Introduction to CUDA Parallel Programming   Homework Assignment 3
Due 2021/04/13

1. Solve the Laplace equation on the 512 x 512 square lattice with the boundary conditions:

   $\phi = +1$, on the top boundary

   $\phi = -1$, on the left boundary

   $\phi = -2$, on the right boundary

   $\phi = +5$, on the bottom boundary

   Use the linux command "diff" to compare the results of CPU, GPU using device memory, and GPU using texture. Find the optimal block sizes for the CUDA codes with and without using texture.

2. Develop a CUDA code for solving the Laplace equation on a 3D lattice with boundary conditions. To verify your code, you can use a small lattice, say, 4 x 4 x 4 lattice, with the simple boundary conditions

   $\phi = 1$, on the top surface

   $\phi = 0$, on all other surfaces

   Then compare CPU and GPU results.

3. Solve the Poisson equation on a 3D lattice with boundary conditions. Consider a cube of size L x L x L with a point charge q=1 at its center (L/2, L/2, L/2), subject to the boundary conditions with potential equal to zero on its entire surface. Find the potential versus the distance r from the point charge, for L=8, 16, 32, 64 respectively. Does the potential approach the Columb's law in the limit L >>1 ?

   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_ps3.tar.gz). Please send your homework from your NTU email account to twchiu@phys.ntu.edu.tw before 24:00 of the due date.