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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:

Jean Berstel (Paris), Andrzej J. Blikle (Warsaw), Ronald V. Book (Santa Barbara), Michal Chytil (Prague), Stephen A. Cook (Toronto), Karel Čulík II (Columbia), Peter van Emde Boas (Amsterdam), Rūsiņš V. Freivalds (Riga), Ivan M. Havel (Prague), Juraj Hromkovič (Paderborn), Václav Koubek (Prague), Michael Luby (Berkeley), Vaughan Pratt (Stanford), Albert R. Meyer (Cambridge), Arto Salomaa (Turku), Andrzej Salwicki (Warsaw), Alexander L. Semenov (Moscow), Martin Wirsing (Passau).

In evaluating the submitted papers, the following referees assisted the program committee members: J. Albert, R. Amachi, P. Beame, M. A. Bednarczyk, L. Boasson, R.N. Bol, G. Boudol, P. Capello, Ch. Choffrut, B. Codenotti, M. Crochemore, M. Dietzfelbinger, F. Dedericks, K. Diks, S. Dube, O. Egecioglu, M. Figge, I. Fris, Ch. Frougny, R. Gavalda, A. Goerdt, M. Goldwurm, M. Grabowski, I. Guessarian, R. Hennicker, M.L. Hilton, J. Honkala, O. Ibarra, P. Jančar, J. Karhumäki, J. Kari, L. Kari, Ker-I-Ko, R. Klasing, J. N. Kok, M. Křivánek, T. Leighton, J. Lutz, Y. Métivier, F. Meyer auf der Heide, G. Mirkowska, A. Mueck, V. Niemi, D. Niwiński, K. S. Nowinski, E. Ochmański, F. Otto, W. Pawlowski, M. Pelligrini, W. Penczek, M. Penttonen, D. Perrin, H. Peterreins, V.J. Pollara, W. Preilowski, A. Renvall, B. Reüs, J. Sakarovitch, K. Salomaa, Sheng Yu, V. Shoup, M. A. Sridhar, J. Stewart, T. Szymacha, J. Tyszkiewicz, B. Thomsen, W. Unger, P. Urzyczyn, M. Vardi, W. Vogler, H. Volger, R. Wanka, R. Weber, J. Winkowski.

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. Krbec - Chairman, V. Horák, V. Koubek, F. Mráz, J. Peláková, J. Peterka, M. Zeithamlová.

As the editors of these Proceedings we wish to thank all those who submitted papers for consideration, all program committee members and referees for their meritorious work on evaluating the papers. Finally, the excellent cooperation of Springer-Verlag in the publication of this volume is highly appreciated.

Prague, June 1992

Ivan M. Havel, Václav Koubek

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INVITED LECTURES

COMMUNICATIONS

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 $d \le b \le 2d-3$ 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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