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Introduction to Computer Simulation II

Homework 09

Due: Monday, 23 June 2025

17. **Multiple-histogram reweighting**

    Write a computer program for multiple-histogram reweighting, the so-called "Weighted Histogram Analysis Method (WHAM)", and test it for the 2D 16^2 Ising model with the three simulation points $\beta_1 = 0.375$, $\beta_0 = \beta_c = \ln(1+\sqrt{2})/2 \approx 0.440\,686\,79\ldots$, $\beta_2 = 0.475$ (cp. problem 22 of Computer Simulation I).

18. **Master plot for the susceptibility**

    Determine the susceptibility χ of the 2D Ising model on lattices of size 16×16, 32×32, 64×64, and 128×128 for 31 inverse temperatures β in the high-temperature phase in the range $0.85\beta_c, \ldots, \beta_c$ close to the critical point at β_c analogously to problem 16. Plot these data

    i) as function of β and then

    ii) in a log-log plot as function of $b \equiv 1 - \beta/\beta_c$. Here it does make sense to compare with $b^{-7/4}$. Finally

    iii) generate the Master plot of $\chi L^{-\gamma/\nu}$ as function of the scaling variable $x = (1-\beta/\beta_c)L^{1/\nu}$ in a log-log representation. Use for this illustration of the scaling property the exact critical exponents of the 2D Ising model $\nu = 1$ and $\gamma = 7/4$ and compare with $x^{-7/4}$.