

# Matrix Multiplication Using MPI With C++

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### 1. Instruction on how to compile and run my code on cluster

- 1) Copy the all files in the source folder into cluster.
- 2) Modify arguments in file "mpi-run.sbatch", for example, the last line of code in this file, "mpirun -n 2 matrix", you can change "2" into the number of processes plus one like 5 and 17. (The number of processes here should be square of a number based on the power of two, like 2, 4, 8 ect.)
- 3) Run `-sbatch mpi-build.sbatch`  
`-sbatch mpi-run.sbatch`
- 4) There will be two slurm-XXXX.out (XXXX is the ID of task running on cluster) files generated, the second .out file will show the result of execution.

### 2. Running time recorded for each of the four cases

The results of executing the program each on my laptop and the cluster are different. To give more details to contrast, both of the results will be posted below:

#### 1) Result on my laptop

##### a) $S = 1$

```
ggtalk:Desktop yeguo$ mpirun -n 2 matrix
The total time cost is 0.781667 seconds
```

##### b) $S = 2$

```
ggtalk:Desktop yeguo$ mpirun -n 5 matrix
The total time cost is 0.270596 seconds
```

##### c) $S = 4$

```
ggtalk:Desktop yeguo$ mpirun -n 17 matrix
The total time cost is 0.230301 seconds
```

##### d) $S = 8$

```
The total time cost is 0.259556 seconds
```

#### 2) Result on the cluster

##### a) $S = 1$

```
The total time cost is 2.05299 seconds
```

```
[compute-002.local:52682] 1 more process has sent help message help-mpi-btl-tcp.txt
```

##### b) $S = 2$

The total time cost is 0.209434 seconds

[compute-002.local:52718] 4 more processes have sent help message help-mpi-btl-tcp.txt

c)  $S = 4$

The total time cost is 0.450978 seconds

[compute-002.local:52728] 16 more processes have sent help message help-mpi-btl-tcp.txt

d)  $S = 8$

The total time cost is 0.103564 seconds

[compute-002.local:52728] 64 more processes have sent help message help-mpi-btl-tcp.txt

### 3. Ten verification of results

a)  $S = 1$

Choose value from point (1, 468)  
Computed value is 128.63 and correct value is 128.63.  
The answer is consistent!

Choose value from point (471, 479)  
Computed value is 133.293 and correct value is 133.293.  
The answer is consistent!

Choose value from point (293, 486)  
Computed value is 129.455 and correct value is 129.455.  
The answer is consistent!

Choose value from point (453, 453)  
Computed value is 131.635 and correct value is 131.635.  
The answer is consistent!

Choose value from point (386, 332)  
Computed value is 127.82 and correct value is 127.82.  
The answer is consistent!

Choose value from point (410, 172)  
Computed value is 125.052 and correct value is 125.052.  
The answer is consistent!

Choose value from point (449, 185)  
Computed value is 129.705 and correct value is 129.705.  
The answer is consistent!

Choose value from point (475, 215)  
Computed value is 119.807 and correct value is 119.807.  
The answer is consistent!

Choose value from point (139, 288)  
Computed value is 116.355 and correct value is 116.355.  
The answer is consistent!

Choose value from point (280, 252)  
Computed value is 119.889 and correct value is 119.889.  
The answer is consistent!

b)  $S = 2$

Choose value from point (1, 468)  
Computed value is 128.63 and correct value is 128.63.  
The answer is consistent!

Choose value from point (471, 479)  
Computed value is 133.293 and correct value is 133.293.  
The answer is consistent!

Choose value from point (293, 486)  
Computed value is 129.455 and correct value is 129.455.  
The answer is consistent!

Choose value from point (453, 453)  
Computed value is 131.635 and correct value is 131.635.  
The answer is consistent!

Choose value from point (386, 332)  
Computed value is 127.82 and correct value is 127.82.  
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Choose value from point (449, 185)  
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Choose value from point (475, 215)  
Computed value is 119.807 and correct value is 119.807.  
The answer is consistent!

Choose value from point (139, 288)  
Computed value is 116.355 and correct value is 116.355.  
The answer is consistent!

Choose value from point (280, 252)  
Computed value is 119.889 and correct value is 119.889.  
The answer is consistent!

c)  $S = 4$

Choose value from point (1, 468)  
Computed value is 128.63 and correct value is 128.63.  
The answer is consistent!

Choose value from point (471, 479)  
Computed value is 133.293 and correct value is 133.293.  
The answer is consistent!

Choose value from point (293, 486)  
Computed value is 129.455 and correct value is 129.455.  
The answer is consistent!

Choose value from point (453, 453)  
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Choose value from point (139, 288)  
Computed value is 116.355 and correct value is 116.355.  
The answer is consistent!

Choose value from point (280, 252)  
Computed value is 119.889 and correct value is 119.889.  
The answer is consistent!

d)  $S = 8$

Choose value from point (1, 468)  
Computed value is 128.63 and correct value is 128.63.  
The answer is consistent!

Choose value from point (471, 479)  
Computed value is 133.293 and correct value is 133.293.  
The answer is consistent!

Choose value from point (293, 486)  
Computed value is 129.455 and correct value is 129.455.  
The answer is consistent!

Choose value from point (453, 453)  
Computed value is 131.635 and correct value is 131.635.  
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Choose value from point (386, 332)  
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Computed value is 116.355 and correct value is 116.355.  
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Choose value from point (280, 252)  
Computed value is 119.889 and correct value is 119.889.  
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