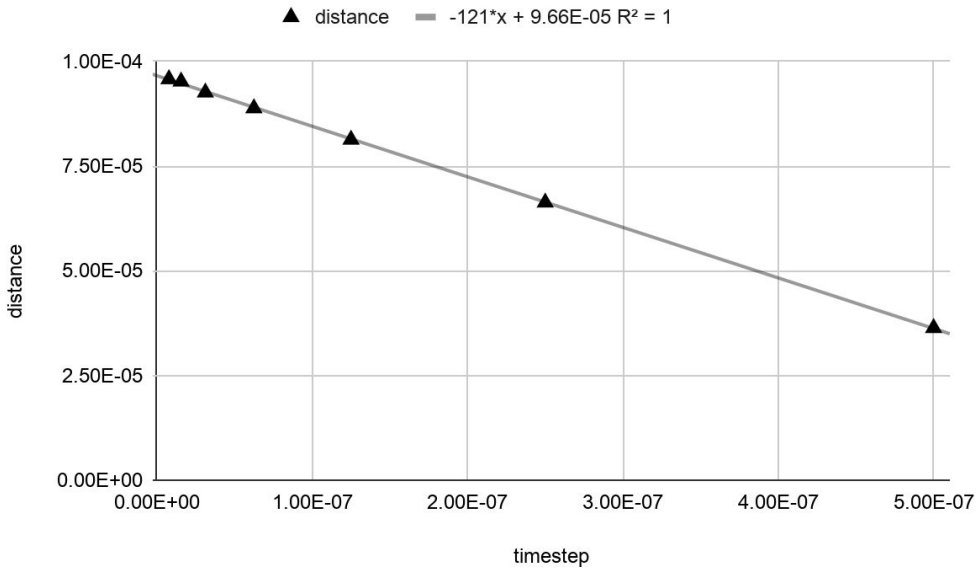
Step 2 Report

Our collision detector works as follows: for each particle i, we check the distance between it and another particle (from $j = i + 1...n$). If the distance between itself and the other particle <= 0.01, then we merge them appropriately while also updating their positions similarly to the velocity update:

$$x = \frac{m_i}{m_i+m_j}x_i + \frac{m_j}{m_i+m_j}x_j$$

To experimentally measure the convergence order, we measured $|y_h - y_{h/2^k}|$ for $k \in \{2, 3, ...8\}$ and $h = 1 \times 10^{-6}$. We define $|y_1 - y_2|$ as the distance between the first points plus the distance between the second points. For the 3 body problem in the assignment:



As shown in the diagram above, the convergence order is linear - $O(h)$, because the difference between the original solution and the 'better' solution decreases linearly with h. This is consistent with the fact that analytically, Explicit Euler is $O(h)$ as well. To confirm this we measured the convergence order directly for a setup with particles at (-1,0,0) and (1,0,0) (we would expect the collision points to be at (-0.005, 0, 0) and (0.005, 0, 0)):