HW2

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Problem 1

a) For one-to-all broadcast and cut-through in a two-dimensional torus, the first step is broadcasting from source to other 5 nodes in its row, it would take time:

$$t_s + 4t_h + mt_w$$

The second step shall take $t_s + 2t_h + mt_w$ and the third step shall take $t_s + t_h + mt_w$. Then we consider broadcasting in column, the procedure is same as it broadcast in row, so The total time is:

$$6t_s + 14t_h + 1000t_w = 6 * 10 + 14 * 2 + 6 * 10 = 148ms$$

b) All-to-all scatter can be divided into two parts, the first part is scattering in the row from the source, which takes time as:

$$6t_s + 6t_h + (5 + 4 + 3 + 2 + 1) * 1000t_w$$

The second part is scattering in the columns, which takes time as:

$$6t_s + 6t_h + (5 + 4 + 3 + 2 + 1) * 6 * 1000t_w$$

So the total time is:

$$10t_s + 10t_h + 105 * 1000 * t_w = 10 * 10 + 10 * 2 + 105 * 10 = 1170ms$$

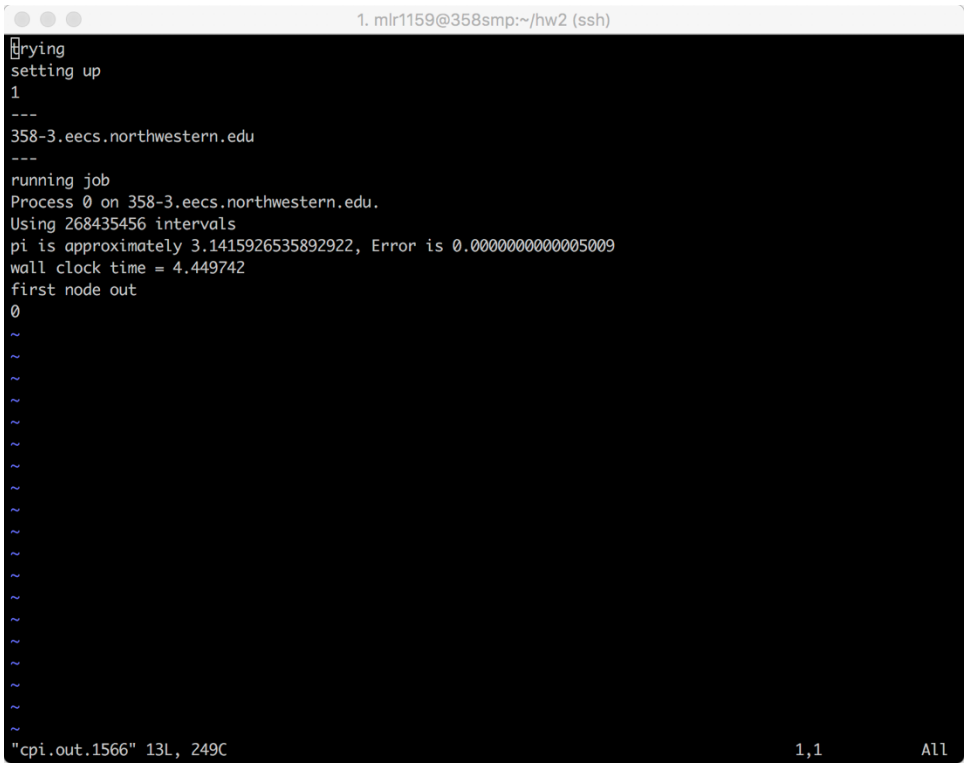
c) For the circulate shift, it would take 5 steps in total,
So the total time is:

