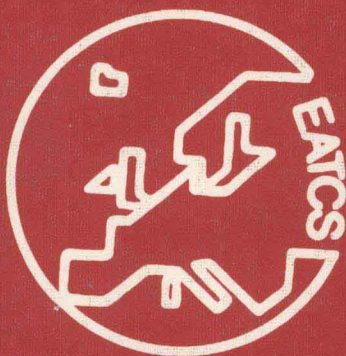


Susanne Albers
Tomasz Radzik (Eds.)

LNCS 3221

Algorithms – ESA 2004

12th Annual European Symposium
Bergen, Norway, September 2004
Proceedings



Springer

Susanne Albers Tomasz Radzik (Eds.)

Algorithms – ESA 2004

12th Annual European Symposium
Bergen, Norway, September 14-17, 2004
Proceedings

Volume Editors

Susanne Albers

Albert-Ludwigs-Universität Freiburg

Institut für Informatik

Georges-Köhler-Allee 79, 79110 Freiburg, Germany

E-mail: salbers@informatik.uni-freiburg.de

Tomasz Radzik

King's College London

Department of Computer Science

London WC2R 2LS, UK

E-mail: radzik@dcs.kcl.ac.uk

Library of Congress Control Number: 2004111289

CR Subject Classification (1998): F.2, G.1-2, E.1, F.1.3, I.3.5, C.2.4, E.5

ISSN 0302-9743

ISBN 3-540-23025-4 Springer Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

Springer is a part of Springer Science+Business Media

springeronline.com

© Springer-Verlag Berlin Heidelberg 2004

Printed in Germany

Typesetting: Camera-ready by author, data conversion by PTP-Berlin, Protago-TeX-Production GmbH

Printed on acid-free paper SPIN: 11319627 06/3142 5 4 3 2 1 0

Commenced Publication in 1973

Founding and Former Series Editors:

Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board

David Hutchison

Lancaster University, UK

Takeo Kanade

Carnegie Mellon University, Pittsburgh, PA, USA

Josef Kittler

University of Surrey, Guildford, UK

Jon M. Kleinberg

Cornell University, Ithaca, NY, USA

Friedemann Mattern

ETH Zurich, Switzerland

John C. Mitchell

Stanford University, CA, USA

Moni Naor

Weizmann Institute of Science, Rehovot, Israel

Oscar Nierstrasz

University of Bern, Switzerland

C. Pandu Rangan

Indian Institute of Technology, Madras, India

Bernhard Steffen

University of Dortmund, Germany

Madhu Sudan

Massachusetts Institute of Technology, MA, USA

Demetri Terzopoulos

New York University, NY, USA

Doug Tygar

University of California, Berkeley, CA, USA

Moshe Y. Vardi

Rice University, Houston, TX, USA

Gerhard Weikum

Max-Planck Institute of Computer Science, Saarbruecken, Germany

Lecture Notes in Computer Science

For information about Vols. 1–3112

please contact your bookseller or Springer

Vol. 3241: D. Kranzlmüller (Ed.), *Recent Advances in Parallel Virtual Machine and Message Passing Interface*. XIII, 452 pages. 2004.

Vol. 3240: I. Jonassen, J. Kim (Eds.), *Algorithms in Bioinformatics*. IX, 476 pages. 2004. (Subseries LNBI).

Vol. 3232: R. Heery, L. Lyon (Eds.), *Research and Advanced Technology for Digital Libraries*. XV, 528 pages. 2004.

Vol. 3224: E. Jonsson, A. Valdes, M. Almgren (Eds.), *Recent Advances in Intrusion Detection*. XII, 315 pages. 2004.

Vol. 3223: K. Slind, A. Bunker, G. Gopalakrishnan (Eds.), *Theorem Proving in Higher Order Logic*. VIII, 337 pages. 2004.

Vol. 3221: S. Albers, T. Radzik (Eds.), *Algorithms – ESA 2004*. XVIII, 836 pages. 2004.

Vol. 3220: J.C. Lester, R.M. Vicari, F. Paraguaçu (Eds.), *Intelligent Tutoring Systems*. XXI, 920 pages. 2004.

Vol. 3210: J. Marcinkowski, A. Tarlecki (Eds.), *Computer Science Logic*. XI, 520 pages. 2004.

Vol. 3208: H.J. Ohlbach, S. Schaffert (Eds.), *Principles and Practice of Semantic Web Reasoning*. VII, 165 pages. 2004.

Vol. 3207: L.T. Jang, M. Guo, G.R. Gao, N.K. Jha, *Embedded and Ubiquitous Computing*. XX, 1116 pages. 2004.

Vol. 3206: P. Sojka, I. Kopecek, K. Pala (Eds.), *Text, Speech and Dialogue*. XIII, 667 pages. 2004. (Subseries LNAI).

