

Ph22 Lab4

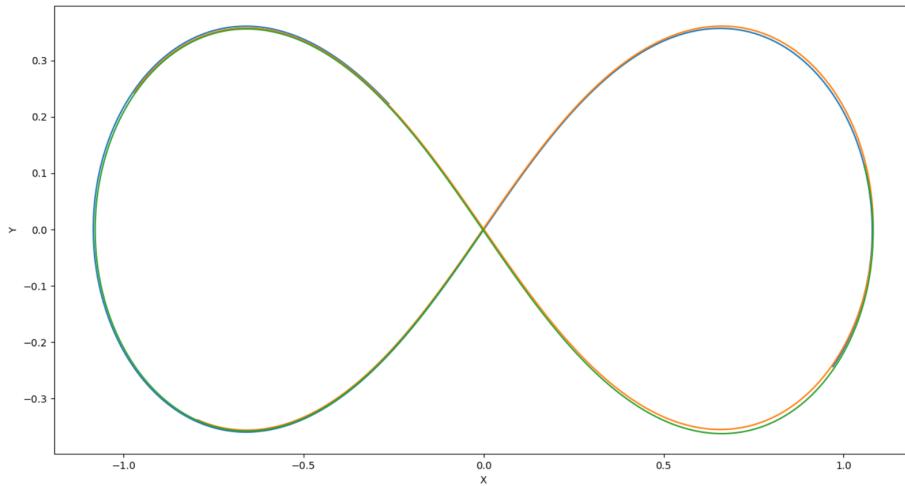
Samir Johnson

May 2020

1 N-Body Simulation

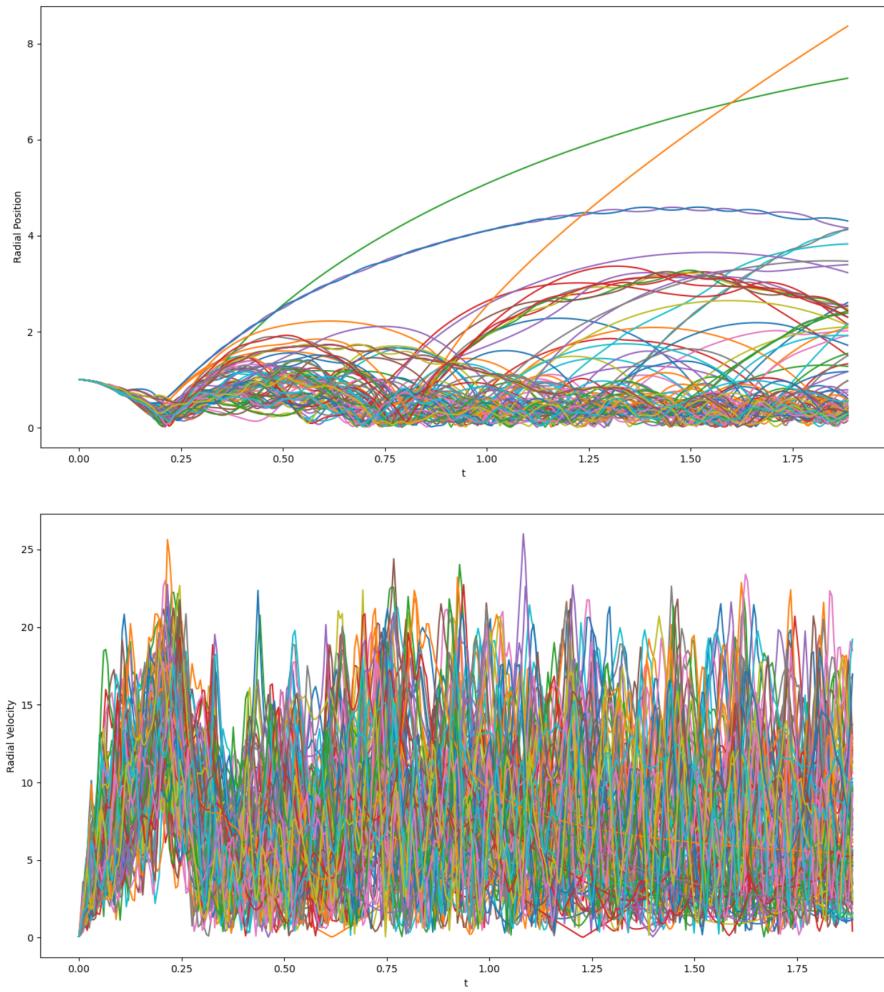
1.1 Testing on Figure 8 Orbit

We test the N-body simulation on the 3-body figure 8 orbit with initial conditions specified in the previous lab. The following is the output:



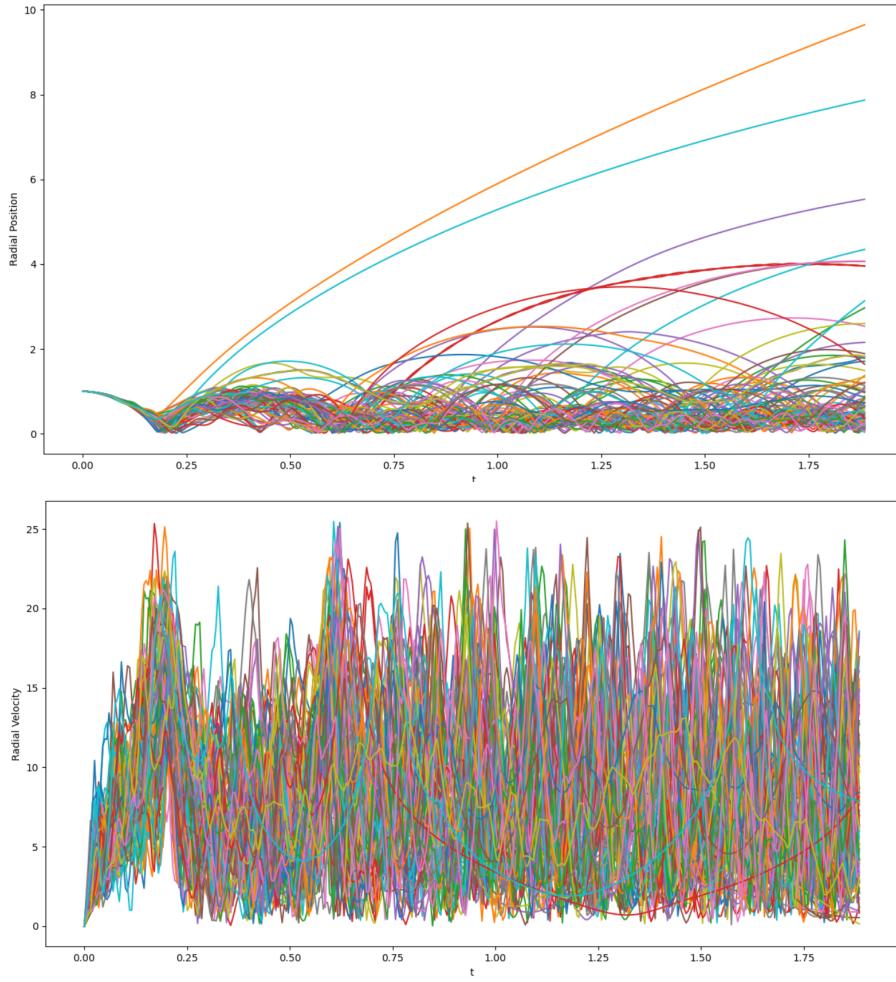
1.2 100 Body Simulation: $v_0 = 0.1$

We run the simulation for $N = 100$ with unit masses and unit G spread randomly across the unit circle in the x-y plane. Initial velocities were given random directions with magnitude $v_0 = 0.1$, and the simulation was run for $3t_{orb}$ with $\Delta t = 0.005$. The other parameters used were specified in the lab notes. The radial position and radial velocity versus time plots are shown below.



1.3 100 Body Simulation: $v_0 = 0$

We run the simulation with the same exact parameters and randomly generated positions on the unit circle, except now with zero initial velocity. We notice more clustering around the center of mass. The following are the radial position and radial velocity versus time plots.

