

1 Results

1.1 2×2 lattice, analytical expressions

If we scale the value of β from $1/k_B T$ to $1/J$ (Scaling factor $k_B T/J$) in the analytical expression from section ??, we will get a good benchmark for computer computations to come. These values are listed in table 1 below. Note that all values are divided by four, since we want the values per bond, and not for the entire lattice.

Mean energy, $\langle E \rangle$	-1.9960
Mean absolute magnetization, $\langle \mathcal{M} \rangle$	0.9987
Specific heat capacity, C_V	0.0321
Susceptibility, χ	3.9933

Table 1: Benchmark for material characteristics per bond for a 2×2 lattice

1.2 Ising model: simulation over temperature

We ran the program for different amounts of Monte Carlo cycles and plotted the error (analytical – simulated) in figure 9 below. Using 10^7 Monte Carlo cycles, we seem to be getting pretty accurate results.

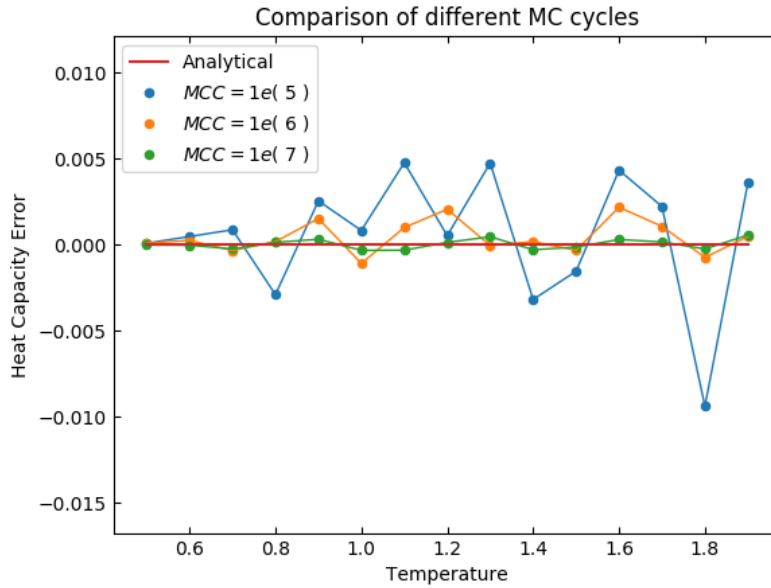


Figure 1: Shows the accuracy of different amount of MC cycles over temperature.

1.3 20×20 lattice

$T = 1.0$

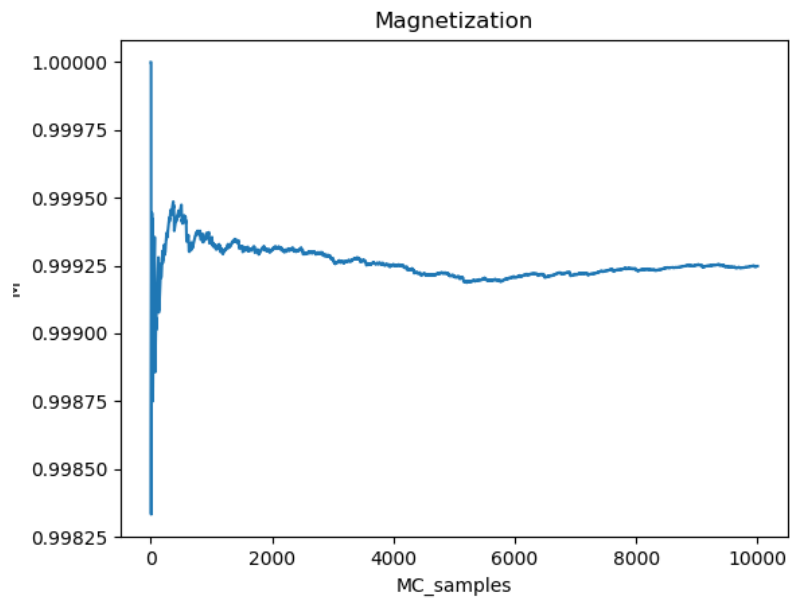


Figure 2: Shows the computed value for the mean magnetization, with ordered initialization, against the number of MC cycles. The scaled temperature is $T = 1.0$

