CS 475/575 -- Spring Quarter 2017

Project #6

OpenCL Array Multiply, Multiply-Add, and Multiply-Reduce

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I. Runtime environment

In this project, I ran my program on OSU's server rabbit.engr.oregonstate.edu. Then I got the following results, and graph.

Part 1.

II. Results and graph

Multiply and Multiply-Add performance versus Global Work Size

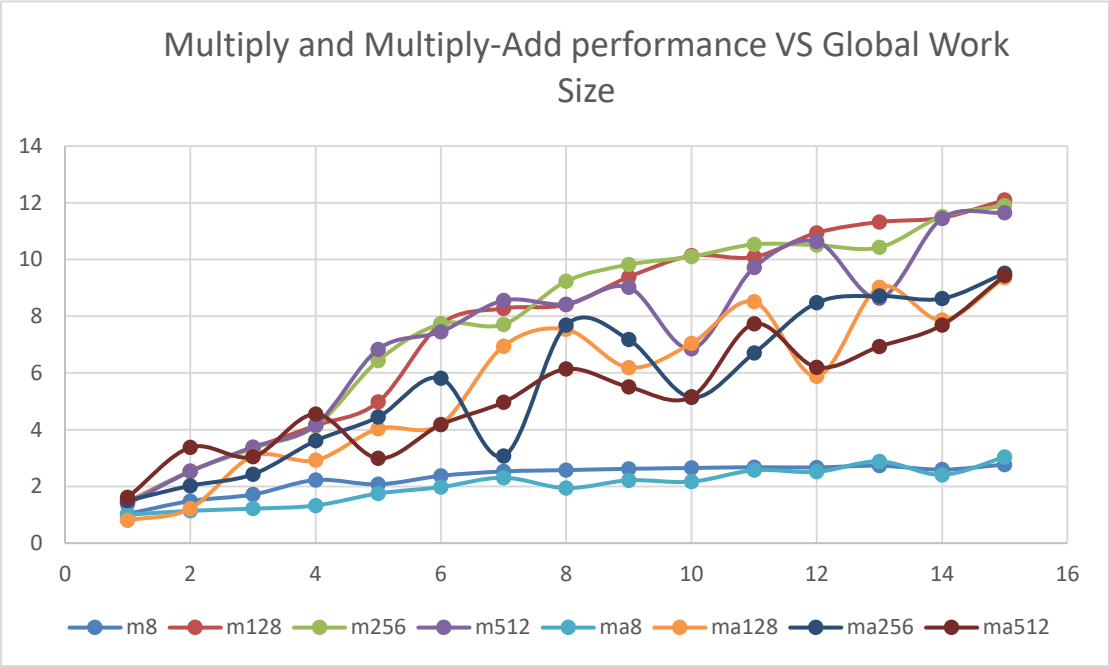
Multiply

	m8	m128	m256	m512
1	1.032	1.452	1.417	1.389
2	1.485	2.536	2.534	2.529
3	1.715	3.354	3.34	3.391
4	2.226	4.147	4.125	4.166
5	2.074	4.976	6.436	6.834
6	2.375	7.729	7.727	7.454
7	2.529	8.276	7.713	8.554
8	2.576	8.41	9.229	8.42
9	2.621	9.382	9.817	9.013
10	2.65	10.132	10.101	6.852
11	2.677	10.085	10.53	9.716
12	2.669	10.937	10.505	10.63
13	2.731	11.32	10.425	8.638
14	2.592	11.47	11.512	11.447
15	2.771	12.094	11.893	11.649

Multiply-Add

	ma8	ma128	ma256	ma512
1	1.002	0.807	1.499	1.611
2	1.141	1.22	2.023	3.373
3	1.216	3.064	2.43	3.049
4	1.328	2.921	3.608	4.545
5	1.751	4.034	4.45	2.99
6	1.978	4.19	5.811	4.178
7	2.308	6.946	3.067	4.964
8	1.942	7.534	7.685	6.139
9	2.216	6.191	7.175	5.506
10	2.168	7.038	5.139	5.156
11	2.57	8.511	6.699	7.728
12	2.516	5.886	8.473	6.2
13	2.884	9.021	8.71	6.929
14	2.411	7.867	8.619	7.69

