

Lab 5- Cache Optimization

Step 1: Chart your Run times and Cache data

matmul - Pi	-O0	-O1	-O2	-O3
Average CPI	6.510441602	19.018464499	19.2509944	19.23743627
Instructions	41,523,676,557	11, 379,436,317	11, 370, 646, 179	11,365,193,211
Branch-misses	26,390,314	28, 299, 198	28, 974, 893	29,201,498
Cache Misses	1,085,866, 115	1, 081,034,746	1, 080,980,553	1,080,856,262
Cache References	22, 614,769,317	3, 230,371,020	3,228,400,554	3,227,828,046
Runtime (Measured)	226.536018841	182.886227315	184.203568989	183.232085000

matmul - ARM	-O0	-O1	-O2	-O3
Average CPI	2.762645244	5.684965552	4.434650422	4.434413223
Instructions	51,266,188,136	11,462,007	12,523,039,540	12,518, 611, 949
Branch-misses	24,219,337	21,212,674	20,809,874	22,279,775
Cache Misses	1,078,391,960	1,078,258,866	1,078,261,862	1,078,259
Cache References	22, 484, 122, 249	3,107,471,961	3,106,424,407	3,105,900,670
Runtime (Measured)	70.954308729	32.679066685	27.784741000	27.775209000

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Step 2: Loop Unrolling

Loop Unrolling only	
Average CPI	2.5
Instructions	7,416,070,932
Branch-misses	19,327,582
Cache Misses	270,761,371
Cache References	2,032,165,334
Cycle Count	18,540,256,299
Runtime (Measured)	9.357197740

Step 2 Column Major Order Only

Column Major Order only	
Average CPI	1.285559459
Instructions	11,188,432,798
Branch-misses	12,322,869
Cache Misses	33,638,623
Cache References	2,714,027,051
Cycle Count	14,383,395,611
Runtime (Measured)	7.250637828

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Step 3 Loop Unrolling only and Column Major Order

Loop Unrolling only and Column Major Order	
Average CPI	1.108759959
Instructions	6,353,175,502
Branch-misses	11,153,298
Cache Misses	16,877,207
Cache References	1,640,285,205
Cycle Count	7,044,146,607
Runtime (Measured)	3.528764799

<u>With best compiler optimization level</u>	Original with Best Compiler Optimization	Just Loop Unrolling	Just Column- Major	Loop Unrolling plus Column- Major
Runtime	27.775209000	9.357197740	7.250637828	3.528764799
Cache Misses	1,078,259	270761371	33638623	16,877,207
Cache References	3,105,900,670	2,032,165,334	2,714,027,051	1,640,285,205