CS 33 Spring 2012
Lab 5: CUDA

Introduction
In this lab assignment, you will improve the performance of the lab 4 code by using CUDA. The lab handout contains the following files:

`header.h`	Header function prototypes and helpful macros.
`localization.c`	Reference source file (OpenMP version).
`localization.cu`	Incomplete CUDA source file (edit and submit this).
`main.c`	Source file containing main() and initialization code.
`Makefile`	Build script.
`input.txt`	Program input data.
`correct.txt`	Correct program output data.
`submit`	Script to submit a source file.
`status`	Script to check submission status.
`results`	Script to check submission results.
`clear`	Script to clear submissions in progress.

You will edit and submit only `localization.cu`.

Grading
Your grade for this assignment will be proportional to the amount of speedup you achieve relative to the OpenMP version of the code. For full credit, you must match the time of the OpenMP version (1X speedup). Extra credit will be awarded for speedup beyond that amount. To ensure fairness in measuring execution time, you will submit your code to be run on the Hoffman computing cluster. The included scripts allow you to submit and check the status of your code. To avoid confusion, for this lab you do not need to submit anything to CourseWeb. Instead, your **most recent lnxsrv02 submission** will be graded.

Compiling and Running
You can compile and run the OpenMP version on your local machine or `lnxsrv`. You can compile the CUDA version on `lnxsrv`, but you must use device emulation mode since the machines do not have GPUs. This will run very slowly. If you have an Nvidia GPU with CUDA installed, you can compile and run on your own machine. When you submit your file to the Hoffman cluster, it will be compiled and run on a GPU.

To compile the CUDA version:
```
[user@lnxsrv]$ make
```
To use device emulation mode, add the following option:
```
[user@lnxsrv]$ make EMU=1
```
To compile using a different source file, add the following option:
```
[user@lnxsrv]$ make SRC=localization_try2
```
To compile the OpenMP version:
```
[user@lnxsrv]$ make omp
```
To run:
```
[user@lnxsrv]$ make run
```

The executable will compare its results with the data in the existing file `correct.txt`. If your code is correct, the results will be identical and nothing extra will be printed. If there is an incorrect result, a message like this will be printed:

```
Invalid result at row 1!
```

The executable will also print the total execution time of the important portions of the program.
To remove the executable and output files:

```
[user@lnxsrv]$ make clean
```

`lnxsrv` Setup

To be able to run the CUDA compiler on `lnxsrv`, you must set a few environment variables. The easiest way is to add the following lines to the file `.cshrc` in your home directory:

```
setenv PATH ${PATH}:/usr/local/cuda/bin
setenv MANPATH ${MANPATH}:/usr/local/cuda/man
setenv LD_LIBRARY_PATH /usr/local/cuda/lib64
```

Or if you use the bash shell, then add these lines to the file `.profile`:

```
export PATH=$PATH:/usr/local/cuda/bin
export MANPATH=$MANPATH:/usr/local/cuda/man
export LD_LIBRARY_PATH=/usr/local/cuda/lib64
```

Once you add these lines, you must log out and log back in for them to take effect.

Submission

To submit a file to be run on the Hoffman cluster, you must be logged in to `lnxsrv02`.
Then simply run the submit script:

```
[user@lnxsrv02]$ ./submit FILE.cu
```

A unique cookie will be printed to allow you to identify your submissions.
To check the status of your submissions, use the status script:

```
[user@lnxsrv02]$ ./status
```

The check the results of your completed submissions:

```
[user@lnxsrv]$ ./results COOKIE
```

The overall results scoreboard can be viewed on the web here:

```
http://www.seas.ucla.edu/~cs33t2/spring2012/cudalab.html
```

You are limited to 3 submissions in progress at one time. To clear your submissions that have not completed yet, use the clear script:

```
[user@lnxsrv]$ ./clear
```

You are also limited to a certain number of submissions within a short time period. Use the clear script if you want to cancel your existing submissions. It may take several minutes before your submissions run.