Introduction to MPI, some exercises.

If running on multiple nodes : add -machinefile nodes

where nodes are a file with a single line per node with the

hostname (or ip number) of the node. An example using localhost:

Shell>cat nodes

localhost

localhost

1)

A simple hello world program in Fortran 90 showing ranks etc.

Compile and run :

mpif90 -o hello.x hello.f90

mpirun -np 4 hello.x

2)

To illustrate that all ranks are independent of each other explore

this example, pipeline.f90. Check the variable a. Each of the independent

ranks only execute the relevant part in the case list.

try: mpirun -np 4 pwd

Compile and run :

mpif90 -o pipeline.x pipeline.f90

mpirun -np 4 pipeline.x 23.4

Note how the data is sent from the sender to the receiver.

A single MPI\_REAL number.

Is this program really parallel ?

3)

A very simple f90 program to illustrate the send / receive functions

of MPI. It's simplest to run using two ranks.

Compile and run :

mpif90 -o mpi-send-loop.x mpi-send-loop.f90

mpirun -np 2 mpi-send-loop.x

Note how the data is sent from the sender to the receiver.

4)

A simple program using collective operations, in this example allreduce.

Compile and run :

mpicc -o allreduce.x allreduce.c mpirun -np 4 allreduce.x

Try to ask other than the master (rank 0) print.

5)

Compute Pi using a couple of methods.

5a)

Compute Pi using MPI and only send / receive MPI functions.

Compile and run like (2 or more ranks) :

mpicc -o pi.x pi-1.c

mpirun -np 2 pi.x 10000

5b)

Compute Pi using the atan series and monte Carlo simulation.

reference : https://github.com/kiwenlau/MPI\_PI/blob/master/Montecarlo/mpi\_pi.c

mpicc -o pi.x pi-2.c

mpirun -np 2 ./pi.x

mpicc -mavx2 -march=znver1 -Ofast -o pi.x pi-3.c

mpirun -np 2 ./pi.x

6)

A benchmark program to measure the bandwidth between to MPI ranks.

mpicc -o bandwidth.x bandwidth.c

mpirun -np 2 bandwidth.x -b o

Run with only 2 ranks.

Note the ping-pong for zero byte message, this is time it takes to

send the message and receive the response.

Note the highest bandwidth, it varies with message size.

Try running without arguments, ping-ping and exchange (sending and receiving

simultaniously).