

Tampere University

COMP.CE.350 Multicore and GPU

Programming Lab Work

Second Phase

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Second part: OpenCL Parallelization

Note: *The data has been excluded from the first line*

1. The original C version without optimizations

Total frametime: 5249ms, satellite moving: 582ms, space coloring: 2276ms.
Total frametime: 2585ms, satellite moving: 302ms, space coloring: 2238ms.
Total frametime: 2611ms, satellite moving: 292ms, space coloring: 2287ms.
Total frametime: 2839ms, satellite moving: 292ms, space coloring: 2514ms.
Total frametime: 2708ms, satellite moving: 349ms, space coloring:
2270ms.Total frametime: 2820ms, satellite moving: 348ms, space coloring:
2438ms

2. The original C version with most optimizations

Total frametime: 3012ms, satellite moving: 568ms, space coloring: 1150ms.
Total frametime: 1474ms, satellite moving: 293ms, space coloring: 1137ms.
Total frametime: 1507ms, satellite moving: 282ms, space coloring: 1188ms.
Total frametime: 1457ms, satellite moving: 283ms, space coloring: 1147ms.
Total frametime: 1450ms, satellite moving: 297ms, space coloring: 1121ms.
Total frametime: 1429ms, satellite moving: 282ms, space coloring: 1118ms

3. The OpenCL version on GPU, WG size 1x1

Total frametime: 48ms, satellite moving: 4ms, space coloring: 37ms.
Total frametime: 44ms, satellite moving: 4ms, space coloring: 36ms.
Total frametime: 44ms, satellite moving: 4ms, space coloring: 36ms.
Total frametime: 46ms, satellite moving: 4ms, space coloring: 38ms.
Total frametime: 41ms, satellite moving: 4ms, space coloring: 33ms.
Total frametime: 35ms, satellite moving: 5ms, space coloring: 26ms.

Total frametime: 34ms, satellite moving: 4ms, space coloring: 26ms.
Total frametime: 34ms, satellite moving: 5ms, space coloring: 25ms.
Total frametime: 35ms, satellite moving: 4ms, space coloring: 26ms.
Total frametime: 34ms, satellite moving: 4ms, space coloring: 26ms.

4. The OpenCL version on GPU,WG size 4x4

Total frametime: 14ms, satellite moving: 5ms, space coloring: 3ms.
Total frametime: 15ms, satellite moving: 4ms, space coloring: 3ms.
Total frametime: 21ms, satellite moving: 9ms, space coloring: 3ms.
Total frametime: 13ms, satellite moving: 5ms, space coloring: 3ms.
Total frametime: 16ms, satellite moving: 4ms, space coloring: 3ms.
Total frametime: 18ms, satellite moving: 5ms, space coloring: 3ms.
Total frametime: 16ms, satellite moving: 4ms, space coloring: 3ms.
Total frametime: 16ms, satellite moving: 4ms, space coloring: 3ms.
Total frametime: 17ms, satellite moving: 4ms, space coloring: 3ms.
Total frametime: 17ms, satellite moving: 4ms, space coloring: 3ms.

5. The OpenCL version on GPU,WG size 8x4

Total frametime: 14ms, satellite moving: 6ms, space coloring: 2ms.
Total frametime: 16ms, satellite moving: 4ms, space coloring: 3ms.
Total frametime: 16ms, satellite moving: 4ms, space coloring: 3ms.
Total frametime: 17ms, satellite moving: 5ms, space coloring: 2ms.
Total frametime: 20ms, satellite moving: 8ms, space coloring: 2ms.
Total frametime: 15ms, satellite moving: 6ms, space coloring: 2ms.
Total frametime: 15ms, satellite moving: 4ms, space coloring: 3ms.
Total frametime: 16ms, satellite moving: 4ms, space coloring: 2ms.
Total frametime: 17ms, satellite moving: 4ms, space coloring: 2ms.
Total frametime: 16ms, satellite moving: 4ms, space coloring: 2ms.
Total frametime: 24ms, satellite moving: 11ms, space coloring: 2ms.

6. The OpenCL version on GPU,WG size 8x8

Total frametime: 2404ms, satellite moving: 55ms, space coloring: 3ms.
Total frametime: 14ms, satellite moving: 5ms, space coloring: 2ms.
Total frametime: 11ms, satellite moving: 4ms, space coloring: 2ms.
Total frametime: 23ms, satellite moving: 10ms, space coloring: 3ms.
Total frametime: 14ms, satellite moving: 5ms, space coloring: 3ms.
Total frametime: 13ms, satellite moving: 4ms, space coloring: 3ms.
Total frametime: 16ms, satellite moving: 5ms, space coloring: 2ms.
Total frametime: 17ms, satellite moving: 5ms, space coloring: 2ms.
Total frametime: 17ms, satellite moving: 4ms, space coloring: 3ms.
Total frametime: 16ms, satellite moving: 5ms, space coloring: 2ms.
Total frametime: 17ms, satellite moving: 5ms, space coloring: 2ms.
Total frametime: 16ms, satellite moving: 5ms, space coloring: 2ms.
Total frametime: 18ms, satellite moving: 4ms, space coloring: 3ms.

