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Geoffrey C Fox ; *Florida State University*
Data Parallel SPMD Programming Models from Fortran to Java

Participant Individuals:
Senior personnel(s) : Bryan Carpenter
Graduate student(s) : Sung-Hoon Ko; Han-Ku Lee; Sang Boem Lim

Participants' Detail

Partner Organizations:

Other collaborators:

Xiaoming Li, Peking University, China.
Co-author of original proposals for HPspmd.
Carpenter visited him in Peking for lectures earlier this year.

Vladimir Getov, University of Westminster, UK.
Organized the Java Grande Message-Passing Working Group, in which
we were involved.

Mark Baker, University of Portsmouth, UK.
Collaborated on Java MPI. Investigating Jini-based approaches.

Other participants in the Java Grande Forum.

Activities and findings:

Research Activities:

We have been investigating a language model that combines characteristic data-parallel features from the HPF (High Performance Fortran) language with an explicitly SPMD programming style. A goal of this model (the 'HPspmd model') is to facilitate calls to libraries for parallel programming with distributed data from within an explicitly SPMD-parallel program.

In particular we have been implementing and testing these ideas within an environment called HPJava, built around an implementation of the HPspmd language extensions that use Java as the base language.

The current HPJava compiler is a source-to-source translation tool taking a parallel program written in the HPspmd-extended Java language as input, and generating a standard Java program with classes describing the HPspmd distributed arrays. At the time of writing an initial version of the HPJava compiler is operational. It has been tested on a kernel of small test programs exercising most features of

the extended language. Recently we have successfully compiled and run an 800-line Multigrid benchmark, transcribed from an existing Fortran 90 program. In terms of ease of programming, the results are encouraging. The fully parallelized HPJava program is about the same length, and (arguably) about as readable as the original Fortran.

The translation scheme adopted in the initial version of the compiler is deliberately naive. Over the next few months we will replace this with a 'production quality' translation scheme (largely already specified). This will allow meaningful benchmarks of the system, and, we hope, help prove the model as a realistic tool for scientific programming.

Both as part of the HPJava environment, and as a useful package in its own right, we have also been investigating and developing bindings of MPI-like message-passing primitives for Java.

Activities and findings:

Research Findings:

As indicated above, evidence so far is that the HPspmd programming will provide an expressive tool for writing efficient, parallel programs. The definition of the HPJava extensions is essentially complete.

Research Training:

A series of lectures on HPspmd and related issues was developed and delivered by Carpenter at Peking University in January 2000. The lectures are online at http://aspen.csit.fsu.edu/pss/HPJava/beijing.html

Several graduate students have worked on the project. Sung-Hoon Ko received his Ph.D. degree on work related to this project in August 2000.

Education and Outreach:

Java Grande Forum http://www.javagrande.org is related and a very successful community activity.

Journal Publications:

Bryan Carpenter, Geoffrey Fox, Sung Hoon Ko and Sang Lim, "Object Serialization for marshaling data in a Java interface to MPI", *Concurrency: Practice and Experience*, vol. 12, (2000), p. . Accepted

Bryan Carpenter, Vladimir Getov, Glenn Judd, Anthony Skjellum, Geoffrey Fox, "MPJ: MPI-like message passing for Java", *Concurrency: Practice and Experience*, vol. 12, (2000), p. . Accepted

Book(s) of other one-time publications(s):

Sung Hoon Ko, "Java for High Performance SPMD and Message Passing Programming" , bibl. , (2000). *Thesis* Syracuse University dissertation

Other Specific Products:

Software (or netware)

mpiJava -- Java wrappers for MPI.

It is downloadable from the mpiJava home page:
http://aspen.csit.fsu.edu/pss/HPJava/mpiJava.html

Has been downloaded by approx 400 people.

Internet Dissemination:

http://aspen.csit.fsu.edu/pss/HPJava/

HPJava project home page, including mpiJava project home page.

Includes HPJava language definition (see the document "Parallel Programming in HPJava"), mpiJava API definition, downloadable software for mpiJava, lectures on data parallel, SPMD programming, other papers and presentations.

Contributions:

Contributions within Discipline:

The HPspmd model attempts to integrate some of the best features from HPF and MPI-style, SPMD programming with libraries, in a practical and elegant way. These ideas will be captured in an environment based on the most successful language of recent times for internet programming -- Java.

Contributions to Education and Human Resources:

4 graduate students were actively involved in the project at Syracuse. One recently graduated. 2 have transferred with the project to Florida State University.

We have extensively involved students in the ACM Java Grande conferences which were initiated from related research several years ago.

Special Requirements for Annual Project Report:

Unobligated funds: less than 20 percent of current funds

Categories for which nothing is reported:
Participants: Partner organizations
Contributions to Other Disciplines
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