CS 5220 Pre-Class Questions 2

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Question 1

Accelerators:

(2 flops/FMA)*(8 FMA/vector FMA)*(1.053 GHz)*(15 accelerators) = 250 GFLOPS

Cores:

(2 flops/FMA)*(8 FMA/vector FMA)*(3.2 GHz)*(60 cores)= 3.02 TFLOPS

Total: 3.27 TFLOPS

Question 2 In light of the calculation done in the lecture slides, given that I also have an i5 Haswell processor (albeit a 1.3 GHz one), following the same calculation as the professor, I arrive at roughly 42 GFLOPS.

Question 3 According to the lecture slides, the maximum speedup would be p, independent of the number of tasks.

Question 4

Minimum serial time= 2.75 hrs.

Minimum parallel time= 2.25 hrs. (will add diagram after lecture)

Question 5 This plot (on next page) tells me that my computer has markedly poor performance when accessing the L3 cache with a moderate stride on a very large array. This is pretty clear from the dramatically red wedge corresponding to these processes at the upper center of the graphic.

Question 6 Unsurprisingly, Totient appears to performs slightly better than my machine. There is a temporary, observable plateau between stride sizes of 2^6 and 2^10 (roughly). This corresponds to what I think is L2 cache access, telling us that Totient has a fairly ample L2 cache. After strides of around 2^10 bytes, we see a dramatic spike in processing time, indicating that the L3 cache access is not quite as speedy. (See plot below)

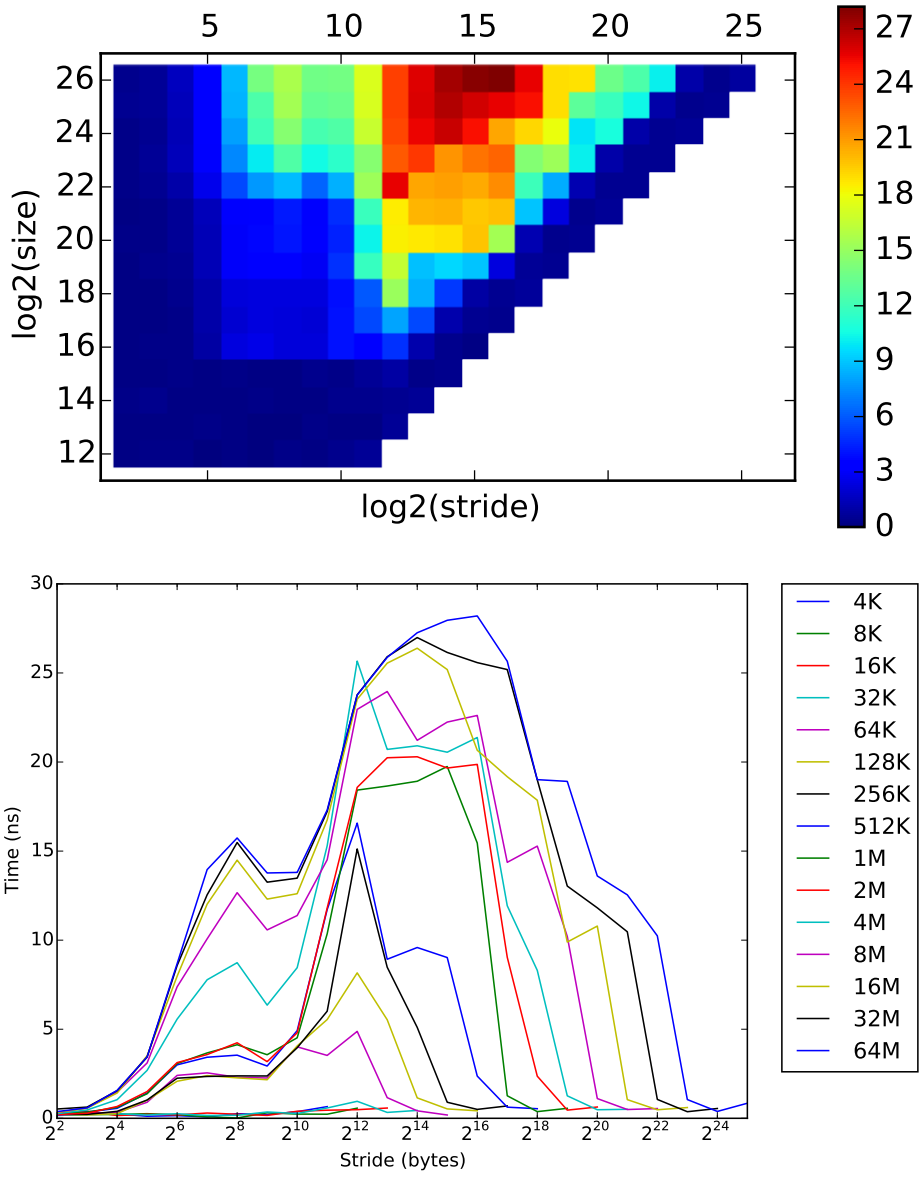
Question 7 The execution times resulting from these three algorithms (run on my machine) are as follows:

