02614 High-Performance Computing January 12, 2018

Programming in CUDA C: the Mandelbrot set

Don't use the Sun compiler for this exercise,- please use gcc from now on.

Please get the new version of pngwrite, which has been updated (ex2_mandelbrot.zip).

Use your exercise from last week as the starting point. If you used the Fortran version for OpenMP, you now have to consider the C version for CUDA C. A Makefile template is provided on CampusNet.

Exercise 3:

1. Write CUDA C code for generating the mandelbrot set on the GPU. Setup the GPU → CPU transfer of the resulting output. Run the executable and check the output in the mandelbrot.png file.

   Hints: Work initially with only one thread until the result is correct, then go for a 2D launch configuration that uses one thread per pixel. Use `cudaMallocHost` and `cudaFreeHost` instead of `malloc` and `free` in order to get pinned transfers.
2. Time your code and calculate the speed-up compared to the OpenMP version from week 2. Consider what influence warming up the device has.
3. How much time is used for compute and how much for the GPU → CPU transfer of the output? Calculate both the speed-up including transfer and excluding transfer.

```
GPU:
$ mandelbrot 5000
Compute = 0.00 seconds
IO =      0.01 seconds
Total =   0.01 seconds
```

```
OpenMP:
$ OMP_NUM_THREADS=8 mandelbrot 5000
Compute = 1.73 seconds
Total =   1.73 seconds
```