Lecture Notes in Computer Science 4475

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
University of California, Los Angeles, CA, 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

Pierluigi Crescenzi Giuseppe Prencipe
Geppino Pucci (Eds.)

Fun with Algorithms

4th International Conference, FUN 2007
Castiglioncello, Italy, June 3-5, 2007
Proceedings

Springer

Volume Editors

Pierluigi Crescenzi
Università degli Studi di Firenze, Dipartimento di Sistemi e Informatica
Viale Morgagni 65, 50134 Firenze, Italy
E-mail: piluc@dsi.unifi.it

Giuseppe Prencipe
Università degli Studi di Pisa, Dipartimento di Informatica
Largo Bruno Pontecorvo 3, 56127 Pisa, Italy
E-mail: prencipe@di.unipi.it

Geppino Pucci
Università degli Studi di Padova, Dipartimento di Ingegneria dell'Informazione
Via Gradenigo 6/B, 35131 Padova, Italy
E-mail: geppo@dei.unipd.it

The logo is the work of Hadrien Dussoix.

Library of Congress Control Number: 2007927412

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

LNCS Sublibrary: SL 1 – Theoretical Computer Science and General Issues

ISSN 0302-9743
ISBN-10 3-540-72913-5 Springer Berlin Heidelberg New York
ISBN-13 978-3-540-72913-6 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

springer.com

© Springer-Verlag Berlin Heidelberg 2007
Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India
Printed on acid-free paper SPIN: 12072804 06/3180 5 4 3 2 1 0

Preface

This volume contains the papers presented at the Fourth International Conference on Fun with Algorithms (FUN 2007), held June 3–5, 2007 in the beautiful Tuscanian coastal town of Castiglioncello, Italy.

FUN is a three-yearly conference dedicated to the use, design, and analysis of algorithms and data structures, focusing on results that provide amusing, witty but nonetheless original and scientifically profound contributions to the area. The previous three meetings were held on Elba Island, Italy, and special issues of the journals *Theoretical Computer Science* (FUN 1998), *Discrete Applied Mathematics* (FUN 2001), and *Theory of Computing Systems* (FUN 2004) feature extended versions of selected papers from the three conference programs.

In response to the Call for Papers for FUN 2007, we received 41 submissions from 25 countries. Each submission was reviewed by at least three Program Committee members. At the end of the selection process, the committee decided to accept 20 papers. The program also includes three invited talks by Giuseppe Di Battista (U. Rome III, Italy), Nicola Santoro (Carleton U., Canada), and Luca Trevisan (U.C. Berkeley, USA).

We wish to thank all the authors who submitted their papers to FUN 2007 and thus contributed to the creation of a high-quality program and entertaining meeting, as well as the colleagues who accepted to serve on the Program Committee and provided invaluable help with the reviewing process. We also wish to thank the external reviewers (listed on the following pages) including those who completed urgent reviews during the discussion phase. Paper submission, selection, and generation of the proceedings was greatly eased by the use of the public-domain *EasyChair* Conference System (`http://www.easychair.org`). We wish to thank the EasyChair creators and maintainers for their selfless committment to the scientific community. Finally, special thanks go to Vincenzo Gervasi, whose constant help and dedication was crucial in making FUN 2007 a successful event.

April 2007

Pierluigi Crescenzi
Giuseppe Prencipe
Geppino Pucci

Conference Organization

Program Chairs

Pierluigi Crescenzi (University of Firenze, Italy)
Geppino Pucci (University of Padua, Italy)

Program Committee

Nancy Amato (Texas A & M University, USA)
Nina Amenta (University of California at Davis, USA)
Marcella Anselmo (University of Salerno, Italy)
Anna Bernasconi (University of Pisa, Italy)
Paolo Boldi (University of Milano, Italy)
Irene Finocchi (University of Roma "La Sapienza", Italy)
Luisa Gargano (University of Salerno, Italy)
Sandy Irani (University of California at Irvine, USA)
Christos Kaklamanis (University of Patras, Greece)
Shay Kutten (Technion, Haifa, Israel)
Fabrizio Luccio (University of Pisa, Italy)
Bernard Mans (Macquarie University, Australia)
Paolo Penna (University of Salerno, Italy)
Andrea Richa (Arizona State University, Tempe, USA)
Iain Stewart (University of Durham, UK)
Erkki Sutinen (University of Joensuu, Finland)
Denis Trystram (ID-IMAG Grenoble, France)
Peter Widmayer (ETH Zurich, Switzerland)