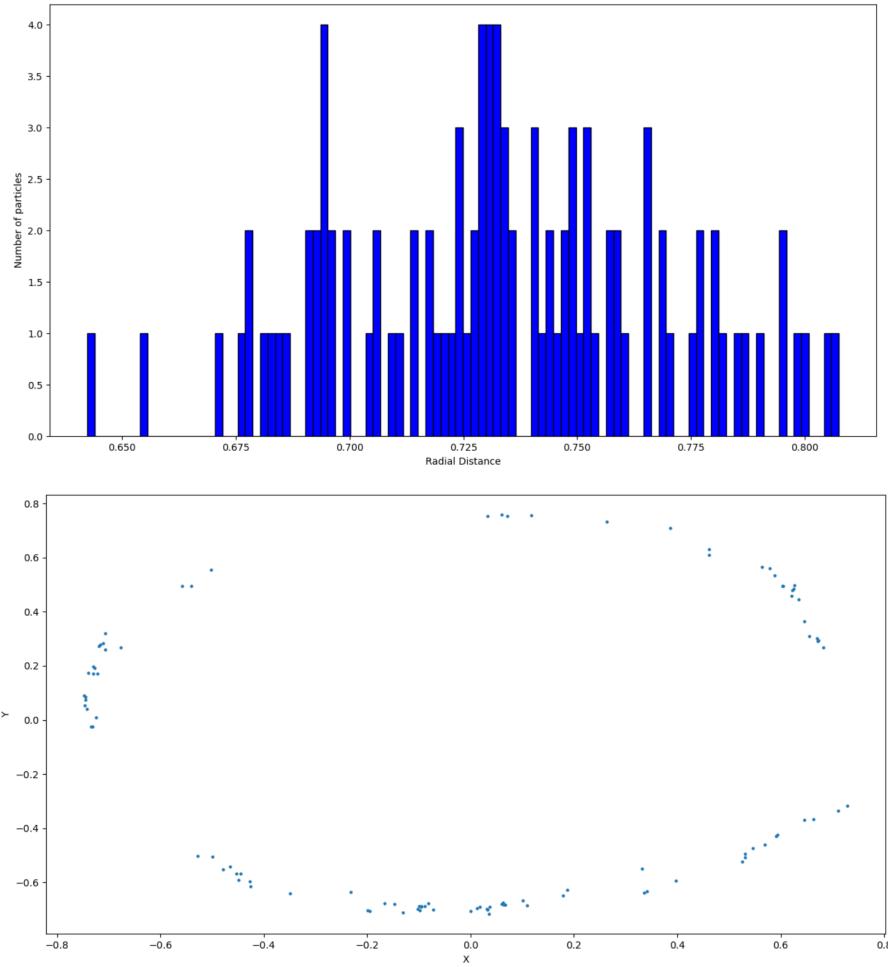


1.4 100-Body Simulation: Radial Distribution and Scatter Plots

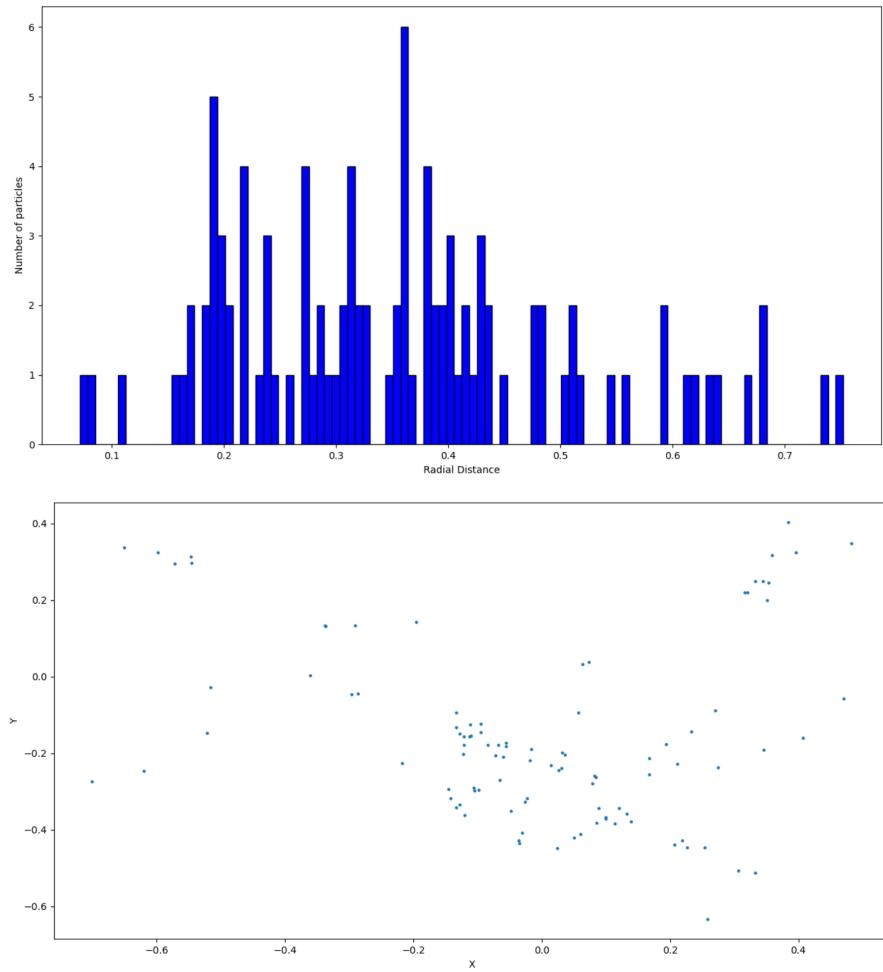
Below are plots of the distribution of radial position and plots of position in x-y plane for the bodies at times $\frac{1}{2}t_{relax}$, t_{relax} , $\frac{3}{2}t_{relax}$, $2t_{relax}$, where

