Introduction to CUDA Parallel Programming Homework Assignment 6
Due 2021/05/11

1. Monte Carlo integration in 10-dimensions

Write a C/C++ program to perform the Monte Carlo integration of the 10-dimensional integral

$$I = \int_0^1 dx_1 \int_0^1 dx_2 \cdots \int_0^1 dx_{10} \frac{1}{1 + x_1^2 + x_2^2 + \cdots + x_{10}^2}$$

using the following algorithms:

(a) Simple sampling.

(b) Importance sampling with the Metropolis algorithm, using the weight function

$$W(x_1, x_2, \cdots, x_{10}) = w(x_1) w(x_2) \cdots w(x_{10}), \qquad w(x_i) = Ce^{-ax_i},\ i = 1, \cdots, 10,$$

where the normalization constant *C* and the value of *a* are determined by yourself. In each case, compute the mean and the standard deviation versus the number of samplings, $N = 2^n,\ n = 6, \cdots, 16$ respectively. Discuss your results for all cases.

2. GPU accelerated Monte Carlo integration in 10-dimensions

Write a CUDA code to perform the Monte Carlo integration in problem 1, with multi-GPUs. Test your code with one and two GPUs, by comparing GPU and CPU results. You may start by writing your CUDA code for one GPU. Then to determine the optimal block sizes for one and two GPUs respectively.

As usual, your homework report should include your source codes, results, and discussions. The discussion file should be prepared with a typesetting system, e.g., LaTeX, Word, etc., and it is converted to a PDF file. All files should be zipped into one gzipped tar file, with a file name containing your student number and the problem set number (e.g., r05202043_ps6.tar.gz). Please send your homework from your NTU email account to twchiu@phys.ntu.edu.tw before 24:00 of the due date.

If the mail server does not allow you to attach the gzipped tar file, you can put it in the home directory of your account in twqcd80, e.g.,
twqcd80:/home/r05202043/HW6/r05202043_ps6.tar.gz
and also send email notification to me.