O. Nurmi E. Ukkonen (Eds.)

Algorithm Theory – SWAT '92

Third Scandinavian Workshop on Algorithm Theory
Helsinki, Finland, July 8-10, 1992
Proceedings

Springer-Verlag
Berlin Heidelberg New York
London Paris Tokyo
Hong Kong Barcelona
Budapest

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CR Subject Classification (1991): F.1-2, E.1-2, G.2-3

ISBN 3-540-55706-7 Springer-Verlag Berlin Heidelberg New York
ISBN 0-387-55706-7 Springer-Verlag New York Berlin Heidelberg

Typesetting: Camera ready by author/editor
Printing and binding: Druckhaus Beltz, Hemsbach/Bergstr.
45/3140-543210 - Printed on acid-free paper

Preface

The papers in this volume were presented at SWAT '92, the Third Scandinavian Workshop on Algorithm Theory. The workshop, which continues the tradition of SWAT '88, SWAT '90, and the Workshop on Algorithms and Data Structures (WADS '89, WADS '91), is intended as an international forum for researchers in the area of design and analysis of algorithms. The call for papers sought contributions in algorithms and data structures, in all areas, including combinatorics, computational geometry, data bases, parallel and distributed computing, and graphics. There were 120 papers submitted, of which the program committee selected 34 for presentation. In addition, invited lectures were presented by Leslie G. Valiant (Direct bulk-synchronous parallel algorithms), Alexander A. Razborov (On small depth threshold circuits), Gaston Gonnet (Efficient two-dimensional searching), and Emo Welzl (New results on linear programming and related problems).

SWAT '92 was held in Helsinki, July 8–10, 1992, and was organized in cooperation with the Department of Computer Science of the University of Helsinki. The organizing committee consisted of B. Aspvall (University of Bergen), H. Hafsteinsson (University of Iceland), R. Karlsson (Lund University), E. M. Schmidt (Aarhus University), O. Nurmi, J. Tarhio, and E. Ukkonen (University of Helsinki).

The program committee wishes to thank all referees who aided in evaluating the papers. The organizers would like to thank J. Kivinen, S. Palander, and J. Vilo for excellent service in all organizational matters related to the conference. Finally, we are very grateful to Nordiska Forskarutbildningsakademin, Ministry of Education (Finland), the Academy of Finland, University of Helsinki, EATCS, the Finnish Society for Computer Science, SUN Microsystems Oy, and ICL Data Oy for sponsoring the workshop.

Helsinki, May 1992

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Direct Bulk-Synchronous Parallel Algorithms *

Alexandros V. Gerbessiotis and Leslie G. Valiant
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Abstract

We describe a methodology for constructing parallel algorithms that are transportable among parallel computers having different numbers of processors, different bandwidths of interprocessor communication and different periodicity of global synchronisation. We do this for the bulk-synchronous parallel (BSP) model, which abstracts the characteristics of a parallel machine into three numerical parameters p, g, and L, corresponding to processors, bandwidth, and periodicity respectively. The model differentiates memory that is local to a processor from that which is not, but, for the sake of universality, does not differentiate network proximity. The advantages of this model in supporting shared memory or PRAM style programming have been treated elsewhere. Here we emphasise the viability of an alternative direct style of programming where, for the sake of efficiency the programmer retains control of memory allocation. We show that optimality to within a multiplicative factor close to one can be achieved for the problems of Gauss-Jordan elimination and sorting, by transportable algorithms that can be applied for a wide range of values of the parameters p, g, and L. We also give some simulation results for PRAMs on the BSP to identify the level of slack at which corresponding efficiencies can be approached by shared memory simulations, provided the bandwidth parameter g is good enough.

1 The Model

The bulk-synchronous parallel or BSP model as described in [17] consists of three parts:
(i) a number of processor/memory components. Here we will assume that each consists of a sequential processor with a block of local memory.
(ii) a router that can deliver messages (typically to implement read and write operations) point to point among the components, and
(iii) facilities for globally synchronizing, in barrier style, all or a subset of the components.

The parameters of such a machine are p, the number of processor/memory components, L, the minimal time (measured in terms of basic local computation steps)

*This research was supported in part by the National Science Foundation under grant CCR-89-02500 and by the Office of Naval Research under grant N00014-85-K-0445.