

Title: Lenz-Ising model and Metropolis algorithm on the square lattice

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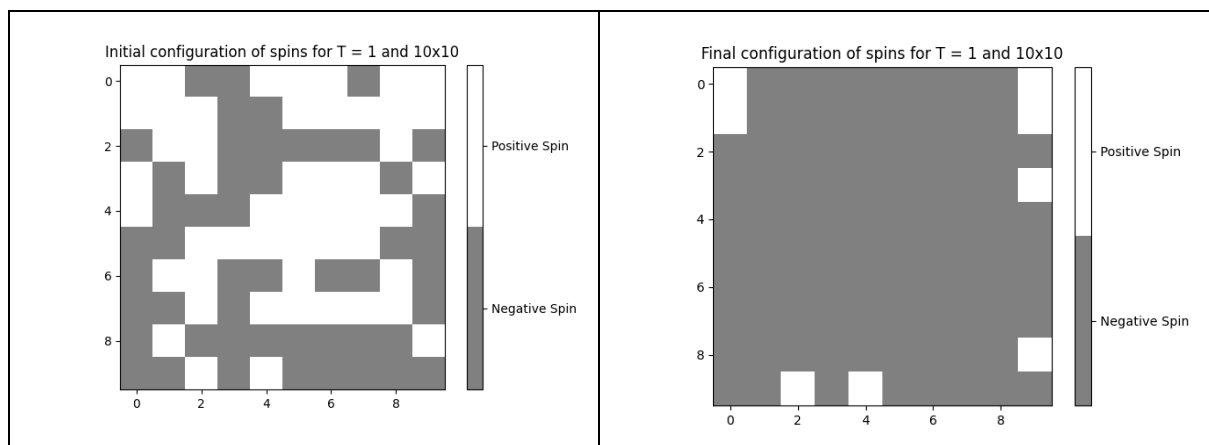
Short description:

- i. Language: Python
- ii. Environment: Visual Studio Code
- iii. Basic info about the computer used for simulations: Processor: 2,7 GHz Dual-Core Intel Core i5, RAM: 8 GB 1867 MHz DDR3

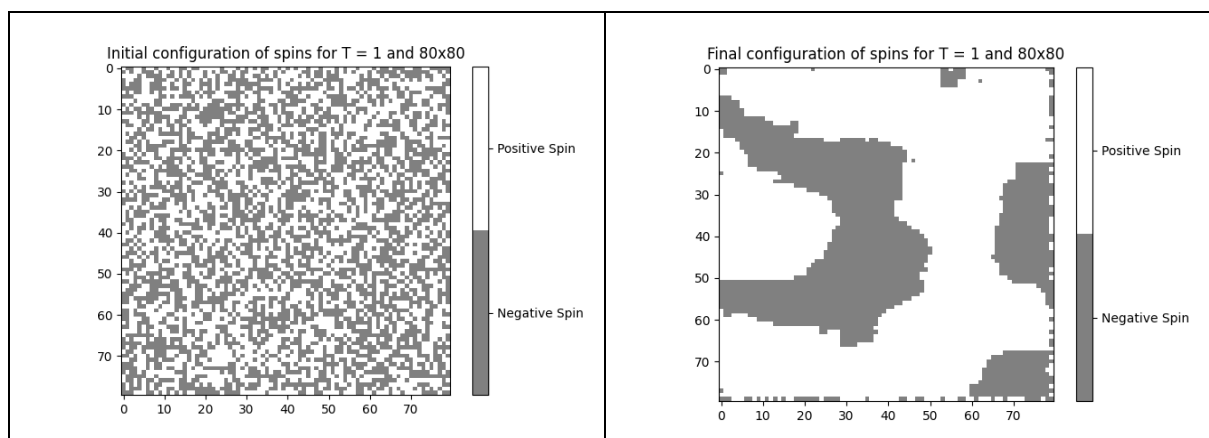
1. Configuration of spins after 100 MC steps for a lattice of 10×10 and 80×80 for three temperatures: $T_1 = 1$, $T_2 = 2.26$, $T_3 = 4$.

For all of figures initial value of spin was set for 50%.

