Random Walk Simulation Project

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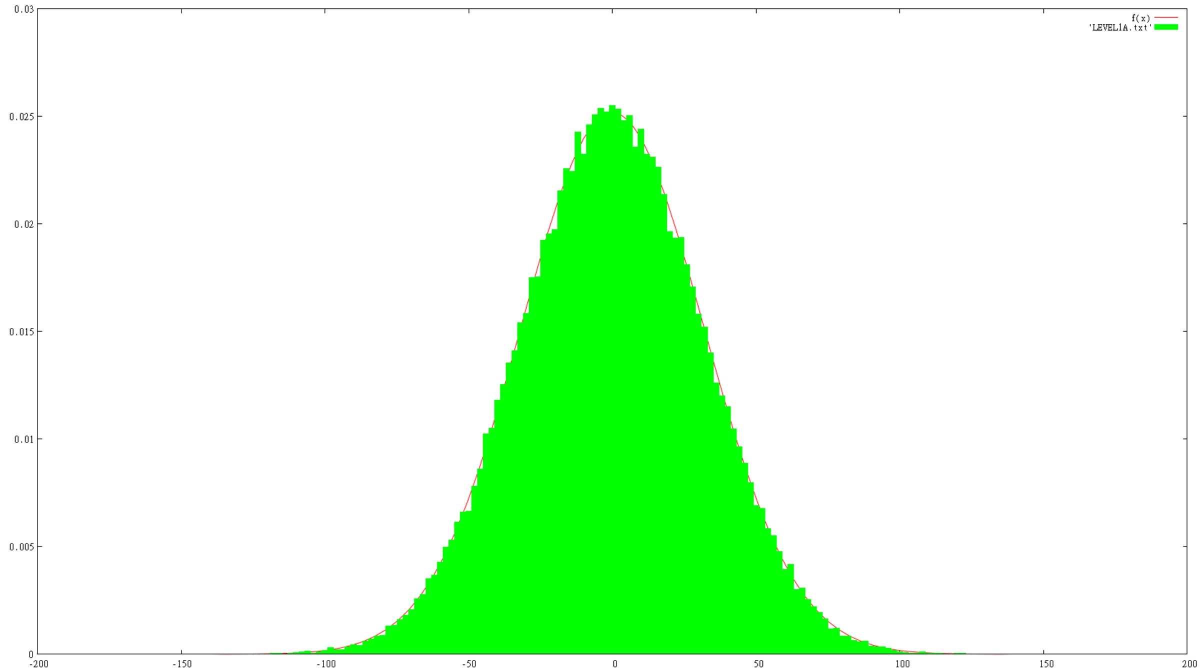
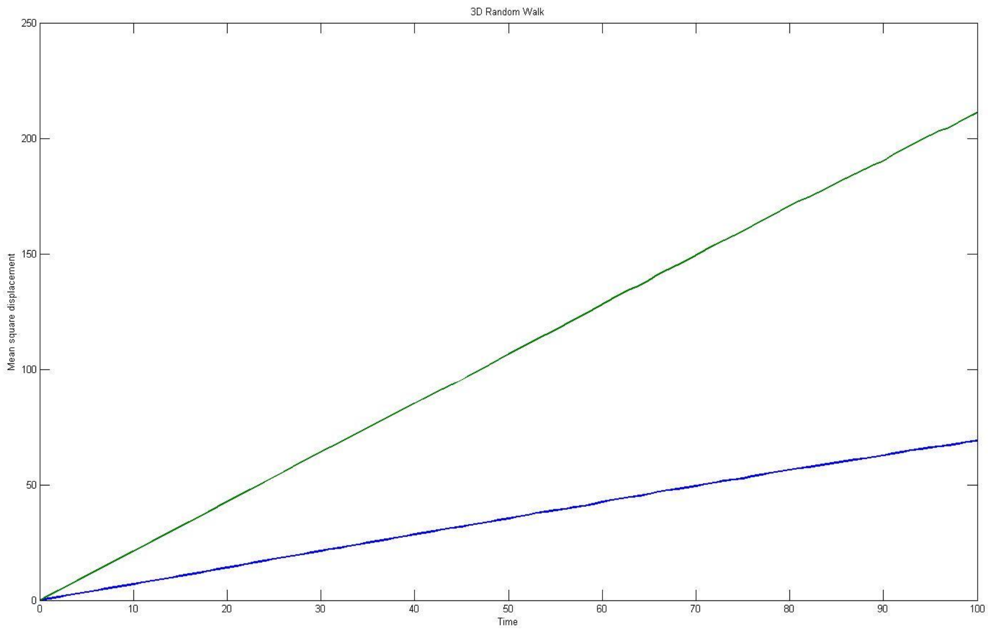
Level 0:

A one dimensional random walk with equal probabilities of moving left or right. A histogram was obtained by plotting position versus frequency of landing up on that position.
The plot was as expected, a Gaussian and it was fitted to the standard form. Evidently there is maximum probability of a random walker of such nature to land up where he started from.(In this case lattice point 0)



