CS 475/575 -- Spring Quarter 2021

Project #4

Vectorized Array Multiplication/Reduction using SSE

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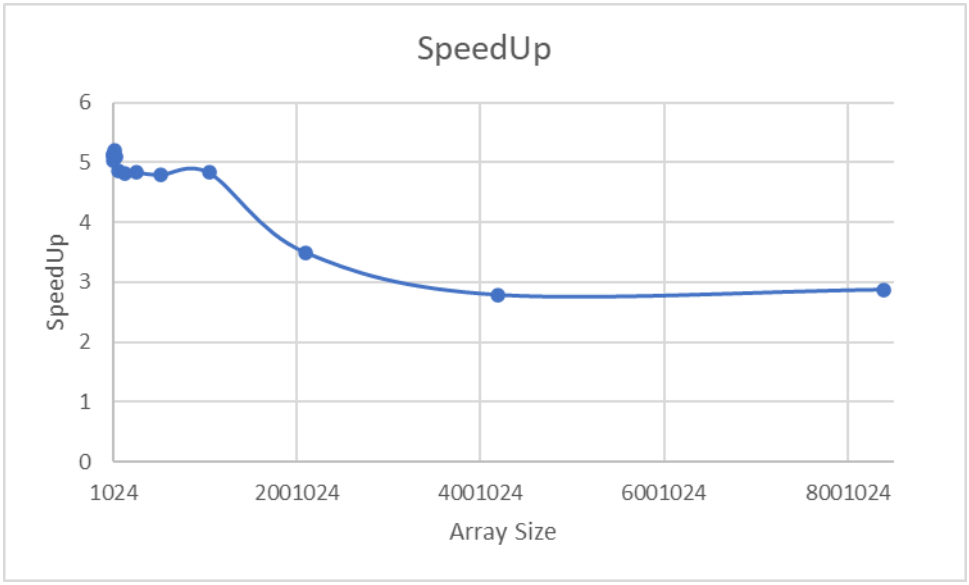
1. **What machine you ran this on:**

   OSU Engineering Server: rabbit

2. **Show the table of performances for each array size and the corresponding speedups:**

Array_size	MaxSIMDPerformance	MaxNonSIMDPerformance	SpeedUp
1024	923.959	183.988	5.02185
2048	1780.59	348.002	5.1166
4096	1778.43	347.754	5.11403
8192	1787.1	347.644	5.14059
16384	1776.45	340.927	5.21064
32768	814.868	159.789	5.09966
65536	1615.48	332.546	4.85792
131072	1664.21	344.845	4.82597
262144	1608.26	332.695	4.83405
524288	1635.67	341.06	4.79583
1048576	1659.77	343.531	4.83152
2097152	1186.37	339.433	3.49514
4194304	942.282	338.39	2.7846
8388608	931.16	324.168	2.87246

3. **Show the graph of SIMD/non-SIMD speedup versus array size (one curve only):**



4. **What patterns are you seeing in the speedups?**

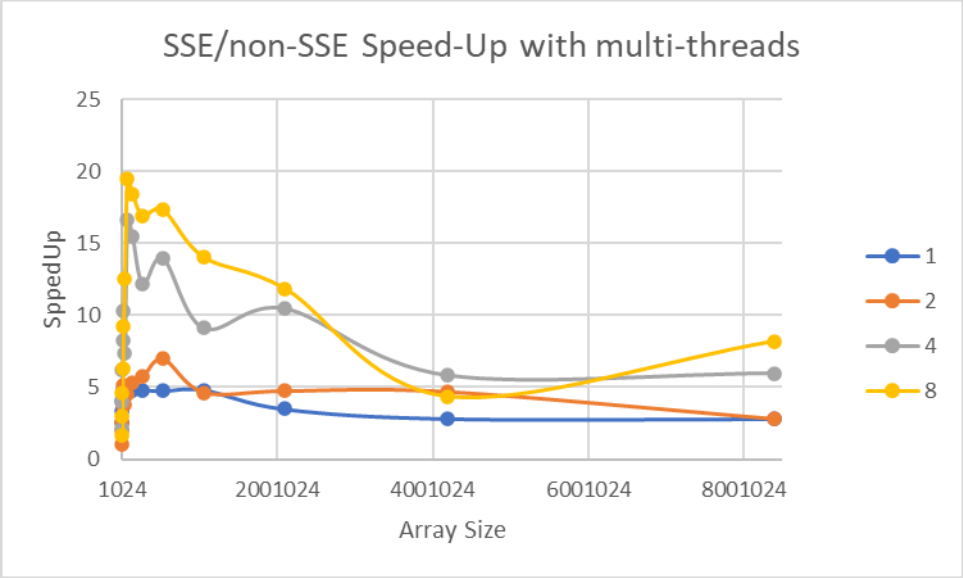
   Are they consistent across a variety of array sizes?

   Why or why not, do you think?

   Based on the graph, we can find that the values of speedup are between 4 to 5 mostly. Basically, the pattern is linear and smooth. I think they are consistent across a variety of array sizes depending on the result. The result shows that the performance is quite stable (5.0 ± noise effect) before 2097152; however, it goes lower and lower after it. This is a issue which can be solved by using prefetching.

5. Extra Credit:

1.1 Graph:



1.2 Table:

Threads / Size	1	2	4	8
1024	2.528	1.05272	2.11704	1.66896
2048	3.3616	2.02445	3.94338	3.01752
4096	4.02039	2.52871	6.21117	4.5679
8192	4.50383	5.12277	8.2944	6.32741
16384	4.89862	3.66914	10.3162	9.22434
32768	4.76779	3.79904	7.39079	12.5187
65536	4.72209	4.53979	16.6001	19.4796
131072	4.74971	5.26489	15.5078	18.4612
262144	4.80944	5.71526	12.1798	16.9505
524288	4.75151	6.97479	13.9746	17.3597
1048576	4.81552	4.63439	9.10289	14.0525
2097152	3.48433	4.73862	10.4746	11.856
4194304	2.81571	4.67615	5.8207	4.35175
8388608	2.79849	2.79159	5.97783	8.19697

1.3 The result and table are similar to the slide which Professor provided. In addition, the most situation became stable after size 524288.