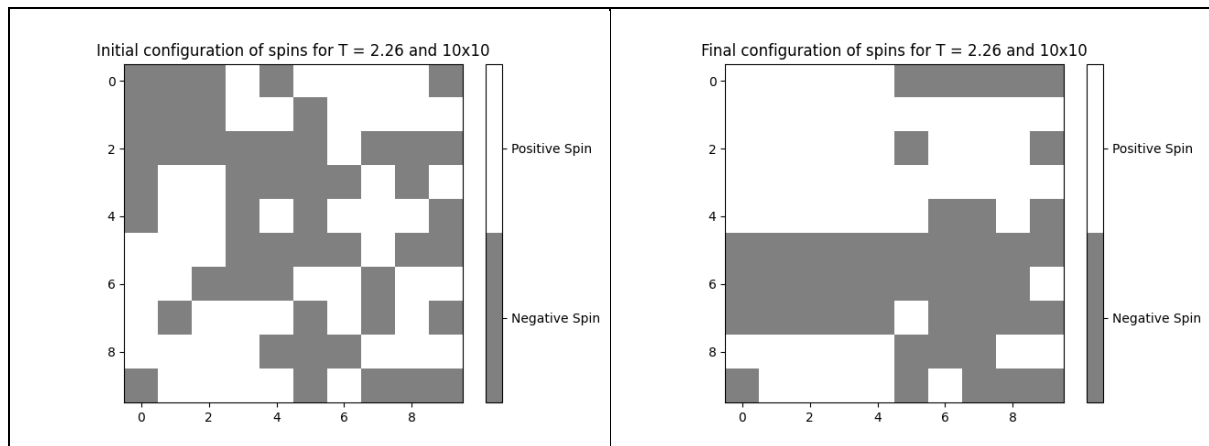
a) Square lattice 10×10 , $T = 1$



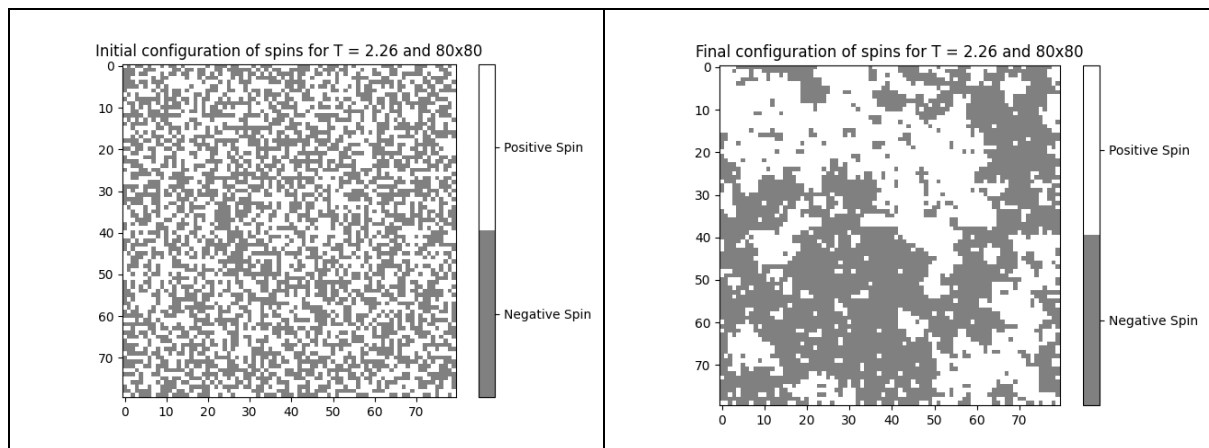
b) Square lattice 80×80 , $T = 1$



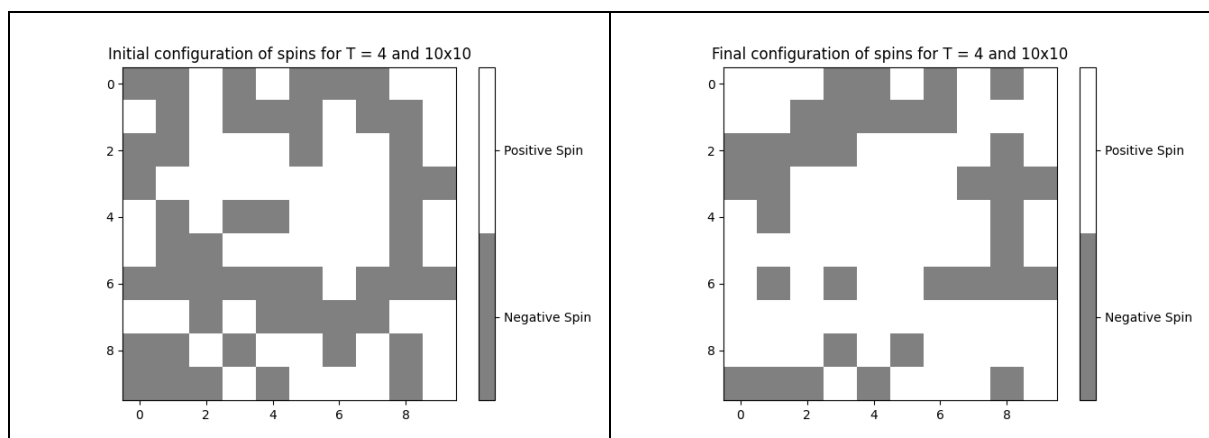
c) Square lattice 10 x 10, $T = 2.26$



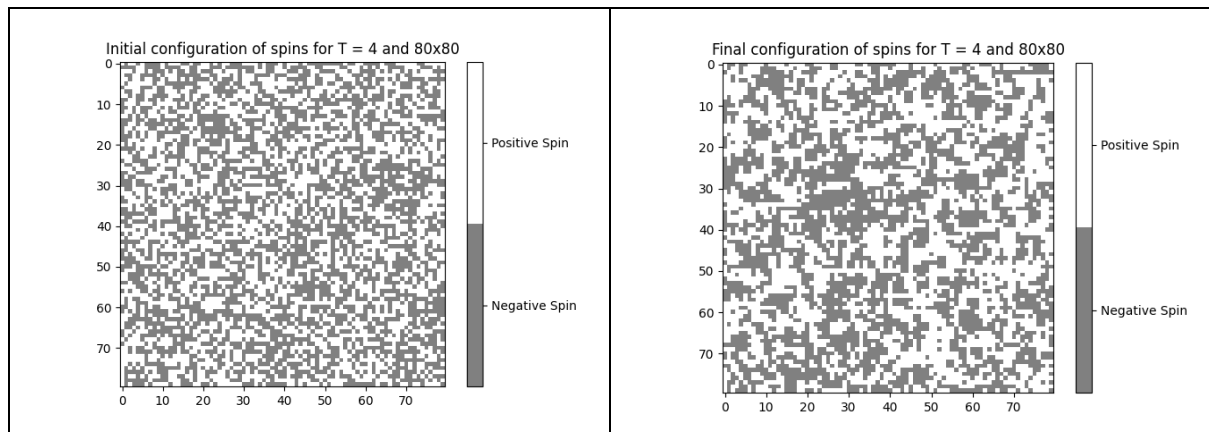
d) Square lattice 80 x 80, $T = 2.26$



e) Square lattice 10 x 10, $T = 4$



f) Square lattice 80 x 80, $T = 4$



2. Trajectories for temperature: $T_1 = 1$ for each L (four figures in total). Place 10 trajectories for the same set of parameters in each figure.