15	3.032	9.359	9.511	9.434



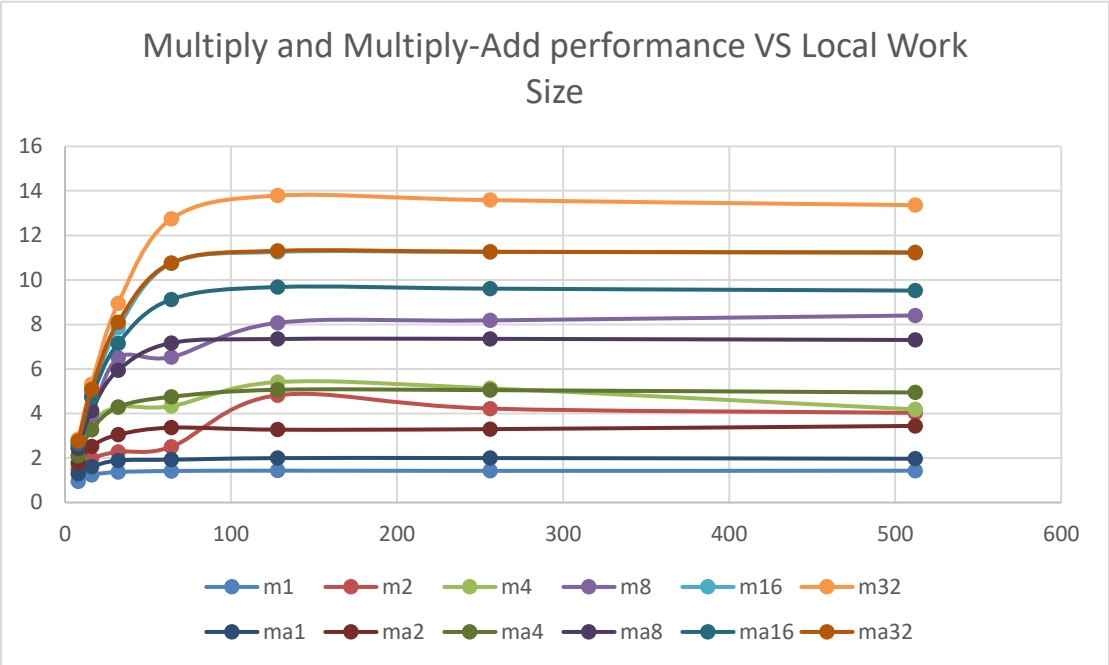
Second part is Multiply and Multiply-Add performance versus Local Work Size.

Multiply

	m1	m2	m4	m8	m16	m32
8	0.945	1.496	2.111	2.507	2.729	2.851
16	1.238	1.97	3.565	3.925	4.903	5.31
32	1.368	2.279	4.291	6.5	7.858	8.944
64	1.417	2.503	4.33	6.53	10.739	12.735
128	1.432	4.82	5.409	8.071	11.257	13.785
256	1.422	4.22	5.128	8.181	11.258	13.583
512	1.43	4.027	4.183	8.401	11.242	13.358

Multiply-Add

	ma1	ma2	ma4	ma8	ma16	ma32
8	1.289	1.767	2.098	2.435	2.637	2.758
16	1.608	2.519	3.27	4.132	4.728	5.077
32	1.888	3.045	4.289	5.944	7.154	8.096
64	1.924	3.362	4.75	7.167	9.123	10.762
128	1.995	3.273	5.065	7.344	9.68	11.307
256	1.998	3.296	5.048	7.353	9.608	11.265
512	1.968	3.441	4.943	7.301	9.521	11.223



III. Pattern analysis

With this two graphs, I can see, Multiply and Multiply-Add have same patterns, with constant local size, while global size rising, performance rising. For constant global size, with local size rising, they will meet horizons, once reach those tops, performance will be horizonal.

These two patterns are reasonable, as we know number of groups are Array size divide local size, and array size depends on NMB, which is global size. While global size rising, number of work groups will rise, there will be more groups working parallelly, so that performance will increase. For local size rising, because GPU can deal with some work items in the local memory, there will be a better use in each group, however, there will be a peak size for each group, when the size grew to that value, the performance will not increase.