$$5t_s + 5t_h + 5mt_w = 10 * 5 + 2 * 10 + 5 * 10 = 110ms$$

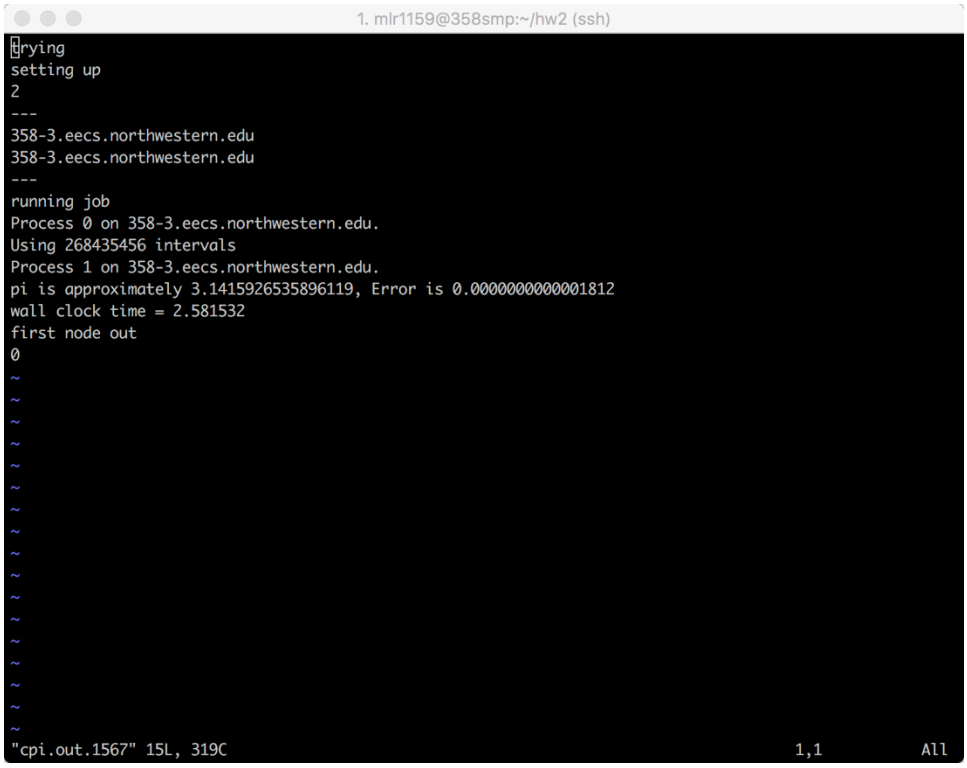
Problem 2

Procs = 1: 4.449742s
Procs = 2: 2.581532s
Procs = 4: 1.598804s
Procs = 8: 1.074631s
Procs = 16: 0.585419s

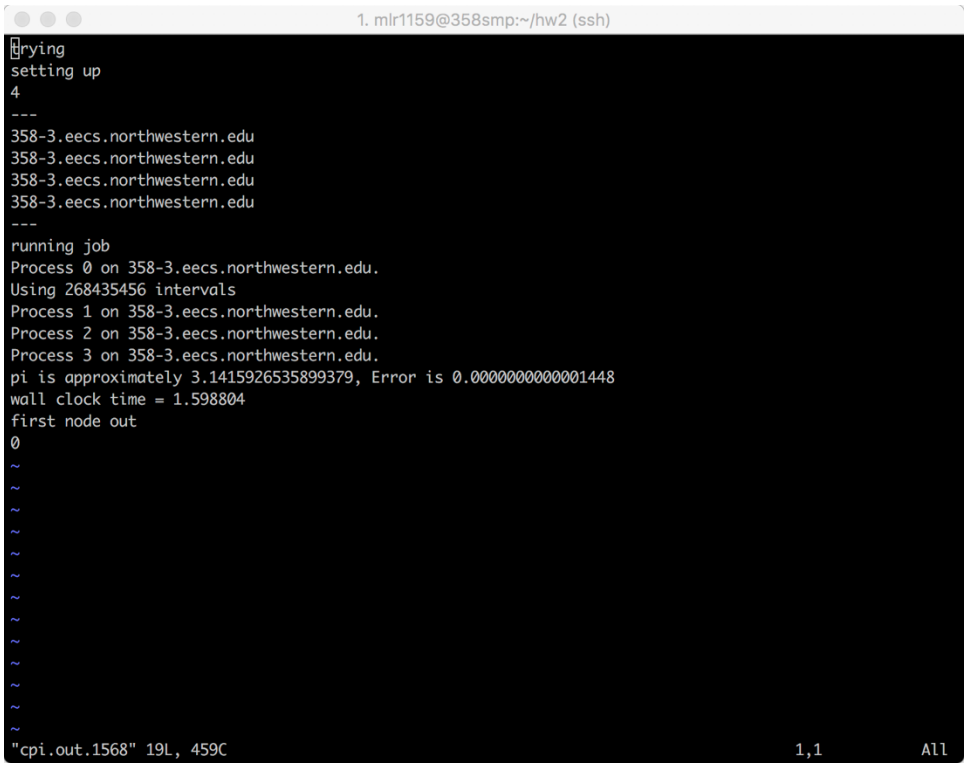
1 Processor:



