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FOREWORD

This volume contains 10 invited papers and 40 short communications contributed for presentation at the 17th Symposium on Mathematical Foundations of Computer Science - MFCS'92, held in Prague, Czechoslovakia, August 24 - 28, 1992.

The contributions in these Proceedings were selected from 78 papers submitted in response to the call for papers. The following program committee members took part in the evaluation and selection of submitted papers:

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The symposium was organized by the Faculty of Mathematics and Physics, Center for Theoretical Study, and Computer Center of Charles University, Prague, and Agency Action M, Prague.

The organizing committee of MFCS'92 consisted of P. Krbeč - Chairman, V. Hořák, V. Koubek, F. Mráz, J. Peláková, J. Peterka, M. Zeithamlová.

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TABLE OF CONTENTS

INVITED LECTURES

P. K. Agarwal, J. Matoušek On Range Searching with Semialgebraic Sets	1
J. Díaz Graph Layout Problems	14
K.-J. Lange, P. Rossmanith, W. Rytter Parallel Recognition and Ranking of Context-Free Languages	24
M. Mihail On the Expansion of Combinatorial Polytopes	37
P. Orponen Neural Networks and Complexity Theory	50
J. V. Tucker, J. I. Zucker Theory of Computation over Stream Algebras, and its Applications	62
U. Vishkin Methods in Parallel Algorithmics	81
O. Watanabe On the Complexity of Small Description and Related Topics	82
J. Wiedermann Weak Parallel Machines: a New Class of Physically Feasible Parallel Machine Models	95
A. Wigderson The Complexity of Graph Connectivity	112

COMMUNICATIONS

H. Bast, M. Dietzfelbinger, T. Hagerup A Perfect Parallel Dictionary	133
B. Becker, J. Hartmann Some Remarks on the Test Complexity of Iterative Logic Arrays	142
H.-J. Burtschick, A. Hoene The Degree Structure of 1-L Reductions	153
J. Cai, L. A. Hemachandra, J. Vyskoč Promise Problems and Access to Unambiguous Computation	162
S. Chari, D. Ranjan, P. Rohatgi On the Complexity of Incremental Computation	172

Ch. Choffrut, M. Goldwurm Rational Transductions and Complexity of Counting Problems	181
H. Comon, M. Fernández Negation Elimination in Equational Formulae	191
J. F. Costa, A. Sernadas, C. Sernadas, H.-D. Ehrich Object Interaction	200
P.-L. Curien, T. Hardin, A. Ríos Strong Normalization of Substitutions	209
R. Daley, B. Kalyanasundaram Probabilistic and Pluralistic Learners with Mind Changes	218
C. Damm, M. Holzer, K.-J. Lange Parallel Complexity of Iterated Morphisms and the Arithmetic of Small Numbers	227
D. Derencourt, J. Karhumäki, M. Latteux, A. Terlutte On Computational Power of Weighted Finite Automata	236
R. Feldmann, P. Mysiwiets The Shuffle Exchange Network has a Hamiltonian Path	246
P. Gastin, A. Petit Poset Properties of Complex Traces	255
A. Goerd A Threshold for Unsatisfiability	264
R. Gold Dataflow Semantics for Petri Nets	275
I. Guessarian, M. Veloso-Peixoto About Boundedness for some <i>DATALOG</i> and <i>DATALOG^{neg}</i> Programs	284
T. Hagerup, O. Petersson Merging and Sorting Strings in Parallel	298
P. Jančár, F. Mráz, M. Plátek Characterization of Context-Free Languages by Erasing Automata	307
L. Kari Insertion and Deletion of Words: Determinism and Reversibility	315
F. Kašćák Small Universal One-State Linear Operator Algorithm	327
C. Laneve, U. Montanari Mobility in the CC-Paradigm	336
K.-J. Lange, P. Rossmanith The Emptiness Problem for Intersections of Regular Languages	346

