

Laporan Praktikum 4

IF3230 Sistem Paralel dan Terdistribusi

“Pengenalanan dan Penggunaan CUDA – Quicksort”



Disusun oleh :

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Pada praktikum 4 ini, kami dikenalkan dengan salah satu bentuk pemrograman GPU yaitu CUDA. CUDA merupakan standar yang dibuat oleh Nvidia untuk melakukan pemrograman GPU dengan *graphic card* Nvidia. Kami diminta membuat implementasi permasalahan *quicksort* paralel menggunakan CUDA. Solusi yang kami buat adalah membuat prosedur *quicksort* menggunakan 1 block dan 1 thread.

Pengujian kami lakukan dengan mengeksekusi program *quicksort* yang menggunakan CUDA, menggunakan empat kasus yaitu *array of integer* berukuran 50.000, 100.000, 200.000, dan 400.000. Hasil eksekusi program dapat dilihat dalam gambar berikut.

```
[13514091@ld5-08 praktikum4]$ ./quicksort3
./quicksort starting with 50000 numbers...
Beginning kernel execution...

Testing results...
SORTING SUCCESSFUL
Time elapsed: 302.526062 ms
[13514091@ld5-08 praktikum4]$ ./quicksort3
./quicksort starting with 100000 numbers...
Beginning kernel execution...

Testing results...
SORTING SUCCESSFUL
Time elapsed: 287.617859 ms
[13514091@ld5-08 praktikum4]$ ./quicksort3
./quicksort starting with 50000 numbers...
Beginning kernel execution...

Testing results...
SORTING SUCCESSFUL
Time elapsed: 288.747803 ms
[13514091@ld5-08 praktikum4]$ ./quicksort3
./quicksort starting with 50000 numbers...
Beginning kernel execution...

Testing results...
SORTING SUCCESSFUL
Time elapsed: 290.548492 ms
[13514091@ld5-08 praktikum4]$ ./quicksort3
./quicksort starting with 100000 numbers...
Beginning kernel execution...

Testing results...
SORTING SUCCESSFUL
Time elapsed: 300.775574 ms
[13514091@ld5-08 praktikum4]$
```

```
[13514091@ld5-08 praktikum4]$ ./quicksort3
./quicksort starting with 100000 numbers...
Beginning kernel execution...

Testing results...
SORTING SUCCESSFUL
Time elapsed: 621.022766 ms
[13514091@ld5-08 praktikum4]$ ./quicksort3
./quicksort starting with 100000 numbers...
Beginning kernel execution...

Testing results...
SORTING SUCCESSFUL
Time elapsed: 617.021118 ms
[13514091@ld5-08 praktikum4]$ ./quicksort3
./quicksort starting with 100000 numbers...
Beginning kernel execution...

Testing results...
SORTING SUCCESSFUL
Time elapsed: 621.109680 ms
[13514091@ld5-08 praktikum4]$ ./quicksort3
./quicksort starting with 100000 numbers...
Beginning kernel execution...

Testing results...
SORTING SUCCESSFUL
Time elapsed: 627.071411 ms
[13514091@ld5-08 praktikum4]$
```

| | |
|---|---|
| <pre>[13514091@ld5-08 praktikum4]\$./quicksort3 ./quicksort starting with 200000 numbers... Beginning kernel execution... Testing results... SORTING SUCCESSFUL Time elapsed: 1335.053101 ms [13514091@ld5-08 praktikum4]\$./quicksort3 ./quicksort starting with 200000 numbers... Beginning kernel execution... Testing results... SORTING SUCCESSFUL Time elapsed: 1351.200806 ms [13514091@ld5-08 praktikum4]\$./quicksort3 ./quicksort starting with 200000 numbers... Beginning kernel execution... Testing results... SORTING SUCCESSFUL Time elapsed: 1326.672363 ms [13514091@ld5-08 praktikum4]\$./quicksort3 ./quicksort starting with 200000 numbers... Beginning kernel execution... Testing results... SORTING SUCCESSFUL Time elapsed: 1318.754639 ms [13514091@ld5-08 praktikum4]\$</pre> | <pre>[13514091@ld5-08 praktikum4]\$./quicksort3 ./quicksort starting with 400000 numbers... Beginning kernel execution... Testing results... SORTING SUCCESSFUL Time elapsed: 2824.961426 ms [13514091@ld5-08 praktikum4]\$./quicksort3 ./quicksort starting with 400000 numbers... Beginning kernel execution... Testing results... SORTING SUCCESSFUL Time elapsed: 2771.812744 ms [13514091@ld5-08 praktikum4]\$./quicksort3 ./quicksort starting with 400000 numbers... Beginning kernel execution... Testing results... SORTING SUCCESSFUL Time elapsed: 2769.262939 ms [13514091@ld5-08 praktikum4]\$./quicksort3 ./quicksort starting with 400000 numbers... Beginning kernel execution... Testing results... SORTING SUCCESSFUL Time elapsed: 2767.549805 ms [13514091@ld5-08 praktikum4]\$</pre> |
|---|---|

```
[13514091@ld5-07 OpenMPI-2]$ mpirun -np 1 --hostfile mpi_hostfile quicksort 50000
Time : 0.987779 second
[13514091@ld5-07 OpenMPI-2]$ mpirun -np 1 --hostfile mpi_hostfile quicksort 100000
Time : 1.086478 second
[13514091@ld5-07 OpenMPI-2]$ mpirun -np 1 --hostfile mpi_hostfile quicksort 200000
Time : 1.077461 second
[13514091@ld5-07 OpenMPI-2]$ mpirun -np 1 --hostfile mpi_hostfile quicksort 400000
Time : 1.178321 second
```

Berdasarkan pengujian yang kami lakukan, program CUDA pada semua kasus ukuran *array of integer* membutuhkan waktu untuk mengeksekusi proses lebih lambat dibanding proses pada program serial pada OpenMPI yang kami uji pada praktikum sebelumnya. Hal ini disebabkan oleh proses pemisahan dan penggabungan data kembali ke satu core GPU yang membutuhkan waktu lama.