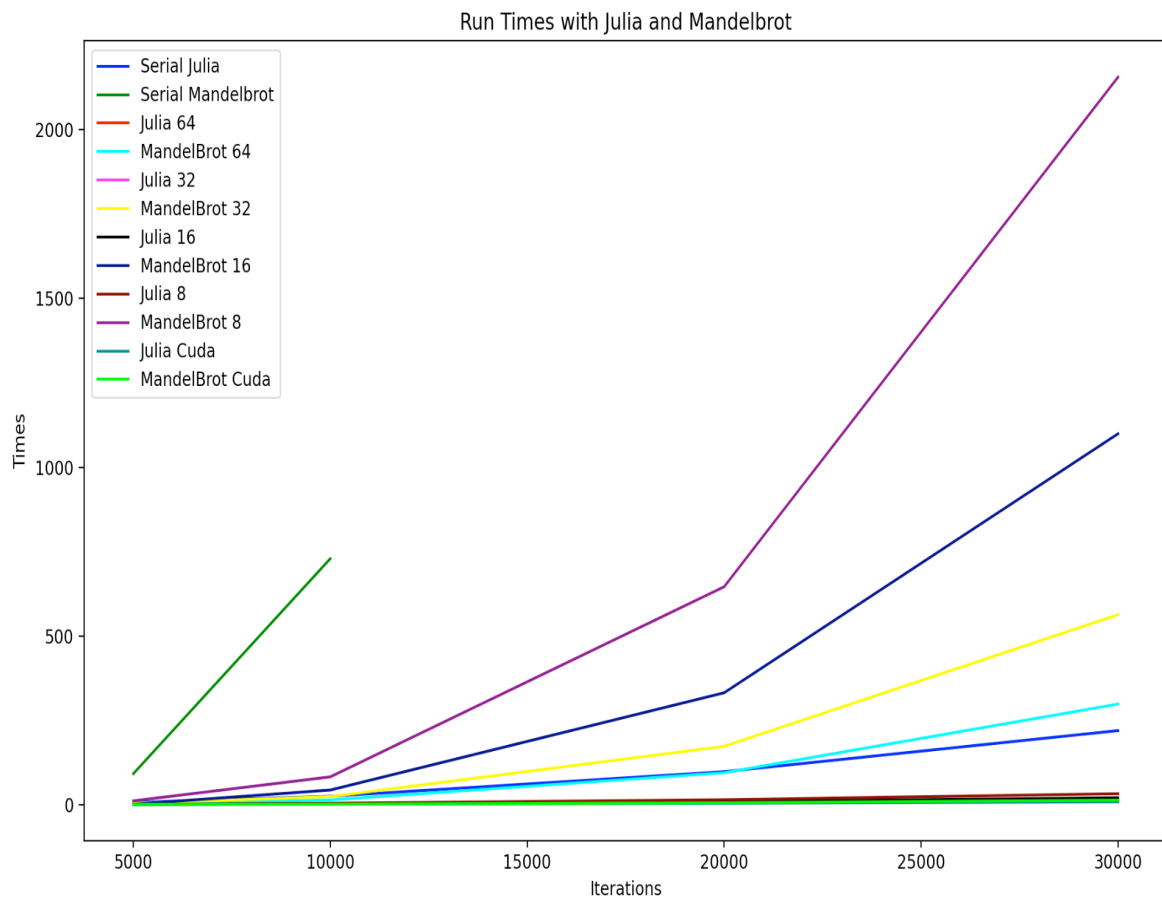


Mandelbrot and Julia Set Analysis

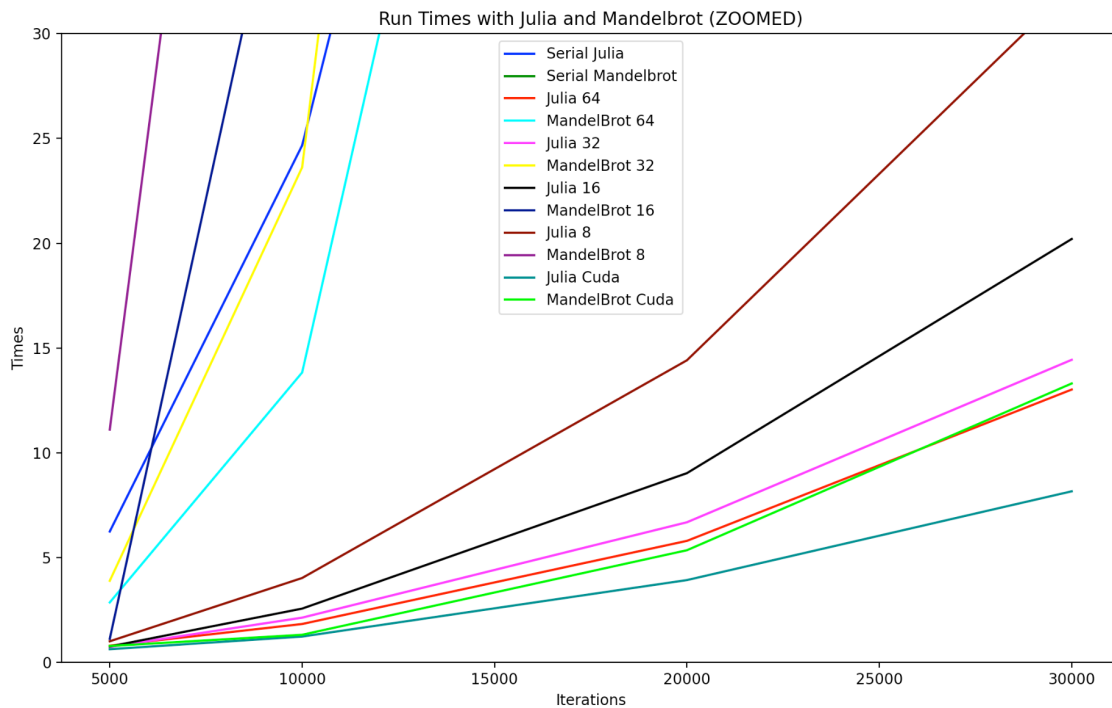
Jack Fineanganof

The Mandelbrot Set and Julia sets were run with 5000, 10000, 20000, and 30000 iterations each for serial, openmp, and cuda. The openmp was run with 8, 16, 32, and 64 threads.

The times we recorded for the simulation can be seen in these graphs:



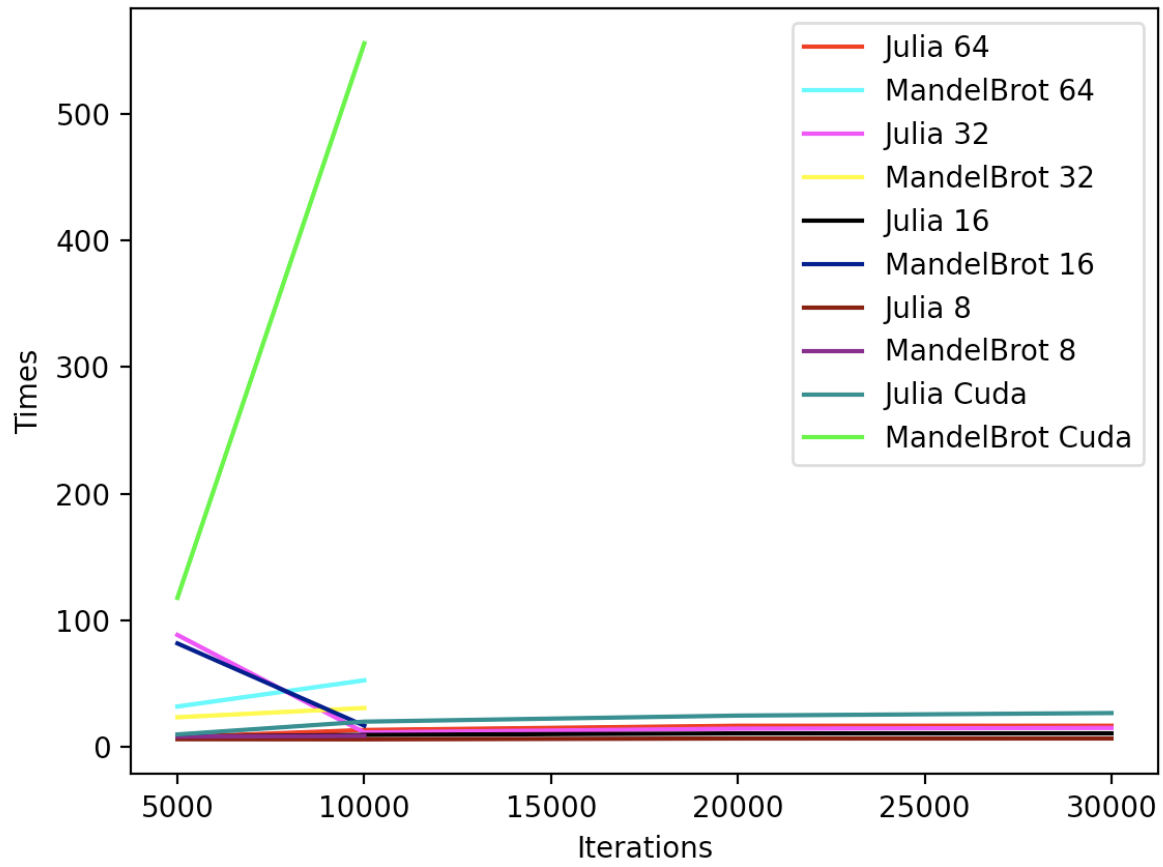
Based on the plots, all mandelbrot times surpasses julia. Serial julia time is seen to even be faster than mandelbrot with 8 threads. Sadly, serial times for mandelbrot iterations of 20000 and 30000 never finished, though following the extreme angle between 5000 iterations and 10000 iterations, we can infer that mandelbrot serial would have exceeded everyone else in terms of time consumption.