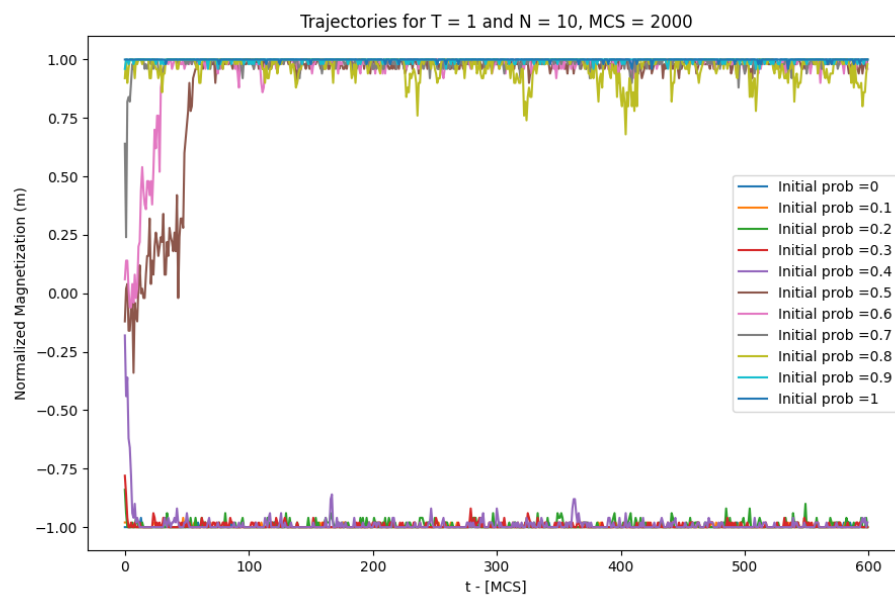


Figure 1 Trajectory of magnetization for $T = 1$ and $N = 10$, MCS = 600

Time needed for generate values, done in 9.957433223724365 seconds.

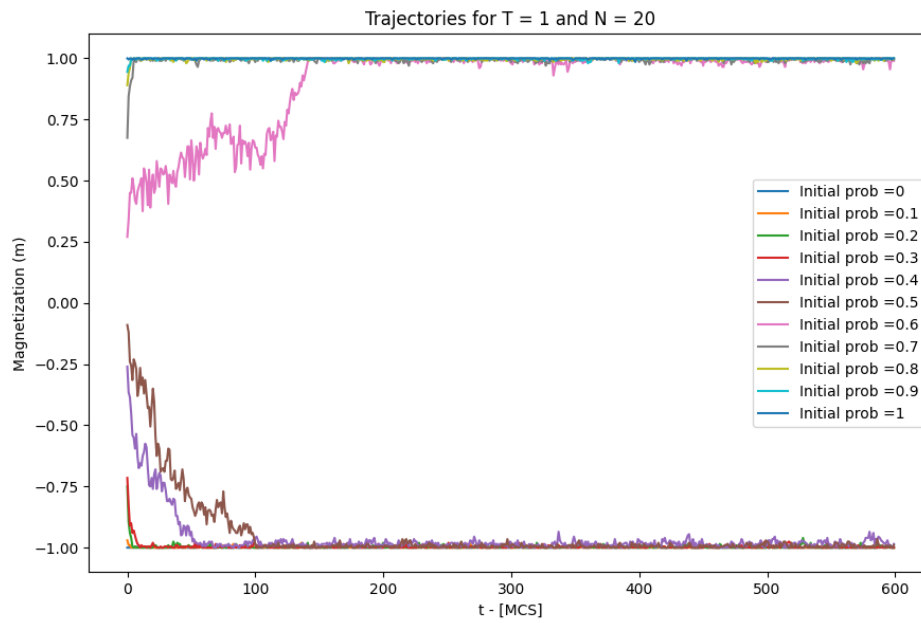


Figure 2 Trajectory of magnetization for $T = 1$ and $N = 20$, $MCS = 600$

Time needed for generate values, done in 36.93180584907532 seconds.

