Homework 11 - Monte Carlo Simulations

Phys 304 - Computational Physics - Spring 2024

Due on April 26, 2024 by 11:59pm

- Newman's Problem 10.9 (56 points)
- Similarly to the Ising model, The XY model consists of spins on a lattice. However, in the XY model each spin can take on any angle θ_i between 0 and 2π . Thus, the energy is given by

  $$E = -Jcos(\theta_i - \theta_j)$$

  where J is the interaction energy that sets the scale for the energy. Code the XY model with Metropolis algorithm. Use it to simulate a system of 20 x 20 spins initially in ordered configuration ($\theta_i = 0$), for at least 10000 MonteCarlo steps with T = 0.2. Repeat with T from 0.3 to 1.5, in steps of 0.1. Monitor the energy of the system and plot it as a function of temperature. (56 points)
- Survey Question: *How long did the homework take you? What did you learn? What was the most interesting item? Was the assignment too short, too long, or just right?* (5 points)

Please follow the same submission logistics as in the previous homework. Prepare a write-up using LaTeX and submit it along with your source code file(s). Your write-up should contain a short narrative of your solution including all fundamental equations used in the exercise. Submit your files via GitHub using the homework repository.

Note: Second item is a Python implementation of
`https://www.compadre.org/stpbook/statistical-mechanics-2/ex9_3.cfm`