikuntanathan Vinod
Vainstein Danny
Vakilian Ali
van Ee Martijn
van Iersel Leo
van Leeuwen Erik Jan
Van Oostrom Vincent

van Stee Rob
Vandin Fabio
Vargaftik Shay
Vargas Koch Laura
Vassilevska Williams Virginia
Vassilvitskii Sergei
Vaz Daniel
Vaze Rahul
Velan Dominik
Veltri Niccolò
Venturi Daniele
Vergnaud Damien
Vetta Adrian
Viglietta Giovanni
Vigny Alexandre
Villagra Marcos
Vinci Cosimo
Vinyals Marc
Vladu Adrian
von Gleissenthall Klaus
Vondrak Jan
Vorotnikova Sofya
Voudouris Alexandros
Vredeveld Tjark
Vusirikala Satyanarayana
Waga Masaki
Wahlström Magnus
Wang Joshua
Warode Philipp
Węgrzycki Karol
Weil Pascal
Weimann Oren
Wein Nicole
Wellnitz Philip
Weltge Stefan
Wiese Andreas
Wille Robert
Williams Ryan
Wimmer Karl
Winter Sarah
Wlodarczyk Michal
Worrell James
Wrochna Marcin
Wrona Michał
Wu David
Wu Steven
Wulff-Nilsen Christian
Xiao Mingyu
Xu Chao
Yamauchi Yukiko
Yao Penghui
Yingchareonthawornchai Sorrachai
Zamaraev Viktor
Zampetakis Manolis
Zandieh Amir
Zanuttini Bruno
Zarei Alireza
Zehavi Meirav
Zetzsche Georg
Zeume Thomas
Zhan Naijun
Zhong Fangwei
Zhou Linfeng
Zhou Zixin
Zhu Shufang
Živný Stanislav

List of Authors

Scott Aaronson (6)
Department of Computer Science, University of Texas at Austin, USA

Amir Abboud (7, 8)
IBM Almaden Research Center, California, USA

Mikkel Abrahamsen (9)
BARC, University of Copenhagen, Universitetsparken 1, DK-2100 Copenhagen, Denmark

Bader Abu Radi (100)
School of Computer Science and Engineering, The Hebrew University, Jerusalem, Israel

Peyman Afshani (10)
Computer Science Department, Aarhus University, Denmark

Akanksha Agrawal (11)
Ben-Gurion University of the Negev, Beersheba, Israel

Eleni C. Akrida (131)
Department of Computer Science, University of Liverpool, UK

Noga Alon (12)
Department of Mathematics, Princeton University, Princeton, NJ 08544, USA; Schools of Mathematics and Computer Science, Tel Aviv University, Tel Aviv 69978, Israel

Aris Anagnostopoulos (136)
Sapienza University of Rome, Italy

Bertie Ancona (13)
MIT, Cambridge, MA, USA

Alexandr Andoni (14, 15)
Columbia University, New York City, NY, USA

Anuja Meetoo Appavoo (149)
Department of Computer Science, National University of Singapore

Srinivasan Arunachalam (16)
Center for Theoretical Physics, MIT, Cambridge, MA, USA

Sepehr Assadi (17)
Department of Computer Science, Princeton University, NJ, USA

Pranjal Awasthi (18)
Rutgers University, Piscataway, NJ, USA

Kyriakos Axiotis (19)
MIT, Cambridge, MA, USA

Mohamed-Amine Baazizi (101)
Sorbonne Université, CNRS, LIP6 UMR 7606, Paris, France

Ainesh Bakshi (18)
Carnegie Mellon University, Pittsburgh, PA, USA

Nikhil Balaji (102)
University of Oxford, UK

Maria-Florina Balcan (18)
Carnegie Mellon University, Pittsburgh, PA, USA

Pablo Barceló (103, 104)
Department of Computer Science, University of Chile, Santiago, Chile; IMFD, Santiago, Chile

Yair Bartal (20)
Department of Computer Science, Hebrew University of Jerusalem, Israel

David Basin (127)
Department of Computer Science, ETH Zürich, Universitätstrasse 6, 8092, Switzerland

Paul C. Bell (105)
Department of Computer Science, Byrom Street, Liverpool John Moores University, Liverpool, L3-3AF, UK

Giulia Bernardini (21)
Department of Informatics, Systems and Communication, University of Milano - Bicocca, Italy

Ivona Bezáková (22)
Department of Computer Science, Rochester Institute of Technology, Rochester, NY, USA

Therese Biedl (23)
David R. Cheriton School of Computer Science, University of Waterloo, Canada

Andreas Björklund (24, 25, 26)
Lund University, Lund, Sweden

Mikołaj Bojańczyk (106)
Institute of Informatics, University of Warsaw, Poland

Matthias Bonne (132)
Department of Computer Science, Technion, Haifa, Israel

46th International Colloquium on Automata, Languages, and Programming (ICALP 2019).
Editors: Christel Baier, Ioannis Chatzigiannakis, Paola Flocchini, and Stefano Leonardi
Leibniz International Proceedings in Informatics
LIPICS Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany

Fernando G. S. L. Brandão (27)
Institute of Quantum Information and Matter, California Institute of Technology, USA

Raimundo Briceño (29)
School of Mathematical Sciences, Tel Aviv University, Tel Aviv 69978, Israel

Paul Brunet (107)
University College London, UK

Andrei A. Bulatov (29)
School of Computing Science, Simon Fraser University, Canada

Mark Bun (30)
Simons Institute for the Theory of Computing, Berkeley, CA, USA; Boston University, MA, USA

Angel A. Cantu (31)
Department of Computer Science, University of Texas - Rio Grande Valley, USA

Ioannis Caragiannis (133)
University of Patras & CTI "Diophantus", Patras, Greece

Titouan Carette (108)
Université de Lorraine, CNRS, Inria, LORIA, F 54000 Nancy, France

Katrin Casel (109)
Hasso Plattner Institute, University of Potsdam, Germany

Arnaud Casteigts (134)
LaBRI, Université de Bordeaux, CNRS, Bordeaux INP, France

Keren Censor-Hillel (132, 135)
Department of Computer Science, Technion, Haifa, Israel

Shantanav Chakraborty (33)
QuIC, Université libre de Bruxelles, Belgium

Sourav Chakraborty (16)
Indian Statistical Institute, Kolkata, India

Jérémie Chalopin (34)
CNRS, Aix-Marseille Université, Université de Toulon, LIS, Marseille, France

Arkadev Chattopadhyay (35)
School of Technology and Computer Science, Tata Institute of Fundamental Research, Mumbai, India

Shiri Chechik (12)
Blavatnik School of Computer Science, Tel Aviv University, Tel Aviv 69978, Israel

Xue Chen (36)
Northwestern University, Evanston, IL, USA

Kuan Cheng (37)
Department of Computer Science, Johns Hopkins University, USA

Siu-Wing Cheng (38)
Department of Computer Science and Engineering, HKUST, Hong Kong

Victor Chepoi (34)
Aix-Marseille Université, CNRS, Université de Toulon, LIS, Marseille, France

Mahdi Cheraghchi (39)
Department of Computing, Imperial College London, London, UK

Eden Chlamtáč (40)
Ben Gurion University of the Negev, Beersheva, Israel

Laura Ciobanu (110)
Heriot-Watt University, Edinburgh EH14 4AS, Scotland

Ilan R. Cohen (136)
CWI, Amsterdam, The Netherlands

Sarel Cohen (12)
Blavatnik School of Computer Science, Tel Aviv University, Tel Aviv 69978, Israel

Vincent Cohen-Addad (41, 42)
CNRS & Sorbonne Université, Paris, France

Amin Coja-Oghlan (43)
Goethe University, Frankfurt, Germany

Alexandru Cojocaru (6)
School of Informatics, University of Edinburgh, UK

Dario Colazzo (101)
Université Paris-Dauphine, PSL, LAMSADE, France

Thomas Colcombet (44)
IRIF, CNRS, Université Paris Diderot, France

Graham Cormode (45)
University of Warwick, UK

Jurek Czyzowicz (137)
Université du Québec en Outaouais, Gatineau, Québec, Canada

Ugo Dal Lago (111)
University of Bologna, Italy; INRIA Sophia Antipolis, France

Mina Dalirrooyfard (46, 47)
MIT, Cambridge, MA, USA

Víctor Dalmau (29)
Department of Information and Communication Technologies, Universitat Pompeu Fabra, Barcelona, Spain

Jacques Dark (45)
University of Warwick, UK

Anuj Dawar (112)
University of Cambridge, UK

Joel D. Day (109)
Department of Computer Science, Loughborough University, UK

Ronald de Wolf (16)
QuSoft, CWI and University of Amsterdam, The Netherlands

Argyrios Deligkas (138)
Department of Computer Science, University of Liverpool, Liverpool, UK; Leverhulme Research Centre for Functional Materials Design, Liverpool, UK

Holger Dell (113)
Cluster of Excellence (MMCI), Saarland Informatics Campus (SIC), Saarbrücken, Germany

Michael Dinitz (40)
Johns Hopkins University, Baltimore, MD, USA

Stefan Dobrev (139)
Institute of Mathematics, Slovak Academy of Sciences, Bratislava, Slovakia

Dani Dorfman (114)
Blavatnik School of Computer Science, Tel Aviv University, Israel

Ran Duan (48)
Institute for Interdisciplinary Information Sciences, Tsinghua University, Beijing, China

Guillaume Ducoffe (49)
National Institute for Research and Development in Informatics, Romania; The Research Institute of the University of Bucharest ICUB, Romania; University of Bucharest, Romania

Josep Díaz (50)
Computer Science Department, Universitat Politècnica de Catalunya, Barcelona

Julian Dörfler (51)
Saarland University, Saarbrücken, Germany

Talya Eden (52)
Tel Aviv University, Tel Aviv, Israel

Murray Elder (110)
University of Technology Sydney, Ultimo NSW 2007, Australia

Yuval Emek (140)
Faculty of Industrial Engineering and Management, Technion - IIT, Haifa, Israel

