

## Spring 2017: Advanced Topics in Numerical Analysis: High Performance Computing (Mini)Assignment 3 (due March 30, 2017)

**Handing in your homework:** Same method as for the previous assignment (send us a link to the git repository). We will use the command

```
git clone YOURPATH/YOURREPO.git
cd YOURREPO
make
mpirun -np 6 ./int_ring 10
```

to run your code on 6 processing cores and for 10 communication rounds.

1. **MPI ring communication.** Write a distributed memory program that sends an integer in a ring starting from process 0 to 1 to 2 (and so on). The last process sends the message back to process 0.
  - Allow for a command line parameter  $N$  that specifies how often the message is communicated around the ring.
  - Start with sending the integer 0 and let every process add its rank to the integer before it is being sent again. Use the result after  $N$  loops to check if all processors have properly added their contribution each time they received and sent the message.
  - Time your program for a larger  $N$  and estimate the latency on your system (i.e., the time used for each communication). If you have access to the CIMS network, try to test your communication ring on more than one machine such that communication must go through the network.<sup>1</sup> If you use MPI on a single processor with multiple cores, the available memory is logically distributed, but messages are not actually sent through a network.<sup>2</sup>
  - Hand in your solution using the filename `int_ring.c`.
  - Modify your code such that instead of a single integer being sent in a ring, you communicate a large array of about 2MByte in a ring. Time the communication and use these timings to estimate the bandwidth of your system (i.e., the amount of data that can be communicated per second).
2. **Pitch your final project.** Summarize your current plan for the final project in one paragraphs. Detail *what* you are planning to do, and with *whom* you will be cooperating. I assume you have already talked to me (or Bill) about this, so (for now) a short summary is sufficient. Email this summary to Bill and me with the link to the repo containing the solution of the ring communication problem.

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<sup>1</sup>See [http://www.cims.nyu.edu/~stadler/hpc17/material/hpc17\\_cims.pdf](http://www.cims.nyu.edu/~stadler/hpc17/material/hpc17_cims.pdf) on how to use multiple hosts when using `mpirun`. Note that on each host, the same compiled file must be available, i.e., they need to have a shared directory such as the home directories in CIMS.

<sup>2</sup>It depends on the implementation of MPI how it handles sending/receiving of data that is stored in the same physical memory.