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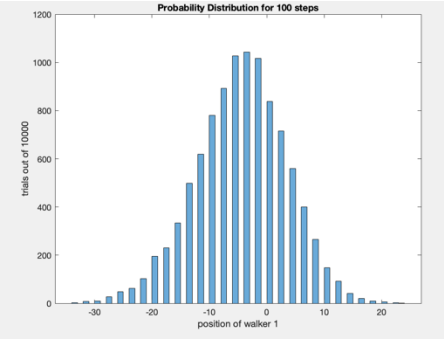
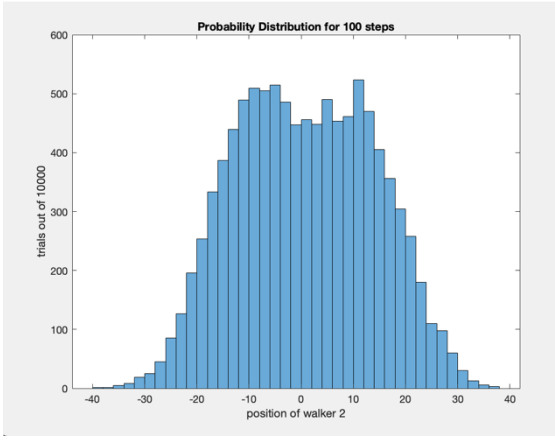
Problem 2

A) The histogram in janeczko_problem2a.m plots the probability distribution of the final position of the bottom particle in a set of 3 particles after 100 steps for 10000 trial runs. The histogram is not symmetric because unlike the particle in temple_abm_random_walk_1d.m, this particle's random behavior has new rules for the steps it can take: its steps are dependent on the randomly-determined steps of the other two particles. Even though otherwise it has a 50% chance of stepping up or down, its new rules are that the particles cannot cross paths or share a space at any step. So, it is obvious that the particle tends to end up in negative positions more often despite beginning at 0, because it is being "pushed downward" by the middle particle (since it cannot cross its path), and thus the distribution is not centered around 0. This distribution ranges from about -40 to about 30. Its shape is unimodal and it seems that [-1,-3] is the bin with the peak.



B) This histogram in janeczko_problem2b.m is not symmetric. Its behavior is dependent on the behavior of the two surrounding particles. It has a 50% chance of going either up or down if it is exactly between the two agents but only an extra 10% of going towards the agent it's closer to if that is the case. Usually the particle will stay close to the top particle or the bottom, and sometimes it'll be closer to the middle. In an individual trial, it tends to "follow" the particle closest to it (with a 60% chance it steps in the direction of the particle closest to it), and so it tends to end up either in a positive or negative ending position, and so after many trials, this will average out to 0, so that is why the U-shape occurring in the middle of the graph around position 0 makes sense. It looks like a bimodal distribution. The middle particle's distribution ranges from about -40 to about 40.



C) There are a couple qualitative differences between these three histograms. As far as what is the same, they are all centered at 0 and are multimodal. The figure for 10 steps has about 3 obviously separate peaks, for 40 steps has about 5 peaks but the peaks and valleys are closer together, and for 160 steps seems to be coming together into one peak. It looks like as the value for number of steps per trial increases, the amount of peaks increase and becomes closer together, but also the heigh difference between the high and low parts of the histogram decreases. It looks like as the samples, or steps,

increase, the distribution tends toward looking like a normal distribution. This has to do with the central limit theorem which says that “when independent random variables are summed up, their properly normalized sum tends toward a normal distribution even if the original variables themselves are not normally distributed” (wikipedia.org).