H. Leung	
On Finite Automata with Limited Nondeterminism	355
I. Litovsky, Y. Métivier, E. Sopena	
Definitions and Comparisons of Local Computations on Graphs	364
B. Martin	
Efficient Unidimensional Universal Cellular Automaton	374
O. Marnyama, S. Miyano	
Inferring a Tree from Walks	383
E. Mayordomo	
Almost Every Set in Exponential Time is P-Bi-Immune	392
D. Murphy, A. Poigné	
A Functorial Semantics for Observed Concurrency	401
E. Ochmański	
Modelling Concurrency with Semi-Commutations	412
J. Pedersen	
Decision Problems for Cellular Automata and Their Semigroups	421
G. M. Pinna, A. Poigné	
On the Nature of Events	430
W. Preilowski, E. Dahlhaus, G. Wechsung	
New Parallel Algorithms for Convex Hull and Triangulation in 3-Dimensional Space	442
T. C. Przymusiński	
Two Simple Characterizations of Well-Founded Semantics	451
S. Ramesh	
Fully Abstract Semantics for Higher Order Communicating Systems	463
N. Reimen	
Superposable Trellis Automata	472
T. Roos, G. Albers	
Maintaining Proximity in Higher Dimensional Spaces	483
A. Szilard, S. Yu, K. Zhang, J. Shallit	
Characterizing Regular Languages with Polynomial Densities	494
D. Wang	
A Strategy for Speeding-up the Computation of Characteristic Sets	504
C. Wrathall, V. Diekert, F. Otto	
One-Rule Trace-Rewriting Systems and Confluence	511

BIBLIOTHEQUE DU CERIST

On Range Searching with Semialgebraic Sets*

Pankaj K. Agarwal[†] and Jiří Matoušek[‡]

Abstract

Let P be a set of n points in $\mathbb{R}^d$ (d a small fixed positive integer), and let Γ be a collection of subsets of $\mathbb{R}^d$, each of which is defined by a constant number of bounded degree polynomials. The Γ -range searching problem is defined as: Preprocess P into a data structure, so that all points of P lying in a given $\gamma \in \Gamma$ can be counted (or reported) efficiently. Generalizing the simplex range searching techniques, we construct a data structure for Γ -range searching with nearly linear space and preprocessing time, which can answer a query in time $O(n^{1-1/b+\delta})$, where $d \leq b \leq 2d-3$ and $\delta > 0$ is an arbitrarily small constant. The actual value of b is related to the problem of partitioning arrangements of algebraic surfaces into constant-complexity cells.

1 Introduction

Let Γ be a family of subsets of the d -dimensional space $\mathbb{R}^d$ (d is a small constant) such that each $\gamma \in \Gamma$ can be described by some fixed number of real parameters (for example, Γ can be the set of balls, or the set of all intersections of two ellipsoids, etc.; see below for a more formal definition). We will consider the Γ -range searching which is defined as: Preprocess a set P of n points in $\mathbb{R}^d$ into a data structure, so that all points of P lying in a query object $\gamma \in \Gamma$ can be counted or reported efficiently. Actually we will consider a more general setting, where one assumes a weight function on points and asks for a cumulative weight of points in $P \cap \gamma$. The weights are assumed to belong to a semigroup, i.e., subtractions are not allowed. We will assume that the semigroup operations can be executed in constant time.

A special case of the Γ -range searching problem that has been intensively studied is the *simplex range searching*, where Γ is the set of all d -dimensional simplices. This simplex range searching is by now reasonably well understood: lower bounds were given by Chazelle [Cha89], and nearly matching upper bounds were given by Chazelle et al. [CSW90] and further improved by Matoušek [Mat91c, Mat92] (some of the several previous significant works on this problem include [Wil82, YY85, HW87, CW89]). Ignoring various logarithmic and smaller factors, these results essentially say that the simplex range searching problem can be solved either with roughly linear storage and preprocessing and $O(n^{1-1/d})$ query time, or with a polylogarithmic

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