4FO3 N-Body Project

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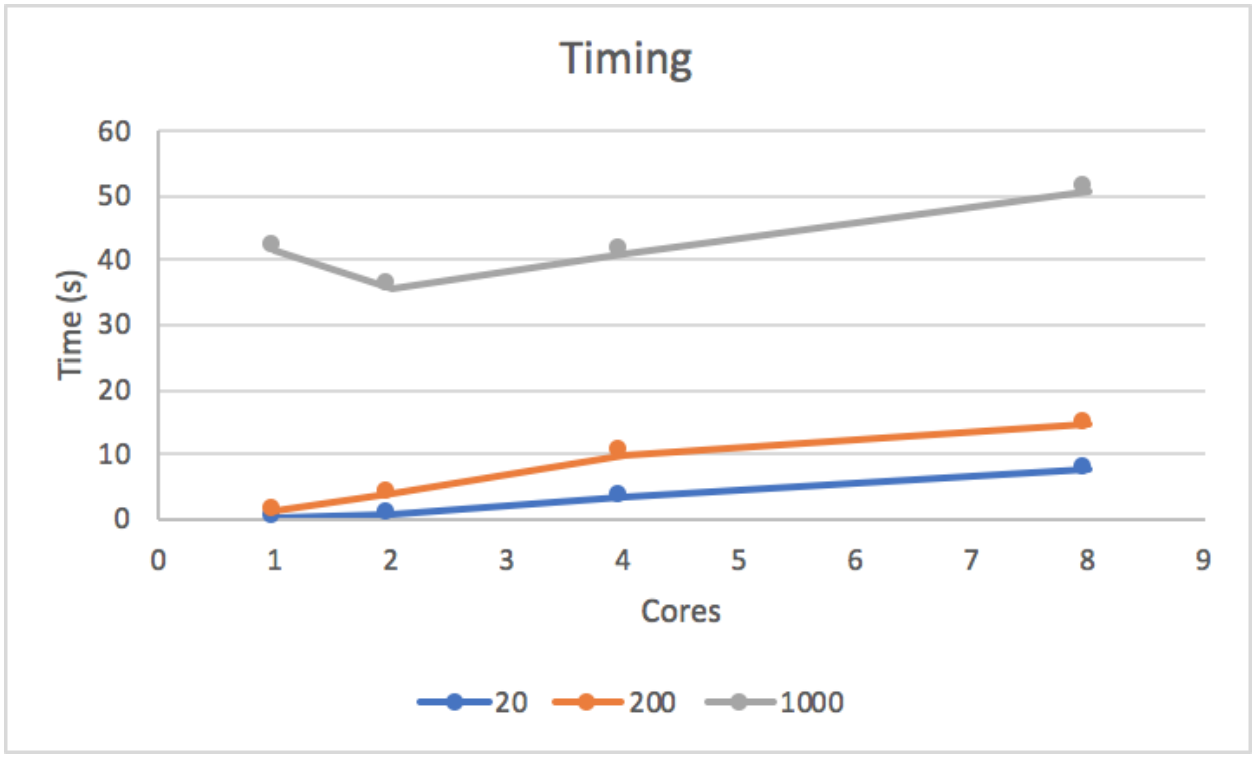
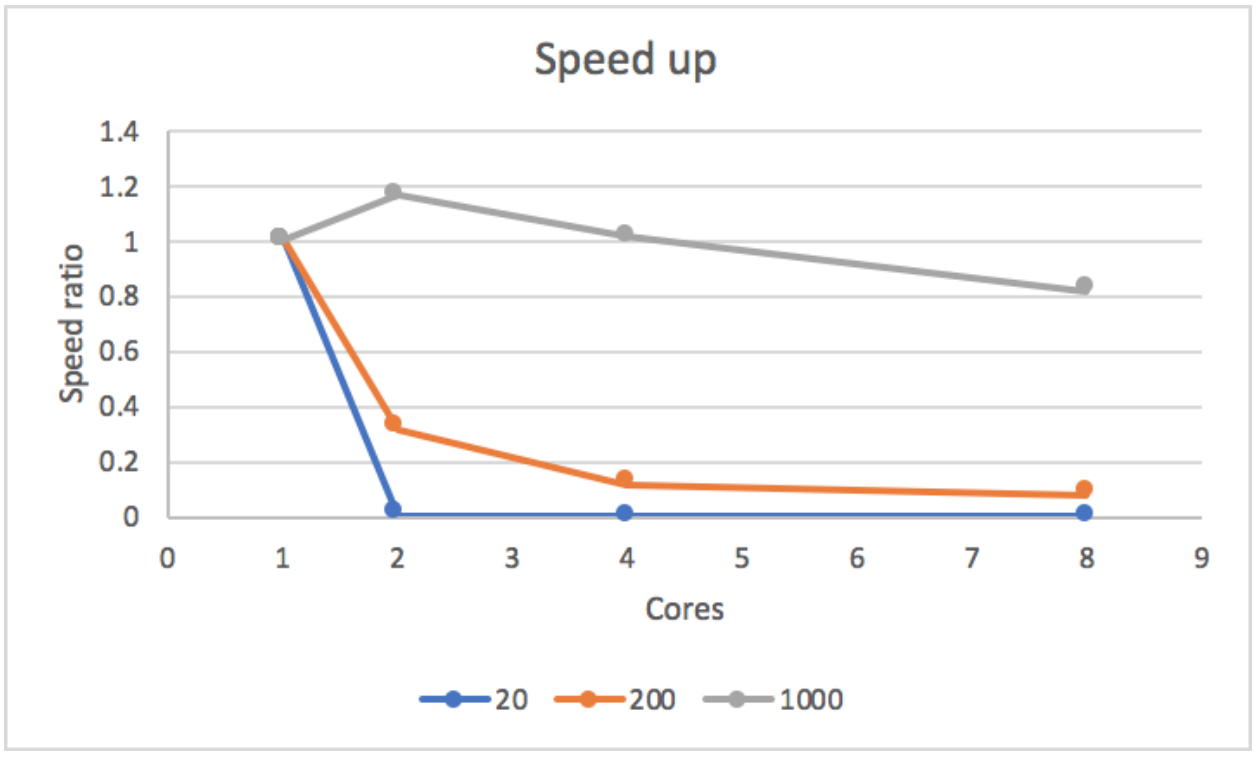
Graphs:

