

Lab 6 report

6314061 – Quang Tuan Le

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1 Task 1: Collective communication

- Change the number of MPI processes to 4, 6, and 8, and measure the execution time.

1.1 Broadcasts from MPI process 0 to all the others MPI processes. Here is the result:

Number of processes	Min time (s)	Max time (s)	Average time (s)
4	0.000023	0.000029	0.000025
6	0.000023	0.000033	0.000029
8	0.000020	0.000031	0.000026

```
quangle — ssh qle010@onyx.cs.fiu.edu — 78x30
qle010@onyx:~/Courses/COP4520/Lab6 266% ~/Courses/openmpi-4.1.4/bin/mpicc coll
ectiveComm1.c -o collectiveComm1
qle010@onyx:~/Courses/COP4520/Lab6 267% ~/Courses/openmpi-4.1.4/bin/mpirun -np
4 collectiveComm1
Process 0 received value 100
Min: 0.000023 Max: 0.000029 Avg: 0.000025
Process 1 received value 100
Process 2 received value 100
Process 3 received value 100
qle010@onyx:~/Courses/COP4520/Lab6 268% ~/Courses/openmpi-4.1.4/bin/mpirun -np
6 collectiveComm1
Process 0 received value 100
Min: 0.000023 Max: 0.000033 Avg: 0.000029
Process 1 received value 100
Process 2 received value 100
Process 3 received value 100
Process 4 received value 100
Process 5 received value 100
qle010@onyx:~/Courses/COP4520/Lab6 269% ~/Courses/openmpi-4.1.4/bin/mpirun -np
8 collectiveComm1
Process 0 received value 100
Min: 0.000020 Max: 0.000031 Avg: 0.000026
Process 1 received value 100
Process 2 received value 100
Process 3 received value 100
Process 4 received value 100
Process 5 received value 100
Process 6 received value 100
Process 7 received value 100
qle010@onyx:~/Courses/COP4520/Lab6 270%
```

1.2 Using scatter and gather, here is the result:

Number of processes	Min time (s)	Max time (s)	Average time (s)
4	0.000034	0.000035	0.000034
6	0.000058	0.000075	0.000065

8	0.000030	0.000042	0.000036
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```
quangle — ssh qle010@onyx.cs.fiu.edu — 78x18
qle010@onyx:~/Courses/COP4520/Lab6 270% ~/Courses/openmpi-4.1.4/bin/mpicc coll
ectiveComm2.c -o collectiveComm2
qle010@onyx:~/Courses/COP4520/Lab6 271% ~/Courses/openmpi-4.1.4/bin/mpirun -np
4 collectiveComm2
The updated array is:
0 1 2 3 5 6 7 8 10 11 12 13 15 16 17 18
Min: 0.000034 Max: 0.000035 Avg: 0.000034
qle010@onyx:~/Courses/COP4520/Lab6 272% ~/Courses/openmpi-4.1.4/bin/mpirun -np
6 collectiveComm2
The updated array is:
0 1 3 4 6 7 9 10 12 13 15 16 12 13 14 15
Min: 0.000058 Max: 0.000075 Avg: 0.000065
qle010@onyx:~/Courses/COP4520/Lab6 273% ~/Courses/openmpi-4.1.4/bin/mpirun -np
8 collectiveComm2
The updated array is:
0 1 3 4 6 7 9 10 12 13 15 16 18 19 21 22
Min: 0.000030 Max: 0.000042 Avg: 0.000036
qle010@onyx:~/Courses/COP4520/Lab6 274%
```

2 Task 2: Cartesian topology

- 2D Cartesian topology (4x4)

1) From my result, the local rank with the global MPI_COMM_WORLD rank are the same number. Here is the result:

```
quangle — ssh qle010@onyx.cs.fiu.edu — 80x19
qle010@onyx:~/Courses/COP4520/Lab6 108% ~/Courses/openmpi-4.1.4/bin/mpirun -np 1
6 cartesianTopology1
Rank 0 in MPI_COMM_WORLD has local rank 0 in the Cartesian communicator (0, 0)
Rank 1 in MPI_COMM_WORLD has local rank 1 in the Cartesian communicator (0, 1)
Rank 2 in MPI_COMM_WORLD has local rank 2 in the Cartesian communicator (0, 2)
Rank 3 in MPI_COMM_WORLD has local rank 3 in the Cartesian communicator (0, 3)
Rank 4 in MPI_COMM_WORLD has local rank 4 in the Cartesian communicator (1, 0)
Rank 5 in MPI_COMM_WORLD has local rank 5 in the Cartesian communicator (1, 1)
Rank 6 in MPI_COMM_WORLD has local rank 6 in the Cartesian communicator (1, 2)
Rank 7 in MPI_COMM_WORLD has local rank 7 in the Cartesian communicator (1, 3)
Rank 8 in MPI_COMM_WORLD has local rank 8 in the Cartesian communicator (2, 0)
Rank 9 in MPI_COMM_WORLD has local rank 9 in the Cartesian communicator (2, 1)
Rank 10 in MPI_COMM_WORLD has local rank 10 in the Cartesian communicator (2, 2)
Rank 11 in MPI_COMM_WORLD has local rank 11 in the Cartesian communicator (2, 3)
Rank 12 in MPI_COMM_WORLD has local rank 12 in the Cartesian communicator (3, 0)
Rank 13 in MPI_COMM_WORLD has local rank 13 in the Cartesian communicator (3, 1)
Rank 14 in MPI_COMM_WORLD has local rank 14 in the Cartesian communicator (3, 2)
Rank 15 in MPI_COMM_WORLD has local rank 15 in the Cartesian communicator (3, 3)
qle010@onyx:~/Courses/COP4520/Lab6 109%
```

2) Here is the result of calculating on each MPI process the average between its local rank and the local rank from each of its neighbors in periodic Cartesian:

```

quangle — ssh qle010@onyx.cs.fiu.edu — 95x35
qle010@onyx:~/Courses/COP4520/Lab6 109% ~/Courses/openmpi-4.1.4/bin/mpirun -np 16 cartesianTopo
logy2
PW[0] Coord(0,0) with local rank: 0 has NEIGHBORS including 12, 4, 3, 1
With the average between its local rank and the local rank from each of its neighbors is 4.00
PW[1] Coord(0,1) with local rank: 1 has NEIGHBORS including 13, 5, 0, 2
With the average between its local rank and the local rank from each of its neighbors is 4.20
PW[2] Coord(0,2) with local rank: 2 has NEIGHBORS including 14, 6, 1, 3
With the average between its local rank and the local rank from each of its neighbors is 5.20
PW[3] Coord(0,3) with local rank: 3 has NEIGHBORS including 15, 7, 2, 0
With the average between its local rank and the local rank from each of its neighbors is 5.40
PW[4] Coord(1,0) with local rank: 4 has NEIGHBORS including 0, 8, 7, 5
With the average between its local rank and the local rank from each of its neighbors is 4.80
PW[5] Coord(1,1) with local rank: 5 has NEIGHBORS including 1, 9, 4, 6
With the average between its local rank and the local rank from each of its neighbors is 5.00
PW[6] Coord(1,2) with local rank: 6 has NEIGHBORS including 2, 10, 5, 7
With the average between its local rank and the local rank from each of its neighbors is 6.00
PW[7] Coord(1,3) with local rank: 7 has NEIGHBORS including 3, 11, 6, 4
With the average between its local rank and the local rank from each of its neighbors is 6.20
PW[8] Coord(2,0) with local rank: 8 has NEIGHBORS including 4, 12, 11, 9
With the average between its local rank and the local rank from each of its neighbors is 8.80
PW[9] Coord(2,1) with local rank: 9 has NEIGHBORS including 5, 13, 8, 10
With the average between its local rank and the local rank from each of its neighbors is 9.00
PW[10] Coord(2,2) with local rank: 10 has NEIGHBORS including 6, 14, 9, 11
With the average between its local rank and the local rank from each of its neighbors is 10.00
PW[11] Coord(2,3) with local rank: 11 has NEIGHBORS including 7, 15, 10, 8
With the average between its local rank and the local rank from each of its neighbors is 10.20
PW[12] Coord(3,0) with local rank: 12 has NEIGHBORS including 8, 0, 15, 13
With the average between its local rank and the local rank from each of its neighbors is 9.60
PW[13] Coord(3,1) with local rank: 13 has NEIGHBORS including 9, 1, 12, 14
With the average between its local rank and the local rank from each of its neighbors is 9.80
PW[14] Coord(3,2) with local rank: 14 has NEIGHBORS including 10, 2, 13, 15
With the average between its local rank and the local rank from each of its neighbors is 10.80
PW[15] Coord(3,3) with local rank: 15 has NEIGHBORS including 11, 3, 14, 12
With the average between its local rank and the local rank from each of its neighbors is 11.00
qle010@onyx:~/Courses/COP4520/Lab6 110% █

```

3 Task 3: MPI I/O

- Here is the result when I follow the steps. The io.bin file has the content as requirements.

```

quangle — ssh qle010@onyx.cs.fiu.edu — 95x14
qle010@onyx:~/Courses/COP4520/Lab6 110% ~/Courses/openmpi-4.1.4/bin/mpirun -np 4 mpiIO
qle010@onyx:~/Courses/COP4520/Lab6 111% od -i io.bin
0000000      0      1      10      11
0000020     20     21     30     31
0000040      2      3     12     13
0000060     22     23     32     33
0000100      4      5     14     15
0000120     24     25     34     35
0000140      6      7     16     17
0000160     26     27     36     37
0000200      8      9     18     19
0000220     28     29     38     39
0000240
qle010@onyx:~/Courses/COP4520/Lab6 112% █

```