

# High Performance Computing — Homework 3

by Manyuan Tao (tm2735)

## Location of my git repository:

<https://github.com/tmyangel/HPC17-Homework3.git>

## MPI ring communication

### 1. Check if processors have properly added their rank

```
Command: mpirun -np 3 ./int_ring 2 |sort
```

```
Loop 0: rank 0 sent      message 0    to rank 1, hosted on crunchy1.cims.nyu.edu
Loop 0: rank 1 received message 0    from rank 0, hosted on crunchy1.cims.nyu.edu
Loop 0: rank 1 sent      message 1    to rank 2, hosted on crunchy1.cims.nyu.edu
Loop 0: rank 2 received message 1    from rank 1, hosted on crunchy1.cims.nyu.edu
Loop 0: rank 2 sent      message 3    to rank 0, hosted on crunchy1.cims.nyu.edu
Loop 1: rank 0 received message 3    from rank 2, hosted on crunchy1.cims.nyu.edu
Loop 1: rank 0 sent      message 3    to rank 1, hosted on crunchy1.cims.nyu.edu
Loop 1: rank 1 received message 3    from rank 0, hosted on crunchy1.cims.nyu.edu
Loop 1: rank 1 sent      message 4    to rank 2, hosted on crunchy1.cims.nyu.edu
Loop 1: rank 2 received message 4    from rank 1, hosted on crunchy1.cims.nyu.edu
Loop 1: rank 2 sent      message 6    to rank 0, hosted on crunchy1.cims.nyu.edu
LoopEND:rank 0 received message 6    from rank 2, hosted on crunchy1.cims.nyu.edu
```

### 2. For your test

```
Command: mpirun -np 6 ./int_ring 10 |sort
```

```
Loop 8: rank 0 received message 120 from rank 5, hosted on crunchy1.cims.nyu.edu
Loop 8: rank 0 sent      message 120 to rank 1, hosted on crunchy1.cims.nyu.edu
Loop 8: rank 1 received message 120 from rank 0, hosted on crunchy1.cims.nyu.edu
Loop 8: rank 1 sent      message 121 to rank 2, hosted on crunchy1.cims.nyu.edu
Loop 8: rank 2 received message 121 from rank 1, hosted on crunchy1.cims.nyu.edu
Loop 8: rank 2 sent      message 123 to rank 3, hosted on crunchy1.cims.nyu.edu
Loop 8: rank 3 received message 123 from rank 2, hosted on crunchy1.cims.nyu.edu
Loop 8: rank 3 sent      message 126 to rank 4, hosted on crunchy1.cims.nyu.edu
Loop 8: rank 4 received message 126 from rank 3, hosted on crunchy1.cims.nyu.edu
Loop 8: rank 4 sent      message 130 to rank 5, hosted on crunchy1.cims.nyu.edu
Loop 8: rank 5 received message 130 from rank 4, hosted on crunchy1.cims.nyu.edu
Loop 8: rank 5 sent      message 135 to rank 0, hosted on crunchy1.cims.nyu.edu
Loop 9: rank 0 received message 135 from rank 5, hosted on crunchy1.cims.nyu.edu
Loop 9: rank 0 sent      message 135 to rank 1, hosted on crunchy1.cims.nyu.edu
Loop 9: rank 1 received message 135 from rank 0, hosted on crunchy1.cims.nyu.edu
Loop 9: rank 1 sent      message 136 to rank 2, hosted on crunchy1.cims.nyu.edu
Loop 9: rank 2 received message 136 from rank 1, hosted on crunchy1.cims.nyu.edu
Loop 9: rank 2 sent      message 138 to rank 3, hosted on crunchy1.cims.nyu.edu
Loop 9: rank 3 received message 138 from rank 2, hosted on crunchy1.cims.nyu.edu
Loop 9: rank 3 sent      message 141 to rank 4, hosted on crunchy1.cims.nyu.edu
Loop 9: rank 4 received message 141 from rank 3, hosted on crunchy1.cims.nyu.edu
Loop 9: rank 4 sent      message 145 to rank 5, hosted on crunchy1.cims.nyu.edu
Loop 9: rank 5 received message 145 from rank 4, hosted on crunchy1.cims.nyu.edu
Loop 9: rank 5 sent      message 150 to rank 0, hosted on crunchy1.cims.nyu.edu
LoopEND:rank 0 received message 150 from rank 5, hosted on crunchy1.cims.nyu.edu
The final message is 150.
The latency is 0.000082063250 seconds per communication.
Total elapsed time is 0.004924 seconds.
```

### 3. Estimate latency

- Run on crunchy1 only

```
Command: mpirun -np 6 ./int_ring 100
```

```
LoopEND:rank 0 received message 1500 from rank 5, hosted on crunchy1.cims.nyu.edu
The final message is 1500.
The latency is 0.000087558258 seconds per communication.
Total elapsed time is 0.052535 seconds.
```

- Run on crunchy3, crunchy4, crunchy1

```
mpirun -np 6 -hosts crunchy3,crunchy4,crunchy1 -perhost 1 ./int_ring 100
```

```
LoopEND:rank 0 received message 1500 from rank 5, hosted on crunchy3.cims.nyu.edu
The final message is 1500.
The latency is 0.000231634928 seconds per communication.
Total elapsed time is 0.138981 seconds.
```

- Result

Machine	Number of processors	N loops	Latency (per communication)
crunchy1	6	100	0.000087558258s
crunchy1,crunchy3,crunchy4			0.000231634928s

### 4. Estimate bandwidth

Here we communicate an array of length  $2e6/\text{sizeof}(\text{int})$ , which is of size 2MB.

- Run on crunchy1 only

```
Command: mpirun -np 6 ./array_ring 10
```

```
LoopEND: rank 0 received message 150 from rank 5, hosted on crunchy1.cims.nyu.edu
Number in the final array is 150.
The bandwidth is 388.429379 MB per second.
Total elapsed time is 0.617873 seconds.
```

- Run on crunchy3, crunchy4, crunchy1

```
mpirun -np 6 -hosts crunchy3,crunchy4,crunchy1 -perhost 1 ./array_ring 10
```

```
LoopEND: rank 0 received message 150 from rank 5, hosted on crunchy3.cims.nyu.edu
Number in the final array is 150.
The bandwidth is 140.226992 MB per second.
Total elapsed time is 1.711511 seconds.
```

- Result

Machine	Array size	Number of processors	N loops	Bandwidth (per second)
crunchy1	2MB	6	10	388.429379MB
crunchy1,crunchy3,crunchy4				140.226992MB