

2021-1 Cloud Computing

Homework #1 Report

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1. Average execution time for 16 by 16 matrix

1) 1 process

1st trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun -np 1 matvec  
max value : 4.712977  
Elapsed time for rank 0 is 0.000626  
[DESKTOP-N1MVSAD:02382] [[51934,0],0] unable to open deb
```

Elapsed time for rank 0 is 0.000626

2nd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun -np 1 matvec  
max value : 4.712977  
Elapsed time for rank 0 is 0.000418  
[DESKTOP-N1MVSAD:02384] [[51904,0],0] unable to open
```

Elapsed time for rank 0 is 0.000418

3rd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun -np 1 matvec  
max value : 4.712977  
Elapsed time for rank 0 is 0.000686  
[DESKTOP-N1MVSAD:02386] [[51906,0],0] unable to open debugge
```

Elapsed time for rank 0 is 0.000686

Average execution time for rank 0 : 0.00057677

2) 2 processes

1st trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun -np 2 matvec  
Elapsed time for rank 1 is 0.003729  
max value : 4.712977  
Elapsed time for rank 0 is 0.004831  
[DESKTOP-N1MVSAD:02388] [[51908,0],0] unable to open debugger attach
```

Elapsed time for rank 1 is 0.003729
Elapsed time for rank 0 is 0.004831

2nd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun -np 2 matvec  
max value : 4.712977  
Elapsed time for rank 0 is 0.001183  
Elapsed time for rank 1 is 0.000074  
[DESKTOP-N1MVSAD:02391] [[51911,0],0] unable to open debugger attach
```

Elapsed time for rank 0 is 0.001183
Elapsed time for rank 1 is 0.000074

3rd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun -np 2 matvec  
max value : 4.712977  
Elapsed time for rank 0 is 0.001162  
Elapsed time for rank 1 is 0.000073  
[DESKTOP-N1MVSAD:02394] [[51914,0],0] unable to open debugger attach
```

Elapsed time for rank 0 is 0.001162
Elapsed time for rank 1 is 0.000073

Average execution time for rank 0 : 0.002392

Average execution time for rank 1 : 0.001292

3) 4 processes

1st trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun -np 4 matvec  
Elapsed time for rank 1 is 0.000093  
max value : 4.712977  
Elapsed time for rank 0 is 0.004044  
[DESKTOP-N1MVSAD:02397] [[51917,0],0] unable to open debugger at  
82109@DESKTOP-N1MVSAD ~
```

```
Elapsed time for rank 1 is 0.000093  
max value : 4.712977  
Elapsed time for rank 0 is 0.004044
```

2nd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun -np 4 matvec  
max value : 4.712977  
Elapsed time for rank 0 is 0.001487  
Elapsed time for rank 1 is 0.000080  
[DESKTOP-N1MVSAD:02402] [[51954,0],0] unable to open debugger at
```

```
max value : 4.712977  
Elapsed time for rank 0 is 0.001487  
Elapsed time for rank 1 is 0.000080
```

3rd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun -np 4 matvec  
max value : 4.712977  
Elapsed time for rank 0 is 0.001960  
Elapsed time for rank 1 is 0.000285  
[DESKTOP-N1MVSAD:02407] [[51959,0],0] unable to open debugger at
```

```
max value : 4.712977  
Elapsed time for rank 0 is 0.001960  
Elapsed time for rank 1 is 0.000285
```

Average execution time for rank 0 : 0.002497

Average execution time for rank 1 : 0.00015267

4) 8 processes

1st trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun --oversubscribe -np 8 matvec  
max value : 4.712977  
Elapsed time for rank 0 is 0.001573  
Elapsed time for rank 1 is 0.000068  
[DESKTOP-N1MVSAD:02413] [[51965,0],0] unable to open debugger att
```

Elapsed time for rank 0 is 0.001573
Elapsed time for rank 1 is 0.000068

2nd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun --oversubscribe -np 8 matvec  
max value : 4.712977  
Elapsed time for rank 0 is 0.001144  
Elapsed time for rank 1 is 0.000070  
[DESKTOP-N1MVSAD:02422] [[51942,0],0] unable to ope
```

Elapsed time for rank 0 is 0.001144
Elapsed time for rank 1 is 0.000070

3rd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun --oversubscribe -np 8 matvec  
max value : 4.712977  
Elapsed time for rank 0 is 0.000659  
Elapsed time for rank 1 is 0.000036  
[DESKTOP-N1MVSAD:02431] [[51951,0],0] unable to open debugge
```

