FYTN02: Computer simulation of the Ising model

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1 Problem 1

A With H=0 and a 100x100 matrix, the critical temperature, defined as $T_c = 2.27$, indeed seems to be located around the theoretical exact value. The effect is however not instant, although the significant change seems to occur within the interval $T \in [T_c - 1, T_c + 1]$.

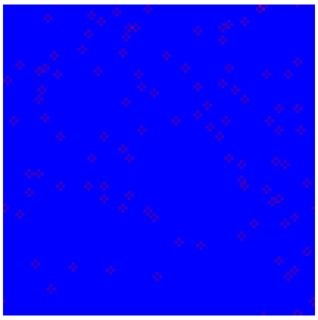
B When instead the magnetization is studied, the rate of change can once again be seen to very gradual. It is on the other hand hard to here state an interval where the change is significant, due to the very apparent hysteresis reaction the model seems to exhibit. When starting out with a magnetization in either direction, the system tends to maintain that achieved state, so that in effect no change of state can be said to appear at a certain point in field-space.

It is apparent that the initial conditions of the system are largely a determining factor for how the magnetization develops under the influence of an external field. In effect, the only noticable consequence of gradual change within the H-range of $[-0.1, 0.1]$ seems to be that there is a small shift in the degree of magnetization. This might indicate that there is no significant phase shift when $T < T_c$.

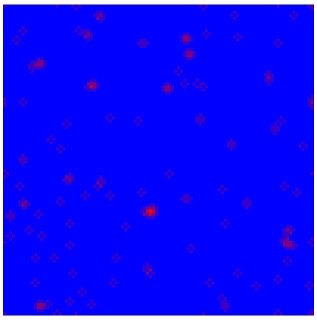
2 Problem 2

One can in the latter exercise observe how small clusters tend to form in certain ways given different values on the magnetization. It is apparent that larger values support the forming of clusers with increasing sizes. However, with a random initial configuration it is hard to draw any adequate conclusions from the attained output of the model; larger clusters seems to appear as the magnetization increases, but not in any clear, determinable way. It could be reasoned that with a larger magnetization, the coupling terms in the energy function become big enough to counteract the tendency to align according to the magnetization.

When comparing to when the overall initial state is not randomly configured, but instead takes a circular shape, clusters are not as likely to form, which ought to be because of the rigidness that comes with an initial, stable configuration – when the spins are already aligned according to their neighbours, they become unwilling to change. However, some boundary effects are nevertheless present, as is to be expected according to the looks of the energy function, as the boundary essentially constructs a probabilistic fringe-zone.



$M = -0.98$



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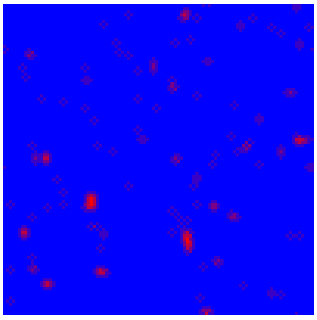
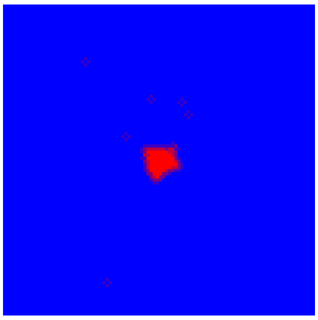


$M = -0.96$

Random initial configuration



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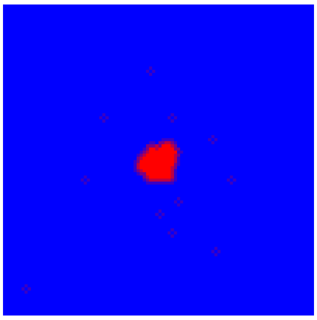

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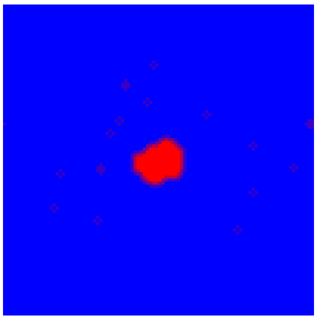

$M = -0.96$

Circular initial configuration