Parallelization of the Barnes-Hut algorithm for n-body gravitational simulations

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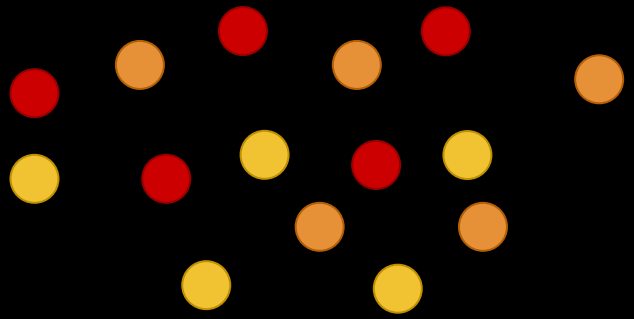
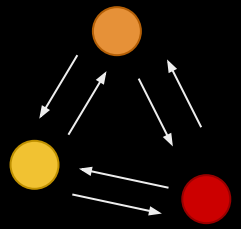
196034

What is the n-body problem?



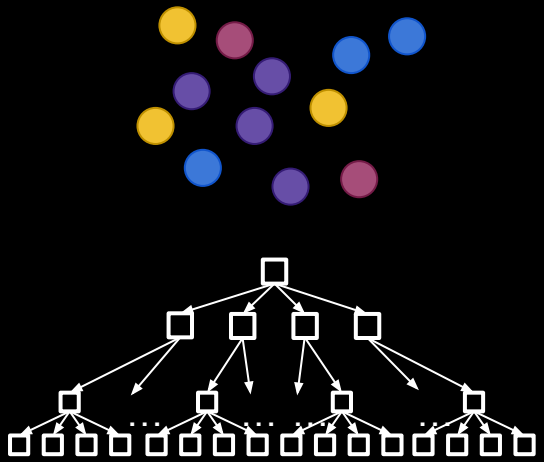


$O(n^2)$ complexity

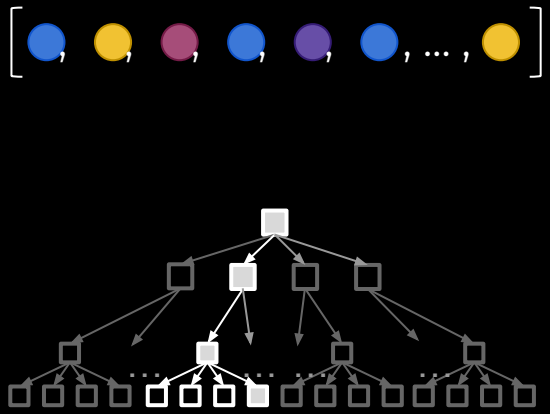
The Barnes-Hut algorithm

Overview

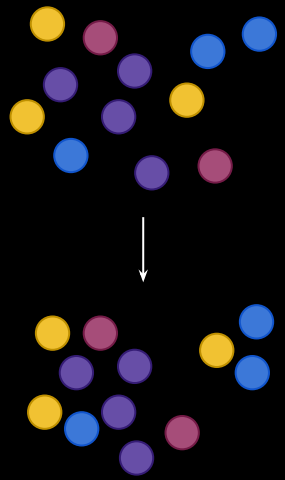
Tree building