Vol. 3205: N. Davies, E. Mynatt, I. Siio (Eds.), *UbiComp 2004: Ubiquitous Computing*. XVI, 452 pages. 2004.

Vol. 3203: J. Becker, M. Platzner, S. Vernalde (Eds.), *Field Programmable Logic and Application*. XXX, 1198 pages. 2004.

Vol. 3202: J.-F. Boulicaut, F. Esposito, F. Giannotti, D. Pedreschi (Eds.), *Knowledge Discovery in Databases: PKDD 2004*. XIX, 560 pages. 2004. (Subseries LNAI).

Vol. 3201: J.-F. Boulicaut, F. Esposito, F. Giannotti, D. Pedreschi (Eds.), *Machine Learning: ECML 2004*. XVIII, 580 pages. 2004. (Subseries LNAI).

Vol. 3199: H. Schepers (Ed.), *Software and Compilers for Embedded Systems*. X, 259 pages. 2004.

Vol. 3198: G.-J. de Vreede, L.A. Guerrero, G. Marín Raventós (Eds.), *Groupware: Design, Implementation and Use*. XI, 378 pages. 2004.

Vol. 3194: R. Camacho, R. King, A. Srinivasan (Eds.), *Inductive Logic Programming*. XI, 361 pages. 2004. (Subseries LNAI).

Vol. 3193: P. Samarati, P. Ryan, D. Gollmann, R. Molva (Eds.), *Computer Security – ESORICS 2004*. X, 457 pages. 2004.

Vol. 3192: C. Bussler, D. Fensel (Eds.), *Artificial Intelligence: Methodology, Systems, and Applications*. XIII, 522 pages. 2004. (Subseries LNAI).

Vol. 3190: Y. Luo (Ed.), *Cooperative Design, Visualization, and Engineering*. IX, 248 pages. 2004.

Vol. 3189: P.-C. Yew, J. Xue (Eds.), *Advances in Computer Systems Architecture*. XVII, 598 pages. 2004.

Vol. 3186: Z. Bellahsene, T. Milo, M. Rys, D. Suciu, R. Unland (Eds.), *Database and XML Technologies*. X, 235 pages. 2004.

Vol. 3185: M. Bernardo, F. Corradini (Eds.), *Formal Methods for the Design of Real-Time Systems*. VII, 295 pages. 2004.

Vol. 3184: S. Katsikas, J. Lopez, G. Pernul (Eds.), *Trust and Privacy in Digital Business*. XI, 299 pages. 2004.

Vol. 3183: R. Traunmüller (Ed.), *Electronic Government*. XIX, 583 pages. 2004.

Vol. 3182: K. Bauknecht, M. Bichler, B. Pröll (Eds.), *E-Commerce and Web Technologies*. XI, 370 pages. 2004.

Vol. 3181: Y. Kambayashi, M. Mohania, W. Wöß (Eds.), *Data Warehousing and Knowledge Discovery*. XIV, 412 pages. 2004.

Vol. 3180: F. Galindo, M. Takizawa, R. Traunmüller (Eds.), *Database and Expert Systems Applications*. XXI, 972 pages. 2004.

Vol. 3179: F.J. Perales, B.A. Draper (Eds.), *Articulated Motion and Deformable Objects*. XI, 270 pages. 2004.

Vol. 3178: W. Jonker, M. Petkovic (Eds.), *Secure Data Management*. VIII, 219 pages. 2004.

Vol. 3177: Z.R. Yang, H. Yin, R. Everson (Eds.), *Intelligent Data Engineering and Automated Learning – IDEAL 2004*. XVIII, 852 pages. 2004.

Vol. 3176: O. Bousquet, U. von Luxburg, G. Rätsch (Eds.), *Advanced Lectures on Machine Learning*. VIII, 241 pages. 2004. (Subseries LNAI).

Vol. 3175: C.E. Rasmussen, H.H. Bühlhoff, B. Schölkopf, M.A. Giese (Eds.), *Pattern Recognition*. XVIII, 581 pages. 2004.

Vol. 3174: F. Yin, J. Wang, C. Guo (Eds.), *Advances in Neural Networks – ISNN 2004*. XXXV, 1021 pages. 2004.

Vol. 3173: F. Yin, J. Wang, C. Guo (Eds.), *Advances in Neural Networks – ISNN 2004*. XXXV, 1041 pages. 2004.

Vol. 3172: M. Dorigo, M. Birattari, C. Blum, L. M. Gambardella, F. Mondada, T. Stützle (Eds.), *Ant Colony, Optimization and Swarm Intelligence*. XII, 434 pages. 2004.

Vol. 3170: P. Gardner, N. Yoshida (Eds.), *CONCUR 2004 – Concurrency Theory*. XIII, 529 pages. 2004.

