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Lab 5 Write Up

Original Code	-O0	-O1	-O2	-O3
Runtime	9.128572466	3.571523135	3.653077885	3.474004019
Cache Misses	60,706	25,950	21,579	95,118
Cache References	1,076,454,537	1,076,367,495	1,076,388,163	1,076,427,701

Based off of the data from running the original code, it seems that there is a huge difference in time and cache misses between optimization level 0 and levels 1-3 while cache references remained around the same amount. Overall -O2 has the best performance due to having the overall lowest cache misses. Time betweens O1, O2, and O3 are about the same so having the level with the optimal cache misses will be the best, so in this case, it will be O2.

Note: Compiled using -O2

-O2	Original	Column-major	Tiled 16x16	Tiled 32x32
Runtime	3.653077885	2.10416823	2.080583561	2.044949075
Cache Misses	21,579	28,489	22,552	22,934
Cache References	1,076,388,163	2,059,929	889,044	876,588

Summary

Based on the data we recorded, there was an obvious jump in time between the original code (row-major) and the ones we created. For the most part, the cache misses increased compared to the original code, but stayed around a general amount of about 22,000, so that seems to not impact the runtime very much. However, there is an extremely large jump in cache references between the original code and the rest. It goes from 1 billion references to 2 million, to 800 thousand. This reflects in the runtime as well, where there is a huge jump in runtime between original and column-major since the references decrease immensely and the time makes a 1.5

second jump (1.44x faster). Between column-major and the tiling, there is less of a decrease in references, so there is a less dramatic time change. The same is shown between the 16x16 tiling and 32x32 tiling. The change in time does decrease, but is extremely miniscule since the cache references only decreased about a million between column-major and 16x16 tiling and it only decreased about 10,000 between 16x16 and 32x32 tiling. Compared to the decrease of over 1,050,000,000 between the original code and column-major, the miniscule change in runtime makes sense.

As far as what the compiler can do and comparing that, before changing the code to column-major and tiling it, -O2 was about 2.50x faster than -O0.

Overall, while modifying the code itself made some significant changes, what the compiler does was more effective in this scenario.