Introduction to Parallel Computation
Exercise 2: Message Passing Programming

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December 12, 1997

Write on the Convex SPP parallel programs in Fortran or C solving the "All Pairs Shortest Path" problem. Take the sequential program as the starting point and use the MPI library to develop the parallel program in the message passing model.

1. Compile the sequential program with `-O2`. Measure the execution times for matrix dimensions 256 *and* 384 and take these times as the base times of all your comparisons with the parallel programs.

2. Write a MPI program that implements a row/column-oriented solution organizing all processors in a ring as discussed in class. Compile the program with `-O2` and and measure the execution times for both input sizes and 1, 2, 4, 8, 16 processors (2^i, as many as available).

3. Write a MPI program that implements a block-oriented solution organizing all processors in a matrix as discussed in class. Compile the program with `-O2` and and measure the execution times for both input sizes and 1, 4, 9, 16 processors (i^2, as many as available).

4. For developing the MPI programs

   - call `mpa -sc parallel` to move to subcomplex "parallel",
   - include `/usr/convex/mpich/bin` in your PATH variable,
   - compile the program with `mpicc` or `mpif77` (`-O2`),
   - call `mpirun -np` *`n program`* to run *program* with n processes.
   - use `MPI_Wtime` to measure wall clock times (see the man page),

   Manual pages are available for `MPI`, `mpicc`, `mpif77`, `mpirun`, and `mpiclean` and for all the MPI library calls. Various environment variables can be used to customize the execution (see the man pages).

5. Write a report documenting your results including

- the source code,
- execution times (numerical tables and graphical diagrams),
- speedups (numerical tables and graphical diagrams),
- efficiencies (numerical tables and graphical diagrams),
- a comparison of the behavior and performance of both programs,
- any other findings, problems, comments, etc.

Deliver your preliminary report by the first deadline shown below; be prepared to present and to discuss it in class. Based on our discussions, overwork your programs and deliver the final report by the second deadline shown below. *Both reports will be used for grading.*

First Report and Presentation: January 12
Final Report and Presentation: January 26