Introduction to Computer Simulation II

Homework 4

Due: Thursday, 08 May 2025

7. **Autocorrelations of the single-cluster algorithm for the 2D Ising model**

   Estimate for the 2D Ising model with lattice sizes $L = 8$, 16, 32, and 64 (and periodic boundary conditions) the autocorrelation times of the single-cluster algorithm at the critical point of the infinite system (e.g., by means of the binning method). Compute the rescaling to the time unit of a complete lattice sweep and compare with the corresponding results for local update algorithms from earlier homeworks.

8. **Single-cluster simulations of the susceptibility of the 2D Ising model**

   Repeat problem 2 with the single-cluster algorithm, i.e., determine again the susceptibility of the 2D Ising model

$$\chi = \beta V (\langle m^2 \rangle - \langle |m| \rangle^2)$$

   with $m = (1/V) \sum_{i=1}^{L} \sum_{j=1}^{L} s_{i,j}$, $V = L^2$ around the inverse critical temperature $\beta_c = \ln(1 + \sqrt{2})/2 = 0.440\,686\ldots$. Consider as in problem 2 square lattices of linear extent $L = 8, 16, 32$, and 64 with periodic boundary conditions. Determine again the maxima of χ and test the finite-size scaling ansatz $\chi_{\max} \propto L^{\gamma/\nu}$. Compare your current results with the single-cluster algorithm with those of problem 2 (with local updates).