- Vol. 3166: M. Rauterberg (Ed.), *Entertainment Computing – ICEC 2004*. XXIII, 617 pages. 2004.
- Vol. 3163: S. Marinai, A. Dengel (Eds.), *Document Analysis Systems VI*. XII, 564 pages. 2004.
- Vol. 3162: R. Downey, M. Fellows, F. Dehne (Eds.), *Parameterized and Exact Computation*. X, 293 pages. 2004.
- Vol. 3160: S. Brewster, M. Dunlop (Eds.), *Mobile Human-Computer Interaction – MobileHCI 2004*. XVIII, 541 pages. 2004.
- Vol. 3159: U. Visser, *Intelligent Information Integration for the Semantic Web*. XIV, 150 pages. 2004. (Subseries LNAI).
- Vol. 3158: I. Nikolaidis, M. Barbeau, E. Kranakis (Eds.), *Ad-Hoc, Mobile, and Wireless Networks*. IX, 344 pages. 2004.
- Vol. 3157: C. Zhang, H. W. Guesgen, W.K. Yeap (Eds.), *PRICAI 2004: Trends in Artificial Intelligence*. XX, 1023 pages. 2004. (Subseries LNAI).
- Vol. 3156: M. Joye, J.-J. Quisquater (Eds.), *Cryptographic Hardware and Embedded Systems – CHES 2004*. XIII, 455 pages. 2004.
- Vol. 3155: P. Funk, P.A. González Calero (Eds.), *Advances in Case-Based Reasoning*. XIII, 822 pages. 2004. (Subseries LNAI).
- Vol. 3154: R.L. Nord (Ed.), *Software Product Lines*. XIV, 334 pages. 2004.
- Vol. 3153: J. Fiala, V. Koubek, J. Kratochvíl (Eds.), *Mathematical Foundations of Computer Science 2004*. XIV, 902 pages. 2004.
- Vol. 3152: M. Franklin (Ed.), *Advances in Cryptology – CRYPTO 2004*. XI, 579 pages. 2004.
- Vol. 3150: G.-Z. Yang, T. Jiang (Eds.), *Medical Imaging and Augmented Reality*. XII, 378 pages. 2004.
- Vol. 3149: M. Danelutto, M. Vanneschi, D. Laforenza (Eds.), *Euro-Par 2004 Parallel Processing*. XXXIV, 1081 pages. 2004.
- Vol. 3148: R. Giacobazzi (Ed.), *Static Analysis*. XI, 393 pages. 2004.
- Vol. 3146: P. Érdi, A. Esposito, M. Marinaro, S. Scarpetta (Eds.), *Computational Neuroscience: Cortical Dynamics*. XI, 161 pages. 2004.
- Vol. 3144: M. Papatriantafyllou, P. Hunel (Eds.), *Principles of Distributed Systems*. XI, 246 pages. 2004.
- Vol. 3143: W. Liu, Y. Shi, Q. Li (Eds.), *Advances in Web-Based Learning – ICWL 2004*. XIV, 459 pages. 2004.
- Vol. 3142: J. Diaz, J. Karhumäki, A. Lepistö, D. Sannella (Eds.), *Automata, Languages and Programming*. XIX, 1253 pages. 2004.
- Vol. 3140: N. Koch, P. Fraternali, M. Wirsing (Eds.), *Web Engineering*. XXI, 623 pages. 2004.
- Vol. 3139: F. Iida, R. Pfeifer, L. Steels, Y. Kuniyoshi (Eds.), *Embodied Artificial Intelligence*. IX, 331 pages. 2004. (Subseries LNAI).
- Vol. 3138: A. Fred, T. Caelli, R.P.W. Duin, A. Campilho, D.d. Ridder (Eds.), *Structural, Syntactic, and Statistical Pattern Recognition*. XXII, 1168 pages. 2004.
- Vol. 3137: P. De Bra, W. Nejdl (Eds.), *Adaptive Hypermedia and Adaptive Web-Based Systems*. XIV, 442 pages. 2004.
- Vol. 3136: F. Meziane, E. Métais (Eds.), *Natural Language Processing and Information Systems*. XII, 436 pages. 2004.
- Vol. 3134: C. Zannier, H. Erdogmus, L. Lindstrom (Eds.), *Extreme Programming and Agile Methods – XP/Agile Universe 2004*. XIV, 233 pages. 2004.
- Vol. 3133: A.D. Pimentel, S. Vassiliadis (Eds.), *Computer Systems: Architectures, Modeling, and Simulation*. XIII, 562 pages. 2004.
- Vol. 3132: B. Demoen, V. Lifschitz (Eds.), *Logic Programming*. XII, 480 pages. 2004.
- Vol. 3131: V. Torra, Y. Narukawa (Eds.), *Modeling Decisions for Artificial Intelligence*. XI, 327 pages. 2004. (Subseries LNAI).
- Vol. 3130: A. Syropoulos, K. Berry, Y. Haralambous, B. Hughes, S. Peter, J. Plaice (Eds.), *TeX, XML, and Digital Typography*. VIII, 265 pages. 2004.
- Vol. 3129: Q. Li, G. Wang, L. Feng (Eds.), *Advances in Web-Age Information Management*. XVII, 753 pages. 2004.
- Vol. 3128: D. Asonov (Ed.), *Querying Databases Privately*. IX, 115 pages. 2004.
- Vol. 3127: K.E. Wolff, H.D. Pfeiffer, H.S. Delugach (Eds.), *Conceptual Structures at Work*. XI, 403 pages. 2004. (Subseries LNAI).
- Vol. 3126: P. Dini, P. Lorenz, J.N.d. Souza (Eds.), *Service Assurance with Partial and Intermittent Resources*. XI, 312 pages. 2004.
- Vol. 3125: D. Kozen (Ed.), *Mathematics of Program Construction*. X, 401 pages. 2004.
- Vol. 3124: J.N. de Souza, P. Dini, P. Lorenz (Eds.), *Telecommunications and Networking – ICT 2004*. XXVI, 1390 pages. 2004.
- Vol. 3123: A. Belz, R. Evans, P. Piwek (Eds.), *Natural Language Generation*. X, 219 pages. 2004. (Subseries LNAI).
- Vol. 3122: K. Jansen, S. Khanna, J.D.P. Rolim, D. Ron (Eds.), *Approximation, Randomization, and Combinatorial Optimization*. IX, 428 pages. 2004.
- Vol. 3121: S. Nikolettseas, J.D.P. Rolim (Eds.), *Algorithmic Aspects of Wireless Sensor Networks*. X, 201 pages. 2004.
- Vol. 3120: J. Shawe-Taylor, Y. Singer (Eds.), *Learning Theory*. X, 648 pages. 2004. (Subseries LNAI).
- Vol. 3119: A. Asperti, G. Bancerek, A. Trybulec (Eds.), *Mathematical Knowledge Management*. X, 393 pages. 2004.
- Vol. 3118: K. Miesenberger, J. Klaus, W. Zagler, D. Burger (Eds.), *Computer Helping People with Special Needs*. XXIII, 1191 pages. 2004.
- Vol. 3116: C. Rattray, S. Maharaj, C. Shankland (Eds.), *Algebraic Methodology and Software Technology*. XI, 569 pages. 2004.
- Vol. 3115: P. Enser, Y. Kompatsiaris, N.E. O'Connor, A.F. Smeaton, A.W.M. Smeulders (Eds.), *Image and Video Retrieval*. XVII, 679 pages. 2004.
- Vol. 3114: R. Alur, D.A. Peled (Eds.), *Computer Aided Verification*. XII, 536 pages. 2004.
- Vol. 3113: J. Karhumäki, H. Maurer, G. Paun, G. Rozenberg (Eds.), *Theory Is Forever*. X, 283 pages. 2004.

