Lab 5 Efficiency Report

All of the following tests were run on a virtual machine using an Intel Core i7 9700k clocked at 3.6GHz. This processor has 16 flops per cycle, with a maximum theoretical throughput of 57.6. More specs are shown below, as reported on Intel's website.

Essentials

Export specifications

Product Collection	9th Generation Intel® Core™ i7 Processors
Code Name	Products formerly Coffee Lake
Vertical Segment	Desktop
Processor Number	i7-9700K
Status	Launched
Launch Date	Q4'18
Lithography	14 nm
Included Items	Please note: The boxed product does not include a fan or heat sink
Use Conditions	PC/Client/Tablet
Recommended Customer Price	$374.00 - $385.00

CPU Specifications

# of Cores	8
# of Threads	8
Processor Base Frequency	3.60 GHz
Max Turbo Frequency	4.90 GHz
Cache	12 MB Intel® Smart Cache
Bus Speed	8 GT/s
Intel® Turbo Boost Technology 2.0 Frequency‡	4.90 GHz
TDP	95 W

Flops Mode Efficiency

Type	Size	Threads	Elapsed Time(s)	Measured Throughput (GFlops/s)	Efficiency(%)
Single	Small	1	1.430	6.99	12.135
Single	Small	2	0.699	14.313	24.849
Single	Small	4	0.287	34.855	60.512
Single	Medium	1	14.005	7.140	12.396
Single	Medium	2	7.00	14.293	24.814
Single	Medium	4	3.482	28.720	49.861
Single	Large	1	138.889	7.200	12.500
Single	Large	2	69.617	14.364	24.938
Single	Large	4	34.847	28.697	50.290
Double	Small	1	4.452	2.246	3.899
Double	Small	2	2.260	4.424	7.681
Double	Small	4	0.892	11.210	19.462
Double	Medium	1	44.445	2.250	3.906
Double	Medium	2	22.202	4.504	7.819
Double	Medium	4	11.109	9.002	15.628
Double	Large	1	442.595	2.259	3.922
Double	Large	2	219.235	4.561	7.918
Double	Large	4	110.075	9.084	15.771

- Small = 10
- Medium = 100
- Large = 1000

Matrix Mode Efficiency

Type	Size	Threads	Elapsed Time(s)	Measured Throughput (Gflops/s)	Efficiency(%)
Single	Small	1	0.586	1.707	2.964
Single	Small	2	0.156	6.392	11.097
Single	Small	4	0.052	19.311	33.526
Single	Medium	1	39.439	1.623	2.818
Single	Medium	2	12.207	5.243	9.102
Single	Medium	4	5.731	11.168	19.389
Single	Large	1	304.115	1.684	2.924
Single	Large	2	96.208	5.322	9.240
Single	Large	4	40.710	12.577	21.835
Double	Small	1	1.016	0.984	1.708
Double	Small	2	0.256	3.900	6.771
Double	Small	4	0.071	14.049	24.391
Double	Medium	1	66.436	0.963	1.672
Double	Medium	2	19.603	3.265	5.668
Double	Medium	4	8.383	7.635	13.255
Double	Large	1	528.034	0.970	1.684
Double	Large	2	163.128	3.139	5.450
Double	Large	4	68.493	7.475	12.977

- Small = 1024
- Medium = 4096
- Large = 8192

Summary

Across all modes, sizes, and types, efficiency increases as the amount of threads increases. Conversely, elapsed time decreases as the amount of threads increases. However, larger sized benchmarks are usually less efficient than smaller sized ones with the same number of threads. This holds for both modes. Multithreading improves computational efficiency by consolidating the overall workload among multiple threads/processes. Efficiency was markedly better when integers were used over doubles, as well as when more than one thread was used. In addition, matrix mode was overall less efficient than flops mode, likely owing to the complexity of matrix multiplication. Even when measures were taken to lessen the computational load (transposition of the second matrix before multiplication) this was still the case.