Exercise 1

This exercise consists in implementing a sequential 2D n-body simulation

Tasks

•Provide a sequential implementation of the n-body simulation in 2D. Hints on how to proceed (not mandatory to follow):

See attachement

•Measure the execution time for various problem sizes. What can you observe?

Execution time grows exponentially with the number of particles but only linearly with the number of timesteps

Execution time with N = 10000, T= 100: 2055.809111 s

Execution time with N = 1000, T= 100: 20.492030 s

Execution time with N = 100, T= 100: 0.203022 s

Execution time with N= 100, T=10000: 20.307104 s

Execution time with N 100, T = 1000: 2.040681 s

•Add your best sequential wall time for 10000 particles and 100 time steps into the comparison spreadsheet linked on Discord.

Execution time with: 10000 particles and 100 time steps: 2055.809111 s

Exercise 2

This exercise consists in investigating and planning optimization and parallelization techniques for Exercise 1.

Parallelization

We can not parallelize the time steps because the time iterations have dependencies between each other. So we would have to parallelize the inner loop.

Open mp parallelization of the inner-middle loop and initialization vectors, for better cache locality. Also for the update of the positions.

We could also do this with Openmpi but this would very likely have lots of communication overhead.

Optimization

Maybe it would be better to create an Array of structs instead of 3 different arrays for each x,y and the masses.

Loop unrolling of the inner loop might also have some positive effects.
