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(*
  June 24th, 2011

  Two-Dimensional Ising Model

  Here simulated is a 50x50 2-D Ising lattice on a torus. The
  magnetic spins are flipped according to the metropolis algorithm,
vying for lower energy states. An array of black/white squares is generated
 to visualize the state of the system at various temperatures and time steps.

  The magnetization per spin is calculated and plotted. Then,
the magnetic susceptibility is calculated and plotted.

     n = number of columns
     m = number of rows
     T = temperature
*)

n = 50;
m = 50;
maxT = 3;
minT = 0.00001;
diffT = -0.00001;


initial = Table[If[Random[] < 0.5, -1, 1], {i, 1, n}, {j, 1, m}];

ArrayPlot[initial, ColorRules → {-1 → White, 1 → Black}, Mesh → True]

config = initial;

nboundary[i_] := 1 + Mod[i - 1, n]
mboundary[j_] := 1 + Mod[j - 1, m]

magnetevolution := (

          nspin = Ceiling[Random[] * n];

          mspin = Ceiling[Random[] * m];

              change =
   2 * 1/T * config[[nspin, mspin]] * ( config[[nboundary[nspin - 1], mspin]] +
                                        config[[nboundary[nspin + 1], mspin]] +
                                        config[[nspin, mboundary[mspin - 1]]] +
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                                    config[[nspin, mboundary[mspin + 1]]] ) ;

  probability = Exp[-change];

  metropolis =
   If[ change ≤ 0, config[[nspin, mspin]] = -config[[nspin, mspin]], acceptance];

  acceptance := If[ Random[] < probability,
                  config[[nspin, mspin]] = -config[[nspin, mspin]],
                 config[[nspin, mspin]] = config[[nspin, mspin]] ] ;

  config[[nspin, mspin]];

  upspins = Count[Flatten[config], 1];
  spinmag = 2 * upspins / (n * m) - 1

)

magnettable = Table[magnetevolution, {T, maxT, minT, diffT}];
array = ArrayPlot[config, ColorRules → {-1 → White, 1 → Black}, Mesh → True]

ListPlot[magnettable]
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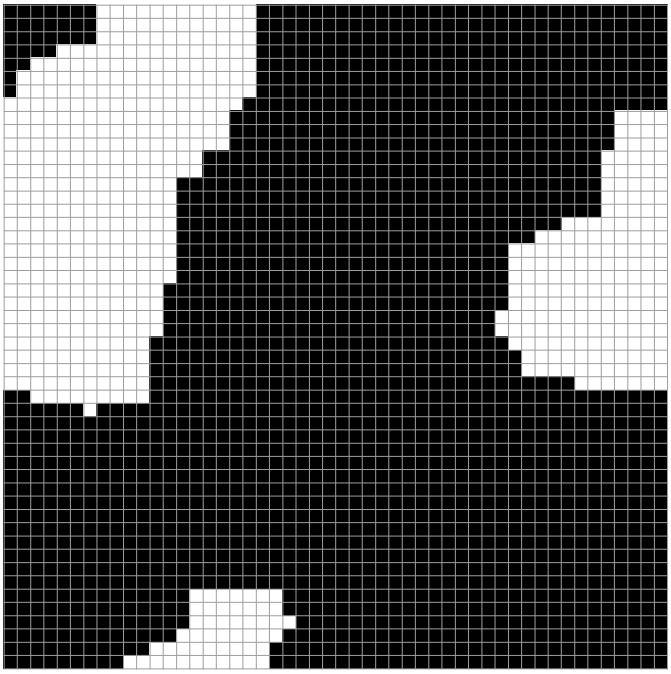

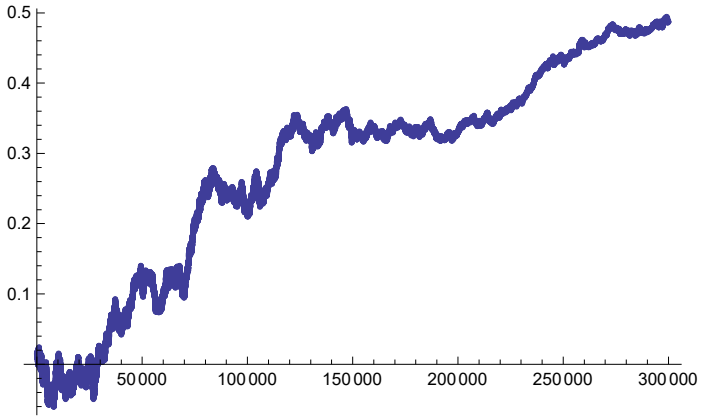
0.5
0.4
0.3
0.2
0.1
50 000
100 000
150 000
200 000
250 000
300 000