

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:


```
1. mlr1159@358smp:~/hw2 (ssh) 📢
Trying
setting up
16
---
358-3.eecs.northwestern.edu
358-3.eecs.northwestern.edu
358-3.eecs.northwestern.edu
358-3.eecs.northwestern.edu
358-3.eecs.northwestern.edu
358-3.eecs.northwestern.edu
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358-3.eecs.northwestern.edu
358-3.eecs.northwestern.edu
358-3.eecs.northwestern.edu
358-3.eecs.northwestern.edu
358-3.eecs.northwestern.edu
---
running job
Process 0 on 358-3.eecs.northwestern.edu.
Using 268435456 intervals
Process 1 on 358-3.eecs.northwestern.edu.
Process 2 on 358-3.eecs.northwestern.edu.
Process 3 on 358-3.eecs.northwestern.edu.
Process 4 on 358-3.eecs.northwestern.edu.
Process 5 on 358-3.eecs.northwestern.edu.
Process 6 on 358-3.eecs.northwestern.edu.
Process 7 on 358-3.eecs.northwestern.edu.
Process 8 on 358-3.eecs.northwestern.edu.
Process 9 on 358-3.eecs.northwestern.edu.
Process 10 on 358-3.eecs.northwestern.edu.
Process 11 on 358-3.eecs.northwestern.edu.
Process 12 on 358-3.eecs.northwestern.edu.
Process 13 on 358-3.eecs.northwestern.edu.
Process 14 on 358-3.eecs.northwestern.edu.
Process 15 on 358-3.eecs.northwestern.edu.
pi is approximately 3.1415926535898961, Error is 0.000000000001030
wall clock time = 0.585419
first node out
0
~
1,1 All
```

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
```