Force calculation

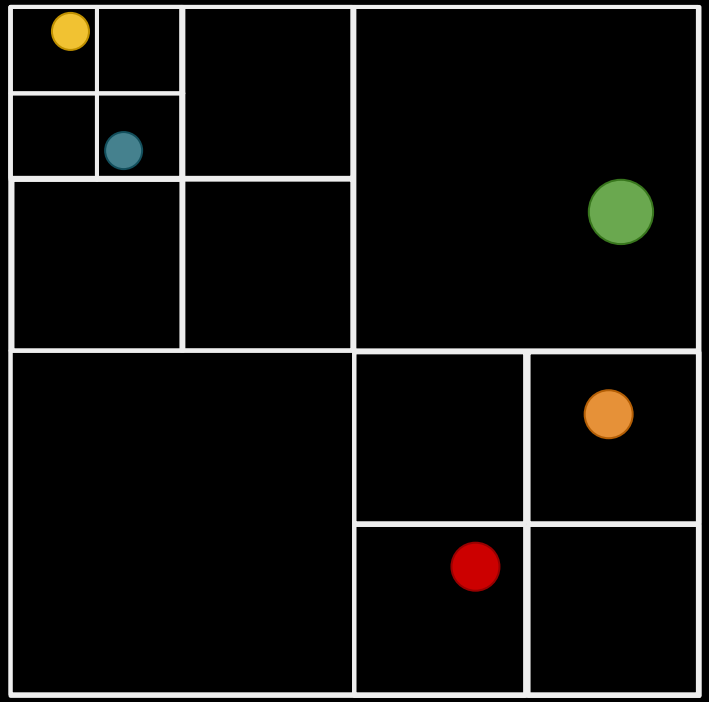


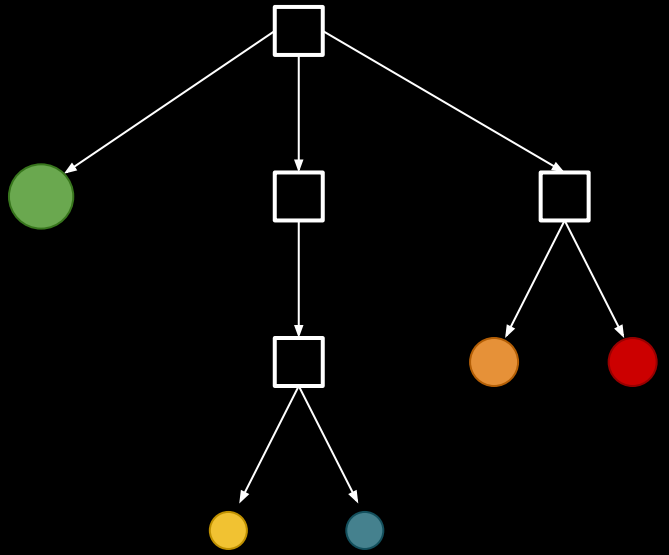
Applying changes



The Barnes-Hut algorithm

Tree building

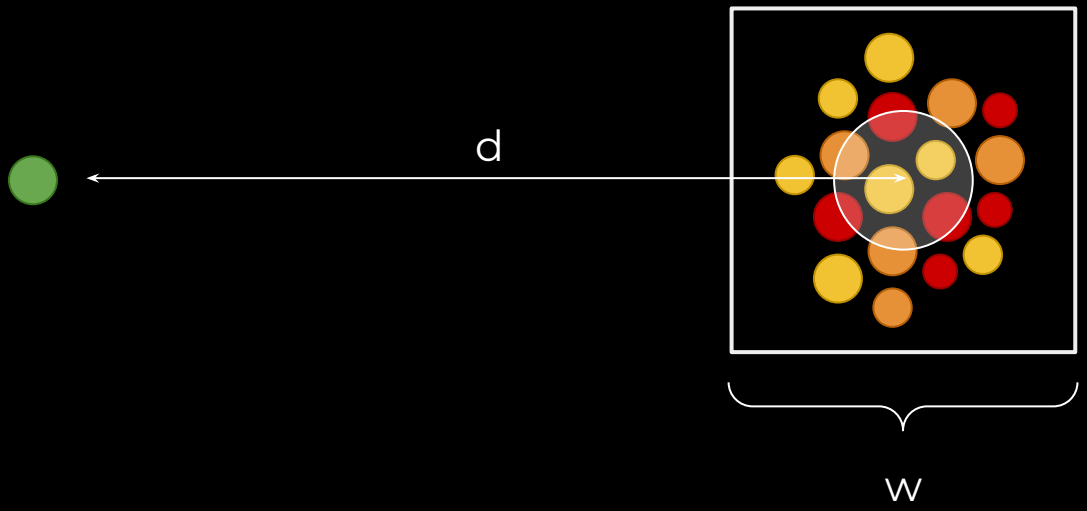




O(nlogn) complexity*

