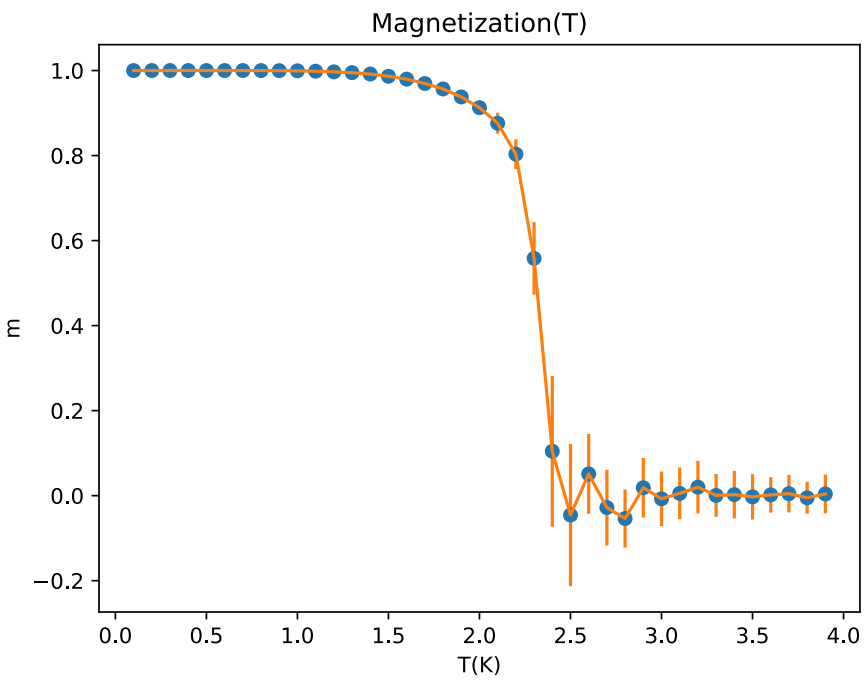
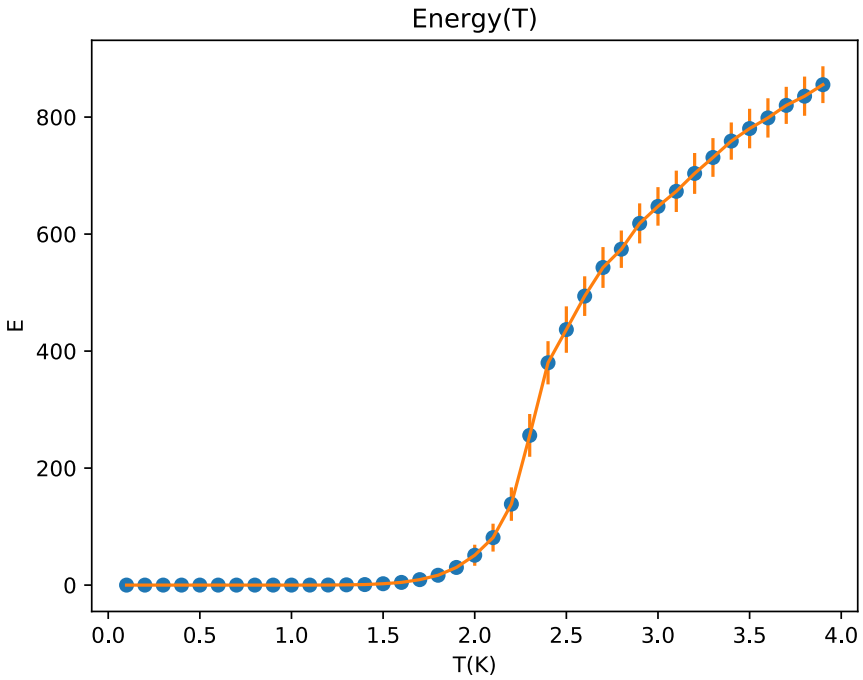
Exercise sheet 8





For this exercise a Monte Carlo simulation has been used to explore the Ising model. In particular, it has been used a squared lattice of side L=50 starting from the ground state configuration of spin up for every point in the lattice. Afterwards, the Metropolis algorithm has been used iteratively for every temperature T in the range (0,4] in step of 0.1 K, each one being explored for 1000 samples. From the Monte Carlo simulation it is possible to draw the magnetization (on the left) and the energy of the system (on the right) both as a function of T. The mean values obtained for each temperature are correlated with an error bar constructed using the standard deviation. What appears evident is the rapid change in the behaviour of both the magnetization and the energy when the temperature reaches a certain value, denoted critical temperature T_C. This value is in fair agreement with the theoretical value for a 2D lattice of $T_C = 2/\log(1+\sqrt{2}) \approx 2.27$ in units of J/k_B. Finally, it is worth noticing that the values around T_C are characterized by higher errors (i.e. greater standard deviation), which reflect the critical slow-down behaviour that happens around the phase transition.