Elapsed time for rank 0 is 0.000659
Elapsed time for rank 1 is 0.000036

Average execution time for rank 0 : 0.0011253

Average execution time for rank 1 : 0.000058

5) 16 processes

1st trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun --oversubscribe -np 16 matvec  
Elapsed time for rank 1 is 0.000065  
max value : 4.712977  
Elapsed time for rank 0 is 0.001809  
[DESKTOP-N1MVSAD:02440] [[51736,0],0] unable to open debugger a
```

Elapsed time for rank 1 is 0.000065
Elapsed time for rank 0 is 0.001809

2nd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun --oversubscribe -np 16 matvec  
Elapsed time for rank 1 is 0.000251  
max value : 4.712977  
Elapsed time for rank 0 is 0.004348  
[DESKTOP-N1MVSAD:02458] [[51722,0],0] unable to open debugger a
```

Elapsed time for rank 1 is 0.000251
Elapsed time for rank 0 is 0.004348

3rd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun --oversubscribe -np 16 matvec  
Elapsed time for rank 1 is 0.000100  
max value : 4.712977  
Elapsed time for rank 0 is 0.002887  
[DESKTOP-N1MVSAD:02475] [[51771,0],0] unable to open debugger a
```

Elapsed time for rank 1 is 0.000100
Elapsed time for rank 0 is 0.002887

Average execution time for rank 0 : 0.00301467

Average execution time for rank 1 : 0.00013867

2. Average execution time for 1024 by 1024 matrix

1) 1 process

1st trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun -np 1 matvec  
max value : 268.994916  
Elapsed time for rank 0 is 0.005055  
[DESKTOP-N1MVSAD:02499] [[51795,0],0] unable to open debugger
```

Elapsed time for rank 0 is 0.005055

2nd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun -np 1 matvec  
max value : 268.994916  
Elapsed time for rank 0 is 0.010148  
[DESKTOP-N1MVSAD:02504] [[51800,0],0] unable to open debugger
```

Elapsed time for rank 0 is 0.010148

3rd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun -np 1 matvec  
max value : 268.994916  
Elapsed time for rank 0 is 0.005823  
[DESKTOP-N1MVSAD:02506] [[51802,0],0] unable to open debugger
```

Elapsed time for rank 0 is 0.005823

Average execution time for rank 0 : 0.00700867

2) 2 processes

1st trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun -np 2 matvec  
max value : 268.994916  
Elapsed time for rank 0 is 0.007095  
Elapsed time for rank 1 is 0.006139  
[DESKTOP-N1MVSAD:02501] [[51797,0],0] unable to open debugger
```

Elapsed time for rank 0 is 0.007095
Elapsed time for rank 1 is 0.006139

2nd trial

```
$ mpirun -np 2 matvec  
max value : 268.994916  
Elapsed time for rank 0 is 0.007952  
Elapsed time for rank 1 is 0.006372  
[DESKTOP-N1MVSAD:02508] [[51804,0],0] unable to open debugger
```

Elapsed time for rank 0 is 0.007952
Elapsed time for rank 1 is 0.006372

3rd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun -np 2 matvec  
Elapsed time for rank 1 is 0.003768  
max value : 268.994916  
Elapsed time for rank 0 is 0.005410  
[DESKTOP-N1MVSAD:02511] [[51807,0],0] unable to open debugger
```

Elapsed time for rank 1 is 0.003768
Elapsed time for rank 0 is 0.005410

Average execution time for rank 0 : 0.006819

Average execution time for rank 1 : 0.0054263

3) 4 processes

1st trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun -np 4 matvec  
max value : 268.994916  
Elapsed time for rank 0 is 0.002022  
Elapsed time for rank 1 is 0.001520  
[DESKTOP-N1MVSAD:02514] [[51778,0],0] unable to open debugge
```

Elapsed time for rank 0 is 0.002022
Elapsed time for rank 1 is 0.001520

2nd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun -np 4 matvec  
max value : 268.994916  
Elapsed time for rank 0 is 0.002179  
Elapsed time for rank 1 is 0.001647  
[DESKTOP-N1MVSAD:02519] [[51783,0],0] unable to open debugger
```