$$t_{relax} \equiv \frac{N}{10 \log(N)} \sqrt{\frac{R^3}{GM}} \approx 0.217$$

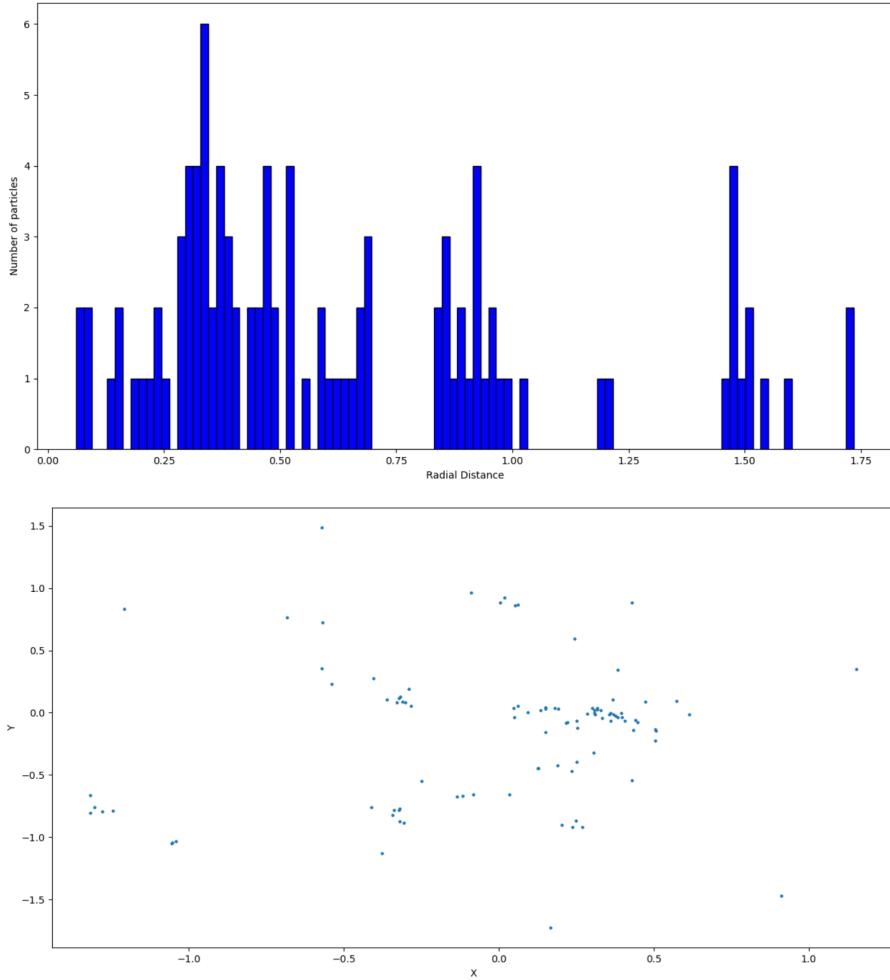
$$t = \frac{1}{2}t_{relax}$$



$t = t_{relax}$



$$t = \frac{3}{2} t_{relax}$$



$t = 2t_{relax}$