Preface

This volume contains the 70 contributed papers and abstracts of two invited lectures presented at the 12th Annual European Symposium on Algorithms (ESA 2004), held in Bergen, Norway, September 14–17, 2004. The papers in each section of the proceedings are arranged alphabetically. The three distinguished invited speakers were David Eppstein, Michael Fellows and Monika Henzinger.

As in the last two years, ESA had two tracks, with separate program committees, which dealt respectively with:

- the design and mathematical analysis of algorithms (the “Design and Analysis” track);
- real-world applications, engineering and experimental analysis of algorithms (the “Engineering and Applications” track).

Previous ESAs were held at Bad Honnef, Germany (1993); Utrecht, The Netherlands (1994); Corfu, Greece (1995); Barcelona, Spain (1996); Graz, Austria (1997); Venice, Italy (1998); Prague, Czech Republic (1999); Saarbrücken, Germany (2000); Århus, Denmark (2001); Rome, Italy (2002); and Budapest, Hungary (2003). The predecessor to the Engineering and Applications track of ESA was the annual Workshop on Algorithm Engineering (WAE). Previous WAEs were held in Venice, Italy (1997); Saarbrücken, Germany (1998); London, UK (1999); Saarbrücken, Germany (2000); and Århus, Denmark (2001).

The proceedings of the previous ESAs were published as Springer-Verlag’s LNCS volumes 726, 855, 979, 1284, 1461, 1643, 1879, 2161, 2461, and 2832. The proceedings of the WAEs from 1999 onwards were published as Springer-Verlag’s LNCS volumes 1668, 1982, and 2141.

