CMM HW5

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1 The Ising Model

1.1 Part 1

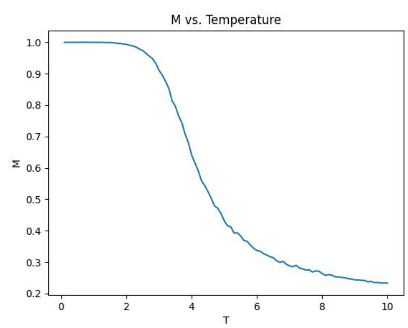

Figure 1: M vs. Temperature

This part requires to plot magnetization M vs. Temperature T. For simplification, the Boltzmann constant k_B is set to be 1. Given that $J = 1.5$, the analytical solution of the critical temperature of the Ising model should be $T_c = 3.402$. To equilibrate a system with a size of $n \times n$, $10000n^2$ Monte Carlo sweeps are needed (very heavy computation).Figure 1 is the plot generated by Metropolis-Hastings algorithm. We can find that the T_c of the system approximately equals to 3.402.

1.2 Part 2

Theoretically, the maximum heat capacity C_{max} will appear at T_c. Due to the heavy computation of the large system (e.g. $n = 100$), I only equilibrate the system at theoretical $T_c = 3.402$ to find C_{max}. I haven't get the answer of the system with size of 200 and 500, since these sizes broke my PC system. The result is shown as Figure 2.

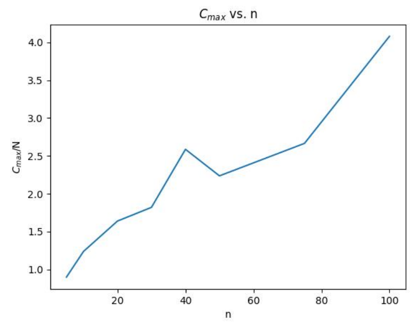

Figure 2: C_{max}/N vs. n

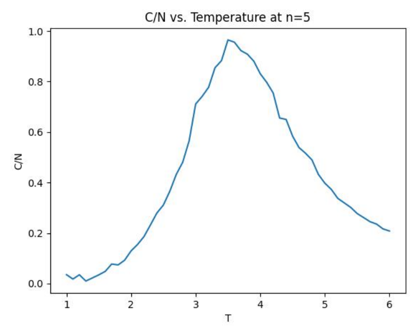

Figure 3: C/N vs. Temperature at n=5

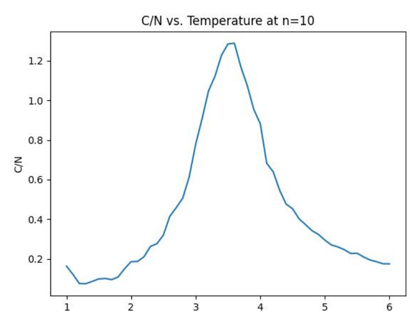

Figure 4: C/N vs. Temperature at n=10

However, the results look not convincing. Additionally, there are some result of C/N vs. T for systems with small sizes (Figure 3, Figure 4).