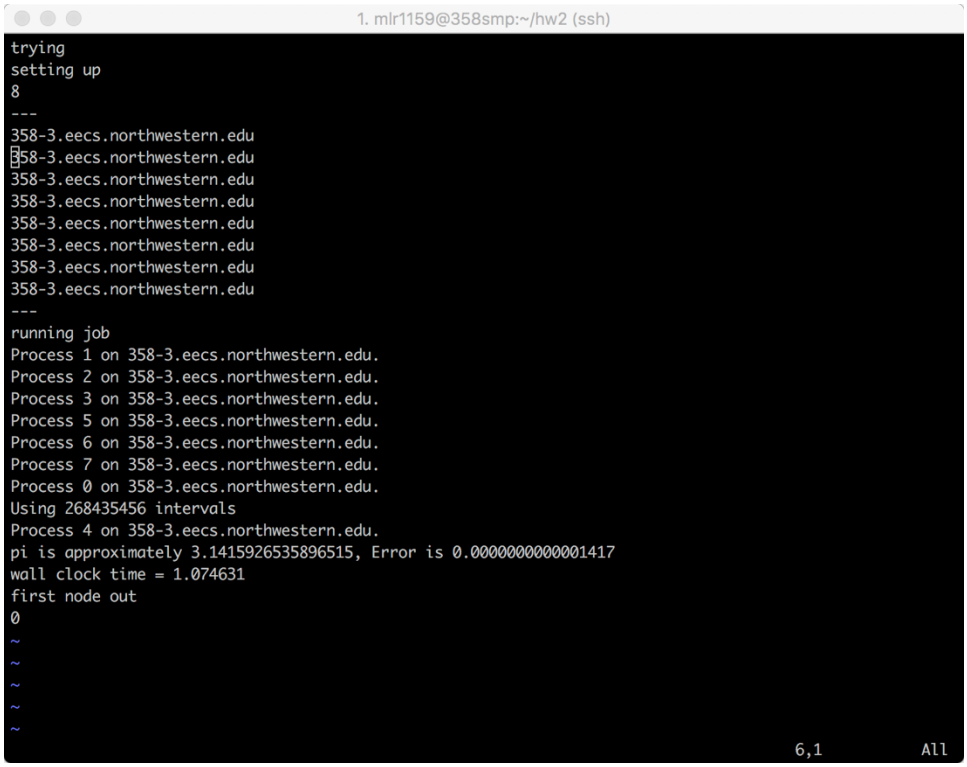
2 Processor:



