**ECE 4822: Engineering Computation IV**

**Homework No. 9: Parallelizing Code Across Multiple GPUs**

**Goal:** Learn how to parallelize across multiple GPU chips and compare this to OMP parallelization.

**Description:**

For this assignment, let’s focus on a $10,000 x 10,000$ matrix multiplication. Use “\*.pdf” for plots and Excel “\*.xlsx” for tables.

In a directory named */p01*, using what was described in the code snippets shown in class for OMP parallelization of matrix multiplication, modify your pointer-based implementation of matrix multiplication to run using $N$ threads. Prepare a plot of cpu time as a function of the number of threads for $N = [1, 32]$. Run this on nedc\_130.

Next, using the template provided here:

*https://www.isip.piconepress.com/courses/temple/ece\_4822/resources/software/example\_vector\_add/*

parallelize your matrix multiplication program so that it runs in parallel using multiple threads and blocks using a single GPU. In a directory */p02*, place your code along with a plot of execution time as a function of the number of blocks and number of threads per block. After examining the data, choose three representative values for the number of blocks, and plot time as a function of the number of threads. Then repeat this process by choosing three representative values for the number of threads and plot as a function of the number of blocks. Also provide a table that tabulates cpu time as a function of both the number of blocks and threads.

Next, again using the above template, in a directory */p03*, modify your code to use multiple GPUs. Optimize the number of GPUs, blocks and threads and produce a table that justifies your choice of the optimal set of parameters.

Finally, in */p04*, explore the differences in cpu time between nedc\_006, nedc\_008, nedc\_011 and nedc\_012. Prepare a detailed table that justifies your choices. Does the optimal configuration change based on the GPU. Is nedc\_012, our newest machine, the fastest of the bunch? Can you increase the number of blocks and threads and get better performance on nedc\_012?