Papers were solicited in all areas of algorithmic research, including but not limited to: computational biology, computational finance, computational geometry, databases and information retrieval, external-memory algorithms, graph and network algorithms, graph drawing, machine learning, network design, on-line algorithms, parallel and distributed computing, pattern matching and data compression, quantum computing, randomized algorithms, and symbolic computation. The algorithms could be sequential, distributed, or parallel. Submissions were strongly encouraged in the areas of mathematical programming and operations research, including: approximation algorithms, branch-and-cut algorithms, combinatorial optimization, integer programming, network optimization, polyhedral combinatorics, and semidefinite programming.

Each extended abstract was submitted to exactly one of the two tracks, and a few abstracts were switched from one track to the other at the discretion of the program chairs during the reviewing process. The extended abstracts were read by at least four referees each, and evaluated on their quality, originality, and relevance to the symposium. The program committees of both tracks met at King’s College London at the end of May. The Design and Analysis track selected for presentation 52 out of 158 submitted abstracts. The Engineering and

Applications track selected for presentation 18 out of 50 submitted abstracts. The program committees of the two tracks consisted of:

Design and Analysis Track

Karen Aardal	(CWI, Amsterdam)
Susanne Albers (Chair)	(University of Freiburg)
Timothy Chan	(University of Waterloo)
Camil Demetrescu	(University of Rome "La Sapienza")
Rolf Fagerberg	(BRICS Århus and University of Southern Denmark)
Paolo Ferragina	(University of Pisa)
Fedor Fomin	(University of Bergen)
Claire Kenyon	(École Polytechnique, Palaiseau)
Elias Koutsoupias	(University of Athens and UCLA)
Klaus Jansen	(University of Kiel)
Ulrich Meyer	(MPI Saarbrücken)
Michael Mitzenmacher	(Harvard University)
Joseph (Seffi) Naor	(Technion, Haifa)
Micha Sharir	(Tel Aviv University)
Peter Widmayer	(ETH Zürich)
Gerhard Woeginger	(University of Twente and TU Eindhoven)

Engineering and Applications Track

Bo Chen	(University of Warwick)
Ulrich Derigs	(University of Cologne)
Andrew V. Goldberg	(Microsoft Research, Mountain View)
Roberto Grossi	(University of Pisa)
Giuseppe F. Italiano	(University of Rome "Tor Vergata")
Giuseppe Liotta	(University of Perugia)
Tomasz Radzik (Chair)	(King's College London)
Marie-France Sagot	(INRIA Rhône-Alpes)
Christian Scheideler	(Johns Hopkins University)
Jop F. Sibeyn	(University of Halle)
Michiel Smid	(Carleton University)

ESA 2004 was held along with the 4th Workshop on Algorithms in Bioinformatics (WABI 2004), the 4th Workshop on Algorithmic Methods and Models for Optimization of Railways (ATMOS 2004), the 2nd Workshop on Approximation and Online Algorithms (WAOA 2004), and an International Workshop on Parametrized and Exact Computation (IWPEC 2004) in the context of the combined conference ALGO 2004. The organizing committee of ALGO 2004 consisted of Pinar Heggernes (chair), Fedor Fomin (co-chair), Eivind Coward, Inge Jonassen, Fredrik Manne, and Jan Arne Telle, all from the University of Bergen.

ESA 2004 was sponsored by EATCS (the European Association for Theoretical Computer Science), the University of Bergen, the Research Council of

Norway, IBM, HP and SGI. The EATCS sponsorship included an award of EUR 500 for the authors of the best student paper at ESA 2004. The winners of the prize were Marcin Muca and Piotr Sandowski for their paper *Maximum Matching in Planar Graphs via Gaussian Elimination*.

Finally, we would like to thank the members of the program committees for their time and work devoted to the paper selection process.

