Monte Carlo simulations 2004. Exercise 7

To be handed in Mon May 3, solutions given Tue(!) May 4 10:15.

1. (6 p) Use the code CA1 available on the course web page, or write your own code, to simulate 1-dimensional cellular automata with $r = 1$, using the general rule described in the lecture notes for 1D automata. Use a system size of 120 and a single set dot as the starting point.

Examine the rules 254, 250, 110, 90 and 30. and determine their class according to the classification given in the lectures.

2. (12 p) Modify the code CA1 available on the course web page, or write your own code, to simulate 1-dimensional cellular automata with $r = 2$, using the variety of outer totalistic rules described in the lecture notes for 1D automata. Use a system size of 120 and several random starting configurations for each rule.

Examine the outer totalistic rules 8, 12, 20, 38, 50 and 52. and determine their class according to the classification given in the lectures.

3. (6 p) Show that the outer totalistic rule $\bar{C}$ for the game of life is 224.

4. (18 p) Write a program for the left-right symmetric 1D sand pile model discussed in the lecture notes. Let the grains land everywhere in the interval $[1, L]$ with a uniform probability. After the system has reached steady state, make statistics of the size of the toppled regions n_t. In what range of n_t do you observe a power-law dependence? What is the power law exponent?