The only different between these two conditions is Multiply performance will better than Multiply-Add, but not too much.

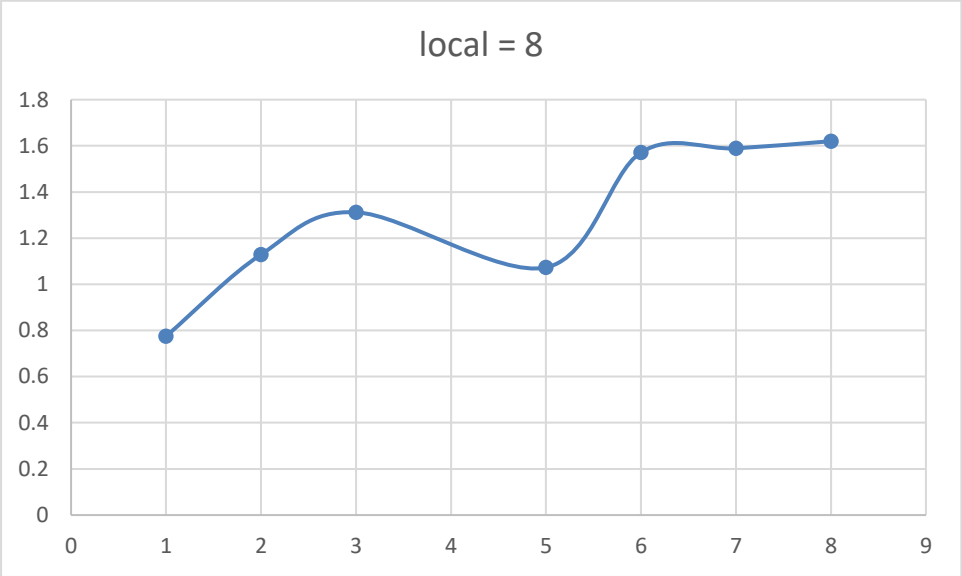
Assign a proper number of local size that will get a proper GPU performance, because GPU can deal with a constant work items, if lower than that will waste GPU performance, but higher than that will have nothing increase.

Part 2.
II. Results and graph

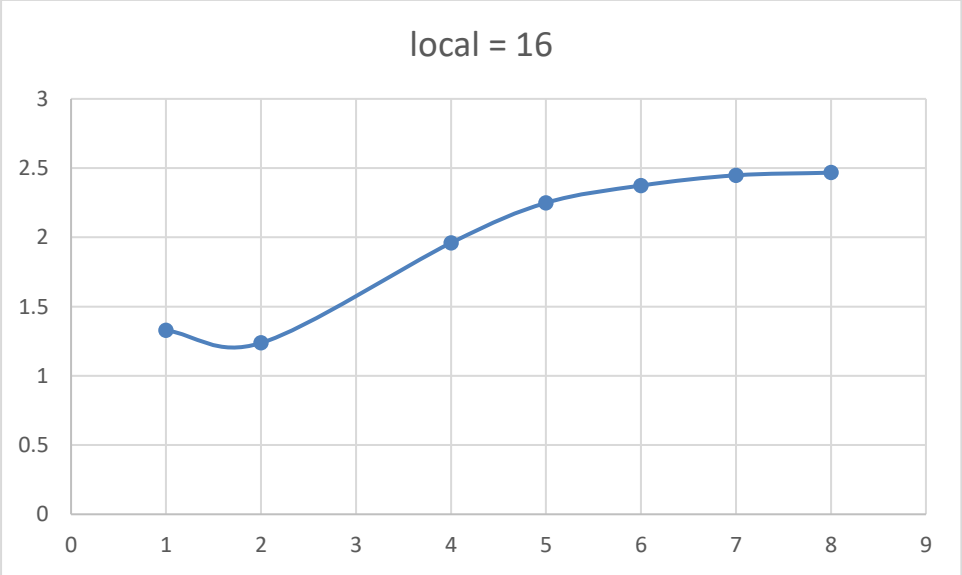
Because it is really hard to find a lot of appropriate values. I picked all success value to get the following graphs.