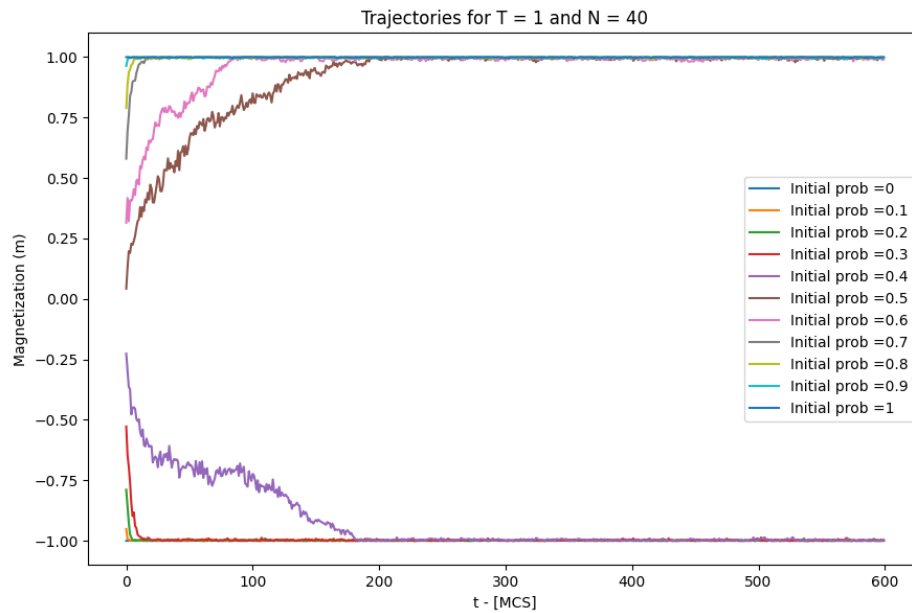


Figure 3 Trajectory of magnetization for $T = 1$ and $N = 40$, $MCS = 600$

Time needed for generate values, done in 155.6384630203247 seconds.

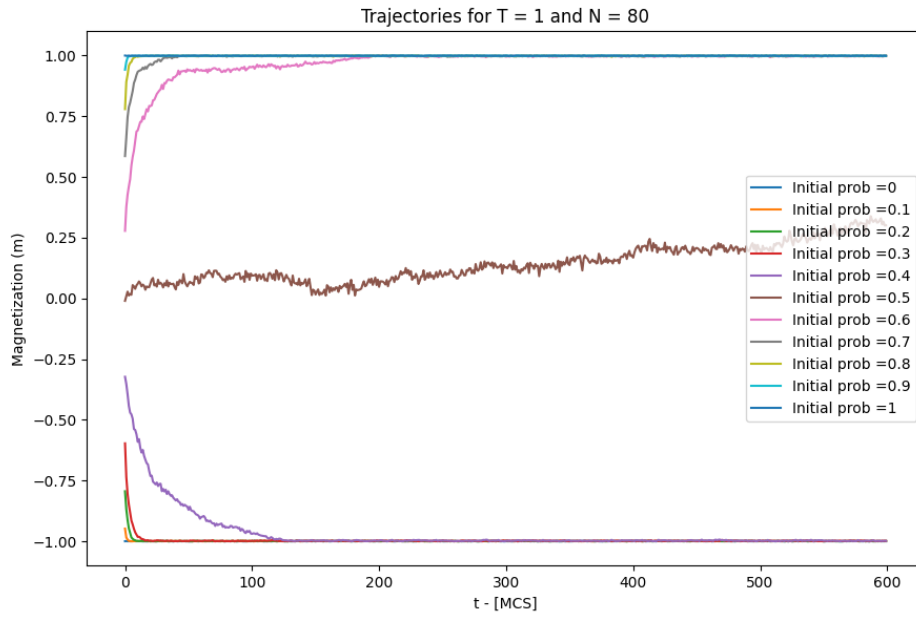


Figure 4 Trajectory of magnetization for $T = 1$ and $N = 80$, $MCS = 600$

Time needed for generate values, done in 590.8359718322754 seconds.

3. Same as in the previous item for 3 temperatures of your choice: $T < T^*$, $T = T^*$, $T > T^*$, where T^* is the critical temperature.