The Barnes-Hut algorithm

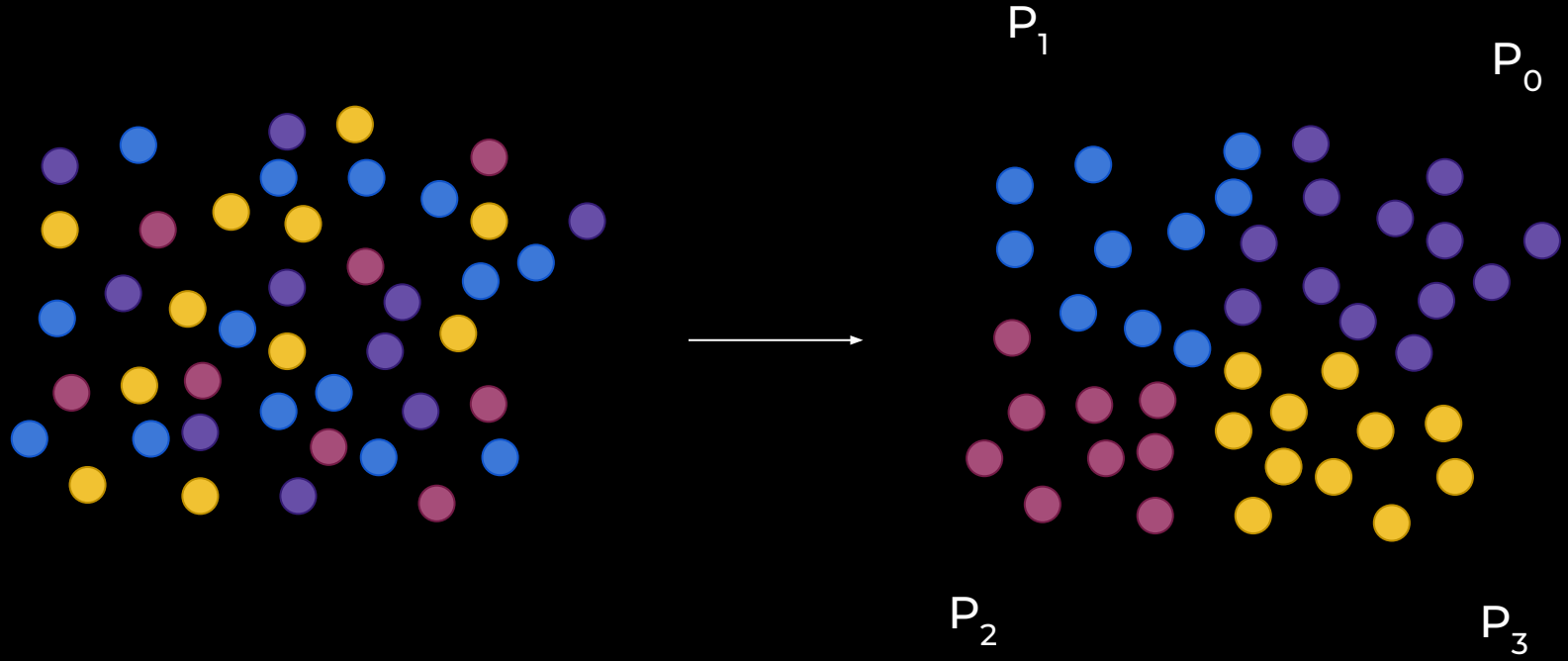
Force Calculation



$$\frac{w}{d} < \theta$$

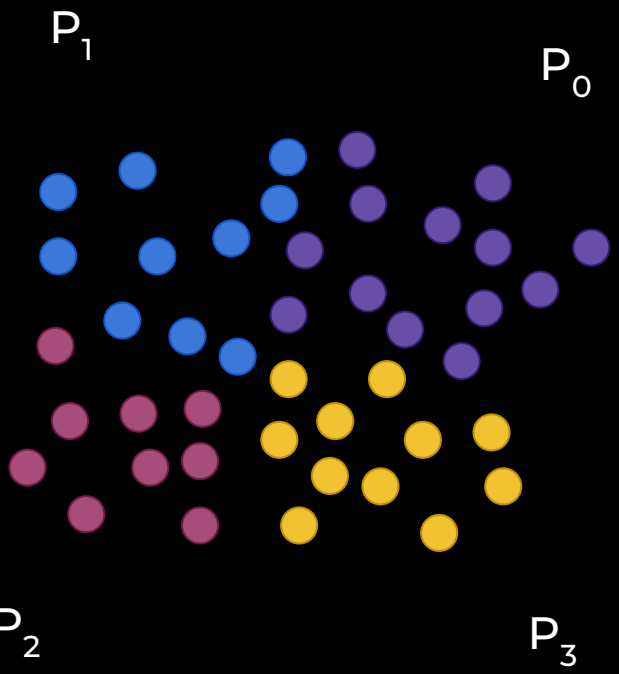
Parallelizing the algorithm

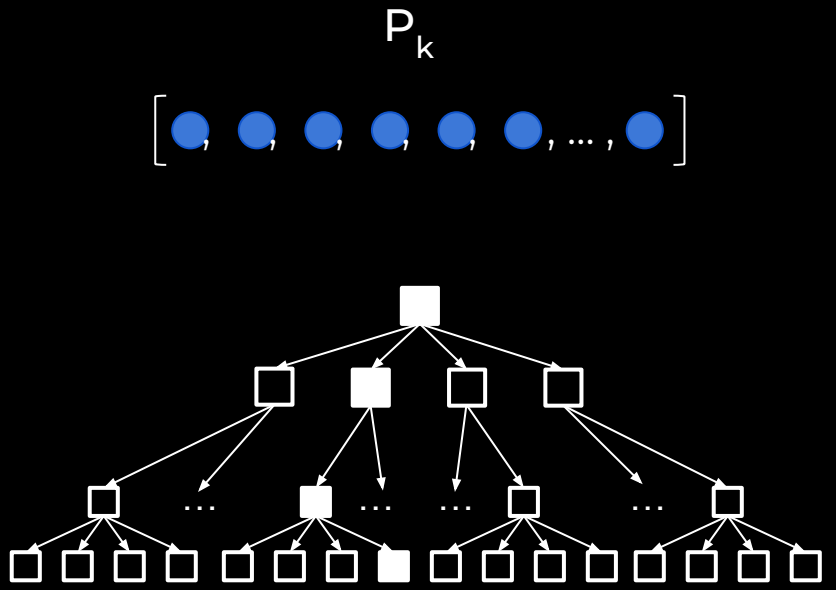