Ordered spin orientation

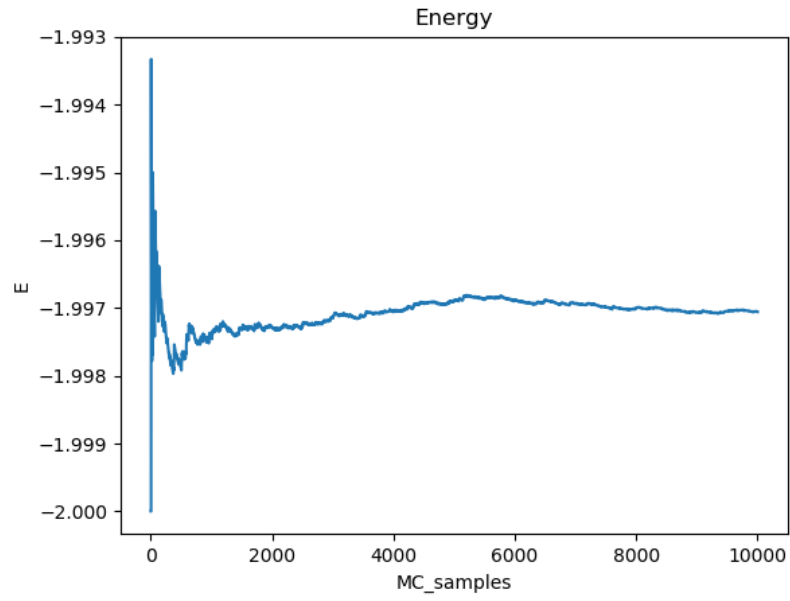


Figure 3: Shows the computed value for the mean magnetization, with ordered initialization, against the number of MC cycles. The scaled temperature is $T = 1.0$

Random spin orientation

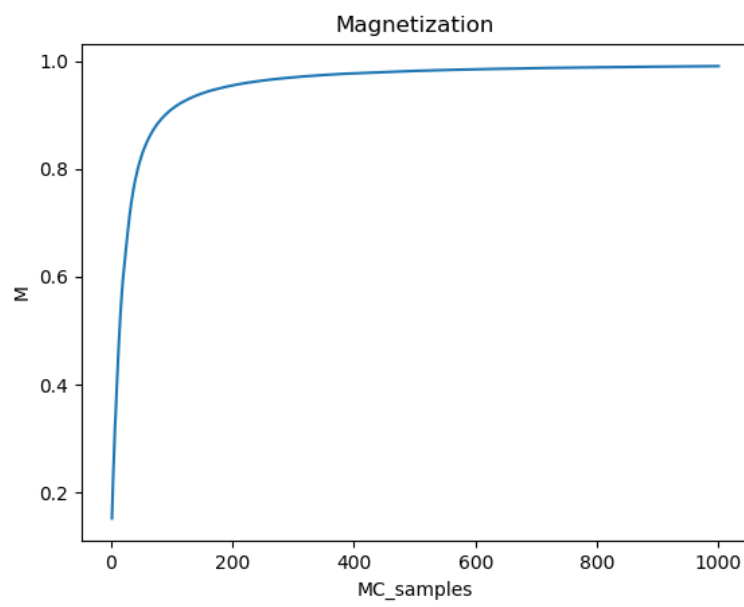


Figure 4: Shows the computed value for the mean magnetization, with random initialization, against the number of MC cycles. The scaled temperature is $T = 1.0$