Alina Ene (53, 54)
Department of Computer Science, Boston University, MA, USA

Massimo Equi (55)
Department of Computer Science, University of Helsinki, Finland

Thomas Erlebach (141)
Department of Informatics, University of Leicester, Leicester, England

Kousha Etessami (115)
School of Informatics, University of Edinburgh, UK

Nova Fandina (20)
Department of Computer Science, Hebrew University of Jerusalem, Israel

Angelo Fanelli (133)
CNRS (UMR-6211), Caen, France

John Fearnley (56, 138)
University of Liverpool, UK

Michal Feldman (1)
Blavatnik School of Computer Science, Tel-Aviv University, Israel

Miron Ficak (57)
Theoretical Computer Science Department, Faculty of Mathematics and Computer Science, Jagiellonian University, Kraków, Poland

Diego Figueira (104)
CNRS & LaBRI, Talence, France

Yuval Filmus (35, 58)
Department of Computer Science, Technion Israel Institute of Technology, Haifa, Israel

Pamela Fleischmann (109)
Department of Computer Science, Kiel University, Germany

Fedor V. Fomin (11, 59, 60)
University of Bergen, Bergen, Norway

Marie Fortin (116)
LSV, CNRS & ENS Paris-Saclay, Université Paris-Saclay, France

Casper Benjamin Freksen (10)
Computer Science Department, Aarhus University, Denmark

Tobias Friedrich (61)
Algorithm Engineering Group, Hasso Plattner Institute, University of Potsdam, Germany

Andreas Galanis (22)
Department of Computer Science, University of Oxford, UK

Ankit Garg (62)
Microsoft Research India, Bangalore, India

Naveen Garg (63)
Computer Science and Engineering Department, Indian Institute of Technology, Delhi, India

Francesco Gavazzo (111)
IMDEA Software Institute, Spain

Dmitry Gavinsky (64)
Institute of Mathematics, Czech Academy of Sciences, 115 67 Žitna 25, Praha 1, Czech Republic

Paweł Gawrychowski (21)
Institute of Computer Science, University of Wrocław, Poland

Oliver Gebhard (43)
Goethe University, Frankfurt, Germany

Loukas Georgiadis (7)
University of Ioannina, Greece

Konstantinos Georgiou (137)
Department of Mathematics, Ryerson University, Toronto, Ontario, Canada

Mohsen Ghaffari (142)
ETH Zurich, Switzerland

Giorgio Ghelli (101)
Dipartimento di Informatica, Università di Pisa, Italy

Alexandru Gheorghiu (6)
Department of Computing and Mathematical Sciences, California Institute of Technology, USA; School of Informatics, University of Edinburgh, UK

Panos Giannopoulos (9)
giCenter, Department of Computer Science, City University of London, EC1V 0HB, London, UK

Seth Gilbert (149)
Department of Computer Science, National University of Singapore

András Gilyén (33, 99)
QuSoft/CWI, The Netherlands

Leslie Ann Goldberg (22)
Department of Computer Science, University of Oxford, UK

Paul W. Goldberg (65)
Department of Computer Science, University of Oxford, United Kingdom

Petr A. Golovach (59)
Department of Informatics, University of Bergen, Norway

Alexander Golovnev (66)
Harvard University, Cambridge, USA

Spencer Gordon (56)
California Institute of Technology, Pasadena, CA, USA

Alex B. Grilo (28)
CWI, Amsterdam, The Netherlands; QuSoft, Amsterdam, The Netherlands

Martin Grohe (2, 117)
RWTH Aachen University, Aachen, Germany

Roberto Grossi (55)
Dipartimento di Informatica, Università di Pisa, Italy

Erich Grädel (112)
RWTH Aachen University, Germany

Anupam Gupta (42, 63, 67)
Carnegie Mellon University, Pittsburgh, PA, USA

Nikhil Gupta (62)
Department of Computer Science and Automation, Indian Institute of Science, India

Siddharth Gupta (143)
Ben-Gurion University of the Negev, Israel

Guru Guruganesh (67)
Google Research, United States

Venkatesan Guruswami (68, 92)
Computer Science Department, Carnegie Mellon University, Pittsburgh, PA, USA

Bernhard Haeupler (144)
Carnegie Mellon University, Pittsburgh, PA, USA

Max Hahn-Klimroth (43)
Goethe University, Frankfurt, Germany

Lianna Hambardzumyan (58)
School of Computer Science, McGill University, Montreal, QC, Canada

Yassine Hamoudi (69)
Université de Paris, IRIF, CNRS, F-75013 Paris, France

Samuel Haney (70)
Duke University, Durham, NC, USA

Hamed Hatami (58)
School of Computer Science, McGill University, Montreal, QC, Canada

Pooya Hatami (58)
Department of Computer Science, UT Austin, Austin, TX, USA

Falko Hegerfeld (71)
Humboldt-Universität zu Berlin, Germany

Monika Henzinger (13)
University of Vienna, Austria

Alexandros Hollender (65)
Department of Computer Science, University of Oxford, United Kingdom

