

PHY220- Homework 4

Due date: April 17th, 2020

Q1. Use Monte Carlo method to compute π . Make a plot of π values in function of the number of terms N used in your Monte Carlo simulation. Make a second plot of the absolute error (difference between the most accurate known value for $\pi = 3,141592653589793 \dots$ and the approximated values you obtained by Monte Carlo) in function of number N of terms used in your simulation. Based on the results of your last plot, how does the error in the Monte Carlo method decreases with N ?

Q2. Brownian motion is the motion of a particle, such as a smoke or dust particles, in a gas, as it is buffeted by random collision with gas molecules. Make a simple computer simulation of such particles in two dimensions as follows. The particle is confined to a square grid or lattice $L \times L$ squares on a side, so that its position can be represented by two integers $i, j = 0 \dots L - 1$. It starts in the middle of the grid. On each step of the simulation, choose a random direction – up, down, left, or right – and move the particle one step in that direction. This process is called a random walk. The particle is not allowed to move outside the limits of the lattice – if it tries to do so, choose a new random direction to move in. Use $L = 101$ and choose N so that you see the trajectory of the particle in the square grid plane. In the same graphic, plot the trajectory of three particles that were initially located in the center of the grid.