# Potts-model - Aaron Miller 17322856

The q-state Potts model in three dimensions describes the statistical mechanics of a set of spins, $\sigma_{x,y} \in \{1, 2, \cdots, q\}$ on the sites a $n^2$ grid, $\Lambda 2$.

The action is given by

$$S = \frac{1}{2} \sum_{x,y \in \Lambda} \left( \sum_{x',y' \in n(x,y)} 1 - \sigma_{x,y}\, \sigma_{x',y'} \right),$$

with which we update the spins of the grids points by the metropolis algorithm. The update however only takes into account the change of action between a proposed state (a random q) and the current state of the system ($\Delta S$). The probability that a proposed state is accepted is given by the Boltzmann probability:

$$\text{Prob} = e^{\beta \Delta S}.$$

The graphs below are of the average magnetism ie: average spin of the lattice. I averaged the collection of the data over a number of iterations once the system was in thermal equilibrium in order to get accurate representations of the actual data which are less dependant on the variance of the system.

For this simulation, I took data 500 times over the interval $\beta \in [0.5,1.5]$. I took averages of the resulting fractional magnetisation over 500 updates after 1500 updates for the system to reach thermal equilibrium.

The results for q=3, and q=5 are displayed below.

Out[95]=