July 2004

Susanne Albers and Tomasz Radzik
Program Chairs, ESA 2004

Referees

Mohamed I. Abouelhoda	Gianna Del Corso
Pankaj Kumar Agarwal	Erik Demaine
Noga Alon	Roman Dementiev
Steven Alpern	Jörg Derungs
Ernst Althaus	Tamal Dey
Christoph Ambühl	Emilio Di Giacomo
Luzi Anderegg	Walter Didimo
Lars Arge	Martin Dietzfelbinger
Vera Asodi	Krzysztof Diks
Franz Aurenhammer	Yefim Dinitz
Yossi Azar	Florian Dittrich
Holger Bast	Debora Donato
Surender Baswana	Eleni Drinea
Luca Becchetti	Vida Dujmovic
Rene Beier	Christian Duncan
Michael Bender	Stefan Edelkamp
Marc Benkert	Herbert Edelsbrunner
Mark de Berg	Alon Efrat
Randeep Bhatia	Stephan Eidenbenz
Ulrik Brandes	Lars Engebretsen
Gerth Stølting Brodal	Roe Engelberg
Hajo Broersma	David Eppstein
Adam Buchsbaum	Leah Epstein
Stefan Burkhardt	Jeff Erickson
Gruia Calinescu	Thomas Erlebach
Saverio Caminiti	Lene Monrad Favrholdt
Frédéric Cazals	Sandor Fekete
Bernard Chazelle	Mike Fellows
Chandra Chekuri	Amos Fiat
Johnny Chen	Irene Finocchi
Joseph Cheriyan	Aleksei Fishkin
Steve Chien	Lisa Fleischer
Jana Chlebikova	Rudolf Fleischer
Marek Chrobak	Paola Flocchini
Julia Chuzhoy	Pierre Fraigniaud
Mark Cieliebak	Gianni Franceschini
Valentina Ciriani	Paolo Franciosa
Andrea Clementi	Gudmund Skovbjerg Frandsen
Richard Cole	Antonio Frangioni
Colin Cooper	Ari Freund
Andreas Crauser	Daniele Frigioni
Janos Csirik	Stefan Funke
Victor Dalmiau	Martin Fürer
Siavash Vahdati Daneshmand	Hal Gabow

Bernd Gärtner
Naveen Garg
Leszek Gasieniec
Olga Gerber
Georg Gottlob
Fabrizio Grandoni
Roberto Grossi
Jens Gustedt
Magnús Halldórsson
Dan Halperin
Sariel Har-Peled
David Hart
Jason Hartline
Refael Hassin
Ryan Hayward
Danny Hermelin
Volker Heun
Stefan Hougardy
Cor Hurkens
Sandy Irani
Rob W. Irving
Riko Jacob
Tommy Jensen
Frank Kammer
Viggo Kann
Haim Kaplan
Juha Kärkkäinen
Brad Karp
Irit Katriel
Michael Kaufmann
Hans Kellerer
Lutz Kettner
Valerie King
Tamas Kiraly
Adam Kirsch
Teemu Kivioja
Ralf Klasing
Bettina Klinz
Daniel Kobler
Jochen Konemann
Alexandr Kononov
Michael Korn
Guy Kortsarz
Dariusz Kowalski
Daniel Kral

Marc van Kreveld
Michael Krivelevich
Piotr Krysta
Alejandro López-Ortiz
Gad Landau
Kim Skak Larsen
James Lee
Gary G. Lee
Moshe Lewenstein
Liane Lewin-Eytan
Andrzej Lingas
Dean Lorenz
Anna Lubiw
Fabrizio Luccio
Flaminia Luccio
Tamas Lukovski
Anil Maheshwari
Thomas Mailund
Christos Makris
Ion Mandoiu
David Manlove
Fredrik Manne
Giovanni Manzini
Gitta Marchand
Alberto Marchetti-Spaccamela
David Orden Martin
Jirka Matousek
Ernst W. Mayr
Alessandro Mei
Peter Bro Miltersen
Joseph Mitchell
Anders Møller
Angelo Monti
Pat Morin
Aziz Moukrim
Haiko Müller
S. Muthukrishnan
Gene Myers
Umberto Nanni
Morten Hegner Nielsen
Naomi Nishimura
Marc Nunkesser
Liadan O'Callaghan
Anna Östlin Pagh
Rasmus Pagh

Linda Pagli
 Aris Pagourtzis
 Igor Pak
 Anna Palbom
 Alessandro Panconesi
 Gopal Pandurangan
 Maurizio Patrignani
 Marcin Peczarski
 Christian N.S. Pedersen
 Leon Peeters
 Marco Pellegrini
 Rudi Pendavingh
 Paolo Penna
 Giuseppe Persiano
 Seth Pettie
 Andrea Pietracaprina
 Maurizio Pizzonia
 Greg Plaxton
 Andrzej Proskurowski
 Kirk Pruhs
 Geppino Pucci
 Uri Rabinovich
 Mathieu Raffinot
 Sven Rahmann
 Rajmohan Rajaraman
 Edgar Ramos
 Michael Rao
 Srinivasa Rao
 R. Ravi
 Dror Rawitz
 Bruce Reed
 Oded Regev
 Franz Rendl
 Romeo Rizzi
 Liam Roditty
 Hein Röhrig
 Günter Rote
 Tim Roughgarden
 Amin Saberi
 Cenk Sahinalp
 Jared Saia
 Peter Sanders
 Miklos Santha
 Nicola Santoro
 Fabiano Sarracco

