Project Problems

Numerical methods to study critical phenomena

Problem A

- Write a Wolff-cluster update code for the $q = 3$ Potts model in square lattices. Determine the probability of the site addition to the cluster, first.

$$H = -\sum_{\langle i,j \rangle} \delta_{s_i, s_j} \quad \text{where} \quad s_i \in \{0,1,2\}$$

- Compute the specific heat at $T = 1$. Estimate its error bar using at least two methods and compare them.

- (option) Find the critical point and estimate the critical exponents α and ν.

Problem B

- Write a Monte-Carlo code for the ferromagnetic Ising model in **triangular lattices**.

- Implement the binning analysis to compute the autocorrelation time for the order parameter $\frac{1}{N}\left|\sum_i s_i\right|$.

- At the exact $T_c/J = 4/\ln 3$, estimate the dynamical scaling exponent z and (optionally) see how it distinguishes between the single-spin update and Wolff cluster update schemes.