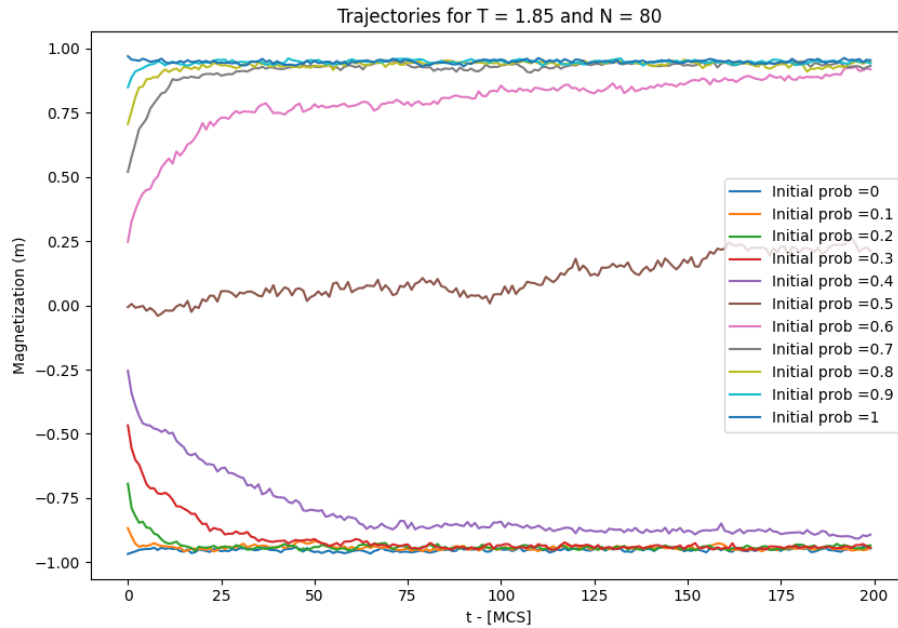


Figure 5 Trajectory of magnetization for $T = 1.85$ and $N = 80$, $MCS = 600$

Time needed to generate values for $T = 1.85$ done in 257.0005769729614 seconds

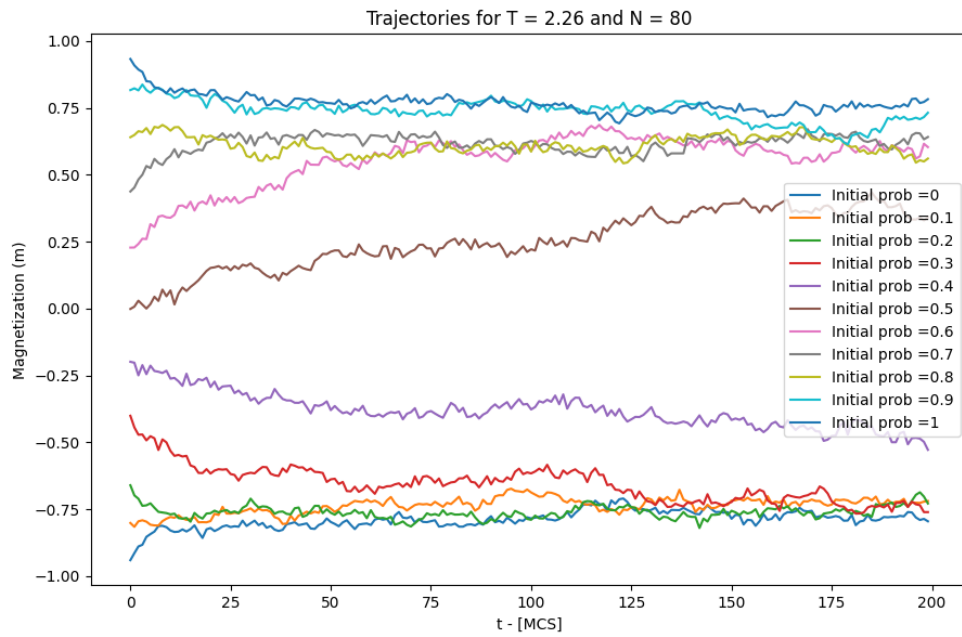


Figure 6 Trajectory of magnetization for $T = 2.26$ and $N = 80$, MCS = 600

Time needed to generate values for $T = 2.65$ done in 225.85198378562927 seconds

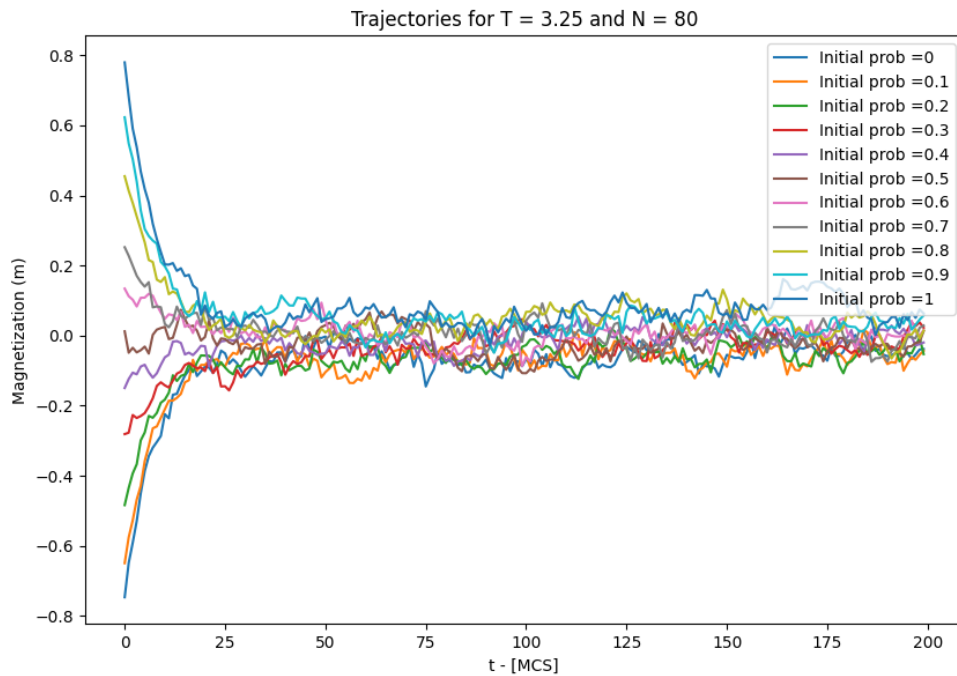


Figure 7 Trajectory of magnetization for $T = 3.25$ and $N = 100$

Time needed to generate values for $T = 3.25$ done in 190.2395420074463 seconds

