

Lecture Notes in Computer Science

1627

Takao Asano Hiroshi Imai D.T. Lee
Shin-ichi Nakano Takeshi Tokuyama (Eds.)

Computing and Combinatorics

5th Annual International Conference, COCOON'99
Tokyo, Japan, July 1999
Proceedings



Springer

Springer

Berlin

Heidelberg

New York

Barcelona

Hong Kong

London

Milan

Paris

Singapore

Tokyo

Takao Asano Hideki Imai D.T. Lee
Shin-ichi Nakano Takeshi Tokuyama (Eds.)

Computing and Combinatorics

5th Annual International Conference, COCOON'99
Tokyo, Japan, July 26-28, 1999
Proceedings



Springer

Volume Editors

Takao Asano

Department of Information and System Engineering
Faculty of Science and Engineering, Chuo University
1-13-27, Kasuga, Bunkyo-ku, Tokyo, 112-8551 Japan
E-mail: asano@ise.chuo-u.ac.jp

Hideki Imai

Department of Information Science, University of Tokyo
7-3-1 Hongo, Bunkyo-ku, Tokyo, 113-0033 Japan
E-mail: imai@is.s.u-tokyo.ac.jp

D.T. Lee

Institute of Information Science, Academia Sinica
Nankang, Taipei, Taiwan
E-mail: dtlee-nu@iis.sinica.edu.tw

Shin-ichi Nakano

Department of Computer Science
Faculty of Engineering, Gunma University
1-5-1 Tenjin-cho, Kiryu, Gunma, 376-8515 Japan
E-mail: nakano@msc.cs.gunma-u.ac.jp

Takeshi Tokuyama

IBM Tokyo Research Laboratory
1623-14, Shimo-Tsuruma, Yamato Kanagawa, 242-0001 Japan
E-mail: ttoku@trl.ibm.co.jp

Cataloging-in-Publication data applied for

Die Deutsche Bibliothek - CIP-Einheitsaufnahme

Computing and combinatorics: 5th annual international conference
proceedings / COCOON'99, Tokyo, Japan, July 26 - 28, 1999.

Takao Asano . . . (ed.). - Berlin ; Heidelberg ; New York ; Barcelona ;
Hong Kong ; London ; Milan ; Paris ; Singapore ; Tokyo : Springer,
1999

(Lecture notes in computer science ; Vol. 1627)

ISBN 3-540-66200-6

CR Subject Classification (1998): F.2, G.2.1-2, I.3.5, C.2.3-4, E.1

ISSN 0302-9743

ISBN 3-540-66200-6 Springer-Verlag 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-Verlag. Violations are liable for prosecution under the German Copyright Law.

© Springer-Verlag Berlin Heidelberg 1999

Printed in Germany

Typesetting: Camera-ready by author

SPIN 10703294

06/3142 - 5 4 3 2 1 0

Printed on acid-free paper

Preface

The abstracts and papers in this volume were presented at the Fifth Annual International Computing and Combinatorics Conference (COCOON '99), which was held in Tokyo, Japan from July 26 to 28, 1999. The topics cover most aspects of theoretical computer science and combinatorics pertaining to computing.

In response to the call for papers, 88 high-quality extended abstracts were submitted internationally, of which 46 were selected for presentation by the program committee. Every submitted paper was reviewed by at least three program committee members. Many of these papers represent reports on continuing research, and it is expected that most of them will appear in a more polished and complete form in scientific journals. In addition to the regular papers, this volume contains abstracts of two invited plenary talks by Prabhakar Raghavan and Seinosuke Toda. The conference also included a special talk by Kurt Mehlhorn on LEDA (Library of Efficient Data types and Algorithms).

The Hao Wang Award (inaugurated at COCOON '97) is given to honor the paper judged by the program committee to have the greatest scientific merit. The recipients of the Hao Wang Award 1999 were Hiroshi Nagamochi and Toshihide Ibaraki for their paper "An Approximation for Finding a Smallest 2-Edge-Connected Subgraph Containing a Specified Spanning Tree".

We wish to thank all who have made this meeting possible: the authors for submitting papers, the program committee members and external referees for their excellent work in reviewing the papers, the sponsors, the local organizers, ACM SIGACT and the University of Tokyo for handling electronic submissions, and Springer-Verlag for their support and assistance.

