Homework 6

Ising spin glass with genetic algorithm Responsible: Levente Rózsa

Consider an $N \times N$ square lattice with periodic boundary conditions and the Hamiltonian

$$H = - \sum_{<i,j>} J_{ij} s_i s_j.$$

The summation goes over the nearest neighbour pairs. The J_{ij} coupling coefficients are randomized at the start of the simulation by setting them to ± 1 with probability 0.5. The $s_i = \pm 1$ variables represent the Ising spins at the lattice points. Determine the approximate ground state energy per lattice point in the system by using a genetic algorithm, with the set of s_i values on the lattice as the genetic code.

Use a set of P different realizations, for the next generation choose $P/2$ with the lowest energies. Generate $P/2$ random children with random gene mixing. Two random genes of individuals get mutated with probability $p = 1/4$. Use $N = 8$, 16 and $P = 100$, 200, 400.