Local Organization

Vincenzo Gervasi (University of Pisa, Italy)
Giuseppe Prencipe (University of Pisa, Italy)

External Reviewers

Luca Becchetti
Hajo Broersma
Valentina Ciriani
David Coudert
Stefan Dantchev
Annalisa De Bonis
Gianluca De Marco

Miriam Di Ianni
Paola Flocchini
Tom Friedetzky
Giulia Galbiati
Goran Konjevod
Zvi Lotker
Ornella Menchi
Filippo Mignosi
Manal Mohammed
Melih Onus
Linda Pagli
Fanny Pascual
Andrea Pietracaprina
Srinivasa Rao
Adele Rescigno
Andrea Richa
Gianluca Rossi
Massimo Santini
Erik Saule
Marinella Sciortino
Riccardo Silvestri
Corinne Touati
Denis Trystram
Sebastiano Vigna
Ivan Visconti
Donglin Xia
Michele Zito
Rosalba Zizza

Table of Contents

On Embedding a Graph in the Grid with the Maximum Number of Bends and Other Bad Features 1
Giuseppe Di Battista, Fabrizio Frati, and Maurizio Patrignani

Close Encounters With a Black Hole or Explorations and Gatherings in Dangerous Graphs 14
Nicola Santoro

Fun with Sub-linear Time Algorithms 15
Luca Trevisan

Wooden Geometric Puzzles: Design and Hardness Proofs 16
Helmut Alt, Hans Bodlaender, Marc van Kreveld, Günter Rote, and Gerard Tel

HIROIMONO Is NP-Complete 30
Daniel Andersson

Tablatures for Stringed Instruments and Generating Functions 40
Davide Baccherini, Donatella Merlini, and Renzo Sprugnoli

Knitting for Fun: A Recursive Sweater 53
Anna Bernasconi, Chiara Bodei, and Linda Pagli

Pictures from Mongolia – Partial Sorting in a Partial World 66
Paolo Boldi, Flavio Chierichetti, and Sebastiano Vigna

Efficient Algorithms for the Spoonerism Problem 78
Hans-Joachim Böckenhauer, Juraj Hromkovič, Richard Královič, Tobias Mömke, and Kathleen Steinhöfel

High Spies (or How to Win a Programming Contest) 93
André Deutz, Rudy van Vliet, and Hendrik Jan Hoogeboom

Robots and Demons (The Code of the Origins) 108
Yoann Dieudonné and Franck Petit

The Traveling Beams Optical Solutions for Bounded NP-Complete Problems 120
Shlomi Dolev and Hen Fitoussi

The Worst Page-Replacement Policy 135
Kunal Agrawal, Michael A. Bender, and Jeremy T. Fineman

Die Another Day 146
Rudolf Fleischer

Approximating Rational Numbers by Fractions 156
Michal Forišek

Cryptographic and Physical Zero-Knowledge Proof Systems for Solutions of Sudoku Puzzles 166
Ronen Gradwohl, Moni Naor, Benny Pinkas, and Guy N. Rothblum

Sorting the Slow Way: An Analysis of Perversely Awful Randomized Sorting Algorithms 183
Hermann Gruber, Markus Holzer, and Oliver Ruepp

The Troubles of Interior Design–A Complexity Analysis of the Game Heyawake 198
Markus Holzer and Oliver Ruepp

Drawing Borders Efficiently 213
Kazuo Iwama, Eiji Miyano, and Hirotaka Ono

The Ferry Cover Problem 227
Michael Lampis and Valia Mitsou

Web Marshals Fighting Curly Link Farms 240
Fabrizio Luccio and Linda Pagli

Intruder Capture in Sierpiński Graphs 249
Flaminia L. Luccio

On the Complexity of the Traffic Grooming Problem in Optical Networks 262
Mordechai Shalom, Walter Unger, and Shmuel Zaks

Author Index 273