Exercise 9

360.252 - Computational Science on Many-Core Architectures
WS 2022

December 12, 2022

The following tasks are due by 23:59pm on Tuesday, January 10, 2023. Please document your answers (please add code listings in the appendix) in a PDF document and submit the PDF together with the code in TUWEL.

You are free to discuss ideas with your peers. Keep in mind that you learn most if you come up with your own solutions. In any case, each student needs to write and hand in their own report. Please refrain from plagiarism!

> "Plagiarism is one of the great academic sins. It has the power to destroy a scholar or writer and turn a lifetime's work to dust."
> — Miranda Devine

There is a dedicated environment set up for this exercise:

https://k40.360252.org/2022/ex9/
https://rtx3060.360252.org/2022/ex9/

To have a common reference, please run all benchmarks for the report on both machines in order to see differences across GPU generations.

Libraries (5 Points)

Given vectors $x = (1, 1, \ldots, 1)$ and $y = (2, 2, \ldots, 2)$ of size N, compute the dot product $\langle x+y, x-y \rangle$ with the following libraries:

1. Boost.Compute (1 Point)
2. Thrust (1 Point)
3. VexCL (1 Point)
4. ViennaCL (make sure to have `VIENNACL_WITH_CUDA` or `VIENNACL_WITH_OPENCL` defined before including the respective headers) (1 Point)

Compare the execution times of these library implementations with your own CUDA and OpenCL implementations for values $N = 10^k$ with $k \in \{1, 2, 3, 4, 5, 6, 7\}$. (1 Point)

HIP (3 Points)

In order to extend your previous implementation of conjugate gradients to AMD GPUs, please convert the CUDA implementation of the Conjugate Gradient solver from previous exercises to HIP (2 Points). Compare the performance with the CUDA implementation and discuss any performance differences you may observe (1 Point).

Bonus: Relaxed Christmas Break (1 Point)

Submit this exercise by Saturday, December 24, at 14:00 and enjoy a Christmas Break without having to worry about this exercise.