Chih-Duo Hong (103)
Department of Computer Science, University of Oxford, UK

Mehran Hosseini (118)
Department of Computer Science, University of Oxford, UK

Pavel Hrubeš (72)
Institute of Mathematics of ASCR, Prague

Zhiyi Huang (73)
The University of Hong Kong

Christian Ikenmeyer (51)
Max Planck Institute for Software Systems, Saarbrücken, Germany

Rahul Ilango (66)
Rutgers University, New Brunswick, USA

Sungjin Im (145)
University of California at Merced, USA

Russell Impagliazzo (66)
University of California San Diego, USA

Giuseppe F. Italiano (7)
LUISS University, Rome, Italy

Klaus Jansen (74, 75)
Department of Computer Science, Christian-Albrechts-Universität, Kiel, Germany

Emmanuel Jeandel (108)
Université de Lorraine, CNRS, Inria, LORIA, F 54000 Nancy, France

Stacey Jeffery (33)
QuSoft/CWI, The Netherlands

Ce Jin (48, 76)
Institute for Interdisciplinary Information Sciences, Tsinghua University, Beijing, China

Lingfei Jin (68)
Shanghai Key Laboratory of Intelligent Information Processing, School of Computer Science, Fudan University, Shanghai, China; Shanghai Institute of Intelligent Electronics & Systems, Shanghai, China; Shanghai Bolckchain Engineering Research Center, Fudan University, Shanghai 200433, China

Zhengzhong Jin (37)
Department of Computer Science, Johns Hopkins University, USA

Valentine Kabanets (39, 66)
Simon Fraser University, Burnaby, Canada

Amir Kalev (27)
Joint Center for Quantum Information and Computer Science, University of Maryland, USA

Lior Kamma (10)
Computer Science Department, Aarhus University, Denmark

Frank Kammer (141)
THM, University of Applied Sciences Mittelhessen, Giessen, Germany

Haim Kaplan (114)
Blavatnik School of Computer Science, Tel Aviv University, Israel

Elham Kashefi (6)
School of Informatics, University of Edinburgh, UK; CNRS LIP6, Université Pierre et Marie Curie, Paris, France

Petteri Kaski (26)
Department of Computer Science, Aalto University, Finland

Neeraj Kayal (62)
Microsoft Research India, Bangalore, India

Sandra Kiefer (106, 117)
Department of Computer Science, RWTH Aachen University, Germany

Stefan Kiefer (102, 119)
University of Oxford, UK

Ryan Killick (137)
School of Computer Science, Carleton University, Ottawa, Ontario, Canada

Philipp Kindermann (23)
Lehrstuhl für Informatik I, Universität Würzburg, Germany

Lefteris Kirousis (50)
Department of Mathematics, National and Kapodistrian University of Athens; Computer Science Department, Universitat Politècnica de Catalunya, Barcelona

Tomasz Kociumaka (109)
Department of Computer Science, Bar-Ilan University, Ramat Gan, Israel; Institute of Informatics, University of Warsaw, Poland

Sofia Kokonezi (50)
Department of Mathematics, National and Kapodistrian University of Athens

Vladimir Kolmogorov (77)
Institute of Science and Technology Austria, Klosterneuburg, Austria

Antonina Kolokolova (66)
Memorial University of Newfoundland, St. John's, Canada

Christian Konrad (45)
University of Bristol, UK

Amos Korman (146)
Université de Paris, IRIF, CNRS, F-75013 Paris, France

Sajin Koroth (35)
Department of Computer Science, University of Haifa, Haifa, Israel

Adrian Kosowski (143)
Inria, Paris, France

Dariusz R. Kowalski (147)
Department of Computer Science, University of Liverpool, UK; SWPS University of Social Sciences and Humanities, Warsaw, Poland

Marcin Kozik (57)
Theoretical Computer Science Department, Faculty of Mathematics and Computer Science, Jagiellonian University, Kraków, Poland

Evangelos Kranakis (137)
School of Computer Science, Carleton University, Ottawa, Ontario, Canada

Stefan Kratsch (71)
Humboldt-Universität zu Berlin, Germany

Robert Krauthgamer (7)
Weizmann Institute of Science, Israel

Danny Krizanc (137)
Department of Mathematics & Comp. Sci., Wesleyan University, Middletown, CT, USA

Fabian Kuhn (144)
University of Freiburg, Germany

Amit Kumar (42, 63)
IIT Delhi, India

Mrinal Kumar (78)
University of Toronto, Canada

Orna Kupferman (100)
School of Computer Science and Engineering, The Hebrew University, Jerusalem, Israel

Adam Kurpisz (79)
ETH Zürich, Department of Mathematics, Rämistrasse 101, 8092 Zürich, Switzerland

William Kuszmaul (80)
Massachusetts Institute of Technology, Cambridge, USA

Shay Kutten (140)
Faculty of Industrial Engineering and Management, Technion - IIT, Haifa, Israel

Manuel Lafond (137)
Department of Computer Science, Université de Sherbrooke, Sherbrooke, Québec, Canada

Benoît Larose (29)
LACIM, Université du Québec a Montréal, Montréal, Canada

Kasper Green Larsen (10)
Computer Science Department, Aarhus University, Denmark

Alexandra Lassota (75)
Department of Computer Science, Kiel University, Kiel, Germany