VS Global

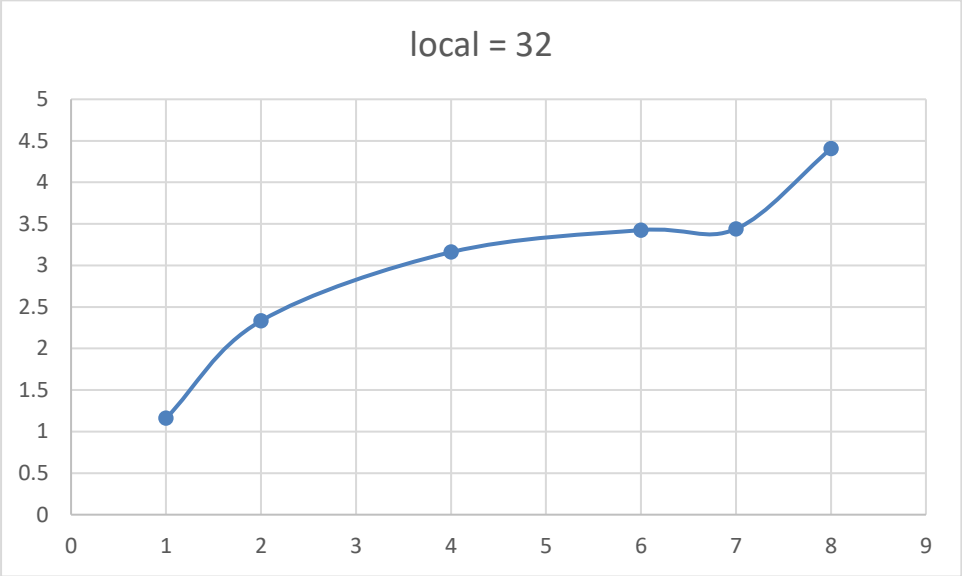
	1	2	3	5	6	7	8
8	0.775	1.129	1.312	1.073	1.571	1.589	1.62



	1	2	4	5	6	7	8
16	1.328	1.237	1.96	2.249	2.374	2.448	2.467

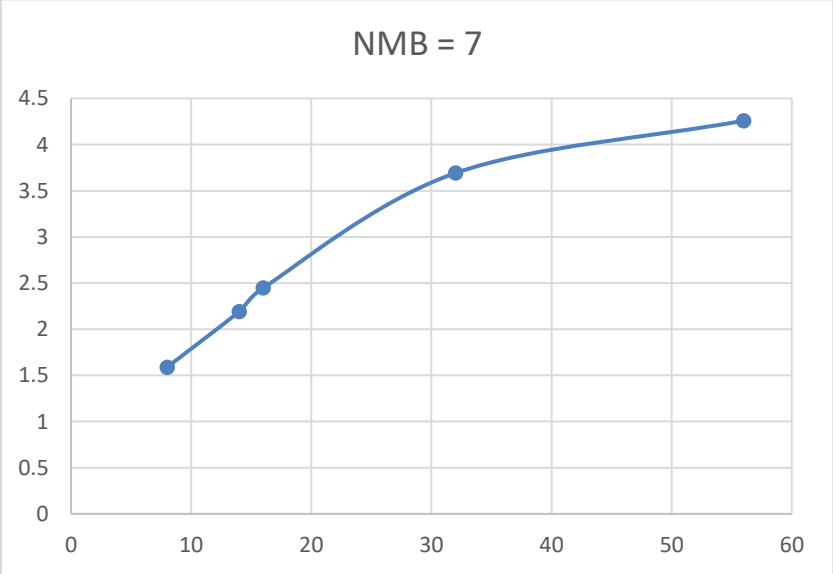


	1	2	4	6	7	8
32	1.161	2.333	3.16	3.425	3.44	4.405



VS Local

	8	14	16	32	56
7	1.589	2.192	2.448	3.692	4.259



III. Pattern analysis

Both two situations, I got them increasing patterns, at first, they will increase faster, however, they will slow down.

I think the reason is the same as previous, when they won't have conflicts, they will have a better performance while global size or local size rising.

Also, for the proper use of GPU parallel computing are also the same as previous, it is about setting appropriate size of local size.