Report for Exercise 03

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1 Task 1

In Figure 1, one can see the histogram of the demon Energy values obtained from the Creutz algorithm simulating a microcanonical Ising model on a 3-d cubic lattice of size $L = 6$. The plot shows the demon Energy for a specific energy $E = -288$. I fitted an exponential function $a \exp(-\frac{Ed}{k_B T})$ to the data and obtained $T = 4.00$ from it.

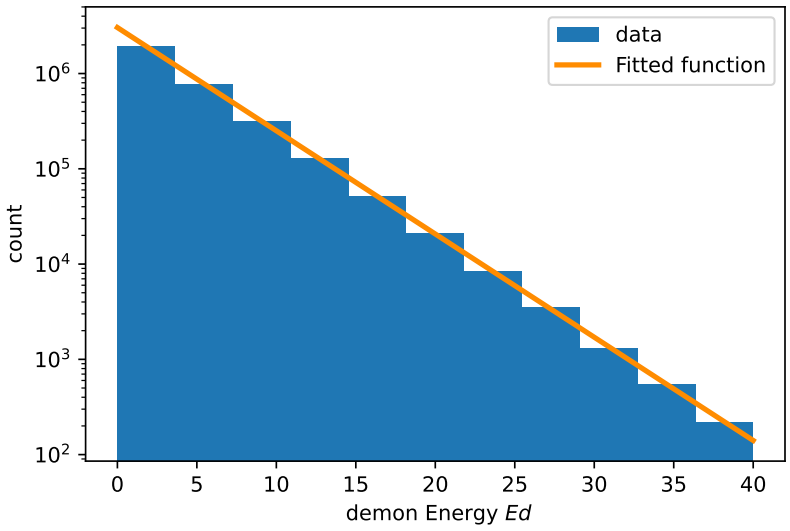
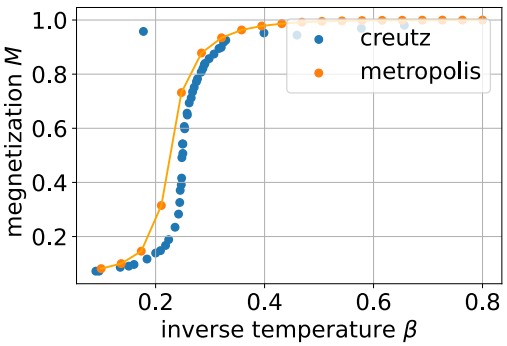


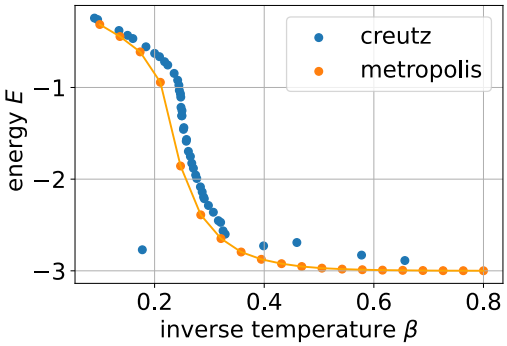
Figure 1: Histogram of the demon Energy and fit for a 3d microcanonical Ising model at specific energy $E = -288$ where $T = 4.00$ comes from the fit.

2 Task 2

In Figure 2, one can see the plot for the magnetization M and energy E over the inverse Temperature T both computed using the Creutz algorithm for a microcanonical ensemble and the metropolis algoritm for a canonical ensemble.



(a) plot of the magnetization $M(T)$



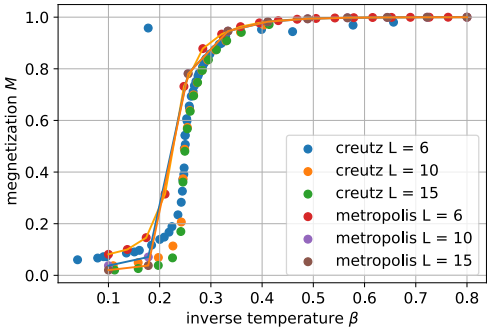
(b) plot of the energy $E(T)$

Figure 2: Plots for the magnetization M and energy E over the inverse Temperature T both computed using the Creutz algorithm for a microcanonical ensemble and the metropolis algoritm for a canonical ensemble.

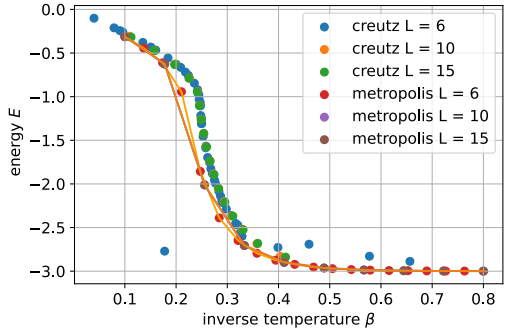
The graphs show that the data points generated using the Creutz algorithm lie close to the graph from the Metropolis algorithm except a few outliers. I do not really know where these outliers come from. But exept that It looks like the Creutz algorithm is a good alternative for computing the quantities of the Ising model.

3 Task 3

In Figure 3, one can again see the plots for magnetization and energy over temperature comparing the Creutz and the Metropolis algorithm like in task 2, but now additionally for two bigger grid-sizes, namely $L = 10$ and $L = 15$.



(a) plot of the magnetization $M(T)$ for different system sizes



(b) plot of the energy $E(T)$ for different system sizes

Figure 3: Plots for the magnetization M and energy E over the inverse Temperature T for different system sizes, both computed using the Creutz algorithm for a microcanonical ensemble and the metropolis algoritm for a canonical ensemble.

The outliers in the Creutz algorithm disappear for $L = 10$ and $L = 15$ which means that we should at least use system sizes bigger then $L = 10$. Other then that there are no big differences visible for the different system sizes for neither Creutz or Metropolis algorithm. For the magnetization and the energy the graphs from the metropolis algorithm have a little offset to the left compared

to the Creutz algrorithm. It would be interesting to see that if this offset disappears for even bigger system sizes.