Ron Lavi (140)
Faculty of Industrial Engineering and Management, Technion - IIT, Haifa, Israel

Xuan-Bach Le (103)
Department of Computer Science, University of Oxford, UK

Euiwoong Lee (42)
New York University, NY, USA

Troy Lee (16, 64)
Centre for Quantum Software and Information, School of Software, Faculty of Engineering and Information Technology, University of Technology Sydney, Australia

Stefano Leonardi (136)
Sapienza University of Rome, Italy

Nathan Lhote (106)
Institute of Informatics, University of Warsaw, Poland

Jason Li (41, 42)
Carnegie Mellon University, Pittsburgh, PA, USA

Tongyang Li (27)
Joint Center for Quantum Information and Computer Science, University of Maryland, USA

Xin Li (37)
Department of Computer Science, Johns Hopkins University, USA

Mehraneh Liaee (70)
Northeastern University, Boston, MA, USA

Anthony W. Lin (103)
Technische Universität Kaiserslautern, Germany

Bingkai Lin (81)
National Institute of Informatics, Tokyo, Japan; Nanjing University, Nanjing, China

Cedric Yen-Yu Lin (27)
Joint Center for Quantum Information and Computer Science, University of Maryland, USA

John Livieratos (50)
Department of Mathematics, National and Kapodistrian University of Athens

Philipp Loick (43)
Goethe University, Frankfurt, Germany

Daniel Lokshtanov (11, 24, 59, 60)
University of California Santa Barbara, Santa Barbara, California

Zhenjian Lu (39)
School of Computing Science, Simon Fraser University, Burnaby, BC, Canada

Austin Luchsinger (31)
Department of Computer Science, University of Texas - Rio Grande Valley, USA

Kelin Luo (141)
School of Management, Xi'an Jiaotong University, Xianning West Road, Xi'an, China

Christof Löding (120)
RWTH Aachen University, Ahornstr. 55, 52074 Aachen, Germany

Maarten Löffler (9)
Department of Information and Computing Sciences, Utrecht University, The Netherlands

Bruce M. Maggs (70)
Duke University, Durham, NC, USA; Akamai Technologies, Cambridge, MA, USA

Frédéric Magniez (69)
Université de Paris, IRIF, CNRS, F-75013 Paris, France

Tal Malkin (15)
Columbia University, New York City, NY, USA

Frederik Mallmann-Trenn (148)
MIT, CSAIL, Cambridge, MA, US

Nikhil S. Mande (30)
Georgetown University, Washington, DC, USA

Florin Manea (109)
Department of Computer Science, Kiel University, Germany

Yuchen Mao (38)
Department of Computer Science and Engineering, HKUST, Hong Kong

Emanuel Martinov (115)
School of Informatics, University of Edinburgh, UK

Anders Martinsson (144)
ETH Zurich, Switzerland

Jannik Matuschke (82)
Research Center for Operations Management, KU Leuven, Leuven, Belgium

Yannic Maus (148)
Department of Computer Science, Technion, Haifa, Israel,

Richard Mayr (119)
University of Edinburgh, UK

Ruta Mehta (56)
University of Illinois at Urbana-Champaign, IL, USA

Or Meir (35)
Department of Computer Science, University of Haifa, Haifa, Israel

Themistoklis Melissourgos (138)
Department of Computer Science, University of Liverpool, Liverpool, UK

Arturo I. Merino (83)
Dept. of Mathematical Engineering and CMM, Universidad de Chile & UMI-CNRS 2807, Santiago, Chile

Ian Mertz (84)
University of Toronto, Canada

George B. Mertzios (131)
Department of Computer Science, Durham University, UK

Stefan Milius (130)
Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

Eyal Mizrachi (85)
Computer Science Department, Technion, Haifa 32000, Israel

Antonio Molina Lovett (121)
University of Waterloo, Canada

Shay Moran (34)
Department of Computer Science, Princeton University, Princeton, USA

Benjamin Moseley (86, 145)
Carnegie Mellon University, Pittsburgh, PA, USA

William K. Moses Jr. (140)
Faculty of Industrial Engineering and Management, Technion - IIT, Haifa, Israel

Miguel A. Mosteiro (147)
Computer Science Department, Pace University, New York, NY, USA

Anca Muscholl (122)
LaBRI, University of Bordeaux, France

Nabil H. Mustafa (87)
Université Paris-Est, Laboratoire d'Informatique Gaspard-Monge, ESIEE Paris, France

Dimitrios Myrisiotis (39)
Department of Computing, Imperial College London, London, UK

Veli Mäkinen (55)
Department of Computer Science, University of Helsinki, Finland

Joseph (Seffi) Naor (88)
Technion, Haifa, Israel

Lata Narayanan (137, 139)
Department of Comp. Sci. and Software Eng., Concordia University, Montreal, Québec, Canada

Sivaramakrishnan Natarajan Ramamoorthy (72)
Paul G. Allen School of Computer Science & Engineering, University of Washington, USA

Ofer Neiman (20)
Department of Computer Science, Ben-Gurion University of the Negev, Beer-Sheva, Israel

