

Lecture Notes in Computer Science

Edited by G. Goos and J. Hartmanis

452

B. Rovan (Ed.)



Mathematical Foundations of Computer Science 1990

Banská Bystrica, Czechoslovakia

August 27–31, 1990

Proceedings



Springer-Verlag

Berlin Heidelberg New York London

Paris Tokyo Hong Kong Barcelona

Editorial Board

D. Barstow W. Brauer P. Brinch Hansen D. Gries D. Luckham
C. Moler A. Pnueli G. Seegmüller J. Stoer N. Wirth

Editor

Branislav Rovan
Department of Computer Science
Comenius University
842 15 Bratislava, Czechoslovakia

CR Subject Classification (1987): F.1–4, G.2, D.3.1, D.4.1, E.5, I.1.2

ISBN 3-540-52953-5 Springer-Verlag Berlin Heidelberg New York
ISBN 0-387-52953-5 Springer-Verlag New York Berlin Heidelberg

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 other ways, and storage in data banks. Duplication of this publication or parts thereof is only permitted under the provisions of the German Copyright Law of September 9, 1965, in its version of June 24, 1985, and a copyright fee must always be paid. Violations fall under the prosecution act of the German Copyright Law.

© Springer-Verlag Berlin Heidelberg 1990
Printed in Germany

Printing and binding: Druckhaus Beltz, Hemsbach/Bergstr.
2145/3140-543210 – Printed on acid-free paper

FOREWORD

This volume contains papers selected for presentation at the 15th Symposium on Mathematical Foundations of Computer Science - MFCS'90, held in Banská Bystrica, Czechoslovakia, August 27-31, 1990.

It is the fifteenth symposium in the series of international meetings which took place in Czechoslovakia and Poland. The aim of these symposia is to bring together specialists in theoretical fields of computer science from various countries and to stimulate mathematical research in theoretical computer science. The previous meetings took place in Jablona, 1972; Štrbské pleso, 1973; Jadwisin, 1974; Mariánské Lázně, 1975; Gdańsk, 1976; Tatranská Lomnica, 1977; Zakopane, 1978; Olomouc, 1979; Rydzina, 1980; Štrbské Pleso, 1981; Prague, 1984; Bratislava, 1986; Carlsbad, 1988; and Porąbka-Kozubnik, 1989.

The Proceedings consist of invited papers and communications. The latter have been selected by the international Program Committee from a total of 128 submitted papers. The following program committee members took part in the evaluation and the selection of submitted papers: S.Abiteboul (Paris), D.Bjørner (Lyngby), M.Broy (München), M.Chytil (Prague), P. van Emde Boas (Amsterdam), M.Fischer (New Haven), I.Guessarian (Paris), O.Ibarra (Santa Barbara), P.Kanellakis (Providence), I.Korec (Bratislava), V.E.Kotov (Novosibirsk), K.Mehlhorn (Saarbrücken), G.Mirkowska (Warsaw), D.Mundici (Milan), I.Németi (Budapest), B.Rovan - chairman (Bratislava), Ch.Rackoff (Toronto), A.Salomaa (Turku), G.Wechsung (Jena).

I would like to thank all the Program Committee members for their meritorious work in evaluating the submitted papers as well as to the following referees, who assisted the Program Committee members: S. M. Achasova, H. Andréka, J. M. Autebert, E. Badonel, L. Banachowski, O. L. Bandman, W. Bartol, D. Beauquier - Girault, J. Beauquier, R. Beigel, U. Berger, R. Berghammer, G. Bernot, J. Berstel, A. Bertoni, M. Bidoit, L. Boasson, H. L. Bodlaender, J. D. Boissonnat, A. Bossi, Bouge, M. Breu, L. Brim, L. Bukovský, M. A. Bulyonkov, A. V. Bystrov, K. Chen, L. A. Cherkasova, C. Choffrut, C. Choppy, J.-L. Coquidé, R. Cori, K. Culik II., P. Darondeau, J. Dassow, F. Dedericks, J. P. Delahaye, P. Dembiński, G. Demichelis, J. Deminet, C. Dendorfer, J. Desel, A. Deutsch, M. Dezani, C. Dony, V. Donzeau - Gouge, A. G. Dragalin, P. Ďuriš, P. Enjalbert, L. Fariñas del Cerro, P. Feautrier, M. Ferbus, M. Ferenczi, A. S. Filurin, Ch. Frougny, U. Furbach, J. Gallier, D. Gardy, P. Gastin, V. Geffert, A. Geser, F. Gire, O. Goldreich, M. Goldwurm, S. Grigorieff, J. Gruska, M. R. Hansen, A. E. Haxthausen, T. Harju, R. Hennicker, A. Hemmerling, D. Hillen, P. Jacquet, P. Jančar, K. P. Jantke, C. Jard, R. Jeansoulin, K. M. Jensen, T. Jiang, J.-P. Jouannaud, H. Jung, J. Karhumäki, J. Kari, T. Katriňák, A. Kelemenová, H. C. Kirchner, J. Kivinen, J. Komara, V. Koubek, M. Krause, F. Kröger, M. Křivánek, G. Kucherov, G. A. Lanzarone, M. J. Lao, M. Latteux, J.J. Levy, G. Linde, M. Linna, G. Lischke, I. Litovsky, A. I. Litwiniuk, H. H. Lovgreen, W. Lukaszewicz, A. Martelli, G. Mauri, Ch. Meinel, D. Meinhardt, D. Mery, T. Mihálydeák, M. Milkowska, M. Mnuk, B. Möller, H. Müller, F. Nickl, M. Nielsen, V. Niemi, D. Niwinski, E. Ochmanski, R. Ochranová, E. Orlowska, P. Padawitz, M.A. Palis, A. Peht, M. Pellentier, D. Perrin, A. Petit, J. Plesník, L. Pomello, L. Priese, I. Prívara,