July 1999

Takao Asano
Hiroshi Imai
D. T. Lee
Shin-ichi Nakano
Takeshi Tokuyama

Sponsoring Institutions

COCOON '99 was sponsored by Chuo University and the Algorithm Engineering Project, Grant-in-Aid of MESSC Japan. It was organized in cooperation with the Special Interest Group on Algorithms of the Information Processing Society of Japan (SIGAL, IPSJ), and the Technical Group on Computation of the Institute of Electronics, Information, and Communication Engineers of Japan (TGCOMP, IEICE).

Conference Organization

Program Committee Co-chairs

D. T. Lee (Academia Sinica, Taiwan)

Takeshi Tokuyama (IBM Tokyo Research Laboratory, Japan)

Program Committee

Jean-Daniel Boissonnat (INRIA, France)

Zhi-Zhong Chen (Tokyo Denki University, Japan)

Xiaotie Deng (Hong Kong City University, Hong Kong)

David Eppstein (UC Irvine, USA)

Uriel Feige (Weizmann Institute, Israel)

Harold Gabow (University of Colorado, USA)

Ronald Graham (UC San Diego, USA)

Frank Hwang (Chiao Tung University, Taiwan)

Tao Jiang (McMaster University, Canada)

Howard Karloff (Georgia Institute of Technology, USA)

Samir Khuller (University of Maryland, USA)

Rao Kosaraju (Johns Hopkins University, USA)

Xuemin Lin (University of New South Wales, Australia)

Bruce Maggs (Carnegie Mellon University, USA)

Kurt Mehlhorn (Max Planck Institut für Informatik, Germany)

Satoru Miyano (University of Tokyo, Japan)

Seffi Naor (Technion, Israel)

Günter Rote (Freie Universität, Germany)

Madhu Sudan (MIT, USA)

Roberto Tamassia (Brown University, USA)

Jeff Vitter (INRIA, France and Duke University, USA)

Guoliang Xue (University of Vermont, USA)

Organizing Committee

Takao Asano (Conference Co-chair, Chuo University, Japan)

Hiroshi Imai (Conference Co-chair, University of Tokyo, Japan)

Shin-ichi Nakano (Publicity, Gunma University, Japan)

Referees

Miklós Ajtai
Hiroki Arimura
Woyciech Banaszczyk
Bob Beals
Arnon Boneh
Dan Boneh
Jin-Yi Cai
Mao-cheng Cai
Claude Carlet
Eranda Cela
Barun Chandra
Kevin Christian
Hossam El-Gindy
Ran El-Yaniv
Vladimir Estivill-Castro
Stefan Felsner
Amos Fiat
Bill Gasarch
Qian-Ping Gu
Sudipto Guha
Xin He
Kouichi Hirata
Daisuke Ikeda
Russell Impagliazzo
Michael Kaufmann
Sanjeev Khanna
Bettina Klinz
Pil Joong Lee
Daniel Lehmann

Weifa Liang
Guo-Hui Lin
Eric Martin
Hiroshi Matsuno
Balaji Raghavachari
Franz Rendl
Leonard Schulman
Steve Seiden
Jose Sempere
Henry Shapiro
Bruce Shepherd
Yaoyun Shi
Shinichi Shimozone
Takayoshi Shoudai
Arcot Sowmya
Yuji Takada
Seinosuke Toda
Ron van der Meyden
Lusheng Wang
Todd Wareham
Lorenz Wernisch
Gerhard Woeginger
Rebecca Wright
Jinhui Xu
Neal Young
Yuzhong Zhang
An Zhu
Huafei Zhu

Table of Contents

Invited Talks

The Web as a Graph: Measurements, Models and Methods	1
<i>Jon M. Kleinberg (Cornell University), S. Ravi Kumar, Prabhakar Raghavan, Sridhar Rajagopalan, and Andrew S. Tomkins (IBM Almaden Research Center)</i>	

Some Observations on the Computational Complexity of Graph Accessibility Problem	18
<i>Jun Tarui (University of Electro-Communications) and Seinosuke Toda (Nihon University)</i>	

Hao Wang Award Paper

An Approximation for Finding a Smallest 2-Edge-Connected Subgraph Containing a Specified Spanning Tree	31
<i>Hiroshi Nagamochi, Toshihide Ibaraki (Kyoto University)</i>	

Data Structures

Theory of 2-3 Heaps	41
<i>Tadao Takaoka (University of Canterbury)</i>	

An External Memory Data Structure for Shortest Path Queries	51
<i>David Hutchinson, Anil Maheshwari (Carleton University), and Norbert Zeh (Carleton University and Friedrich-Schiller-Universität)</i>	

