Gordon Bell Prize Lectures 1993

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Abstract

The Gordon Bell Prize recognizes significant achievements in the application of supercomputers to scientific and engineering problems. In a special session at Supercomputing '93 the finalists of the 1993 prize competition will give presentations about their winning entries. In this note we summarize the rules for the Gordon Bell Prize, and give a brief review of the history of this Prize, which reflects some of the developments in high performance computing in the last five years.

1 Introduction

The Gordon Bell Prize recognizes significant achievements in the application of supercomputers to scientific and engineering problems. In contrast to serial processing, typically used in personal computers as well as in many larger machines, parallel processing allows a task to be broken down into many sub-tasks that are performed simultaneously on multiple processors sometimes numbering in the hundreds or even the thousands. Writing programs for these powerful systems is a major challenge for software and computer engineers. Gordon Bell, a former National Science Foundation division director, now an independent consultant, offers the prizes to spur the transition of parallel processing from computer science research to useful applications.

In 1993 prizes were offered in three categories: performance, price/performance, and compiler parallelization. The performance prize recognizes those who solved a real problem in less elapsed time than anyone else. The price/performance prize recognizes those who developed a system that achieved the best performance at the lowest cost. The compiler parallelization prize recognizes those who developed a compiler that improved the performance of a program.

2 Rules for the 1993 Competition

The 1993 prizes will be given in two of three categories:

1. **Performance**: The entrant will be expected to convince the judges that the submitted program is running faster than any other comparable engineering or scientific application. Suitable evidence will be the megaflop rate based on actual operation counts or the solution of the same problem with a properly tuned code on a machine of known performance, such as a Cray Y-MP. If neither of these measurements can be made, the submitter should document the performance claims as well as possible.

2. **Price/performance**: The entrant must show that the performance of the application divided by the list price of the smallest system needed to achieve the reported performance is better than that of any other entry. Performance measurements will be evaluated as for the performance prize. Only the cost of the CPUs, memory, and any peripherals critical to the application need be included in the price. For example, if the job can be run on diskless computer servers, the cost of disks, keyboards, and displays need not be included.

3. **Compiler parallelization**: The combination of compiler and application that generates the most speed-up will be the winner. Speed-up will be measured by dividing the wall clock time of the
parallel run by that of a good serial implementation of the same job. These may be the same program if the entrant can convince the judges that the serial code is a good choice for a uniprocessor. Compiler directives and new languages are permitted. However, anyone submitting an entry in other than a standard, sequential language will have to convince the judges that the parallelism was detected by the compiler, not by the programmer.

There are some general conditions:

1. The submitted program must have utility; it must solve a problem that is considered a routine production run, such as making daily weather predictions or solving an important engineering or scientific problem. It should not be a contrived or experimental problem that is intended just to show high speed-up.

2. Entrants in the price/performance category must demonstrate that the machine they used has real utility. Only list prices of components should be used. If the machine is not on the market, the entry is probably not eligible although the judges will consider any reasonable estimate of the price.

3. One criterion the judges will use for all categories is how much the entry advances the state of the art of some field. For example, an entry running at 15 Gflops but solving a problem in a day that previously took a year might win over an entry running at 20 Gflops solving a more mundane problem. Entrants who believe their submission meets this criterion are advised to document their claims carefully.

4. In all cases the burden of proof is on the contestants. The judges will make an honest effort to compare the results of different programs solving different problems running on different machines, but they will depend primarily on the submitted material.

3 The 1993 Competition

The finalists shattered records in 1993 Gordon Bell Prize competition. Increased participation, record-breaking performance, and high overall quality were indicative of rapid progress in the application of parallel processing to scientific and engineering problems. With 23 entries in this year's competition, participation was nearly double that of any previous year, and results improved markedly in several areas. The performance reported by the top entry was over eight times the previous best, and two entries exceeded 60 billion floating-point operations per second (Gf/s). More significantly, 12 entries achieved sustained rates exceeding 25 percent of the theoretical peak performance of the machines they ran on. Price/performance improved by almost 600 percent, to 7.5 Gf/s/million dollars.

The 1993 finalists are

- Peter Lomdahl, Pablo Tamayo, Niels Gronbech-Jensen, and David M. Beazley, of Los Alamos National Laboratory for “50 Gflops Molecular Dynamics on the Connection Machine 5.”
- Lyle N. Long and Matt Kamon of Pennsylvania State University, and Denny Dahl, Mark Bromley, Robert Lordi, Jacek Myczkowski, and Richard Shapiro of Thinking Machines Corp., for “A Deterministic Parallel Algorithm to Solve a Model Boltzmann Equation (BGK).”
- Gary Sabot, Skef Wholey, Jonas Berlin, and Paul Oppenheimer of Thinking Machines Corp. for “Parallel Execution of a Fortran 77 Weather Prediction Model.”
- Many of the entries reported very high performance on Cray Research C90 processors. The fifth finalist is thus Cray Research itself—the first time a company has been so honored in Gordon Bell Prize competition. Sara Graffunder will represent Cray, under the title “Barrier-breaking Performance for Industrial Problems on the CRAY C916.”

Since the winners will be only announced during the conference, we will make no further comments on their work here.

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