

**My github repo for this homework is [https://github.com/rzc1731/HPC\\_hw4](https://github.com/rzc1731/HPC_hw4)**

1.

I tested the inner product and matrix-vector multiplication with a square matrix and dimension  $N = 5000$ .

Machine	Memory Band (inner product) GB/s	Memory Band (matrix-vector) GB/s
cuda1	0.325	59.034
cuda2	0.711	180.689
cuda3	0.329	185.895
cuda4	0.676	95.181
cuda5	0.313	49.368

2.

I tested my CUDA implementation with a square matrix and dimension  $N = 1000$  and 100 iterations.

The computed residual\_norms of my CUDA implementation are the same as my openMP implementation.

The following is the result:

```
./jacobi 1000 1
```

```
res_start = 0.001
```

```
iter #: 1, residual_norm = 1000
```

```
iter #: 2, residual_norm = 999.125
```

```
iter #: 3, residual_norm = 998.539
```

```
iter #: 4, residual_norm = 998.067
```

```
iter #: 5, residual_norm = 997.661
```

```
iter #: 6, residual_norm = 997.3
```

```
iter #: 7, residual_norm = 996.97
```

```
iter #: 8, residual_norm = 996.666
```

```
iter #: 9, residual_norm = 996.381
```

```
iter #: 10, residual_norm = 996.114
```

```
iter #: 11, residual_norm = 995.86
```

iter #: 12, residual\_norm = 995.618  
iter #: 13, residual\_norm = 995.386  
iter #: 14, residual\_norm = 995.164  
iter #: 15, residual\_norm = 994.949  
iter #: 16, residual\_norm = 994.743  
iter #: 17, residual\_norm = 994.542  
iter #: 18, residual\_norm = 994.348  
iter #: 19, residual\_norm = 994.159  
iter #: 20, residual\_norm = 993.976  
iter #: 21, residual\_norm = 993.797  
iter #: 22, residual\_norm = 993.622  
iter #: 23, residual\_norm = 993.451  
iter #: 24, residual\_norm = 993.285  
iter #: 25, residual\_norm = 993.121  
iter #: 26, residual\_norm = 992.961  
iter #: 27, residual\_norm = 992.804  
iter #: 28, residual\_norm = 992.651  
iter #: 29, residual\_norm = 992.499  
iter #: 30, residual\_norm = 992.351  
iter #: 31, residual\_norm = 992.205  
iter #: 32, residual\_norm = 992.061  
iter #: 33, residual\_norm = 991.92  
iter #: 34, residual\_norm = 991.781  
iter #: 35, residual\_norm = 991.644  
iter #: 36, residual\_norm = 991.509  
iter #: 37, residual\_norm = 991.375  
iter #: 38, residual\_norm = 991.244  
iter #: 39, residual\_norm = 991.114

iter #: 40, residual\_norm = 990.986  
iter #: 41, residual\_norm = 990.86  
iter #: 42, residual\_norm = 990.735  
iter #: 43, residual\_norm = 990.612  
iter #: 44, residual\_norm = 990.49  
iter #: 45, residual\_norm = 990.37  
iter #: 46, residual\_norm = 990.251  
iter #: 47, residual\_norm = 990.133  
iter #: 48, residual\_norm = 990.016  
iter #: 49, residual\_norm = 989.901  
iter #: 50, residual\_norm = 989.787  
iter #: 51, residual\_norm = 989.674  
iter #: 52, residual\_norm = 989.562  
iter #: 53, residual\_norm = 989.451  
iter #: 54, residual\_norm = 989.341  
iter #: 55, residual\_norm = 989.233  
iter #: 56, residual\_norm = 989.125  
iter #: 57, residual\_norm = 989.018  
iter #: 58, residual\_norm = 988.912  
iter #: 59, residual\_norm = 988.808  
iter #: 60, residual\_norm = 988.704  
iter #: 61, residual\_norm = 988.6  
iter #: 62, residual\_norm = 988.498  
iter #: 63, residual\_norm = 988.397  
iter #: 64, residual\_norm = 988.296  
iter #: 65, residual\_norm = 988.196  
iter #: 66, residual\_norm = 988.097  
iter #: 67, residual\_norm = 987.999

iter #: 68, residual\_norm = 987.901  
iter #: 69, residual\_norm = 987.805  
iter #: 70, residual\_norm = 987.708  
iter #: 71, residual\_norm = 987.613  
iter #: 72, residual\_norm = 987.518  
iter #: 73, residual\_norm = 987.424  
iter #: 74, residual\_norm = 987.331  
iter #: 75, residual\_norm = 987.238  
iter #: 76, residual\_norm = 987.146  
iter #: 77, residual\_norm = 987.054  
iter #: 78, residual\_norm = 986.963  
iter #: 79, residual\_norm = 986.873  
iter #: 80, residual\_norm = 986.783  
iter #: 81, residual\_norm = 986.693  
iter #: 82, residual\_norm = 986.605  
iter #: 83, residual\_norm = 986.517  
iter #: 84, residual\_norm = 986.429  
iter #: 85, residual\_norm = 986.342  
iter #: 86, residual\_norm = 986.255  
iter #: 87, residual\_norm = 986.169  
iter #: 88, residual\_norm = 986.083  
iter #: 89, residual\_norm = 985.998  
iter #: 90, residual\_norm = 985.914  
iter #: 91, residual\_norm = 985.83  
iter #: 92, residual\_norm = 985.746  
iter #: 93, residual\_norm = 985.663  
iter #: 94, residual\_norm = 985.58  
iter #: 95, residual\_norm = 985.497

iter #: 96, residual\_norm = 985.416  
iter #: 97, residual\_norm = 985.334  
iter #: 98, residual\_norm = 985.253  
iter #: 99, residual\_norm = 985.172  
iter #: 100, residual\_norm = 985.092

CPU computation time: 2.02732

GPU:

res\_start = 0.001

iter #: 1, residual\_norm = 1000  
iter #: 2, residual\_norm = 999.125  
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iter #: 49, residual\_norm = 989.901  
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iter #: 52, residual\_norm = 989.562  
iter #: 53, residual\_norm = 989.451  
iter #: 54, residual\_norm = 989.341  
iter #: 55, residual\_norm = 989.233  
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iter #: 57, residual\_norm = 989.018  
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iter #: 99, residual\_norm = 985.172  
iter #: 100, residual\_norm = 985.092  
GPU computation time: 0.197413

3.



We have mapped out a general idea of code structure for the CUDA implementation of SGD. Also, we have generated a large dataset for testing. We are going to finish the coding in the next week and start testing and analyzing.