The Ising model and phase transitions in magnetic systems

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Abstract

1 Introduction

2 Methods

2.1 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

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

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

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

2.2 Monte Carlo simulations

2.3 Metropolis' algorithm

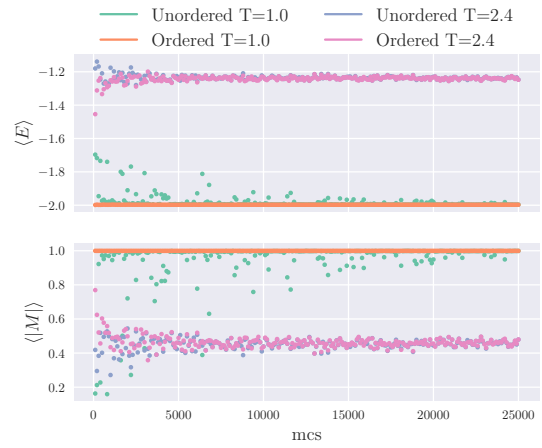The Metropolis' algorithm is an algorithm that can be used to solve the Ising model.
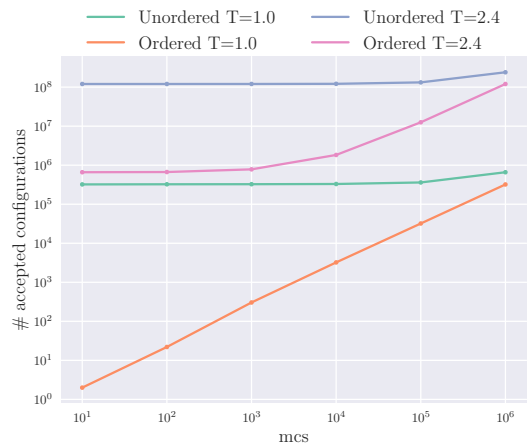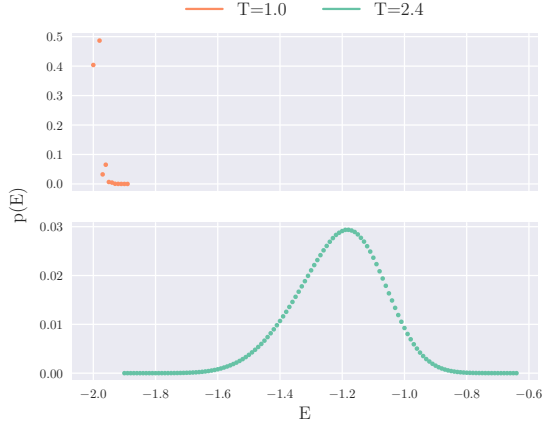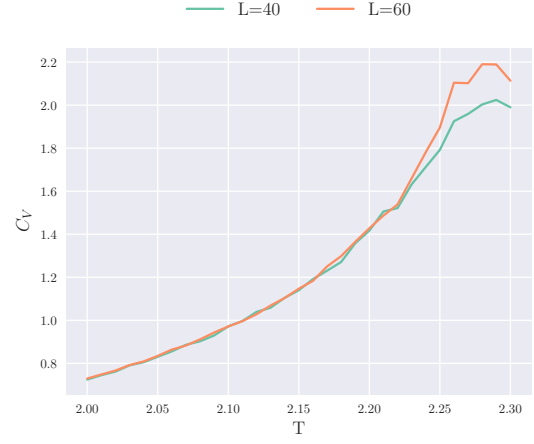

Figure 1:

Figure 2:

1

Figure 3:

Figure 5:

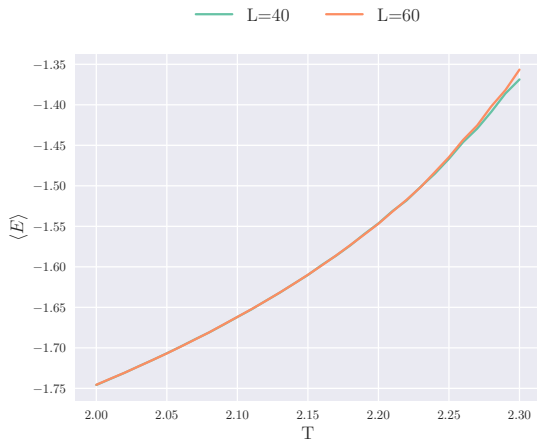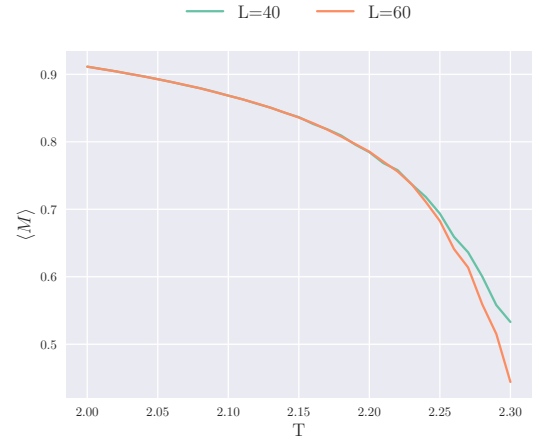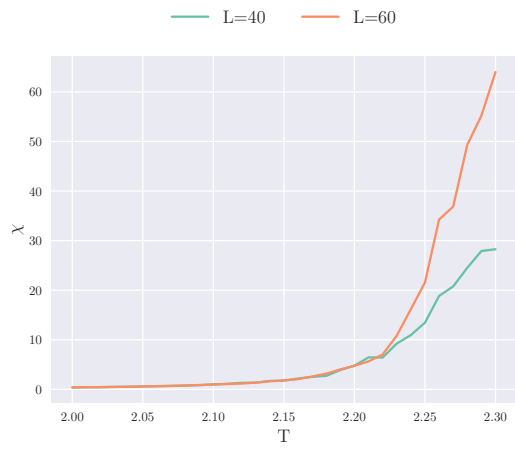| T	$\langle E \rangle$	σ^2
1.0	-1.997	0.025
2.4	-1.237	8.116

Table 1:

Figure 4:

Figure 6:

Figure 7:

3 Results

4 Discussion

Appendix