2D ISING square and triangular lattices

Consider a **2-D Ising model with only nearest-neighbor inte**raction but with the possibility of altering the sign of the interaction, i.e. making it ferromagnetic or antiferromagnetic.

Consider the **square** (already done in class; use this case to test your codes) and **triangular** lattice. Consider the temperature in UNITS of INTERACTION. Use periodic boundary conditions.

1) Simulations of the ferromagnetic case

For each lattice, perform Metropolis MC simulations for numerous temperatures and plot E, M, c_v, χ versus T. Determine the approximate transition temperature T_c. Show a snapshot of the spin lattices at the critical temperatures.

Hint: a) A plot of E vs. T is not enough to have an estimate of T_c for some lattices. Why?

b) For each type of lattice, you should consider a few increasing sizes L of the simulation box. (use at least L= 4, 8, 15, 16, 32)

2) Simulations of the antiferromagnetic case

For this case, consider only the square and the triangular lattice.

What happens between odd and even values of L? (e.g., what do you see using L= 4, 8, 15, 16, 32 ?)

3) Calculations of the spatial correlation function.

For the square lattice only, calculate the correlation function in dependence of the distance r to the spin spin(0) , i.e.:

$$G_{spin}(r) = < spin(r)spin(0) > - < spin >^2$$

Calculate it for the critical temperature and for a few temperatures below and above it. How does it looks like?

At the critical temperature you should be able to fit it with a decreasing exponential, and find the correlation length. How much is it? Are you able to estimate the correlation length also at other temperatures?