Partitioning the domain



Parallelizing the algorithm

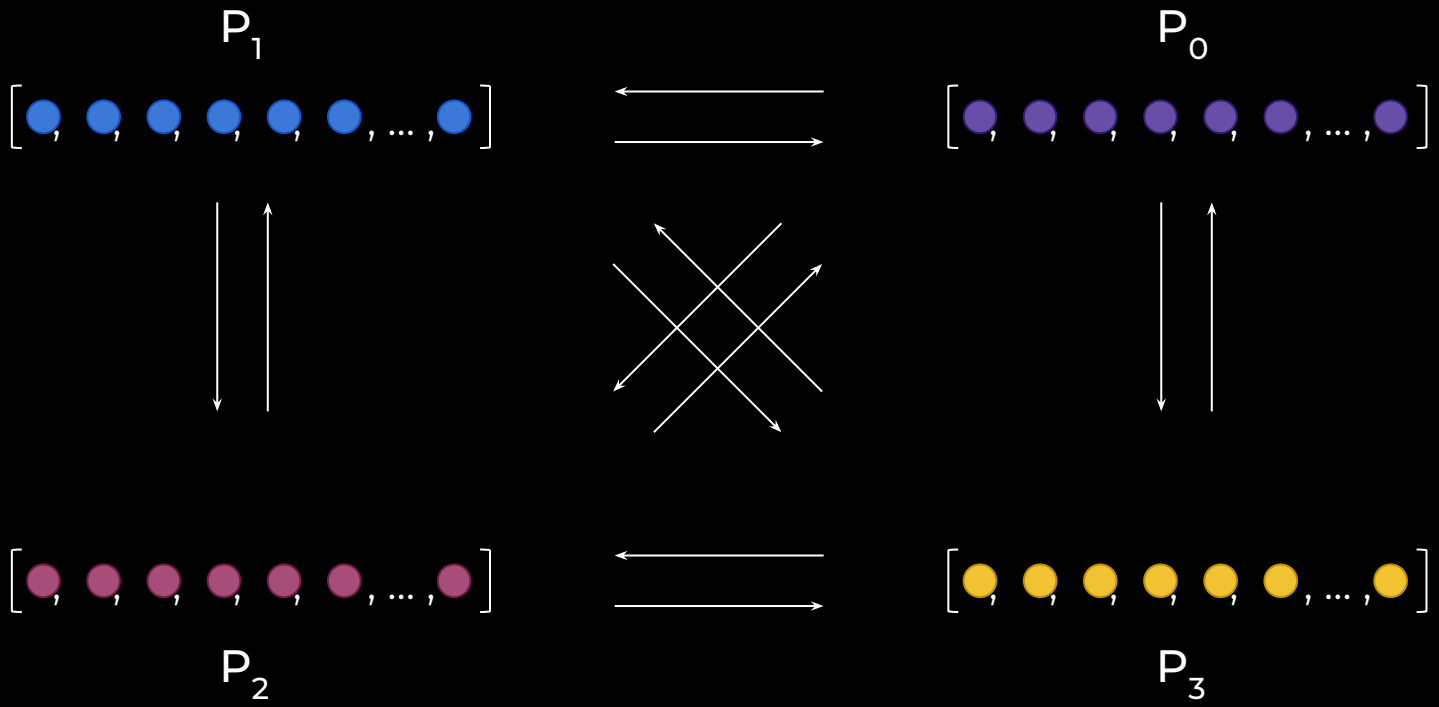
Force calculation





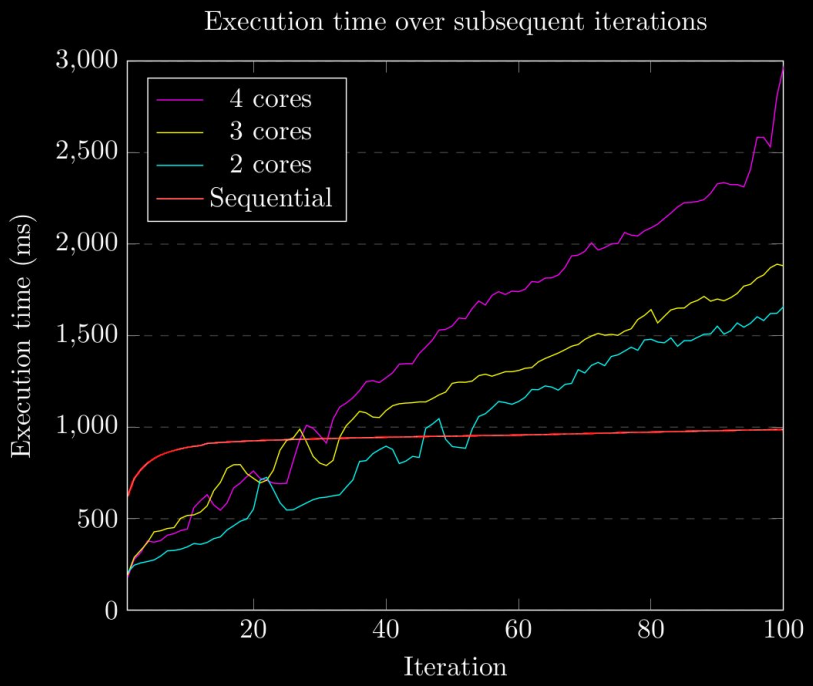
Parallelizing the algorithm

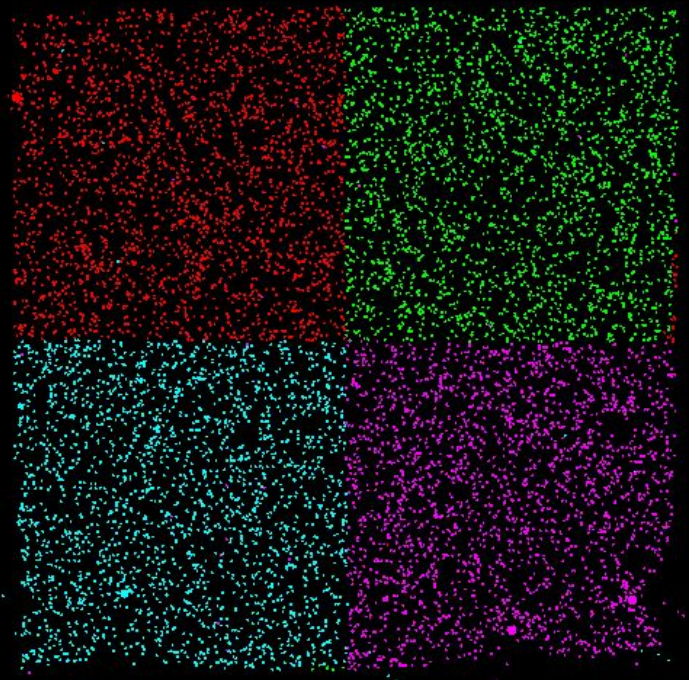
