CS-601

Software Development for Scientific Computing

MidSem-2022

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Results:

1) **Matmul1:**

Matrix Size	Time Taken(sec)	L1 Misses	L2 misses	Total Instructions	**Total Cycles**
1024	8.040	1066428795	1066428795	8599398891	**23488020068**
2048	76.679	8698203872	8698203972	6875385296	**230190126087**
4096	950.670	149036323059	94821230049	549918766955	**2914340949582**

2) Matmul2:

Matrix Size	Time Taken(sec)	L1 Misses	L2 misses	Total Instructions	**Total Cycles**
1024	6.020	136106279	3416278	4358950952	**1617788793**
2048	9.005	1193636290	708720652	34615680452	**26543751282**
4096	7.531	17336379610	6256409812	275904218666	**221147484867**

3) Matmul3:

Matrix Size	Block	Time Taken(sec)	L1 Misses	L2 misses	Total Instructions	**Total Cycles**
1024	16	.611	136330737	47056787	4366599456	**1697940596**
	32	.561	137075396	25101156	4366927458	**1506288616**
	64	.485	138807944	2445669	4367583484	**1291359198**
	128	.477	142064031	1169086	4368895524	**1272008358**
2048	16	4.350887	1194739856	356475721	34646291426	**13270921860**
	32	4.350	1194739216	356475721	34646291426	**13270921860**
	64	4.70647	1210513780	347081162	34647602729	**13111153968**
	128	4.056862	1229749433	246046854	34650224281	**12562115214**
4096	16	35.771	17465571406	2317941355	276020442836	**111992877268**
	32	36.235	17480473648	2253335034	276021695790	**111776184700**
	64	35.544	17448681965	2052952974	276024414042	**109769968813**
	128	36.932135	17450699799	2293314881	276029656872	**113341093746**

Conclusion and Inference

We can conclude from above data:

i) On basis of time taken to execute:

a) Changing O0, O1, O2, O3 we get most optimal result in O3.

For a particular N Matmul2 performs better than Matmul1 and Matmul3 performs better than both. Faster run-time for matmul2 than matmul1 refers that matmul2 the inner most loop has to store and perform scalar vector multiplication while in matmul1 it has to perform product of 2vectors.Matmul3 gives best ^{result} due to multiplication on blocked matrix.

Computation intensity of blocked matrix =q-2n/N (Number of blocks).

Form a particular matrix multiplication doubling the dimensions increases the run time by approximately 8 times as the cost of matrix multiplication is approx.O(n^3).

ii) Cache Miss:

Among the three different multiplication approaches the row block matrix gives the least execution time. Total number of instructions, the total L1 cache miss, the total L2 cache miss is tableted above with total number of instructions executed and total number of cycles. Total number instructions do not change significantly with dimensions of block size.

For matmul1 and matmul2 the L1 and L2 cache misses increase greatly with the increase in dimension of matmul3 the cache miss increases significantly with dimension size, however show a slight variation with increasing size.