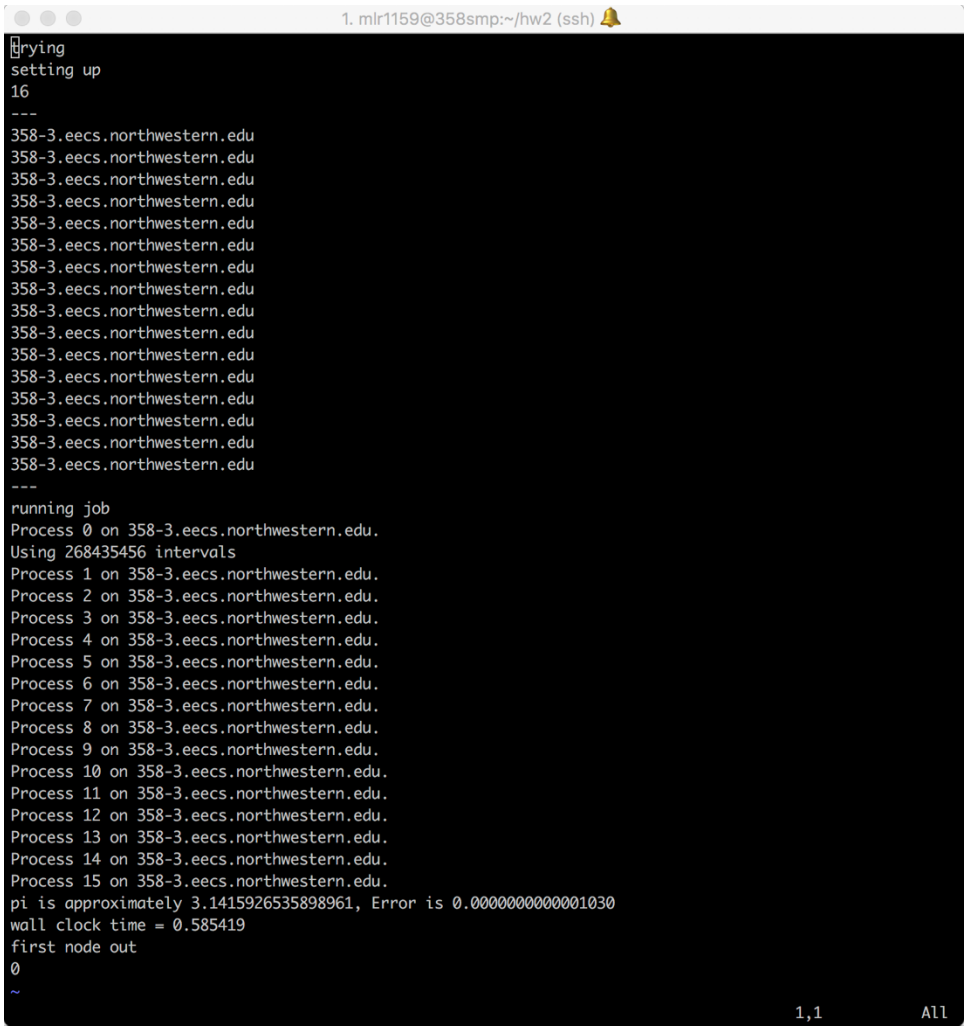
4 Processor:



8 Processor:



16 Processor:



Problem 3
Procs = 1: 58.087286s
Procs = 2: 36.058547s
Procs = 4: 32.723941s
Procs = 8: 24.628714s
Procs = 16: 32.395209s

1 processor:

```
[mlr1159@murphy ~/newfolder]$ mpiexec -n 1 ./hw2 5000 1234

Process number 0
Random seed = 1234

Matrix dimension N = 5000.
Number of processors = 1.

Initializing...

Computing Parallely Using MPI.

elapsed time = 58.087286
```

2 processors:

```
[mlr1159@murphy ~/newfolder]$ mpiexec -n 2 ./hw2 5000 1234

Process number 0
Random seed = 1234

Process number 1
Matrix dimension N = 5000.
Number of processors = 2.

Initializing...

Computing Parallely Using MPI.

elapsed time = 36.058547
```

4 processors:

```
[mlr1159@murphy ~/newfolder]$ mpiexec -n 4 ./hw2 5000 1234

Process number 0
Random seed = 1234

Matrix dimension N = 5000.
Number of processors = 4.

Initializing...

Process number 1
Process number 2
Process number 3
Computing Parallely Using MPI.

elapsed time = 31.723921
```

8 processors:

```
[mlr1159@murphy ~/newfolder]$ mpiexec -n 8 ./hw2 5000 1234

Process number 0
Random seed = 1234

Matrix dimension N = 5000.
Number of processors = 8.

Initializing...

Process number 1
Process number 2
Process number 3
Process number 4
Process number 5
Process number 6
Process number 7
Computing Parallely Using MPI.

elapsed time = 24.628714
```

16 processors:

```
[mlr1159@murphy ~/newfolder]$ mpiexec -n 16 ./hw2 5000 1234

Process number 0
Random seed = 1234

Matrix dimension N = 5000.
Number of processors = 16.

Initializing...

Process number 1
Process number 5
Process number 6
Process number 7
Process number 8
Process number 9
Process number 2
Process number 4
Process number 10
Process number 13
Process number 14
Process number 15
Process number 11
Process number 3
Process number 12
Computing Parallely Using MPI.

elapsed time = 32.395209
```