Joe Sawada
 Cynthia Sawchuk
 Gabriel Scalosub
 Guido Schäfer
 Baruch Schieber
 Manfred Schimmmler
 Christian Schindelhauer
 Klaus Schittkowski
 Susanne Schmitt
 Frank Schulz
 Maria Serna
 Jiri Sgall
 Ron Shamir
 Roded Sharan
 Bruce Shepherd
 David Shmoys
 Riccardo Silvestri
 Amitabh Sinha
 Naveen Sivadasan
 Martin Skutella
 Roberto Solis-Oba
 Bettina Speckmann
 Frits Spiessma
 Divesh Srivastava
 Rob van Stee
 Cliff Stein
 Ileana Streinu
 Maxim Sviridenko
 Gabor Szabo
 Arie Tamir
 Eric Tannier
 Jan Arne Telle
 Moshe Tennenholtz
 Thorsten Theobald
 Dimitrios Thilikos
 Ralf Thöle
 Torsten Tholey
 Carsten Thomassen
 Mikkel Thorup
 Ioan Todinca
 Laura Toma
 Esko Ukkonen
 Peter Ullrich
 Takeaki Uno
 Eli Upfal

Berthold Vöcking
Jan Vahrenhold
Kasturi Varadarajan
Elad Verbin
Stephane Vialette
Eric Vigoda
Luca Vismara
Tjark Vredeveld
Mirjam Wattenhofer
Birgitta Weber
Michael Weber
Udi Wieder
Ryan Williams

Alexander Wolff
David Wood
Deshi Ye
Anders Yeo
Neal Young
W. Zang
Christos Zaroliagis
Norbert Zeh
Alex Zelikovski
Guochuan Zhang
Hu Zhang
Uri Zwick

Table of Contents

Invited Lectures

A Survey of FPT Algorithm Design Techniques with an Emphasis on Recent Advances and Connections to Practical Computing	1
<i>Michael R. Fellows</i>	

Algorithmic Aspects of Web Search Engines	3
<i>Monika Henzinger</i>	

Design and Analysis Track

Efficient Tradeoff Schemes in Data Structures for Querying Moving Objects	4
<i>Pankaj K. Agarwal, Lars Arge, Jeff Erickson, Hai Yu</i>	

Swap and Mismatch Edit Distance	16
<i>Amihoud Amir, Estrella Eisenberg, Ely Porat</i>	

Path Decomposition Under a New Cost Measure with Applications to Optical Network Design	28
<i>Elliot Anshelevich, Lisa Zhang</i>	

Optimal External Memory Planar Point Enclosure	40
<i>Lars Arge, Vasilis Samoladas, Ke Yi</i>	

Maximizing Throughput in Multi-queue Switches	53
<i>Yossi Azar, Arik Litichevsky</i>	

An Improved Algorithm for CIOQ Switches	65
<i>Yossi Azar, Yossi Richter</i>	

Labeling Smart Dust	77
<i>Vikas Bansal, Friedhelm Meyer auf der Heide, Christian Sohler</i>	

Graph Decomposition Lemmas and Their Role in Metric Embedding Methods	89
<i>Yair Bartal</i>	

Modeling Locality: A Probabilistic Analysis of LRU and FWF	98
<i>Luca Becchetti</i>	

An Algorithm for Computing DNA Walks	110
<i>Ankur Bhargava, S. Rao Kosaraju</i>	

Algorithms for Generating Minimal Blockers of Perfect Matchings in Bipartite Graphs and Related Problems	122
<i>Endre Boros, Khaled Elbassioni, Vladimir Gurvich</i>	
Direct Routing: Algorithms and Complexity	134
<i>Costas Busch, Malik Magdon-Ismaïl, Marios Mavronicolas, Paul Spirakis</i>	
Lower Bounds for Embedding into Distributions over Excluded Minor Graph Families	146
<i>Douglas E. Carroll, Ashish Goel</i>	
A Parameterized Algorithm for Upward Planarity Testing	157
<i>Hubert Chan</i>	
Fisher Equilibrium Price with a Class of Concave Utility Functions	169
<i>Ning Chen, Xiaotie Deng, Xiaoming Sun, Andrew Chi-Chih Yao</i>	
Hardness and Approximation Results for Packing Steiner Trees	180
<i>Joseph Cheriyan, Mohammad R. Salavatipour</i>	
Approximation Hardness of Dominating Set Problems	192
<i>Miroslav Chlebík, Janka Chlebíková</i>	
Improved Online Algorithms for Buffer Management in QoS Switches	204
<i>Marek Chrobak, Wojciech Jawor, Jiří Sgall, Tomáš Tichý</i>	
Time Dependent Multi Scheduling of Multicast	216
<i>Rami Cohen, Dror Rawitz, Danny Raz</i>	
Convergence Properties of the Gravitational Algorithm in Asynchronous Robot Systems	228
<i>Reuven Cohen, David Peleg</i>	
The Average Case Analysis of Partition Sorts	240
<i>Richard Cole, David C. Kandathil</i>	
A Fast Distributed Algorithm for Approximating the Maximum Matching	252
<i>Andrzej Czygrinow, Michał Hańćkowiak, Edyta Szymańska</i>	
Extreme Points Under Random Noise	264
<i>Valentina Damerow, Christian Sohler</i>	
Fixed Parameter Algorithms for Counting and Deciding Bounded Restrictive List H -Colorings	275
<i>Josep Díaz, Maria Serna, Dimitrios M. Thilikos</i>	
On Variable-Sized Multidimensional Packing	287
<i>Leah Epstein, Rob van Stee</i>	

