Names: Tim Newman, Josh Conrad

Date: 31 May, 2018

CPE 315 Computer Architecture

Lab 5: Cache Optimization Writeup

Column Major Optimization:

Between the fastest runtime of the original code (O2 Optimization Level) and the column major optimization, there was a huge reduction in runtime from 157.05 seconds to 12.87 seconds for one of our computers, about 8% of the original runtime. For the other, a reduction from 156.80 seconds to 12.87 seconds, or about 8% of the original, was made. Although the cache references was roughly equal between the original and the column major implementation, the cache misses were reduced significantly from 33.080% of the references to 0.117% on one of our computers. The data obviously followed the same trend for the other computer, reducing from 33.112% of references to 0.109% being misses. Below are the charts with both of our data.

Original Code: Comp 1	**-O0**	**-O1**	**-O2**	**-O3**
Runtime	203.502547986	158.443588311	157.050344757	157.693930635
Cache Misses	1,084,958,771 (4.790%)	1,082,466,313 (33.172%)	1,078,820,645 (33.080%)	1,079,664,452 (33.115%)
Cache References	22,648,387,050	3,263,165,751	3,261,202,103	3,260,346,442

With best compiler optimization level: Comp 1	**Original**	**Column-major**	**Tiled 16x16**	**Tiled 32x32**
Runtime	157.050344757	12.874084735	11.510935273	10.167432998
Cache Misses	1,078,820,645 (33.080%)	3,837,421 (0.117%)	134,110,348 (3.853%)	113,923,181 (3.377%)

Cache References	3,261,202,103	3,267,385,346	3,480,801,992	3,373,296,744

Original Code: Comp 1	**-O0**	**-O1**	**-O2**	**-O3**
Runtime	201.551348158	156.841194815	156.804511215	157.704022870
Cache Misses	1,083,692,934 (4.785%)	1,079,825,493 (33.089%)	1,079,807,926 (33.112%)	1,080,339,759 (33.139%)
Cache References	22,648,368,168	3,263,424,463	3,261,099,602	3,260,055,210

With best compiler optimization level: Comp 1	**Original**	**Column-major**	**Tiled 16x16**	**Tiled 32x32**
Runtime	156.804511215	12.873216215	11.506753262	10.069361019
Cache Misses	1,079,807,926 (33.112%)	3,567,484 (0.109%)	133,953,393 (3.848%)	114,445,688 (3.392%)
Cache References	3,261,099,602	3,267,398,142	3,481,114,852	3,373,565,520

Tiling Optimization:

The tiling optimizations very slightly reduced the runtimes further. For the one computer, runtime was reduced to 11.51 seconds for 16x16 tiling and to 10.17 seconds for 32x32 tiling, or 89% and 79% respectively of the column major optimization. For the other computer, runtime was reduced to 11.50 seconds for 16x16 tiling and to 10.06 seconds for 32x32 tiling, or a reduction to 89% and 78% of column major. While the cache references again stayed approximately the same, the cache misses slightly increased. For the first computer, cache misses increased to 3.853% for 16x16 tiling and 3.377% for 32x32 tiling. For the other, cache misses increased to 3.848% for 16x16 tiling and 3.392% for 32x32 tiling.