Huy L. Nguyen (53, 54)
College of Computer and Information Science, Northeastern University, Boston, MA, USA

Lê Thành Dũng Nguyễn (123)
LIPN, UMR 7030 CNRS, Université Paris 13, Sorbonne Paris Cité, France

Sotiris Nikoletseas (131)
Computer Engineering & Informatics Department, University of Patras, and CTI, Greece

Reino Niskanen (103)
Department of Computer Science, University of Oxford, UK

Negev Shekel Nosatzki (15)
Columbia University, New York City, NY, USA

Petr Novotný (102)
Masaryk University, Brno, Czech Republic

Shunhao Oh (149)
Department of Computer Science, National University of Singapore

Igor Carboni Oliveira (32)
Department of Computer Science, University of Oxford, UK

Rafael Oliveira (78)
University of Toronto, Canada

Miroslav Olšák (57)
Department of Algebra, Charles University, Prague, Czech Republic

Jaroslav Opatrny (137, 139)
Department of Comp. Sci. and Software Eng., Concordia University, Montreal, Québec, Canada

Joël Ouaknine (44, 118)
The Max Planck Institute for Software Systems, Saarbrücken, Germany; Department of Computer Science, University of Oxford, United Kingdom

Dominik Pajak (148)
Faculty of Fundamental Problems of Technology, Wroclaw University of Science and Technology, Poland; Tooploox, Wroclaw, Poland

Wied Pakusa (112)
RWTH Aachen University, Germany

Konstantinos Panagiotou (90)
LMU München, Germany

Debmalya Panigrahi (70)
Duke University, Durham, NC, USA

Denis Pankratov (139)
Department of CSSE, Concordia University, Montreal, Canada

Fahad Panolan (60)
University of Bergen, Norway

Greta Panova (51)
University of Southern Californa, Los Angeles, CA, USA; University of Pennsylvania, Philadelphia, PA, USA

Manaswi Paraashar (16)
Indian Statistical Institute, Kolkata, India

Nikos Parotsidis (7)
University of Copenhagen, Denmark

Merav Parter (89)
Weizmann IS, Rehovot, Israel

Matija Pasch (90)
LMU München, Germany

Binghui Peng (67)
Tsinghua University, China

Simon Perdrix (108)
Université de Lorraine, CNRS, Inria, LORIA, F 54000 Nancy, France

Joseph G. Peters (134)
School of Computing Science, Simon Fraser University, Canada

Kalina Petrova (144)
ETH Zurich, Switzerland

Pascal Pfister (144)
ETH Zurich, Switzerland

Matthieu Picantin (124)
IRIF UMR 8243 CNRS & Univ Paris Diderot, 75013 Paris, France

Jean-Éric Pin (125)
IRIF, Université Paris Denis Diderot, CNRS - Case 7014 - F-75205 Paris Cedex 13, France

Anton Pirogov (120)
RWTH Aachen University, Ahornstr. 55, 52074 Aachen, Germany

Nadia Pisanti (21)
Department of Computer Science, University of Pisa, Italy; ERABLE Team, INRIA, France

Solon P. Pissis (21)
CWI, Amsterdam, The Netherlands

Toniann Pitassi (35, 84)
Department of Computer Science, University of Toronto, Canada

Thomas Place (126)
Univ. Bordeaux, CNRS, Bordeaux INP, LaBRI, UMR 5800, F-33400, Talence and IUF, France

Pierre Pradic (123)
ENS de Lyon, Université de Lyon, LIP, France; University of Warsaw, Faculty of Mathematics, Informatics and Mechanics, Poland

Eric Price (36)
The University of Texas at Austin, USA

Kirk Pruhs (145)
University of Pittsburgh, PA, USA

Gabriele Puppis (122)
CNRS, LaBRI, Bordeaux, France

Manish Purohit (145)
Google, Mountain View, CA, USA

Guillermo A. Pérez (102)
University of Antwerp, Belgium

Mikaël Rabie (135)
IRIF, Université de Paris, France; Aalto University, Finland

Akbar Rafiey (91)
Department of Computing Science, Simon Fraser University, Burnaby, Canada

Arash Rafiey (91)
Indiana State University, Terre Haute, IN, USA; Simon Fraser University, Burnaby, Canada

Rajmohan Rajaraman (70)
Northeastern University, Boston, MA, USA

Anup Rao (72)
Paul G. Allen School of Computer Science & Engineering, University of Washington, USA

Christoforos Raptopoulos (131)
Computer Engineering & Informatics Department, University of Patras, and CTI, Greece

Martin Raszyk (127)
Department of Computer Science, ETH Zürich, Universitätstrasse 6, 8092, Switzerland

Christophe Reutenauer (125)
Mathématiques, Université du Québec à Montréal, CP 8888, succ. Centre Ville, Canada H3C 3P8

Pierre-Alain Reynier (128)
Aix Marseille Univ, Université de Toulon, CNRS, LIS, Marseille, France

Andrii Riazanov (92)
Computer Science Department, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, USA, 15213