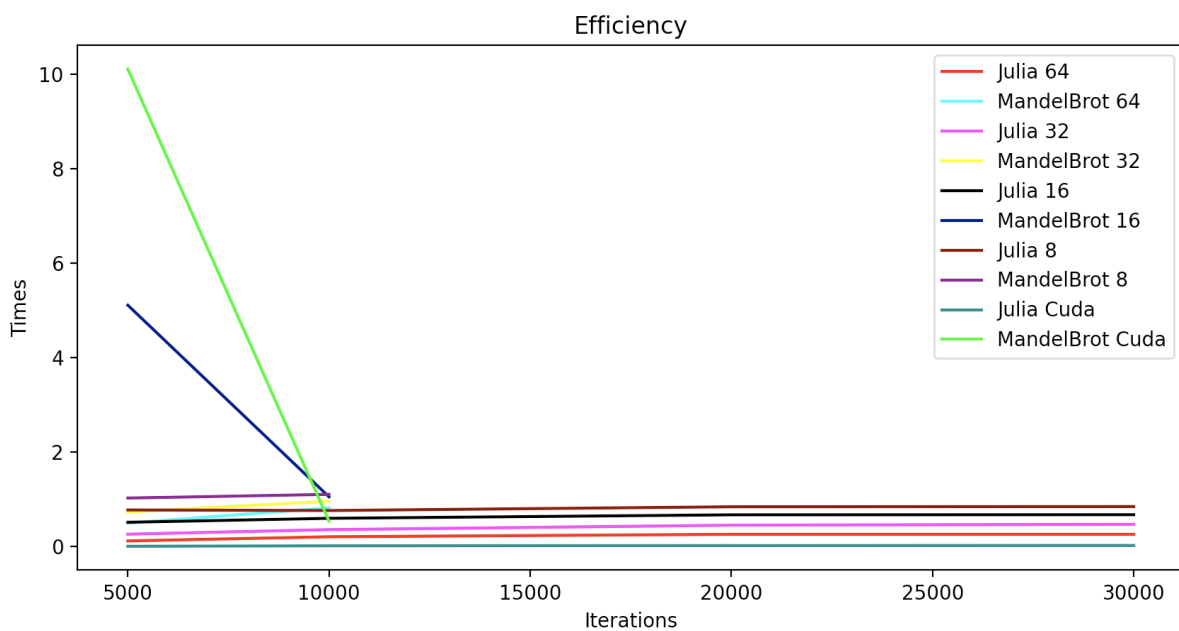
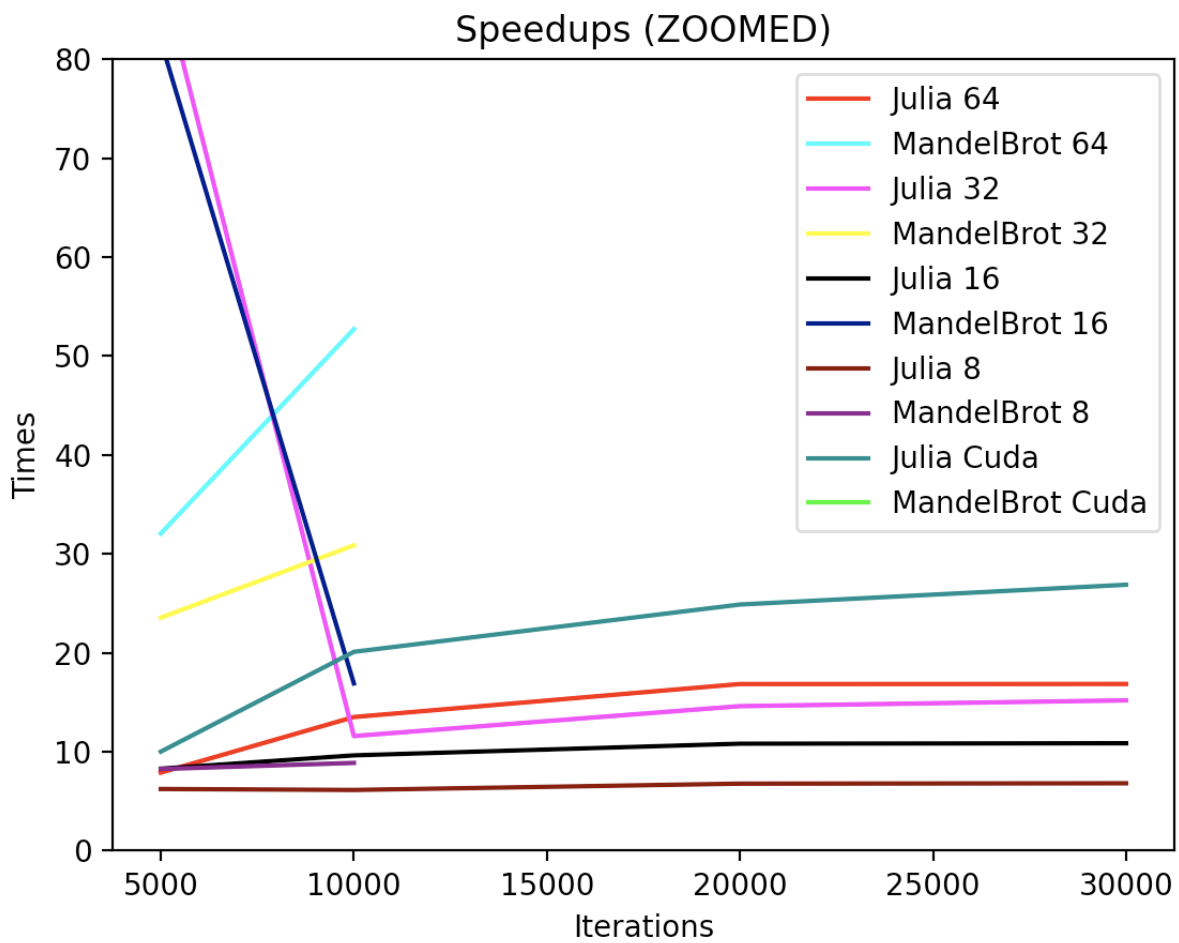


