Small Scale Parallel Programming

Problem Scenario

The task at hand is the development of a GEMM (GEneral Matrix-Matrix) product kernel. You are thus required to implement a kernel capable of computing

$$C \leftarrow A \cdot B$$

where A, B and C are square matrices; the dimension of these matrices shall be one of the arguments of the kernel (i.e. it can be chosen by the code calling the kernel).

The kernel shall be parallelized to exploit available computing capabilities. The code shall be developed in C or C++, in *both* OpenMP and CUDA versions.

Notes

- The kernel may be implemented for data in either single precision (`float`) or double precision (`double`), the student's choice shall be documented in the accompanying report;
- The matrices may be stored either by rows or by columns, the student's choice shall be documented in the accompanying report;
- The kernel shall be tested for correctness against a simple reference serial implementation;
- The student may perform any software tests deemed appropriate, provided they are clearly documented;
- The student may develop the code on any available computer, but the resulting code must run and shall be tested for performance on Crescent;
- The kernel shall be tested for performance, across a range of sizes that shall reach at least size 2048×2048;
- A complete and thorough optimization of the GEMM code may well be beyond the assignment time frame; thus, the students are required to concentrate on the parallelization aspects, and on getting the best level of performance compatible with the development time available to them.

Deliverables

The students shall have to submit:

- The project code, with appropriate makefiles; the code **must** compile and run on Crescent;

- A project report, describing the software design employed; the report shall also include:
- A brief summary design specification and test plan, including correctness and performance testing;
- An analysis of the performance data;

Marking Scheme

40 Software quality & performance;

30 Overall Project Report quality;

10 Design specification and test plan;

20 Performance analysis;

Submission deadline full time students: 9:30 am, April 19th, 2021
Submission deadline part time students: 9:30 am, May 4th, 2021