P. Pudlák, T. Puls, C. Queinnec, J. C. Raoult, B. Ravikumar, H. Rischel, Ph. Robert, L. Rosier, G. Rozenberg, P. Ružička, W. Rytter, J. Sakarovitch, A. Salwicki, A. Saoudi, P. Savický, B. A. Schieder, H. Schlingloff, G. Schmidt, M. Scholl, H. Schröder, D. Schupp, G. Serény, V. N. Shilov, I. Sifakis, C. Simone, A. Slobodová, J. Stavnstrup, J. Steensgaard - Madsen, M. Steinby, J. Steiner, O. Sýkora, A. Szalas, Szécsényi, Gy. Szérenyi, M. Szöts, J. Šefránek, M. Škoviera, J. Šturm, V. Tannen, A. Tarlecki, J. Tiuryn, D. Uhlig, E. Ukkonen, S. Valentini, D. Vidal, J. Villadsen, L. Voelkel, J. Vogel, I. Vrto, S. Waack, K. W. Wagner, S. Waligórska, J. Warpechowska, R. Weber, J. Westbrook, J. Wiedermann, M. Wieth, M. Wirsing, A. Zanardo, T. Zeugmann, W. Zielonka, J. Zlatuška.

MFCS'90 was organized by the Association of Slovak Mathematicians and Physicists of the Slovak Academy of Sciences, The House of Technology in Banská Bystrica, and the Comenius University in Bratislava in cooperation with the following institutions: VUSEI-AR, Bratislava; Computing Center of the Slovak Academy of Sciences, Bratislava; Masaryk University, Brno; Šafárik University, Košice; Charles University, Prague; Slovak Technical University, Bratislava.

The Organizing Committee consisted of G. Andrejková, E. Bitnerová, Z. Bouša, I. Černá, Z. Felixová, R. Galbavý, J. Hromkovič, J. Hvorecký, V. Jankovič, B. Rovan, P. Ružička, D. Senčeková, A. Slobodová, H. Štefanová, I. Vrto.

Being the editor of these Proceedings I am much indebted to all contributors to the scientific program of the symposium, especially to the authors of papers. Special thanks go to those authors of communications who managed to stay within the seven page limit and made the life easier for me. I would also like to gratefully acknowledge the support of all the above mentioned cooperating institutions. Last but not least I want to thank Springer-Verlag for excellent co-operation in publication of this volume.

Bratislava, May 1990

Branislav Rovan

CONTENTS

Invited Lectures

| | | |
|---|---|-----|
| E. Börger | A Logical Operational Semantics of Full Prolog | 1 |
| J.-P. Jouannaud | Syntactic Theories | 15 |
| D. Kozen | On Kleene Algebras and Closed Semirings | 26 |
| J. Krajíček, P. Pudlák, J. Sgall | Interactive Computations of Optimal Solutions | 48 |
| Ch. Meinel | Restricted Branching Programs and Their Computational Power | 61 |
| F. Meyer auf der Heide | Dynamic Hashing Strategies | 76 |
| A. L. Selman | One-Way Functions in Complexity Theory | 88 |
| J. Tiuryn | Type Inference Problems: A Survey | 105 |
| J. Torán | Counting the Number of Solutions | 121 |
| W. G. Vree | Implementation of Parallel Graph Reduction by Explicit Annotation and Program Transformation | 135 |

Communications

| | | |
|---|--|-----|
| M. Alberts | Interrogative Complexity of ω -Languages' Recognition | 152 |
| E. Allender, U. Hertrampf | On the Power of Uniform Families of Constant Depth Threshold Circuits | 158 |
| F. d'Amore, P. G. Franciosa | Separating Sets of Hyperrectangles | 165 |
| S. K. Baruah, R. R. Howell, L. E. Rosier | On Preemptive Scheduling of Periodic, Real-Time Tasks on One Processor | 173 |
| A. de Bruin, E. P. de Vink | Retractions in Comparing Prolog Semantics | 180 |