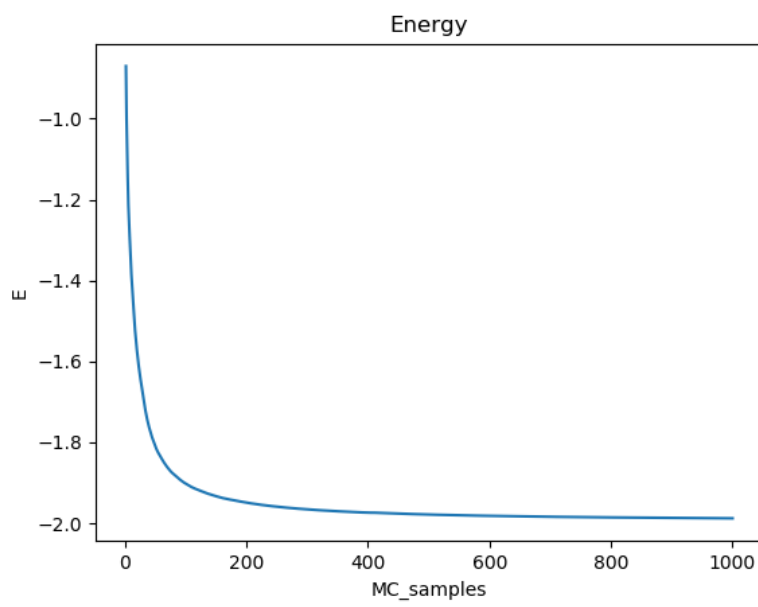


Figure 5: Shows the computed value for the mean magnetization, with random initialization, against the number of MC cycles. The scaled temperature is $T = 1.0$

$$T = 2.4$$

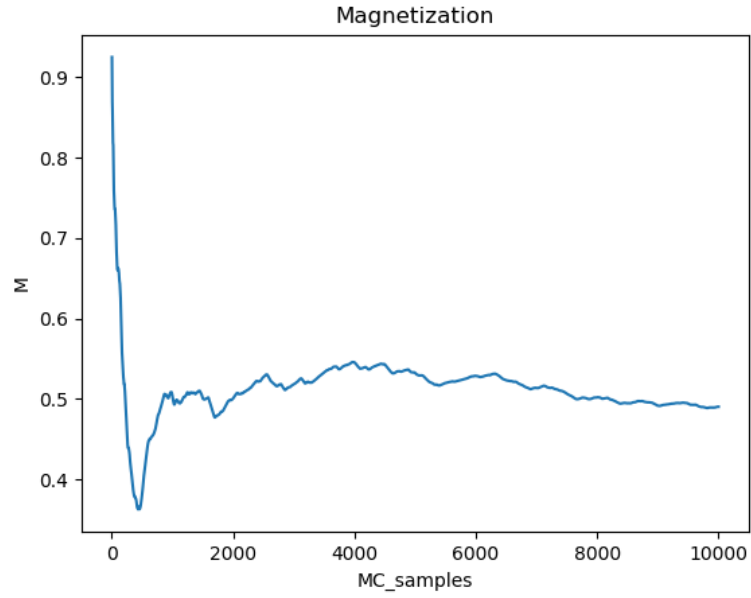


Figure 6: Shows the computed value for the mean magnetization, with ordered initialization, against the number of MC cycles. The scaled temperature is $T = 2.4$

