EECS 495 – CUDA Programming

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1. Naive Code

Goal: Naive code, only one thread executes the kernel from the ref
Difficulties: Figure out the whole framework, cuda functions must be written in .cu file
Hours: 1 person * 4.5 hours

Timing 'ref_2dhisto' started
GetTimeOfDay Time (for 50 iterations) = 0.062
Clock Time (for 50 iterations) = 0.07
Timing 'ref_2dhisto' ended

Timing 'opt_2dhisto' started
GetTimeOfDay Time (for 50 iterations) = 46.332
Clock Time (for 50 iterations) = 46.33
Timing 'opt_2dhisto' ended

2. First Improvement

Goal: Try to optimize code with use of more threads in the kernel, use 2 blocks, totally 1024 threads for each height, that is input[idx][j]
Difficulties: atomicAdd require uint32_t data while the bin is uint8_t data, the input is not sequential
Hours: 1 person * 5 hours

Timing 'ref_2dhisto' started
GetTimeOfDay Time (for 50 iterations) = 0.063
Clock Time (for 50 iterations) = 0.06
Timing 'ref_2dhisto' ended
Timing 'opt_2dhisto' started
GetTimeOfDay Time (for 50 iterations) = 1.645
Clock Time (for 50 iterations) = 1.64
Timing 'opt_2dhisto' ended

Speed up over naive version = 46.33 / 1.64 = 28.25

3. Second Improvement

Goal: Make use of shared memory to hold the sub histograms so that the threads can work only on their sections of the data
Difficulties: Requires initial clearing of the sub-histogram, threads compute sub histograms and finally a global memory update is required
Hours: 2 * 1 hour

Timing 'ref_2dhisto' started
GetTimeOfDay Time (for 50 iterations) = 0.068

```
          Clock Time        (for 50 iterations) = 0.07
Timing 'ref_2dhisto' ended
Timing 'opt_2dhisto' started
        GetTimeOfDay Time (for 50 iterations) = 0.171
         Clock Time        (for 50 iterations) = 0.18
Timing 'opt_2dhisto' ended

Test PASSED
```

Speed Up over previous improvement = 1.64 / 0.18 = 9.1

4. Third Improvement

```
Goal:            Improve the concurrency by using more streaming multiprocessors
Difficulties:    Calculating row id, column id for accessing the input
Hours:           2 * 1 hour

Timing 'ref_2dhisto' started
          GetTimeOfDay Time (for 50 iterations) = 0.063
         Clock Time        (for 50 iterations) = 0.07
Timing 'ref_2dhisto' ended
Timing 'opt_2dhisto' started
          GetTimeOfDay Time (for 50 iterations) = 0.042
          Clock Time        (for 50 iterations) = 0.05
Timing 'opt_2dhisto' ended

Test PASSED
```

Speed up over previous improvement = 0.18 / 0.05 = 3.6

We also execute the code for 1000 iterations and report the result below

```
Timing 'ref_2dhisto' started
           GetTimeOfDay Time (for 1000 iterations) = 1.249
          Clock Time        (for 1000 iterations) = 1.25
Timing 'ref_2dhisto' ended
Timing 'opt_2dhisto' started
          GetTimeOfDay Time (for 1000 iterations) = 0.731
          Clock Time        (for 1000 iterations) = 0.73
Timing 'opt_2dhisto' ended

Test PASSED
```