7. The OpenCL version on GPU, WG size 16x16

Total frametime: 14ms, satellite moving: 5ms, space coloring: 2ms.
Total frametime: 17ms, satellite moving: 5ms, space coloring: 3ms.
Total frametime: 16ms, satellite moving: 4ms, space coloring: 3ms.
Total frametime: 17ms, satellite moving: 5ms, space coloring: 3ms.
Total frametime: 16ms, satellite moving: 4ms, space coloring: 2ms.
Total frametime: 17ms, satellite moving: 5ms, space coloring: 2ms.
Total frametime: 16ms, satellite moving: 4ms, space coloring: 2ms.
Total frametime: 17ms, satellite moving: 4ms, space coloring: 2ms.
Total frametime: 16ms, satellite moving: 4ms, space coloring: 2ms.
Total frametime: 17ms, satellite moving: 4ms, space coloring: 2ms.

With the work group size size 1x1 there seem to be a huge difference in space coloring and total frametime compare to other work group size.

By reducing the window to very small 80x80 and with WG size 16x16

```
trinh@trinhhuu:~/ParallelSummer$ ./parallel  
Error check passed!
```

Total frametime: 6ms, satellite moving: 6ms, space coloring: 0ms.
Total frametime: 11ms, satellite moving: 4ms, space coloring: 0ms.
Total frametime: 27ms, satellite moving: 13ms, space coloring: 0ms.
Total frametime: 13ms, satellite moving: 9ms, space coloring: 1ms.
Total frametime: 11ms, satellite moving: 5ms, space coloring: 0ms.
Total frametime: 16ms, satellite moving: 4ms, space coloring: 0ms.
Total frametime: 18ms, satellite moving: 4ms, space coloring: 1ms.
Total frametime: 16ms, satellite moving: 4ms, space coloring: 0ms.
Total frametime: 17ms, satellite moving: 5ms, space coloring: 0ms.
Total frametime: 17ms, satellite moving: 5ms, space coloring: 0ms.
Total frametime: 16ms, satellite moving: 4ms, space coloring: 0ms.
Total frametime: 18ms, satellite moving: 6ms, space coloring: 0ms.
Total frametime: 16ms, satellite moving: 5ms, space coloring: 0ms.
Total frametime: 18ms, satellite moving: 6ms, space coloring: 0ms.

By reducing the window to very small 80x80 and with most optimization on -O3 flag

```
trinh@trinhhuu:~/ParallelSummer$ gcc -o parallel_origin parallel_origin.c -  
std=c99 -lglut -lGL -lm -O3 -ftree-vectorize -fopt-info-vec  
parallel_origin.c:183:4: optimized: loop vectorized using 16 byte vectors  
parallel_origin.c:136:4: optimized: basic block part vectorized using 16 byte  
vectors  
parallel_origin.c:394:4: optimized: loop vectorized using 16 byte vectors  
parallel_origin.c:346:4: optimized: basic block part vectorized using 16 byte  
vectors
```

parallel_origin.c:491:4: optimized: basic block part vectorized using 16 byte vectors

trinh@trinhhuu:~/ParallelSummer\$./parallel_origin
Error check passed!

Total frametime: 60ms, satellite moving: 57ms, space coloring: 3ms.
Total frametime: 61ms, satellite moving: 58ms, space coloring: 3ms.
Total frametime: 61ms, satellite moving: 59ms, space coloring: 2ms.
Total frametime: 61ms, satellite moving: 58ms, space coloring: 3ms.
Total frametime: 61ms, satellite moving: 58ms, space coloring: 3ms.
Total frametime: 61ms, satellite moving: 59ms, space coloring: 2ms.
Total frametime: 61ms, satellite moving: 57ms, space coloring: 3ms.
Total frametime: 61ms, satellite moving: 58ms, space coloring: 3ms.
Total frametime: 61ms, satellite moving: 58ms, space coloring: 3ms.
Total frametime: 60ms, satellite moving: 58ms, space coloring: 2ms.
Total frametime: 61ms, satellite moving: 58ms, space coloring: 3ms.
Total frametime: 61ms, satellite moving: 58ms, space coloring: 3ms.

What was the most difficult thing in this exercise work?

For me the most difficulties is to get familiar with OpenCL structure and definitions which require to look up and check out the example code, how to create a context, command queue, read,write from/to buffer and build program. Another thing is that install CUDA take me a lot of time to fix the driver issue which is incompatible with my old driver for NVIDIA graphic card.