4. Magnetization as a function of temperature T for $T = 0.5 : 0.05 : 3.5$. This time put results for all lattice sizes in one figure using different symbols and the legend for L . Choose the thermalization time yourself based on the results from the previous sections.

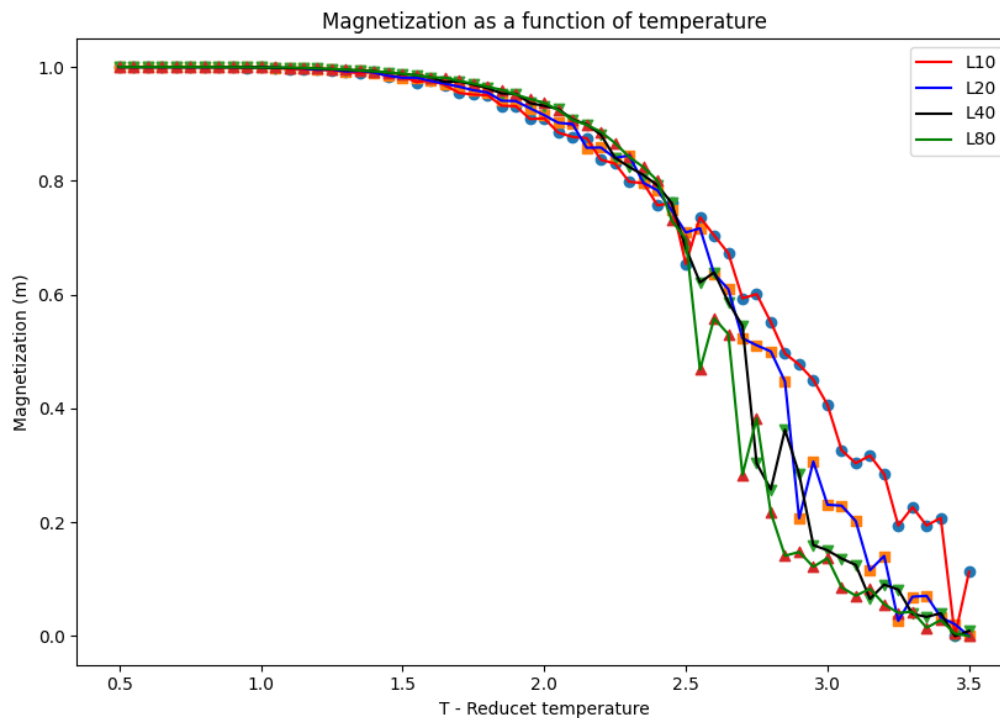


Figure 8 Magnetization as a function of temperature for different values of Lattice size. All performed using 1000 of MCs.

Needed time to execute for every of shown graphs:

$L = 10$, MCs = 1000 done in 77.87305498123169 seconds, $L = 20$, MCs = 1000 done in 300.332759141922 seconds, $L = 40$, MCs = 1000 done in 1235.331425189972 seconds, $L = 80$, MCs = 1000 done in 4961.521048784256 seconds.