Assignment 4 - Parallel Matrix Multiplication on GPU

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1 Introduction

The objective in this assignment is to parallelize traditional matrix multiplication using Cuda. In the rest of this document, we will discuss the platform specifications, implementation approach, experiment method and the results.

2 Platform

The program is written in C++ using Cuda. Furthermore, here is the specification of the system:

```
Linux zenbookux434flcux433flc 5.15.32-1-MANJARO 1 SMP PREEMPT x86_64 GNU/Linux
CPU(s):  8
Vendor ID: GenuineIntel
Model name:  Intel(R) Core(TM) i7-10510U CPU @ 1.80GHz
MemTotal:  16179008 kB
GPU: NVIDIA GP108BM [GeForce MX250] driver:  nvidia v:  510.60.02
CUDA Driver Version / Runtime Version:  11.6 / 11.6
```

3 Parallel Implementation

Instead of parallelization the traditional algorithm, another approach called tiling is adopted in order to optimize the algorithm.

4 Experiment

Multiplication of matrices with sizes 256, 512, 1024, 2048 is calculated 10 times with GPU with block sized 16 and 32, and on CPU. For larger matrices with sizes 4096 and 8192 we have only done with GPU due to the fact that it is time-consuming task on CPU. Each reported duration is average of 10 times of execution.

5 Results

In the following table, we can see the results of explained experiment in the previous section.

	Matrix Dimension					
	256	512	1024	2048	4096	8192
CPU	0.0004	0.722	6.194	309.895		
GPU-blocksize = 16	0.0004	0.003	0.22	0.137	1.075	8.541
GPU-blocksize = 32	0.088	0.003	0.021	0.130	0.999	7.943
Best Speedup	197.195	231.086	284.055	2383.0807		

Table 5.1 - Comparison duration of matrix multiplication between GPU and CPU.

As it is shown in the table 5.1, the fastest approach to compute matrix multiplication is using GPU with block size 32. The speedup rate of this method compared with CPU is 197, 231, 284 and 2383

6   Conclusion

To conclude, the bigger the matrix becomes, the faster will GPU compute. Also, The algorithm runs faster with block size 32 on GPU in comparison with block size 16.