Thomas Robinson (40)
Ben Gurion University of the Negev, Beersheva, Israel

Yoav Rodeh (146)
Ort Braude College, Karmiel, Israel

Liam Roditty (13)
Bar Ilan University, Ramat Gan, Israel

Lars Rohwedder (74, 75)
Department of Computer Science, Christian-Albrechts-Universität, Kiel, Germany

Miguel Romero (104)
Department of Computer Science, University of Oxford, Oxford, UK

Dana Ron (52)
Tel Aviv University, Tel Aviv, Israel

Will Rosenbaum (52)
Max Planck Institute for Informatics, Saarbrücken, Germany

Giovanna Rosone (21)
Department of Computer Science, University of Pisa, Italy

Günter Rote (9)
Institut für Informatik, Freie Universität Berlin, Takustraße 9, 14195 Berlin, Germany

Marc Roth (113)
Cluster of Excellence (MMCI), Saarland Informatics Campus (SIC), Saarbrücken, Germany

Ralf Rothenberger (61)
Algorithm Engineering Group, Hasso Plattner Institute, University of Potsdam, Germany

Chandan Saha (62)
Department of Computer Science and Automation, Indian Institute of Science, India

Andrej Sajenko (141)
THM, University of Applied Sciences Mittelhessen, Giessen, Germany

Miklos Santha (64)
CNRS, IRIF, Université de Paris, 75205 Paris, France; Centre for Quantum Technologies, National University of Singapore, Singapore 117543; MajuLab, UMI 3654, Singapore

Thiago Santos (91)
Indiana State University, Terre Haute, IN, USA

Swagato Sanyal (64)
Indian Institute of Technology Kharagpur, India

Ramprasad Saptharishi (78)
Tata Institute of Fundamental Research

Carlo Sartiani (101)
DIMIE, Università della Basilicata - Potenza, Italy

Thomas Sauerwald (93)
Department of Computer Science and Technology, University of Cambridge, United Kingdom

Saket Saurabh (11, 24, 59, 60)
Institute of Mathematical Sciences, HBNI and UMI ReLaX Chennai, India; University of Bergen, Bergen, Norway

Rahul Savani (56)
University of Liverpool, UK

Ali Sayyadi (142)
Sharif University of Technology, Iran

Christian Scheideler (150)
Paderborn University, Germany

Daniel Schmand (151)
Goethe University Frankfurt, Germany

Markus L. Schmid (109)
Trier University, Germany

Ulrike Schmidt-Kraepelin (82)
Institute of Software Engineering and Theoretical Computer Science, TU Berlin, Berlin, Germany

Sylvain Schmitz (129)
LSV, ENS Paris Saclay & CNRS, Université Paris-Saclay, France; IUF, France

Jason Schoeters (134)
LaBRI, Université de Bordeaux, CNRS, Bordeaux INP, France

Marc Schröder (151)
RWTH Aachen University, Germany

Roy Schwartz (85)
Computer Science Department, Technion, Haifa 32000, Israel

Robert Schweller (31)
Department of Computer Science, University of Texas - Rio Grande Valley, USA

Pavel Semukhin (44)
Department of Computer Science, University of Oxford, United Kingdom

Alexander Setzer (150)
Paderborn University, Germany

Jeffrey Shallit (121)
University of Waterloo, Canada

Sunil Shende (137)
Department of Computer Science, Rutgers University, Camden, NJ, USA

Mahsa Shirmohammadi (102, 119)
CNRS, Paris, France; IRIF, Paris, France

Alexandra Silva (107)
University College London, UK

Sahil Singla (63)
Princeton University and Institute for Advanced Study, USA

Alexander Skopalik (151)
University of Twente, Netherlands

Shay Solomon (17)
School of Electrical Engineering, Tel Aviv University, Israel

José A. Soto (83)
Dept. of Mathematical Engineering and CMM, Universidad de Chile & UMI-CNRS 2807, Santiago, Chile

Paul G. Spirakis (131, 138)
Department of Computer Science, University of Liverpool, UK; Computer Engineering & Informatics Department, University of Patras, Greece

Joachim Spoerhase (85)
Department of Computer Science, Aalto University, Espoo, Finland

Jakob T. Spooner (141)
Department of Informatics, University of Leicester, Leicester, England

Szymon Stankiewicz (57)
Theoretical Computer Science Department, Faculty of Mathematics and Computer Science, Jagiellonian University, Kraków, Poland

Clifford Stein (14)
Columbia University, New York City, NY, USA

Alistair Stewart (115)
Department of Computer Science, University of Southern California, Los Angeles, CA, USA

Xiaoming Sun (94)
CAS Key Lab of Network Data Science and Technology, Institute of Computing Technology, Chinese Academy of Sciences, Beijing, China; University of Chinese Academy of Sciences, Beijing, China

Ravi Sundaram (70)
Northeastern University, Boston, MA, USA

Ola Svensson (3)
EPFL, Lausanne, Switzerland

Krysta M. Svore (27)
Station Q, Quantum Architectures and Computation Group, Microsoft Research, USA

Avishay Tal (66)
Stanford University, USA

Prafullkumar Tale (11)
Institute of Mathematical Sciences, HBNI, Chennai, India

Justin Thaler (30)
Georgetown University, Washington, DC, USA

Mikkel Thorup (95)
Department of Computer Science, University of Copenhagen, Denmark

