Lab 8 Report
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Computational Physics

Part 1

I did this part of the lab last, so I used my walker class to generate the coordinates. For each value of the number of steps taken I created 10 walks then averaged the results for the plots. The average displacement vectors are plotted in vector_plot.pdf, each of the points represents the endpoint of the average displacement vector for a given number of steps. The average displacement vectors remain near zero as expected. The average distance of the walker from the origin is plotted in distance_plot.pdf. The mean distance seems to remain constant once the number of steps has reached a certain value. This is unexpected, but I think this reflects the fact that (once the walker has made enough steps) the average distance between it and the origin is a characteristic of the transition matrix and not the number of steps.

Part 2

The clusters are listed under FractalPlot_typeNumber_runNumber.pdf. Type1 corresponds to the symmetric walk, these clusters accumulate branches in every direction evenly since the transition probability from one cell to another only depends upon the distance between the two cells. Type 2 clusters are for the biased random walk, these grow in a preferred direction because it is more likely for the walker to transition to one direction than the other (so the walkers are more likely to be found on a particular side of the cluster). Type 3 clusters are for the walk with different step sizes, these plots have extended dimensions in the direction of the longer jump. I would guess that the Type 3 clusters have that shape because most of the walker motion should be in the x-direction, so that they are more likely to be added from the side.

Part 3

I found the fractal dimension for the five type 1 clusters I produced for part 2. The mean dimension of these clusters is 1.702. The plots of $\log(\rho)$ vs $\log(r)$ are under typeNumber_runNumber_dim.pdf.