Diffusion Processes on Complex Networks - Lab

Assignment 4

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1. Simulate a random walk of an agent on a square lattice. The program should take a snapshot of the lattice in every time step and save it to a jpg or png file. These files should then be used to generate a movie (avi or animated gif).

2. Write a computer program to simulate Pearson's random walk in the plane, where the steps have constant length $a = 1$ and uniformly distributed random angles. By simulating many long walks of N steps (e.g. $N = 1000$) starting from the origin, compute and plot normalized histograms (i.e. the PDFs) of A_N, the fraction of time steps when the walker is in right half plane ($x > 0$) and of B_N, the fraction of time the walker is in the first quadrant ($x > 0$, $y > 0$). The expected values are clearly $\langle A_N \rangle = \frac{1}{2}$ and $\langle B_N \rangle = \frac{1}{4}$, but what are the most probable values? Plot several trajectories to illustrate your results.

3. Write a program that...

   - will illustrate a random walk on a given graph (avi or animated gif),
   - for a given origin node will estimate average hitting times of all other nodes.

   Compare the results for graphs of different topologies. Set $N = 20$ for visualization purposes and $N = 100$ otherwise.