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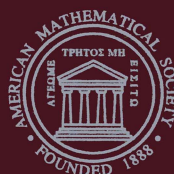
Series in Discrete Mathematics
and Theoretical Computer Science

Volume 30

Parallel Algorithms

Third DIMACS Implementation Challenge
October 17–19, 1994

Sandeep N. Bhatt
Editor



American Mathematical Society

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NSF Science and Technology Center
in Discrete Mathematics and Theoretical Computer Science
A consortium of Rutgers University, Princeton University,
AT&T Labs, Bell Labs, and Bellcore



American Mathematical Society

This volume resulted from the Third DIMACS Implementation Challenge which was conducted as part of the 1993–1994 Special Year on Parallel Algorithms. This Implementation Challenge was held at DIMACS on October 17–19, 1994.

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Foreword

This volume resulted from the Third DIMACS Implementation Challenge which was conducted as part of the 1993–1994 Special Year on Parallel Algorithms. The implementation challenges have become a regular part of DIMACS programs and the center is proud to sponsor and host them.

We are very grateful to Sandeep Bhatt and Pangfeng Liu, his assistant in this work, for their work to plan the challenge and coordinate the work of many individual projects. Sandeep Bhatt also earns our appreciation for the additional work of editing this volume and bringing it to fruition. We are also thankful to David Culler, David S. Johnson, Lennart Johnson, and Charles Leiserson for their assistance as a steering committee for the year's activities.

DIMACS gratefully acknowledges the generous support that makes these programs possible. The National Science Foundation through its Science and Technology Center program, the New Jersey Commission on Science and Technology, and DIMACS partners at Rutgers, Princeton, AT&T Labs, Bell Labs, and Bellcore all generously supported the Special Year and the Implementation Challenge.

Fred S. Roberts
Director

Bernard Chazelle
Co-Director for Princeton

Stephen R. Mahaney
Associate Director

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Preface

The past decade witnessed the development of parallel computers which were successfully used to solve large-scale numerical problems, typically arising from scientific and engineering applications. The use of massive parallelism in non-numerical applications received considerably less attention. However, this period also witnessed a flurry of research in the design of algorithms for discrete combinatorial applications. Despite the large body of theoretical work on parallel algorithms for combinatorial problems, it was unclear what kinds of parallel algorithms would be effective in practice, and how well these would compete with standard sequential algorithms.

The Third Annual DIMACS Implementation Challenge was formulated with the view to provide a forum for a concerted effort to study effective algorithms for combinatorial problems, and to investigate opportunities for massive speedups on parallel computers. The challenge included two problem areas for research study: (a) tree searching algorithms, used in game search and combinatorial optimization for example; and (b) algorithms for sparse graphs.

Participants at sites in the U.S. and Europe undertook projects during the period from November 1993 to October 1994. The Challenge workshop was held at DIMACS on October 17 and 18, 1994. Following the workshop, participants were encouraged to share test instances where possible, to rework their implementations in light of the feedback at the workshop, and to submit a final report for the proceedings. Nine papers were selected for this volume.

Approximately 50 researchers attended the workshop; there were 17 project presentations, 7 invited talks, and a panel discussion. The specific application problems presented at the workshop included connected components and shortest paths in graphs, geometric clustering and dominance, graph partitioning, N -body algorithms for astrophysics, branch-and-bound techniques, and massively parallel chess. The invited presentations focused on topics ranging from good experimental methodology (Guy Blelloch, David Johnson); the interplay between modeling, algorithm design, and implementation (David Culler); and specific applications such as factoring (Arjen Lenstra), traveling salesman (David Applegate), and mesh partitioning (Shanghua Teng, Zdenek Johann).

The expert assistance of the DIMACS staff in hosting and arranging the workshop is gratefully acknowledged. The NSF STC grant supported Pangfeng Liu as a DIMACS post-doctoral fellow to help coordinate the Challenge. Thanks to Pangfeng for his efforts, and also to the rest of the Challenge Steering Committee, which included David Culler (UC Berkeley), David Johnson (AT&T Labs), Lennart Johnsson (Univ. of Houston) and Charles Leiserson (MIT).

Sandeep Bhatt
November 1996

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