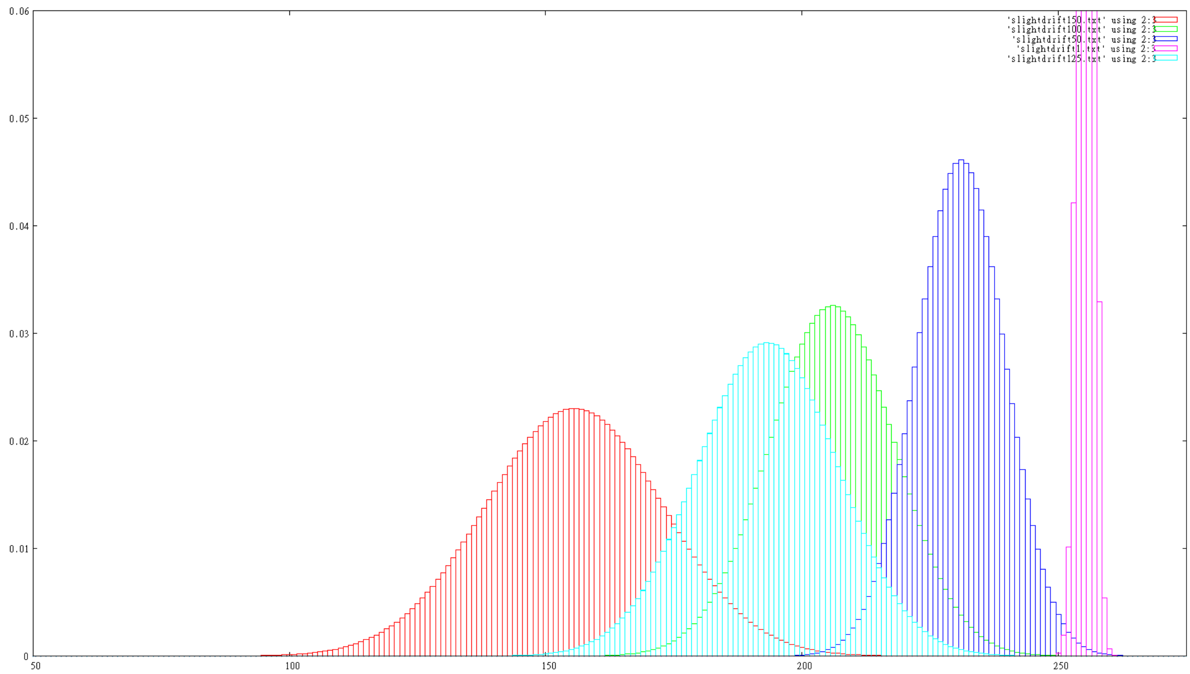
This particular plot is for 1000 steps and 10^5 walks.



This is the plot for mean square displacement versus time for a 3 dimensional random walk with 14 possible steps, each of equal probability and being spherically symmetrical.
The blue line represents mean square displacement in 1 dimension while the green line represents the mean square displacement in 3 dimensional space. The plot turns out as expected i.e. <n^2> is directly proportional to time. Also the mean square displacement in one dimension is exactly one third of the value of the mean square displacement in the three combined dimensions.