Message exchange



Results

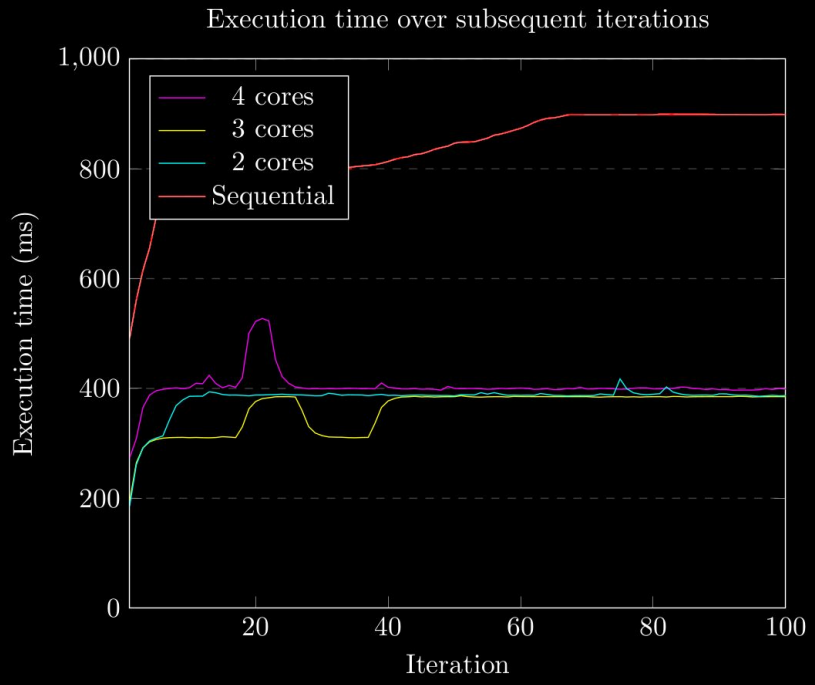
Uniformly distributed particle space

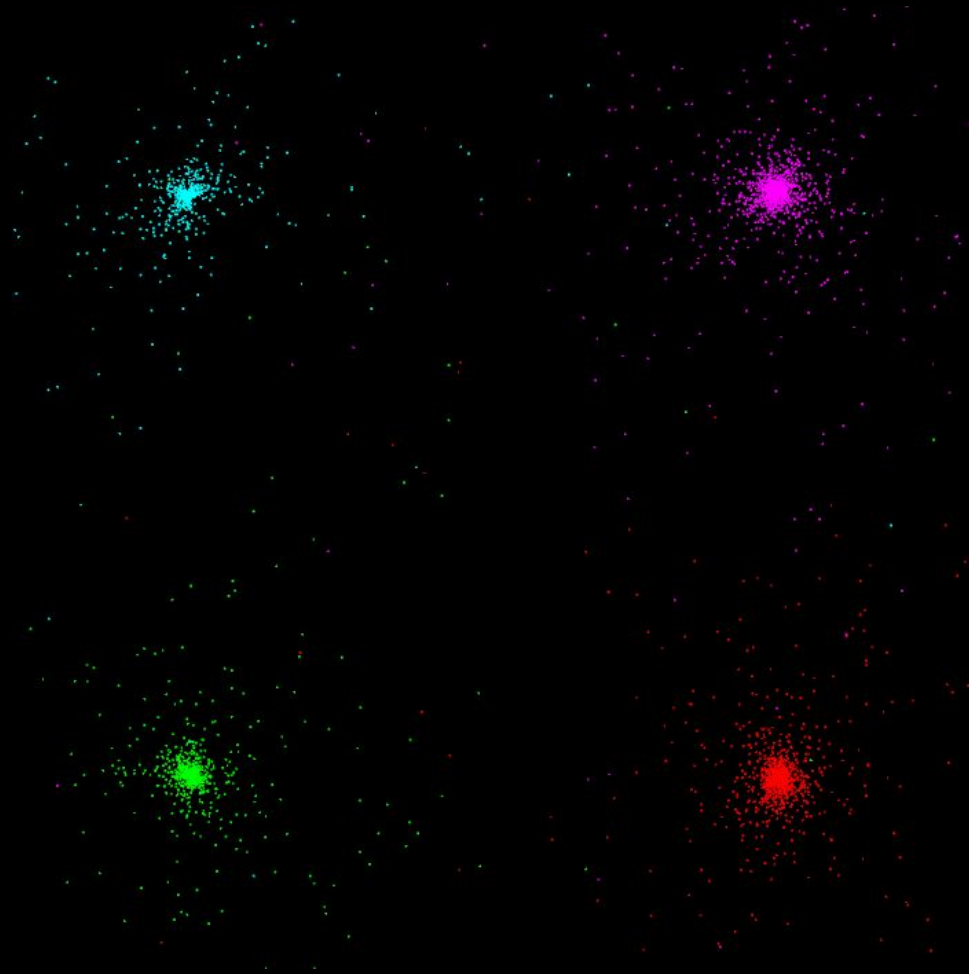




Results

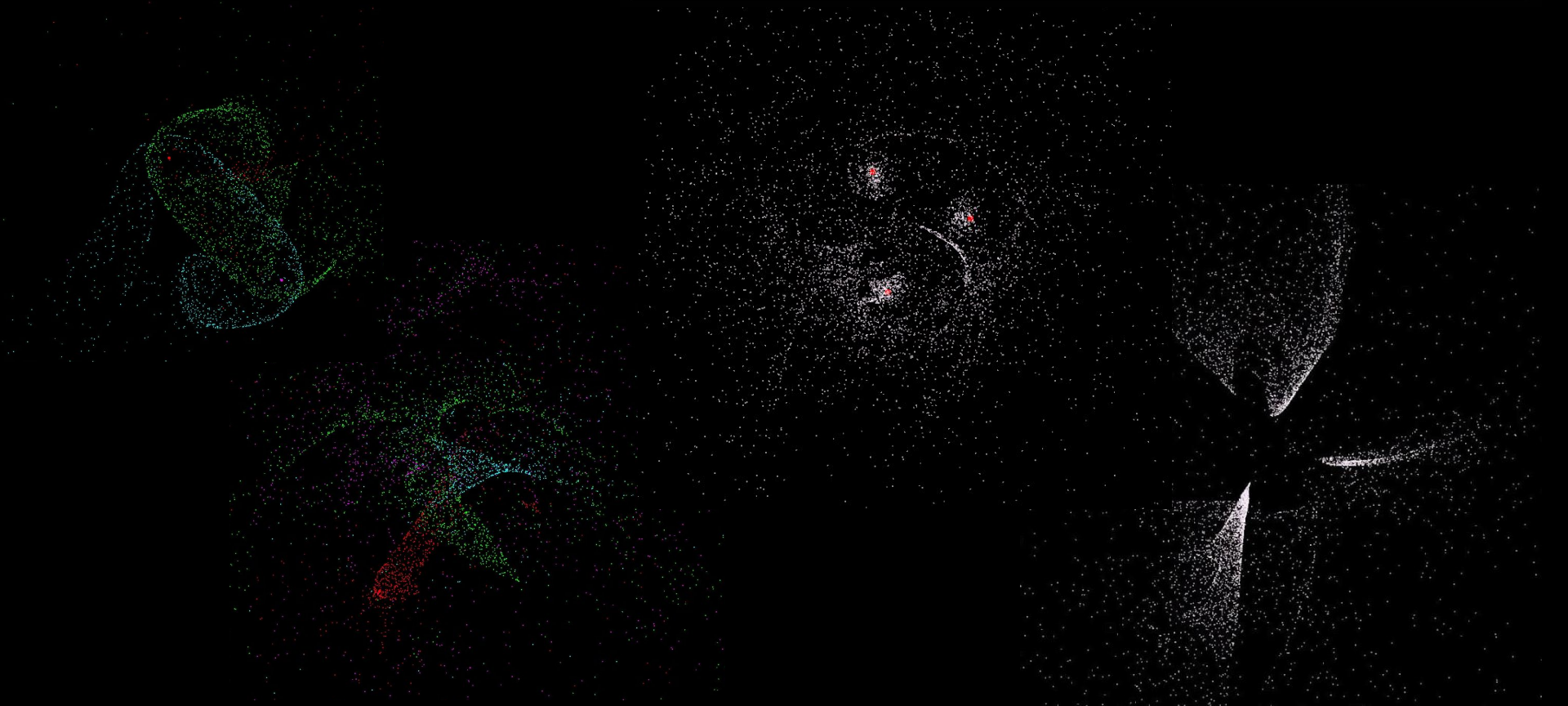
Clustered distribution





Conclusion

# Points	# Iterations	Sequential	4 cores	4 cores optimized
10,000	1000	71.2 ms	47.8 ms	40.05 ms
100,000	1000	898 ms	445 ms	347 ms
1,000,000	25	12.1 s	4.47 s	4.02 s




Thank you for your attention!