

PHY 905 Project 1: Monte Carlo simulation of the 2D ferromagnetic Ising model

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Abstract

A simple Fortran implementation of the Metropolis algorithm for Monte Carlo simulation of the Ising model of ferromagnetism is described. Results are presented for energy and magnetization over a range of temperature.

1 Introduction

1.1 Ising model

The energy of the lattice is a sum over all nearest neighbor spin products, multiplied by an interaction strength J :

$$H = -J \sum_{\langle i,j \rangle} s_i s_j \quad (1)$$

2 Implementation Details

The change in energy due to negating the spin of a single point i in the lattice is computed as the sum of i 's nearest neighbor spins multiplied by the new spin s_i and the interaction strength J :

$$\Delta E_i = J s_i \sum_{\langle j \rangle} s_j \quad (2)$$

2.1 Algorithm

3 Results

The Fortran code implementing the 2D Ising model

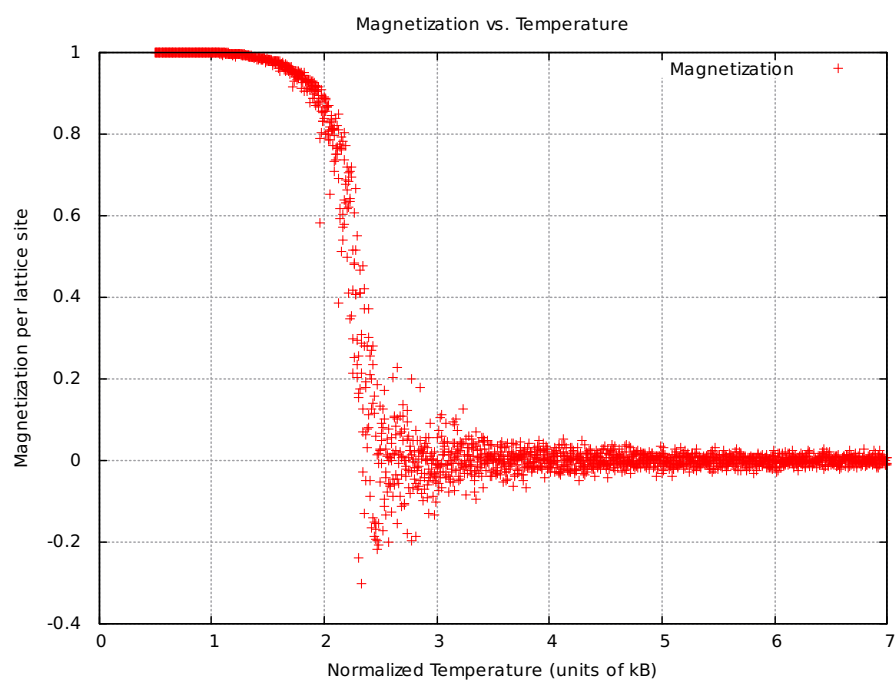


Figure 1: Magnetization per lattice site. Values computed by averaging final 50000 Monte Carlo iterations per temperature value.

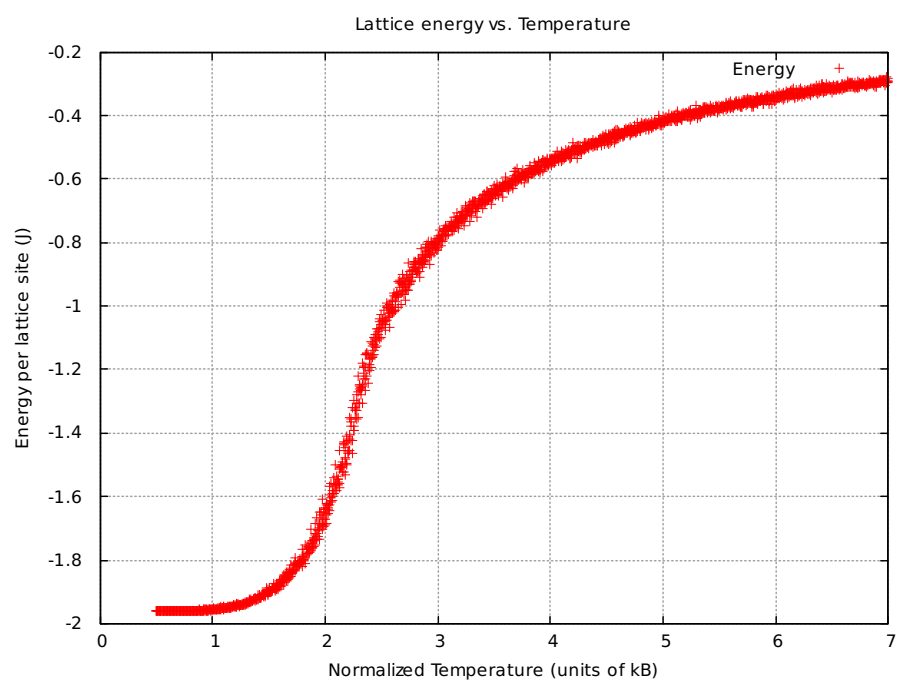


Figure 2: Lattice energy per lattice site. Values computed by averaging final 50000 Monte Carlo iterations per temperature value.