CSCE 4930: GPU Computing
Homework 1
(individual assignment)

Question 1:

For vector addition, assume that each vector length is 4000, each thread calculates one output element, and the thread block size is 512 threads. How many threads will be in the grid?

You are required to implement and run all the tasks below on a computer having a CUDA-Enabled device. You can use any such computer you have access to including computers in the machine learning lab, or you can use Google Colab (based on the provided guide). Please specify the GPU you are using and its CUDA compute capability in your assignment submission. See below for submission instructions.

Task 1:

Write a full CUDA program to perform vector addition such that **each thread** is responsible for computing **four** adjacent elements in the output vector instead of one. The vectors size as well as data should be randomly generated (Hint: Use C `rand` and `srand` functions). The program should print the vectors size, both input vectors, and the output vector at the end.

What is the maximum size of the vectors that can be used if the kernel is launched with a single block?

Task 2:

Write a full program to randomly generate a grayscale picture by generating a 2D array of integers of size 1000x800 randomly initialized to values ranging between 0 and 255. Your program should then use a CUDA kernel with a 2D grid and 2D blocks to multiply each pixel of the picture by 3 (trimming the resulting value to 255 if it exceeds that value). Each block should have 16x16 threads and each thread should be responsible for a single pixel.

How many blocks in each dimension will we have? How many threads in total will be in the grid?

Task 3:

Write a full CUDA program to perform matrix addition on square matrices **such that each thread is responsible for computing one column of the output (sum) matrix**. The size of the matrices and their values should be randomly selected.

- Submission Deadline: Thursday, September 29, 2022, 11:59 PM.
- Submission method: Electronically through BB.
- Your submission should be **a single compressed folder (e.g., zip)** containing a single PDF report including output screenshots from all tasks and answers to all questions. The compressed folder should also contain a source code subfolder for each task.
- Check the readability of your submission. Hard to read submissions will be ignored.
- Plagiarism is NOT tolerated and will be reported.
- Late submissions will be penalized as described in the course syllabus and will NOT be accepted at all if more than 24 hours late.