Alexandru I. Tomescu (55)
Department of Computer Science, University of Helsinki, Finland

Patrick Totzke (119)
University of Liverpool, UK

Ohad Trabelsi (7)
Weizmann Institute of Science, Israel

Dmitriy Traytel (127)
Department of Computer Science, ETH Zürich, Universitätstrasse 6, 8092, Switzerland

Christos Tzamos (19)
University of Wisconsin-Madison, USA

Seeun William Umboh (88)
The University of Sydney, Australia

Sumedha Uniyal (85)
Department of Computer Science, Aalto University, Espoo, Finland

Henning Urbat (130)
Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

Przemysław Uznański (7)
University of Wrocław, Poland

Frits Vaandrager (4)
Department of Software Science, Radboud University, The Netherlands

Joran van Apeldoorn (99)
QuSoft, CWI, The Netherlands

José Verschae (82)
Institute of Engineering Sciences, Universidad de O'Higgins, Rancagua, Chile

Laurent Viennot (143)
Inria, Paris, France

Didier Villevalois (128)
Aix Marseille Univ, Université de Toulon, CNRS, LIS, Marseille, France

Renaud Vilmart (108)
Université de Lorraine, CNRS, Inria, LORIA, F 54000 Nancy, France

Nikhil Vyas (46, 47)
MIT, Cambridge, MA, USA

David Wajc (67)
Carnegie Mellon University, Pittsburgh, PA, USA

Manfred K. Warmuth (34)
Computer Science Department, University of California, Santa Cruz, USA

Thomas Watson (96)
University of Memphis, Memphis, TN, USA

Yuanhao Wei (84)
Carnegie Mellon University, Pittsburgh, PA, USA

Nicole Wein (13, 46, 47)
MIT, Cambridge, MA, USA

Philip Wellnitz (113)
Max Planck Institute for Informatics, Saarland Informatics Campus (SIC), Saarbrücken, Germany

Colin White (18)
Carnegie Mellon University, Pittsburgh, PA, USA

Ryan Williams (25, 26)
Department of Electrical Engineering and Computer Science & CSAIL, MIT, Cambridge, MA, USA

Virginia Vassilevska Williams (13, 46, 47)
MIT, Cambridge, MA, USA

David P. Williamson (88)
Cornell University, Ithaca, NY, USA

Daniel Wolleb-Graf (7)
ETH Zürich, Switzerland

David P. Woodruff (18, 94, 97)
Carnegie Mellon University, Pittsburgh, PA, USA

James Worrell (44, 118)
Department of Computer Science, University of Oxford, United Kingdom

Hongxun Wu (48)
Institute for Interdisciplinary Information Sciences, Tsinghua University, Beijing, China

Ke Wu (37)
Department of Computer Science, Johns Hopkins University, USA

Xiaodi Wu (27)
Joint Center for Quantum Information and Computer Science, University of Maryland, USA

Tim Wylie (31)
Department of Computer Science, University of Texas - Rio Grande Valley, USA

Chaoping Xing (68, 98)
School of Physical and Mathematical Sciences, Nanyang Technological University, Singapore

Yinzhan Xu (46)
MIT, Cambridge, MA, USA

Guang Yang (94, 97)
Institute of Computing Technology, Chinese Academy of Sciences, Beijing, China; Conflux, Beijing, China

Mihalis Yannakakis (5, 115)
Department of Computer Science, Columbia University, New York City, NY, USA

Amir Yehudayoff (72)
Department of Mathematics, Technion-IIT, Haifa, Israel

Eylon Yogev (89)
Technion, Haifa, Israel

Akira Yoshimizu (111)
INRIA Sophia Antipolis, France

Yuancheng Yu (46)
MIT, Cambridge, MA, USA

Chen Yuan (98)
Centrum Wiskunde & Informatica, Amsterdam, The Netherlands

Viktor Zamaraev (131)
Department of Computer Science, Durham University, UK

Or Zamir (95)
Blavatnik School of Computer Science, Tel Aviv University, Israel

Luca Zanetti (93)
Department of Computer Science and Technology, University of Cambridge, United Kingdom

Meirav Zehavi (24, 59, 60)
Ben-Gurion University, Beersheba, Israel

Marc Zeitoun (126)
Univ. Bordeaux, CNRS, Bordeaux INP, LaBRI, UMR 5800, F-33400, Talence, France

Jialin Zhang (94)
CAS Key Lab of Network Data Science and Technology, Institute of Computing Technology, Chinese Academy of Sciences, Beijing, China; University of Chinese Academy of Sciences, Beijing, China

Peilin Zhong (14)
Columbia University, New York City, NY, USA

Xue Zhu (73)
The University of Hong Kong

David Zuckerman (58)
Department of Computer Science, UT Austin, Austin, TX, USA

Uri Zwick (95, 114)
Blavatnik School of Computer Science, Tel Aviv University, Israel

Jakub Łącki (136)
Google Research, New York, USA

Daniel Štefankovič (22)
Department of Computer Science, University of Rochester, Rochester, NY, USA