| | |
|---|-----|
| G. Buntrock, L.A. Hemachandra, D. Siefkes | |
| Using Inductive Counting to Simulate Nondeterministic Computation | 187 |
| I. Černá | |
| Some Properties of Zerotesting Bounded One-Way Multicounter Machines | 195 |
| M. Chrobak, L. L. Larmore | |
| On Fast Algorithms for Two Servers | 202 |
| M. Clerbout, D. Gonzales | |
| Decomposition of Semi Commutations | 209 |
| M. Crochemore, W. Rytter | |
| Parallel Construction of Minimal Suffix and Factor Automata | 217 |
| K. Culik II, S. Dube | |
| Affine Automata: A Technique to Generate Complex Images | 224 |
| C. Damm | |
| The Complexity of Symmetric Functions in Parity Normal Forms | 232 |
| P. Darondeau, P. Degano | |
| Event Structures, Causal Trees, and Refinements | 239 |
| P. Dublish, S. N. Maheshwari | |
| Query Languages which Express all PTIME Queries for Trees and Unicyclic Graphs | 246 |
| E. Fachini, A. Maggiolo Schettini, D. Sangiorgi | |
| Comparisons Among Classes of Y-Tree Systolic Automata | 254 |
| W. I. Gasarch, L. A. Hemachandra, A. Hoene | |
| On Checking Versus Evaluation of Multiple Queries | 261 |
| R. Gavalda, L. Torenvliet, O. Watanabe, J. L. Balcázar | |
| Generalized Kolmogorov Complexity in Relativized Separations | 269 |
| A. Gavilanes-Franco | |
| A First-Order Logic for Partial Recursive Functions | 277 |
| V. Geffert | |
| Speed-up Theorem Without Tape Compression | 285 |
| D. Geidmanis | |
| On Possibilities of One-Way Synchronized and Alternating Automata | 292 |
| A. Goerdt | |
| Unrestricted Resolution Versus N-Resolution | 300 |
| R. Gold, W. Vogler | |
| Quality Criteria for Partial Order Semantics of Place/Transition-Nets | 306 |
| W. Golubski, W.-M. Lippe | |
| Tree-Stack Automata | 313 |

| | |
|---|-----|
| M. R. Hansen, Z. Chao-Chen | |
| Specification and Verification of Higher Order Processes | 322 |
| F. Hinz | |
| The Membership Problem for Context-Free Chain Code Picture Languages | 329 |
| J. Hromkovič, C.-D. Jeschke, B. Monien | |
| Optimum Algorithms for Dissemination of Information in Some Interconnection Networks | 337 |
| B. Jonsson | |
| A Hierarchy of Compositional Models of I/O-Automata | 347 |
| J. Kāneps, R. Freivalds | |
| Minimal Nontrivial Space Complexity of Probabilistic One-Way Turing Machines .. | 355 |
| M. Karpinski, F. Meyer auf der Heide | |
| On the Complexity of Genuinely Polynomial Computation | 362 |
| E. Kounalis | |
| Pumping Lemmas for Tree Languages Generated by Rewrite Systems | 369 |
| M. Kowaluk, K. W. Wagner | |
| Vector Language : Simple Description of Hard Instances | 378 |
| M. Krause | |
| Separating $\oplus L$ from L , NL , $co-NL$ and AL ($= P$) for Oblivious Turing Machines of Linear Access Time | 385 |
| M. Křivánek | |
| The Use of Graphs of Elliptical Influence in Visual Hierarchical Clustering | 392 |
| K.-J. Lange, P. Rossmanith | |
| Characterizing Unambiguous Augmented Pushdown Automata by Circuits | 399 |
| M. Latteux, E. Timmerman | |
| Rational ω -transductions | 407 |
| Ch. Levcopoulos, O. Petersson | |
| Splitsort - An Adaptive Sorting Algorithm | 416 |
| V. Manca, A. Salibra | |
| Equational Calculi for Many-Sorted Algebras with Empty Carrier Sets | 423 |
| E. Ochmański | |
| Semi-Commutation and Deterministic Petri Nets | 430 |
| M. Parigot | |
| Internal Labellings in Lambda-Calculus | 439 |
| A. Pasztor | |
| A Sup-Preserving Completion of Ordered Partial Algebras | 446 |

| | |
|---|-----|
| M. Piotrów | |
| ATIME(n) is Closed Under Counting..... | 457 |
| R. Pliuškevičius | |
| Investigation of Finitary Calculi for the Temporal Logics by Means of Infinitary Calculi | 464 |
| A. Poigné | |
| Typed Horn Logic..... | 470 |
| I. Sain | |
| Results on the Glory of the Past | 478 |
| P. H. Uyen | |
| A Stronger Version of Parikh Theorem..... | 485 |
| S. Waack | |
| The Parallel Complexity of Some Constructions in Combinatorial Group Theory ... | 492 |
| I. Walukiewicz | |
| Gentzen Type Axiomatization for PAL..... | 499 |
| A. Weber | |
| Distance Automata Having Large Finite Distance or Finite Ambiguity | 508 |
| I. Wegener | |
| Bottom-Up-Heap Sort, a New Variant of Heap Sort Beating on Average Quick Sort | 516 |
| I. Wegener, N. Wurm, S.-Z. Yi | |
| Symmetric Functions in AC^0 Can Be Computed in Constant Depth with Very Small Size | 523 |
| M. Wiegert | |
| The k-section of Treewidth Restricted Graphs | 530 |
| T. Zeugmann | |
| Computing Large Polynomial Powers Very Fast in Parallel..... | 538 |