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Project 2 CIS4930
June 30, 2017

Project 2 Report

For Project 2 I used Algorithm 3 from the Efficient 2-Body Statistics Computation on GPUs:Parallelization & Beyond paper. The techniques used in the algorithm are a combination of tiling the input and privatization of the output. I also leave the anchor block L in the register. The first step is to load the atoms in parallel to a local register variable: "atom L = d_histogram[threadIdx.x + blockDim.x*blockIdx.x]" while also initializing the shared histogram to 0 in the same parallel manner. The initialization for loop jumps by block dimension, so if the number of buckets < threads/block then it will only run once. The next step is to tile the input into shared memory, I do this with a for loop which goes from blockIdx.x + 1 to number of blocks. This will load in and compute all distances from L (current threads atom) to all other particles in the blocks ahead of the current block. The inner for loop does these calculations, going from 0 to blockDim.x and saves the distances to the privatized histogram in shared memory using atomicAdd so there are no memory access collisions. After all blocks ahead of current block have been processed, you load all the current blocks particles L into shared memory. Then we have another for loop like the inner one above, which goes from threadIdx.x + 1 to blockDim.x, which then calculates all distances in the current block and saves to the privatized histogram in shared memory. Finally, we merge the privatized histogram into the global histogram using the same type of for loop at the top which initialized the private histogram to 0, except we use atomicAdd to merge the histograms.

This method yielded a 70% improvement on my Nvidia GTX Titan X Pascal. The naive algorithm with inputs 512000 500 128, ran in 54.58330 seconds compared to this algorithm which ran in 16.83682 seconds, which is a significant improvement. The algorithm had almost no improvement

on the pos c4 machines. I also tested it on GTX 970 and GTX 1070 yielding similar results with a 70% improvement.