Computational Biology

Approximating the Nearest Neighbor Interchange Distance for Evolutionary Trees with Non-uniform Degrees	61
<i>Wing-Kai Hon and Tak-Wah Lam (University of Hong Kong)</i>	

Signed Genome Rearrangement by Reversals and Transpositions: Models and Approximations	71
<i>Guo-Hui Lin and Guoliang Xue (University of Vermont)</i>	

Graph Drawing

An Approximation Algorithm for the Two-Layered Graph Drawing Problem	81
<i>Atsuko Yamaguchi and Akihiro Sugimoto (Hitachi Advanced Research Laboratory)</i>	

Area Minimization for Grid Visibility Representation of Hierachically Planar Graphs 92
Xuemin Lin (University of New South Wales) and Peter Eades (University of Newcastle)

Layout Problems on Lattice Graphs 103
Josep Díaz (Universitat Politècnica de Catalunya), Mathew D. Penrose (University of Durham), Jordi Petit, and María Serna (Universitat Politècnica de Catalunya)

Discrete Mathematics

A New Transference Theorem in the Geometry of Numbers 113
Jin-Yi Cai (SUNY Buffalo)

On Covering and Rank Problems for Boolean Matrices and Their Applications 123
Carsten Damm (Universität Trier), Ki Hang Kim, and Fred Roush (Alabama State University)

A Combinatorial Algorithm for Pfaffians 134
Meena Mahajan (Institute of Mathematical Sciences), P.R. Subramanya, and V. Vinay (Indian Institute of Science)

Graph Algorithms 1

How to Swap a Failing Edge of a Single Source Shortest Paths Tree 144
Enrico Nardelli, Guido Proietti (Università di L'Aquila), and Peter Widmayer (ETH Zentrum)

On Bounds for the k -Partitioning of Graphs 154
S.L. Bezrukov (University of Wisconsin), R. Elsässer, and U.-P. Schroeder (University of Paderborn)

A Faster Algorithm for Computing Minimum 5-way and 6-way Cuts 164
Hiroshi Nagamochi, Shigeki Katayama, Toshihide Ibaraki (Kyoto University)

Automata and Language

Probabilities to Accept Languages by Quantum Finite Automata 174
Andris Ambainis (UC Berkeley), Richard Bonner (Mälardalens University), Rūsiņš Freivalds, and Arnolds Ķikusts (University of Latvia)

Distributionally-Hard Languages 184
Lance Fortnow (University of Chicago), A. Pavan, and Alan L. Selman (University at Buffalo)

Circuits and Context-Free Languages	194
<i>Pierre McKenzie (Université de Montréal), Klaus Reinhardt (Universität Tübingen), and V. Vinay (Indian Institute of Science)</i>	

Complexity Theory and Learning

On the Negation-Limited Circuit Complexity of Merging	204
<i>Kazuyuki Amano, Akira Maruoka (Tohoku University), and Jun Tarui (University of Electro-Communications)</i>	

Super-Polynomial versus Half-Exponential Circuit Size in the Exponential Hierarchy	210
<i>Peter Bro Miltersen (University of Aarhus), N.V. Vinodchandran (Institute of Mathematical Science), and Osamu Watanabe (Tokyo Institute of Technology)</i>	

Efficient Learning of Some Linear Matrix Languages	221
<i>Henning Fernau (Universität Tübingen)</i>	

Combinatorial Optimization 1

Minimizing Mean Resoponse Time in Batch Processing System	231
<i>Xiaotie Deng (City University of Hong Kong) and Yuzhong Zhang (Qufu Normal University)</i>	

Approximation Algoirthms for Bounded Facility Location	241
<i>Piotr Krysta and Roberto Solis-Oba (Max Planck Institut für Informatik)</i>	

Scheduling Trees onto Hypercubes and Grids Is <i>NP</i> Complete	251
<i>Satoshi Tayu (Japan Advanced Institute of Science and Technology)</i>	

Graph Algorithms 2

Approximations of Weighted Independent Set and Hereditary Subset Problems	261
<i>Magnús M. Halldórsson (University of Iceland)</i>	

Multi-Coloring Trees	271
<i>Magnús M. Halldórsson (University of Iceland), Guy Kortsarz (Open University), Andrzej Proskurowski (University of Oregon), Ravit Salman, Hadas Shachnai (Technion), Jan Arne Teller (University of Bergen)</i>	

