

5634 - Stochastic Methods
Michelmas Term - 2014-2015
Homework 4 - Due Dec. 17th, 2014

1. **Ising Model - Metropolis Algorithm:** Consider the two-dimensional Ising model with periodic boundary conditions, so that the nearest neighbor to the left of $\sigma_{0,0}$ is $\sigma_{(L-1),0}$. Proceed through the lattice of spins in a ‘typewriter’ fashion, going through the rows in order and update a single spin at a time using the Metropolis algorithm. In this case the proposal matrix proposes that the spin in question be flipped with unit probability. Consideration of all the spins in this way constitutes a single ‘sweep’. Consider a lattice of size $L = 40$ in each dimension. For each $1/k_B T = 0.4, 0.44$ do the following:
 - (a) Starting with the configuration where all spins are set to 1, thermalize for some large number (at least 2000) of sweeps.
 - (b) Measure the average spin (don’t take the absolute value) after every N_s sweeps and make 1000 measurements in total. For $1/k_B T = 0.4$ use $N_s = 20$ and for $1/k_B T = 0.44$ use $N_s = 500$.
 - (c) Finally, divide the interval $[-1, 1]$ into 50 ‘bins’ and make a histogram of the average magnetization. Do you see anything different between the two values of $1/k_B T$?