Elapsed time for rank 0 is 0.002179
Elapsed time for rank 1 is 0.001647

3rd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun -np 4 matvec  
max value : 268.994916  
Elapsed time for rank 0 is 0.001909  
Elapsed time for rank 1 is 0.001307  
[DESKTOP-N1MVSAD:02524] [[51788,0],0] unable to open debugger attac
```

Elapsed time for rank 0 is 0.001909
Elapsed time for rank 1 is 0.001307

Average execution time for rank 0 : 0.0020367

Average execution time for rank 1 : 0.0014913

4) 8 processes

1st trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun --oversubscribe -np 8 matvec  
max value : 268.994916  
Elapsed time for rank 0 is 0.001505  
Elapsed time for rank 1 is 0.000863  
[DESKTOP-N1MVSAD:02530] [[51826,0],0] unable to open debugger a
```

Elapsed time for rank 0 is 0.001505
Elapsed time for rank 1 is 0.000863

2nd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun --oversubscribe -np 8 matvec  
max value : 268.994916  
Elapsed time for rank 0 is 0.001568  
Elapsed time for rank 1 is 0.000816  
[DESKTOP-N1MVSAD:02540] [[51836,0],0] unable to open debugger
```

Elapsed time for rank 0 is 0.001568
Elapsed time for rank 1 is 0.000816

3rd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun --oversubscribe -np 8 matvec  
max value : 268.994916  
Elapsed time for rank 0 is 0.002738  
Elapsed time for rank 1 is 0.000864  
[DESKTOP-N1MVSAD:02550] [[51814,0],0] unable to open debugge
```

Elapsed time for rank 0 is 0.002738
Elapsed time for rank 1 is 0.000864

Average execution time for rank 0 : 0.001937

Average execution time for rank 1 : 0.0008477

5) 16 processes

1st trial

```
$ mpirun --oversubscribe -np 16 matvec  
max value : 268.994916  
Elapsed time for rank 0 is 0.002723  
Elapsed time for rank 1 is 0.000417  
[DESKTOP-N1MVSAD:02559] [[51823,0],0] unable to open debugger
```

Elapsed time for rank 0 is 0.002723
Elapsed time for rank 1 is 0.000417

2nd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun --oversubscribe -np 16 matvec  
max value : 268.994916  
Elapsed time for rank 0 is 0.002430  
Elapsed time for rank 1 is 0.000403  
[DESKTOP-N1MVSAD:02576] [[51584,0],0] unable to open debugger
```

Elapsed time for rank 0 is 0.002430
Elapsed time for rank 1 is 0.000403

3rd trial

```
82109@DESKTOP-N1MVSAD ~  
$ mpirun --oversubscribe -np 16 matvec  
max value : 268.994916  
Elapsed time for rank 0 is 0.001359  
Elapsed time for rank 1 is 0.000429  
[DESKTOP-N1MVSAD:02593] [[51633,0],0] unable to open debugger
```

Elapsed time for rank 0 is 0.001359
Elapsed time for rank 1 is 0.000429

Average execution time for rank 0 : 0.0021707

Average execution time for rank 1 : 0.0004163

3. Analyze execution results

For 16 by 16 matrix,

In case of rank 0, execution time flow was like

0.00057677 -> 0.002392 -> 0.002497 -> 0.0011253 -> 0.00301467 as the number of processes increased. It showed the longest time was in case of 16 processes, and was shortest in 1 process.

In case of rank 1, execution time flow was like

0.001292 -> 0.00015267 -> 0.000058 -> 0.00013867 as the number of processes increased.

It showed that until process increases to 8, the execution time eventually decreased. Compared to rank 0 execution time, it's certain that it's shorter than in case of 2 processes. In case of 1 process, it's because there is no difference of amount of work between 2 processes cause one sends a data, and other receives a data.

For 1024 by 1024 matrix,

In case of rank 0, execution time flow was like

0.00700867 -> 0.006819 -> 0.0020367 -> 0.001937 -> 0.0021707 as the number of processes increased. I showed that the longest time was in case of 1 process, and the time decreased until the number processes became 8. Also, the overall time was longer than 16 by 16 matrix because of the amount of data.

In case of rank 1, execution time flow was like

0.0054263 -> 0.0014913 -> 0.0008477 -> 0.0004163 as the number of processes increased. It showed that the time eventually decreased as the number of processes increased.

To conclude, the execution time eventually decreases as the number of processes increases, and the execution time in rank 0 is longer if the amount of data is bigger.