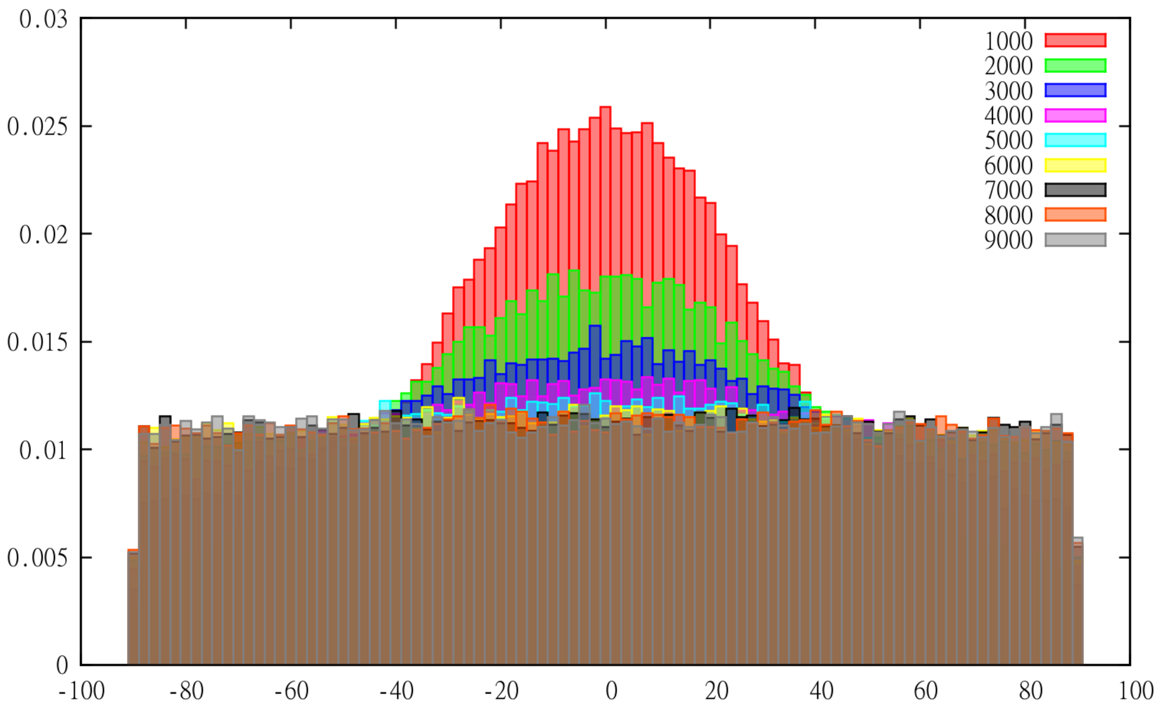
Level 1

First, multiple plots are obtained for a differential equation with diffusion constant =1 and drift velocity= 0.5.
The initial condition was provided that the probability function is a delta function with value 1 at lattice point 256. As can be observed from the graph below that the histogram tends to spread out and the point with maximum probability starts drifting with exactly the drift velocity. Also if one were to join the peaks of the histograms one would obtain an exponential decay curve, which signifies that it becomes less probable with time that the random walker would be at the lattice point with maximum probability.



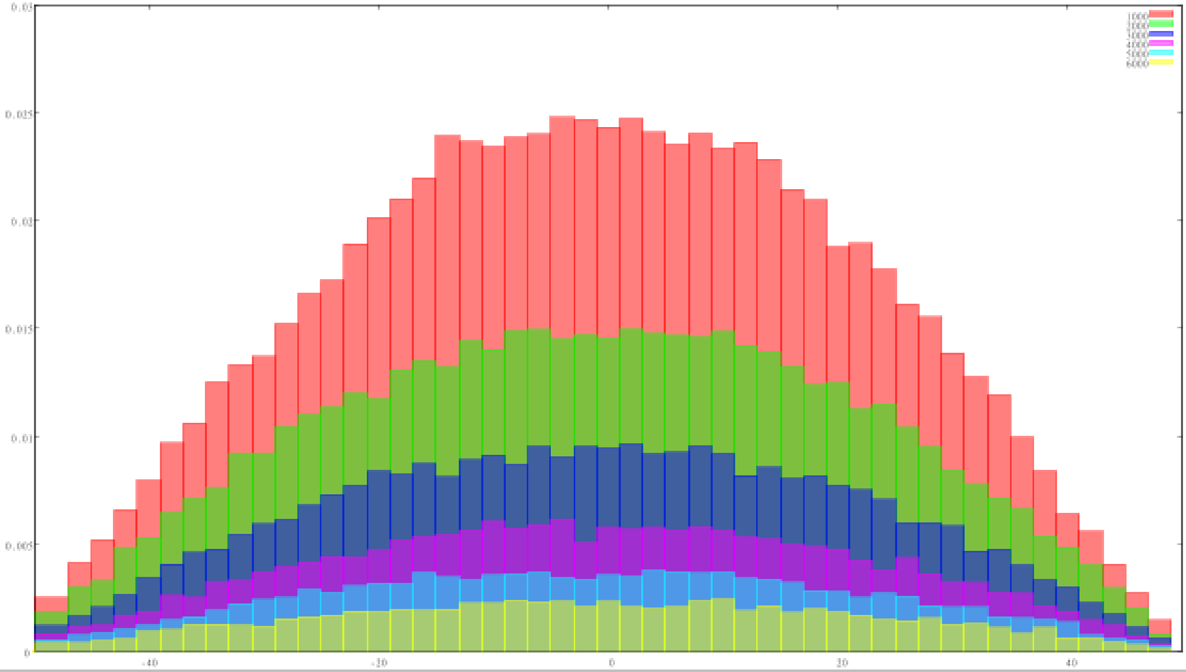
The graphs are plotted for time instants = 50,100,125,150seconds from right to left.

The next step was to plug in reflecting walls at lattice points symmetric about the origin and vary the number of steps and watch the form of the histogram change. As the number of steps becomes sufficiently large the distribution tends to become flat and also one observes the mean square distance rises initially then becomes constant.



This particular graph is plotted for steps in multiples of thousands up till 9000 steps and the reflecting walls are placed at 90,-90.

The next experiment was to put partially absorbing barrier on one side and an absorbing barrier on the other side. One observes that the histogram becomes flatter and flatter as the number of steps increase and the mean square displacement decreases rapidly and starts going to zero as number of steps tends to infinity.



This particular plot was obtained for a partially absorbing wall at -50 and absorbing wall at 50.The probability of absorption at the partially absorbing wall was 20% and hence the histogram tends to have higher values around -50 than it has at 50. It’s because at lattice position 50 the walk ends while at -50 there’s only a 20% chance that it will end so the histogram resembles somewhat the form of one without any absorbing barrier in the neighbourhood of -50.