On the Complexity of Approximating Colored-Graph Problems	281
<i>Andrea E.F. Clementi (Università degli Studi di Roma Tor Vergata), Pierluigi Crescenzi, and Gianluca Rossi (Università degli Studi di Firenze)</i>	

Number Theory

On the Average Sensitivity of Testing Square-Free Numbers 291
Anna Bernasconi (Technische Universität München), Carsten Damm (Universität Trier) and Igor Shparlinski (Macquarie University)

Binary Enumerability of Real Numbers 300
Xizhong Zheng (FernUniversität Hagen)

GCD of Many Integers 310
Gene Cooperman (Northeastern University), Sandra Feisel, Joachim von zur Gathen (Universität-GH Paderborn), George Havas (University of Queensland)

Distributed Computing

Multi-party Finite Computations 318
Tomasz Jurdziński (Wrocław University), Mirosław Kutylowski (Wrocław University and Poznań University), and Krzysztof Loryś (Wrocław University)

Probabilistic Local Majority Voting for the Agreement Problem on Finite Graphs 330
Toshio Nakata (Fukuoka University of Education), Hiroshi Imahayashi, and Masafumi Yamashita (Kyushu University)

Combinatorial Optimization 2

A Dynamic Programming Bound for the Quadratic Assignment Problem . . 339
Ambros Marzetta (International Computer Science Institute, Berkeley) and Adrian Brünger (Novartis Pharma AG)

A New Approach for Speeding Up Enumeration Algorithms and Its Application for Matroid Bases 349
Takeaki Uno (Tokyo Institute of Technology)

Network Routing Problems

On Routing in Circulant Graphs 360
Jin-Yi Cai (SUNY Buffalo), George Havas (University of Queensland), Bernard Mans (Macquarie University), Ajay Nerurkar (SUNY Buffalo), Jean-Pierre Seifert (University of Frankfurt), and Igor Shparlinski (Macquarie University)

Minimum Congestion Embedding of Complete Binary Trees into Tori 370
Akira Matsubayashi and Ryo Takasu (Utsunomiya University)

Computational Geometry

- Maximum Stabbing Line in 2D Plane 379
Francis Y.L. Chin (University of Hong Kong), Cao An Wang (Memorial University of Newfoundland), and Fu Lee Wang (University of Hong Kong)
- Generalized Shooter Location Problem 389
Jeet Chaudhuri and Subhas C. Nandy (Indian Statistical Institute)

Online Algorithms

- A Competitive Online Algorithm for the Paging Problem with “Shelf” Memory 400
Sung-Pil Hong (Chung-Ang University)
- Using Generalized Forecasts for Online Currency Conversion 409
Kazuo Iwama and Kouki Yonezawa (Kyoto University)

Rewriting Systems

- On S -regular Prefix-Rewriting Systems and Automatic Structures 422
Friedrich Otto (Universität Kassel)
- Tractable and Intractable Second-Order Matching Problems 432
Kouichi Hirata, Keizo Yamada, and Masateru Harao (Kyushu Institute of Technology)

Parallel Computing

- Efficient Fixed-Size Systolic Arrays for the Modular Multiplication 442
Sung-Woo Lee, Hyun-Sung Kim (Kyungpook National University), Jung-Joon Kim, Tae-Geun Kim (Wireless Comm. Research Laboratory) and Kee-Young Yoo (Kyunpook National University)
- Improving Parallel Computation with Fast Integer Sorting 452
Ka Wong Chong (University of Hong Kong), Yijie Han (Electronic Data Systems), Yoshihide Igarashi (Gunma University), and Tak Wah Lam (University of Hong Kong)
- A Combinatorial Approach to Performance Analysis of a Shared-Memory Multiprocessor 462
Sajal K. Das (University of North Texas), Bhabani P. Sinha, Rajarshi Chaudhuri (Indian Statistical Institute)

Combinatorial Optimization 3

A Fast Approximation Algorithm for TSP with Neighborhoods and Red-Blue Separation	473
<i>Joachim Gudmundsson and Christos Levcopoulos (Lund University)</i>	
The Greedier the Better: An Efficient Algorithm for Approximating Maximum Independent Set	483
<i>H.Y. Lau and H.F. Ting (University of Hong Kong)</i>	
Author Index	493