In the more **zoomed in graph**, we do see some interesting crossovers. Julia with 64 threads at 30000 iterations actually speeds past the mandelbrot cuda. Serial Julia before 10000 iterations is slower than mandelbrot with 32 threads, however surpasses with speed around 20000 and 30000 iterations. In general, julia times are faster than mandelbrot times which is not surprising due to julia being one constant iteration of mandelbrot.

We should also account for **speed up** and **efficiency**.

Speedups





Unsurprisingly, mandelbrot speedup for cuda contains the most speedup. This makes sense, as the Mandelbrot serial version took the longest especially for larger iterations such as 20000 and 30000 even being long enough to not compile in time to be recorded. There are spiking slow downs for Mandelbrot 16 and Julia 32 in the first two iterations. Surprisingly, mandelbrot 32 and mandelbrot 64 are speeding up.

Despite the Mandelbrot cuda version of speedup, efficiency is seen to be tanked going from 5000 iterations to 10000. Mandelbrot 16 not following the pattern experienced low efficiency as well.

Parallel and cuda works for mandelbrot and cuda sets. Allowing great speed ups. It should be noted that because the julia set is only a portion of the mandelbrot set, it actually should overall have faster times. The multibrot is not included, though my inference would be that the multibrot would have been significantly slower than all the sets. Following the pattern, mandelbrot is only a piece of the multibrot set.