The Third DIMACS International Algorithm Implementation Challenge: General Information

November 16, 1993

This document provides a general overview of the organization of the Challenge.

1 Introduction

In conjunction with its Special Year on Parallel Computing, the Center for Discrete Mathematics and Theoretical Computer Science (DIMACS) invites participation in an international Implementation Challenge to study effective parallel algorithms for combinatorial problems. Participants are invited to carry out research projects related to the problem areas specified below and to present research papers at a DIMACS workshop to be held in October 1994. A refereed workshop proceedings will be published by the American Mathematical Society.

While massively parallel computers are routinely used in a variety of scientific numerical applications, they are not widely used in discrete combinatorial applications. Within the last decade a large body of theoretical work in parallel combinatorial algorithms has emerged. The impact of this theoretical work is not yet visible, and it is unclear what kind of parallel algorithms will be most effective in practice.

The goal of this implementation challenge is to provide a forum for a concerted experimental effort to study effective algorithms for combinatorial problems, and to investigate the opportunities for massive speedups on parallel computers. The challenge is to expose, and perhaps quantify, the issues critical to obtaining high performance on different parallel platforms using different programming models. For example, are the data structures and algorithms of choice radically different for different architectures? What are the implications of selecting one programming model over another (for example data-parallel versus message-passing) to algorithm and data-structure design? Which algorithmic techniques are robust across machine architectures and programming styles?

It is expected that the refereed proceedings of the workshop will provide a state-of-the-art overview of the field, and be an invaluable reference. Other by-products of the challenge will be a database of solution codes, test generators and instances, annotated bibliographies, and other items submitted by participants.

The success of the challenge will be determined by the efforts of the participants. The role of DIMACS is simply to provide general guidance and coordination, to serve as a clearing-house for exchange of programs, benchmarks, and communication among researchers, and to sponsor the workshop and proceedings.

2 Description of Problem Areas

The challenge includes two broad problem areas for research study. The first problem area is *tree searching* algorithms. This area includes but is not limited to branch-and-bound, backtrack, and game tree search. Participants can study these search problems in the context of, say, a specific combinatorial optimization problem (e.g. traveling salesman problem) or game-playing computer program (e.g. chess). Alternatively, participants may choose to develop a generic facility for, say, branch-and-bound which can be used in different applications.

The second problem area is parallel algorithms for sparse graphs and dynamic graphs. There is a large body of literature on parallel graph algorithms as well as algorithms for updating specific properties of dynamic graphs. Examples include, but again are not limited to, minimum spanning trees, shortest paths, connectivity, and graph theoretic approaches to solving sparse linear systems.

Participants are welcome to select applications other than the examples given above. The aim should be to pick an application which presents clear technical obstacles to naive parallelization, and to pick large problem instances to warrant the use of massive parallelism.

In addition to selecting specific implementation projects, participants should address the related issues of developing input specifications, benchmark instances, and input generators. Given the potential diversity of applications as well as the variety of computing platforms, this information will help coordinate the activities of different researchers working on closely related applications.

3 Computing Platforms

Particpants are welcome to conduct their research on a computing environment of their choice. Included are commercially available machines, research prototypes, workstation clusters, or even high-performance workstations with multiple processors. DIMACS is currently investigating possibilities for participants to access massively parallel processors at the NSF Supercomputing Centers across the US.

4 Challenge Administration

Advisory board

A committee of DIMACS members will provide general direction for the Implementation Challenge. Committee members include Sandeep Bhatt, Bellcore and Rutgers University (Coordinator), David Culler, U.C. Berkeley, David Johnson, ATT-Bell Laboratories, S. Lennart Johnsson, Thinking Machines Corporation and Harvard University, Charles Leiserson, MIT, and Pangfeng Liu, DIMACS.

DIMACS support

The DIMACS advisory committee will provide feedback on proposals, and DIMACS facilities will serve as a clearing-house for exchange of programs and communication among researchers. DIMACS cannot provide financial support for research projects.

Challenge Timetable

The Challenge continues through mid-August 1994. During this period the advisory committee will review short proposals from participants and suggest alternative approaches. Individual research groups working on similar problems can also coordinate and exchange ideas with each other. In order to coordinate the various events throughout the Challenge, we suggest prospective participants follow the timetable below.

1. Register with the Challenge *as soon as possible* by sending mail to challenge3@dimacs.rutgers.edu asking to be put on a mailing list which will announce available documents and provide a forum on ongoing research.

2. Submit a two or three page proposal by **January 15, 1994** which will be reviewed by the committee. The proposal should briefly describe the specific application and the experimental approach. The proposal should also discuss input specifications, benchmark instances, input generators and computing platform.

   Participants who select a specific application early are strongly encouraged to send a send a brief statement (2 or 3 paragraphs) soon after planning the project. This will help identify projects with similar objectives early in the challenge.

3. Submit a progress report by **April 15, 1994** which will be reviewed by the committee.

4. Submit an (up to ten page) extended abstract by **August 15, 1994** from which workshop presenters will be chosen by the Committee. This is a firm deadline.

At each review step, the committee will examine each project to identify related, and perhaps duplicated, research efforts and to suggest modifications as may seem appropriate and agreeable to the participants.

Approximately one month before the workshop, the set of accepted extended abstracts in each problem domain will be circulated to those with accepted presentations. This will allow participants to prepare their workshop presentations with the related papers already in mind and will encourage further communication between participants. Shortly after the workshop, a DIMACS technical report will be prepared that consists of the (possibly revised) extended abstracts. Full papers will be due one or two months after the workshop for consideration in the refereed proceedings.

5 Accessing Other Documents

A number of other documents will be ready soon. These include an annotated bibliography and suggested research directions. Periodical update on the Challenge will also be made available. Participants are welcome to suggest additions to the list, and to contribute to the annotated bibliography.

Announcement of these documents will be sent to the participant mailing list. All these documents can be accessed by anonymous FTP, or by sending e-mail to the Challenge.

Anonymous FTP

The Challenge documents can be accessed via anonymous FTP to DIMACS. To use this facility type the following command sequence. Human-generated commands appear in `typewriter` font; `name@address` refers to your full email address.

> % `ftp dimacs.rutgers.edu`
>
> Connected to dimacs.rutgers.edu.
>
> 220 dimacs.rutgers.edu FTP server (Version 6.15 Fri Apr 10 01:00:01 EDT 1992) ready.
>
> Name (local.system.name): `anonymous`
>
> 331 Guest login ok, send e-mail address as password.
>
> Password: `name@address`
>
> 230 Guest login ok, access restrictions apply.
>
> ftp> cd `pub/challenge3`
>
> 250 CWD command successful.

Typing a `?` at the `ftp>` prompt will produce a list of commands. Typing `help commandname` will give a very short description of what the command does. Typing `remotehelp commandname` gives a description of command format. For further information about `FTP`, contact your local system administrator.

The main directory contains several files of general interest. The file INDEX lists all available files and describes the various subdirectories.

Electronic Mail

If you do not have FTP access, the related document can also be obtained by sending email to challenge3@dimacs.rutgers.edu and indicating the requested files.

Currently we plan to use only one address (challenge3@dimacs.rutgers.edu) for electronic mail communication. As the challenge proceeds we will set up a mail-server and an Internet newsgroup when necessary.

Please feel free to send any general questions, comments and suggestions to challenge3@dimacs.rutgers.edu.