Homework 4 Write-up

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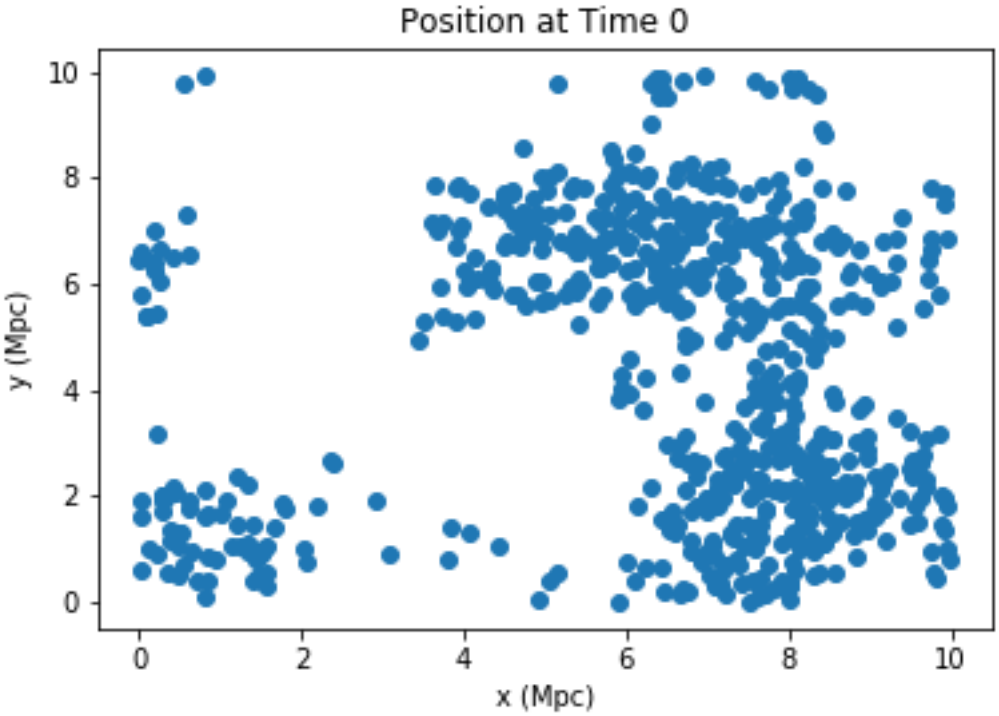
1 question 1

To begin, the whole area that the data is in will have a box created around it and as every new point is read in the area is divided up into more boxes. As every new point is added the boxes divide more to ensure that each point is the only point in ever box. I wrote the NodeClass code to calculate these boxes and the acceleration of each of these points on each other using the Barnes Hut algorithm. In the main code there is a function that is a simplistic integration method that calculates the the next position of the points (galaxies) based on the current position and the gravitational acceleration that is calculated through the NodeClass_BarnesHut.py. My code should loop through a certain number of iterations each time calculating the acceleration of each galaxy and take the previous and current position and send them through the verlet function and to get the new position of each point. These new points become the current position and the current becomes the previous and the whole thing loops until the the loop runs out of iterations run out. The new position of all of the points should be able to print out in the same way the initial points do like this:



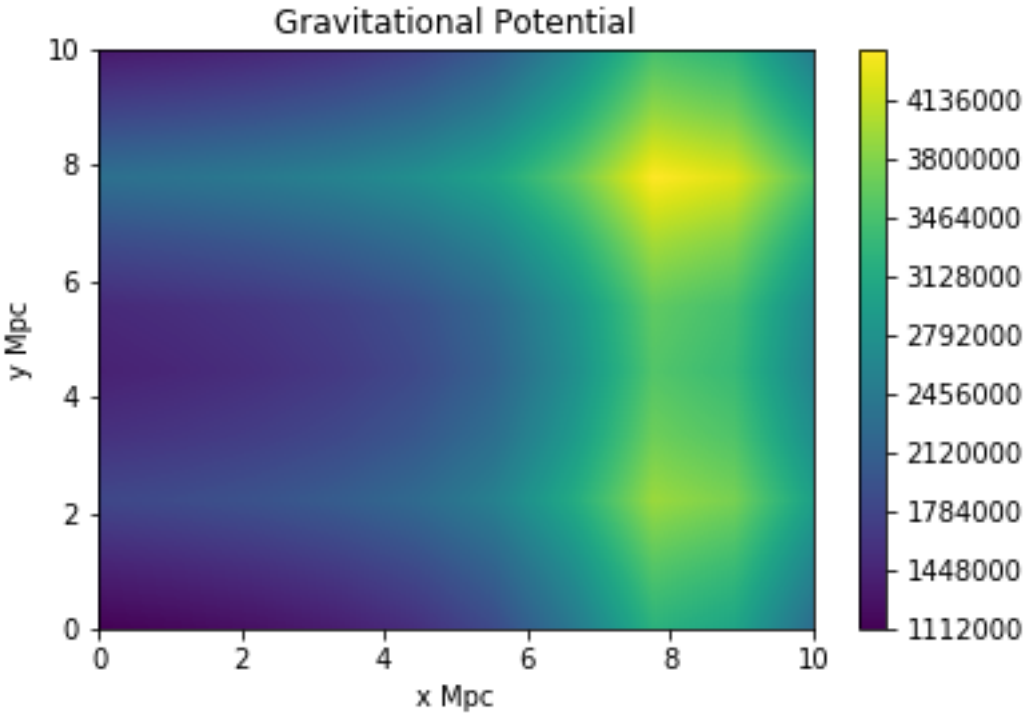
My code runs into an error where is wont take the slice of positions of the current or previous when I try to run it through the verlet function. It works to call gal0[:,0] but when I rename gal0 to prev and run it through the function and call it x0 = points0[:,0] then it get caught up and I'm not sure how to fix it. From my understanding and without getting the results of the code to produce, it seems to follow the correct thinking or at least it makes sense to me. There could be potentially other problems that I haven't seen yet but the general ideas that I have should work.

2 question2

Taking all of the galaxies in the clusters and putting them all in two different clusters, one with 400 and the other with 255 centered at (7,7) and (8,2). My code starts with a function that will calculate the gravitational potential of each cluster using the Plummer model.

$$\phi = \frac{-GM}{\sqrt{r^2 + a^2}} \tag{1}$$

Where G is the gravitational constant and M is the total Mass of the cluster and r is radius or the distance away from the center point and a is the Plummer radius which is a scale parameter that sets the size of the cluster core. I've set this to 1. The resulting contour plot looks like:



I know that this isn't quite right because one of the clusters isn't even sitting at (7,7). I'm not sure why its at (8,8) instead and there seems to be high values that stream out of the area its meant to be in like a cross and the clusters aren't really circular either. I think I might have missed something in the equation for the plummer model. I tried to add volume to the total mass but the (8,2) cluster disappears and the the other still stays at (8,8). I think there must be some boundary conditions that need to be applied but I'm not sure where exactly they need to go. The value of the potentials also seems smaller then it should be by a few factors.