

PHYS 305 - Assignment #3

Purpose: Explore sums of random variables as the limiting process to Brownian motion

Uniform random numbers

Write the code *uniform.cpp* that does the following things:

- Generate a list of 10^5 random integers over the interval $x \in [0..9]$
- Output the bin or histogram counts for each number
- Include a plot of the histogram with a labeled axis. Normalize the plot so that its integral sums to one (make it a proper probability function). Have the plot display the percent deviation for each item from the expected value.

2D random walk

Write the code *2Dwalk_traj.cpp* that does the following things:

- Generate a trajectory of length $N = 10^5$ of a random walk over a 2D grid. Start at $(0, 0)$ and take unit steps in one of the orthogonal directions (\hat{i}, \hat{j}) .
- Output and plot this trajectory.

Write the code *2Dwalk_displacement.cpp* that does the following things:

- Generate a trajectory of length N of a random walk over a 2D grid where N is input from the command line.
- Output total displacement from the initial position $\langle r \rangle$.
- Plot $\langle r \rangle$ vs. N over the interval $N = [10^1, \dots, 10^5]$ using at least 1000 different values of N . Find the best fit line to your data (quadratic, exponential, etc...).

Diffusion Limited Aggeration

Write the code *DLA.cpp* that does the following things:

- Start with a single 'seed' particle at $(0, 0)$.

- New particles enter the system on the boundary of the unit circle one at a time and follow a random walk. Each step the particle takes is in a random direction (ie. the direction is chosen uniformly at random $\theta \in [0..2\pi]$) and a magnitude dr . If at any time the particle exits the unit circle, start over with a new particle. If the particle gets within a distance dr of another seed particle the motion is over and the particle is added to the list of seeds.
- Stop the simulation when 300 seeds are found using a step size $dr = .05$.
- Plot the location of all seeds on a single graph.