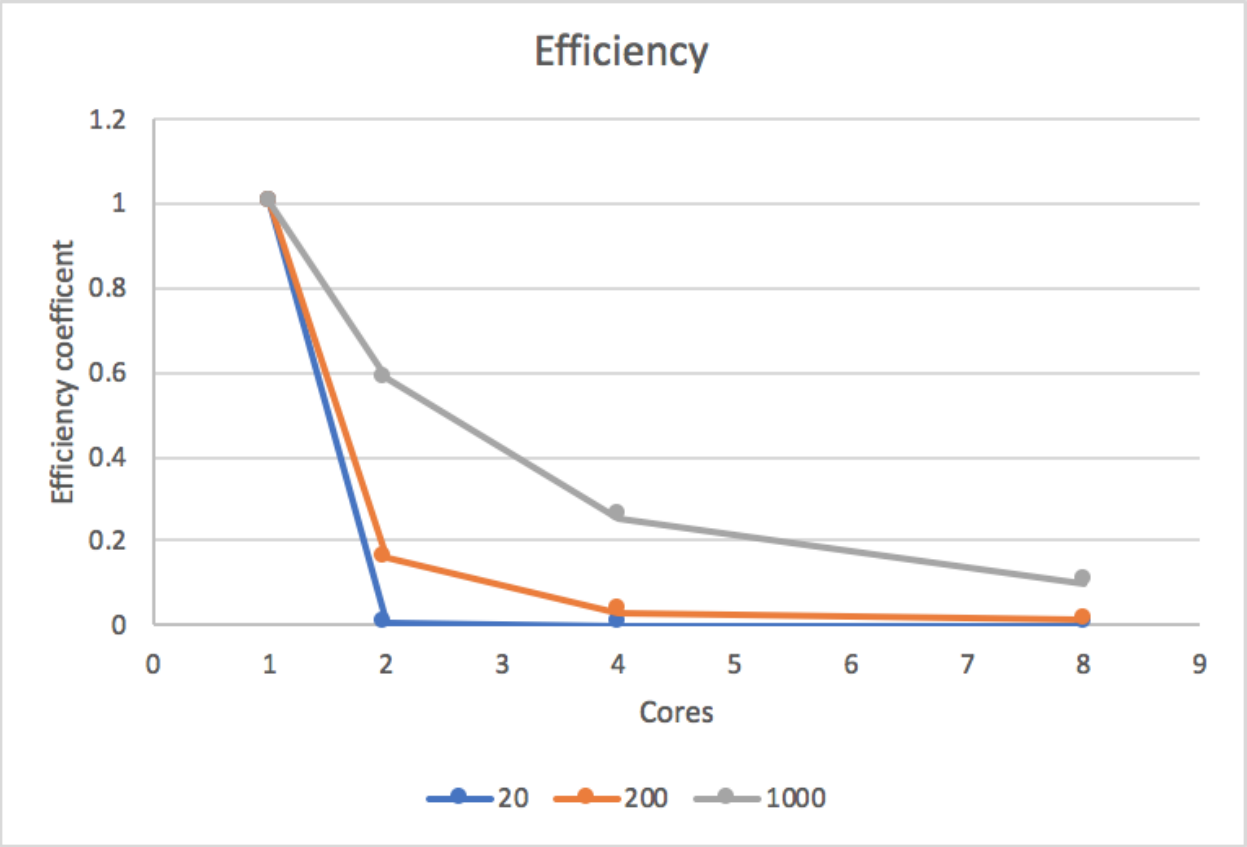
Timing



Speedup



Efficiency



Strong Vs Weak Scalability

Strong (Amdahl's Law)

The algorithm used for this assignment is not strongly scalable, as determined by the strongly scalable ratio (Amdahl's Law). However, as the weight of the job (number of particles/images) increases, we do notice a slight increase in strong scalability with the potential that with a large enough data set, it could qualify as strongly scalable. Due to time and processor constraint for this assignment, we cannot confirm or deny this hypothesis. Therefore, based on our results, this algorithm is not strongly scalable.

(CompletionTime1Core / (CompeltionTimeXCores * XnumberOfCores)) *100
===Strong Scaleable %

Weak (Gustafson's Law)

Similarly to the strongly scalable analysis, based on these data sets, this algorithm is not weakly scalable. With the 1000 particle data set, we see a slight increase in the speed-up ratio from 1 core to 2 cores, however the speed-up ratio then falls beyond 2 cores. This is not expected, as the speed-up ratio should continuously increase with the number of cores. Based on this slight

increase in speed-up ratio from 1 to 2 cores, we could hypothesize that a large enough job weight (number of particles/images) could make this algorithm weakly scalable. However, due to limitations in time and processors, we cannot test this hypothesis. Thus, given the data we have collected, we cannot conclude that this algorithm is weakly scalable.

(CompletionTime1Job1Processor/CompeltionTimeXJobXProcessor)*100

===Weak Scalability Coefficient

Abnormalities

Due to the nature of this assignment as well as being run with MPI, especially on McMasters servers there is an abundance of things that could have, and did, go wrong.

Given the incredibly lengthy run time of the code, a variety of mishaps could affect run time as is natural with all programs run with black box testing as we did for this assignment. Alongside this, the abnormally increased demand on the servers from so many students requesting use of the servers adds increased strain and can cause skewed results. These are both exacerbated by running on a non-isolated system.

Modifications and fine tuning

We first created a serial version of the algorithm. To improve performance, an MPI solution was implemented through which we were able to broadcast the particle data set evenly across multiple processors. Finally, we attempted to implement ring pass communication with limited success. From our results, our parallelization did not decrease run time. However, as stated in the abnormalities section, this could due to many other factors. Through these attempts to fine tune the algorithm, we were not able to improve performance.