

Ising model - Monte Carlo and Metropolis algorithms

Due date **Nov** *overdue*, **2016**

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November 22, 2016

Abstract

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1 Studies of phase transitions in magnetic systems

1.1 Introduction

The aim of this project is to study a widely popular model to simulate phase transitions, the so-called Ising model in two dimensions. At a given critical temperature, this model exhibits a phase transition from a magnetic phase (a system with a finite magnetic moment) to a phase with zero magnetization.

As with all other projects in this course, the important thing is to make the algorithm work. The basic energy calculation of any two-dimensional lattice boils down to this form:

$$E = -J \sum_{\langle kl \rangle}^N s_k s_l \quad (1)$$

where s_k and s_l are ± 1 , N is the total spins in the lattice, J expresses the strength of interaction between neighbouring spins, which are referred to in the summation by $\langle kl \rangle$ as it sums up interaction only between lattice-neighbours near index k and l .

Through the course of this report, we shall investigate different variations on differently-sized lattices and their modelled physical properties.

1.2 Analytical model of 2×2 lattice