

The Ising model and phase transitions in magnetic systems

Anna Lina Petruskeviciute Sjur

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Abstract

1 Introduction

2 Methods

2.1 Statistical physics and thermodynamics

2.2 The Ising model

The Ising model consists of variables s that can exist in two states, typically $+1$ or -1 . These variables represent magnetic dipole moments of atomic spin, and are ordered in a two dimensional lattice consisting of $L \times L$ spins. Given that there is no magnetic field, the energy of the system is modelled as

$$E = -J \sum_{\langle ij \rangle} s_i s_j, \quad (1)$$

where J is a coupling constant expressing the strength of the interaction between neighbouring spins. The symbol $\langle ij \rangle$ means that the sum is over neighbouring spins. The magnetisation of the system is simply the sum of all the spins

$$M = \sum_i s_i. \quad (2)$$

2.3 Monte Carlo simulations

2.4 Metropolis' algorithm

One possibly way of solving the Ising model is by using the so called Metropolis' algorithm.

3 Results

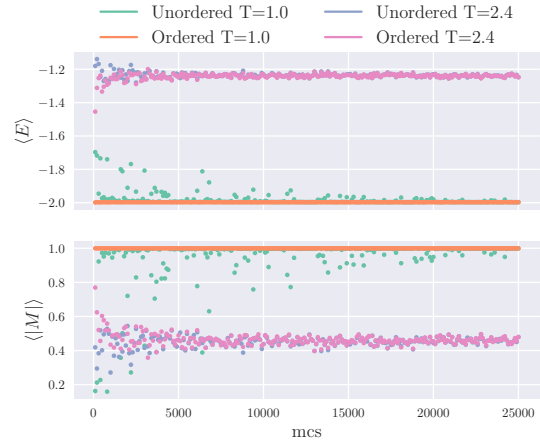


Figure 1:

T	$\langle E \rangle$	σ^2
1.0	-1.997	0.025
2.4	-1.237	8.116

Table 1:

4 Discussion

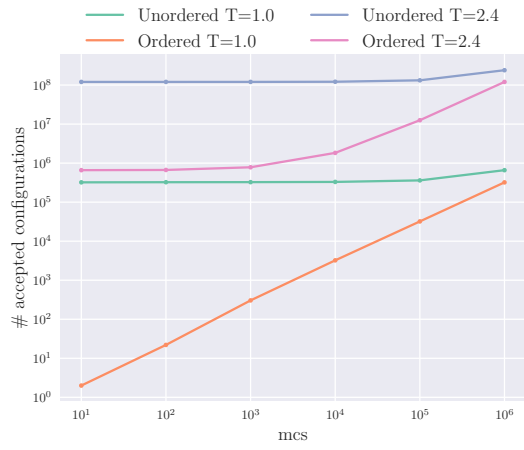


Figure 2:

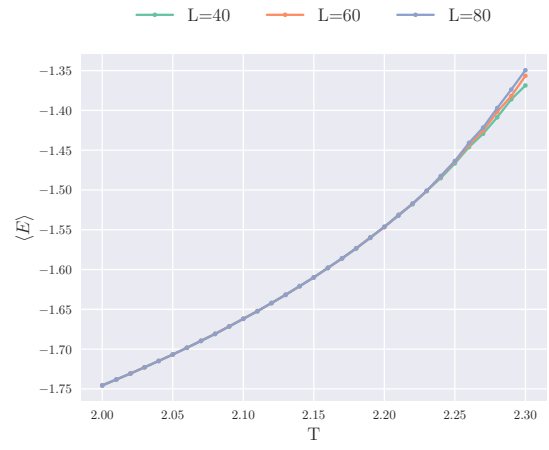


Figure 4:

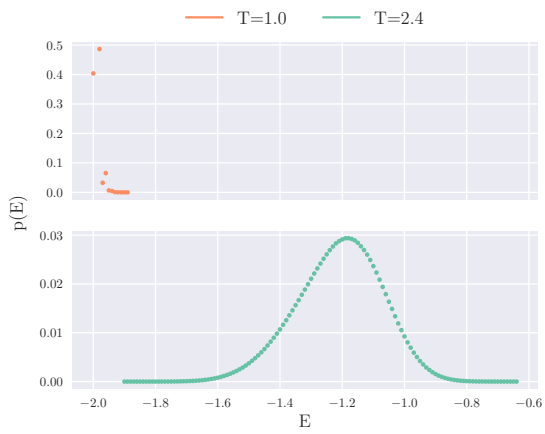


Figure 3:

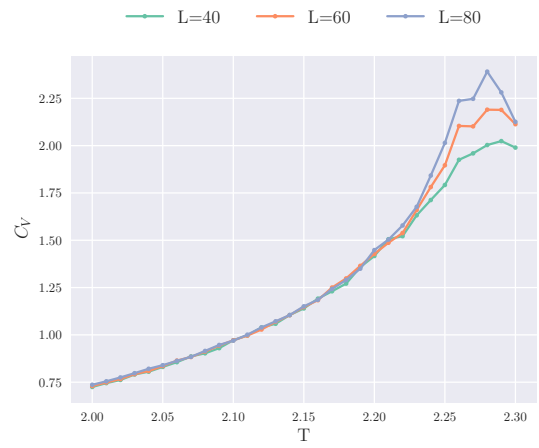


Figure 5:

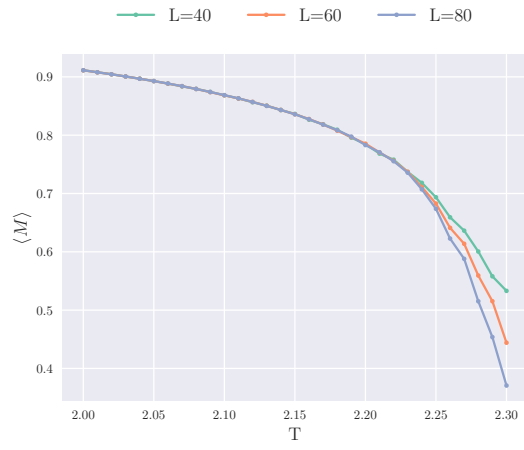


Figure 6:

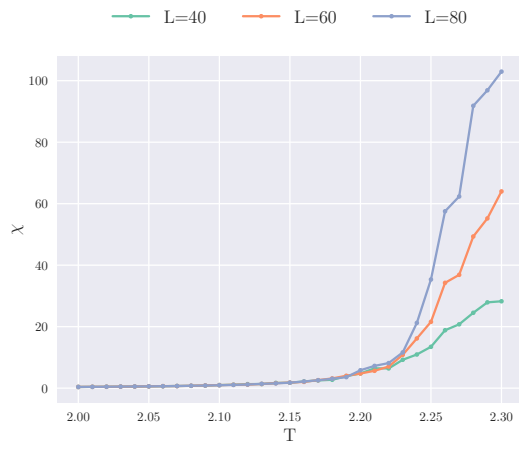


Figure 7:

Appendix