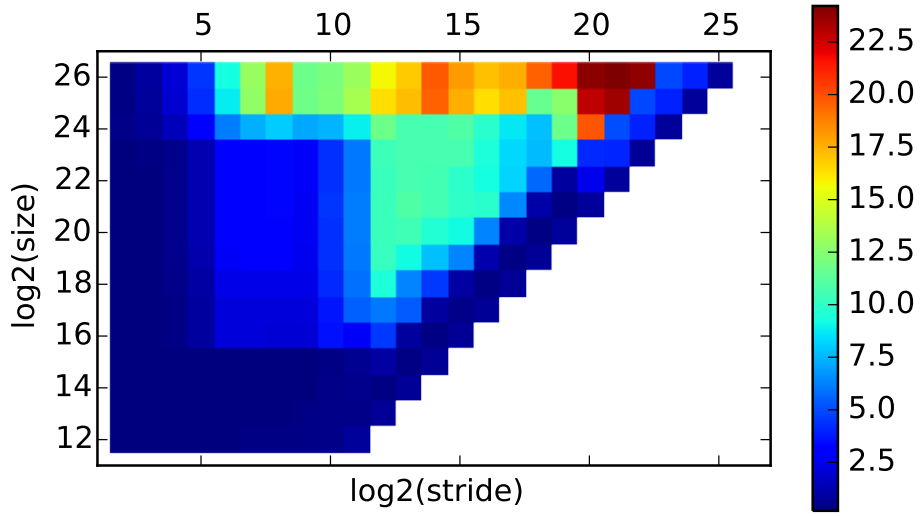
Version 1: 3.994100e-03

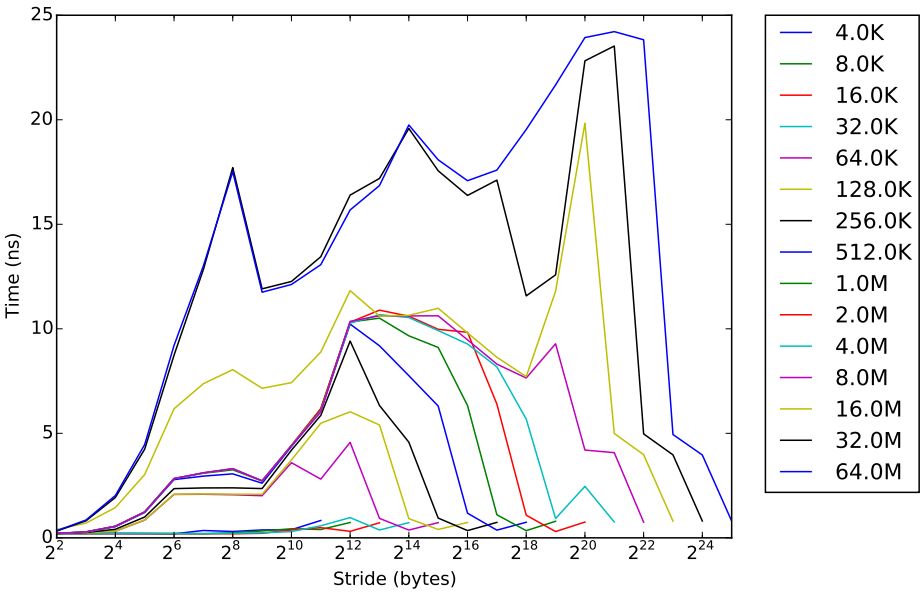
Version 2: 7.231180e-03

Version 3: 7.238760e-03

It is clear that the first is fastest, roughly by a factor of 2. This may be due to having a single loop and only having a single memory location for the array.


5
10
15
20
25
26
24
22
20
18
16
14
12
log2(size)
log2(stride)
27
24
21
18
15
12
9
6
3
0
30
25
20
15
10
5
0
Time (ns)
2^2 2^4 2^6 2^8 2^{10} 2^{12} 2^{14} 2^{16} 2^{18} 2^{20} 2^{22} 2^{24}
Stride (bytes)
4K
8K
16K
32K
64K
128K
256K
512K
1M
2M
4M
8M
16M
32M
64M


5
10
15
20
25
26
24
22
20
18
16
14
12
log2(size)
log2(stride)
22.5
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5


25
20
15
10
5
0
Time (ns)
2^2 2^4 2^6 2^8 2^{10} 2^{12} 2^{14} 2^{16} 2^{18} 2^{20} 2^{22} 2^{24}
Stride (bytes)
4.0K
8.0K
16.0K
32.0K
64.0K
128.0K
256.0K
512.0K
1.0M
2.0M
4.0M
8.0M
16.0M
32.0M
64.0M