An Inductive Construction for Plane Laman Graphs via Vertex Splitting	299
<i>Zsolt Fekete, Tibor Jordán, Walter Whiteley</i>	
Faster Fixed-Parameter Tractable Algorithms for Matching and Packing Problems	311
<i>Michael R. Fellows, C. Knauer, N. Nishimura, P. Ragde, F. Rosamond, U. Stege, Dimitrios M. Thilikos, S. Whitesides</i>	
On the Evolution of Selfish Routing	323
<i>Simon Fischer, Berthold Vöcking</i>	
Competitive Online Approximation of the Optimal Search Ratio	335
<i>Rudolf Fleischer, Tom Kamphans, Rolf Klein, Elmar Langetepe, Gerhard Trippen</i>	
Incremental Algorithms for Facility Location and k -Median	347
<i>Dimitris Fotakis</i>	
Dynamic Shannon Coding	359
<i>Travis Gagie</i>	
Fractional Covering with Upper Bounds on the Variables: Solving LPs with Negative Entries	371
<i>Naveen Garg, Rohit Khandekar</i>	
Negotiation-Range Mechanisms: Coalition-Resistant Markets	383
<i>Rica Gonen</i>	
Approximation Algorithms for Quickest Spanning Tree Problems	395
<i>Refael Hassin, Asaf Levin</i>	
An Approximation Algorithm for Maximum Triangle Packing	403
<i>Refael Hassin, Shlomi Rubinstein</i>	
Approximate Parameterized Matching	414
<i>Carmit Hazay, Moshe Lewenstein, Dina Sokol</i>	
Approximation of Rectangle Stabbing and Interval Stabbing Problems ...	426
<i>Sofia Kovaleva, Frits C.R. Spiessma</i>	
Fast 3-Coloring Triangle-Free Planar Graphs	436
<i>Lukasz Kowalik</i>	
Approximate Unions of Lines and Minkowski Sums	448
<i>Marc van Kreveld, A. Frank van der Stappen</i>	
Radio Network Clustering from Scratch	460
<i>Fabian Kuhn, Thomas Moscibroda, Roger Wattenhofer</i>	

Seeking a Vertex of the Planar Matching Polytope in NC	472
<i>Raghav Kulkarni, Meena Mahajan</i>	
Equivalence of Search Capability Among Mobile Guards with Various Visibilities.....	484
<i>Jae-Ha Lee, Sang-Min Park, Kyung-Yong Chwa</i>	
Load Balancing in Hypercubic Distributed Hash Tables with Heterogeneous Processors.....	496
<i>Junning Liu, Micah Adler</i>	
On the Stability of Multiple Partner Stable Marriages with Ties	508
<i>Varun S. Malhotra</i>	
Flows on Few Paths: Algorithms and Lower Bounds	520
<i>Maren Martens, Martin Skutella</i>	
Maximum Matchings in Planar Graphs via Gaussian Elimination	532
<i>Marcin Mucha, Piotr Sankowski</i>	
Fast Multipoint Evaluation of Bivariate Polynomials.....	544
<i>Michael Nüsken, Martin Ziegler</i>	
On Adaptive Integer Sorting	556
<i>Anna Pagh, Rasmus Pagh, Mikkel Thorup</i>	
Tiling a Polygon with Two Kinds of Rectangles	568
<i>Eric Rémila</i>	
On Dynamic Shortest Paths Problems	580
<i>Liam Roditty, Uri Zwick</i>	
Uniform Algorithms for Deterministic Construction of Efficient Dictionaries	592
<i>Milan Ružić</i>	
Fast Sparse Matrix Multiplication	604
<i>Raphael Yuster, Uri Zwick</i>	
Engineering and Applications Track	
An Experimental Study of Random Knapsack Problems	616
<i>Rene Beier, Berthold Vöcking</i>	
Contraction and Treewidth Lower Bounds.....	628
<i>Hans L. Bodlaender, Arie M.C.A. Koster, Thomas Wolle</i>	
Load Balancing of Indivisible Unit Size Tokens in Dynamic and Heterogeneous Networks	640
<i>Robert Elsässer, Burkhard Monien, Stefan Schamberger</i>	