Ordered spin orientation

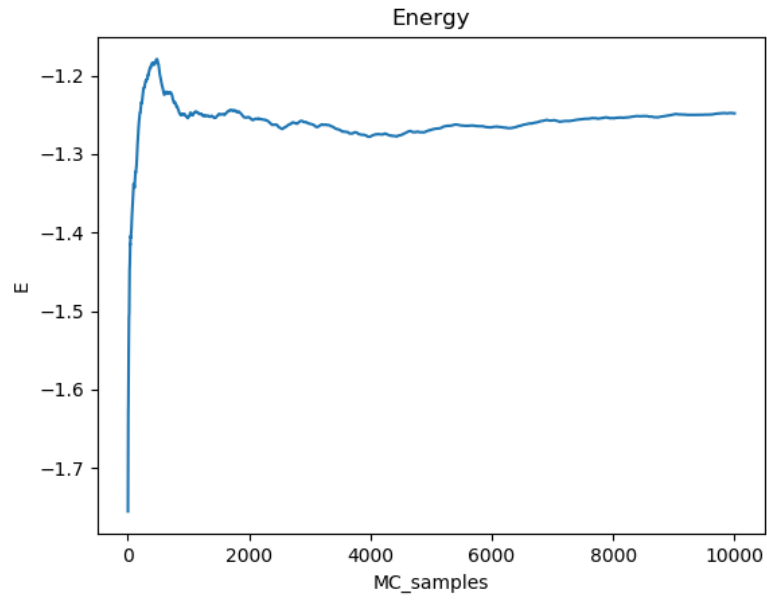


Figure 7: Shows the computed value for the mean magnetization, with ordered initialization, against the number of MC cycles. The scaled temperature is $T = 2.4$

Random spin orientation

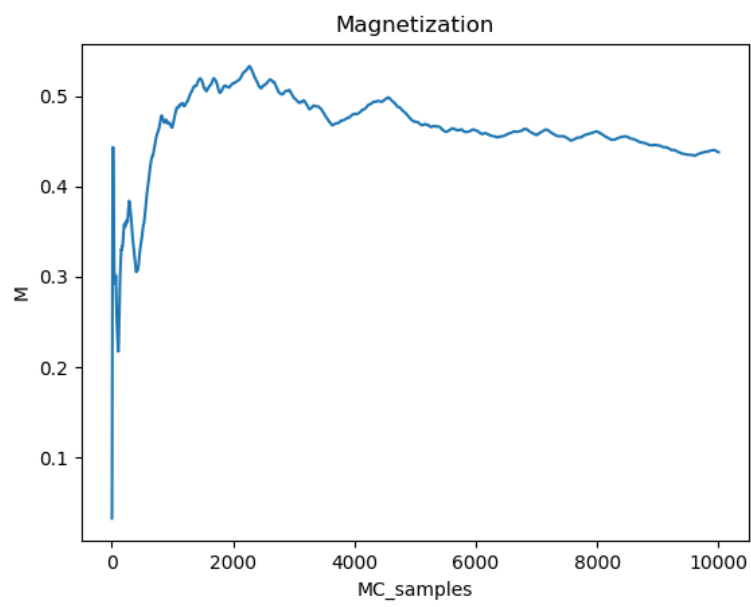


Figure 8: Shows the computed value for the mean magnetization, with random initialization, against the number of MC cycles. The scaled temperature is $T = 2.4$

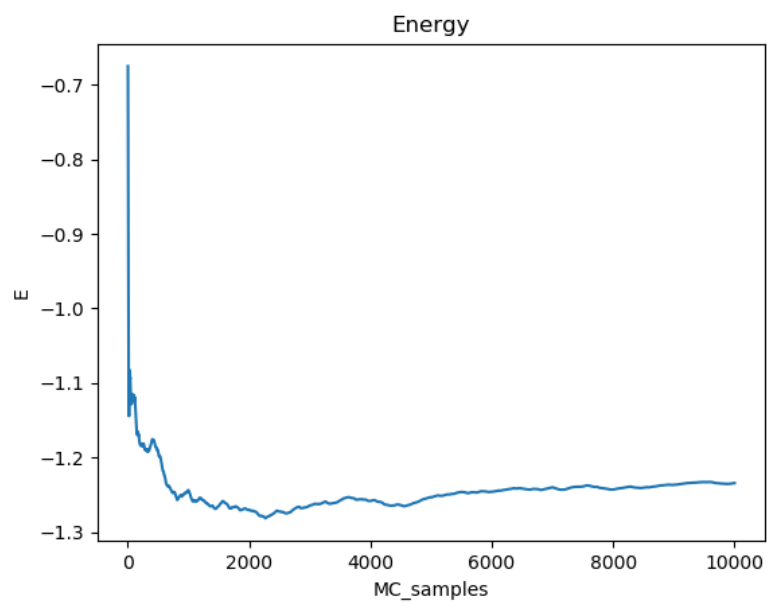


Figure 9: Shows the computed value for the mean magnetization, with random initialization, against the number of MC cycles. The scaled temperature is $T = 2.4$