Prof. Dr. Wolfhard Janke, Fabio Müller SS2025

Introduction to Computer Simulation II

Homework 3

Due: Sunday, 04 May 2025

5. **Single-cluster simulations of the Binder parameter for the 2D Ising model**

   Repeat problem 1 by means of single-cluster simulations, that is determine the Binder parameter U around the critical temperature T_c for square lattices of extent $L = 8, 16, 32$, and 64 with periodic boundary conditions.

   Calculate now also the slopes $dU/d\beta$ and plot the values at T_c as function of the lattice size L in a log-log plot.

   Optional: Due to the strongly reduced "critical slowing down" of the single-cluster algorithm, it now possible to simulate also the $L = 128$ lattice in relatively short time with reasonable accuracy.

6. **Single-cluster algorithm for the 2D Potts model**

   Generalize your computer code for the (nonlocal) Wolff single-cluster algorithm of problem 4 for the 2D Ising model to the 2D q-state Potts model. Test your program for $q = 3$ and small lattice sizes ($L = 4$, 8, and 16) at the critical point of the infinite system [$\beta_c = \ln(1 + \sqrt{q})$]. Determine in particular the energy and specific heat.