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(*
  June 20th, 2011

  Two-Dimensional Ising Model

  Here simulated is a 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.

     n = number of columns
     m = number of rows
     a ≡ J_ab/(k_B T)
     t = time steps taken
*)

n = 100;
m = 100;
a = 1/T;
T = 0.1;
t = 100000;


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 * a * 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]]] +
                                        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];
    downspins = Count[Flatten[config], -1];
    spinmagnetization = (2 * upspins)/(n * m) - 1

  )

magnettable = Table[magnetevolution, {i, 1, t}];
array = ArrayPlot[config, ColorRules → {-1 → White, 1 → Black}, Mesh → True]
ListPlot[magnettable]
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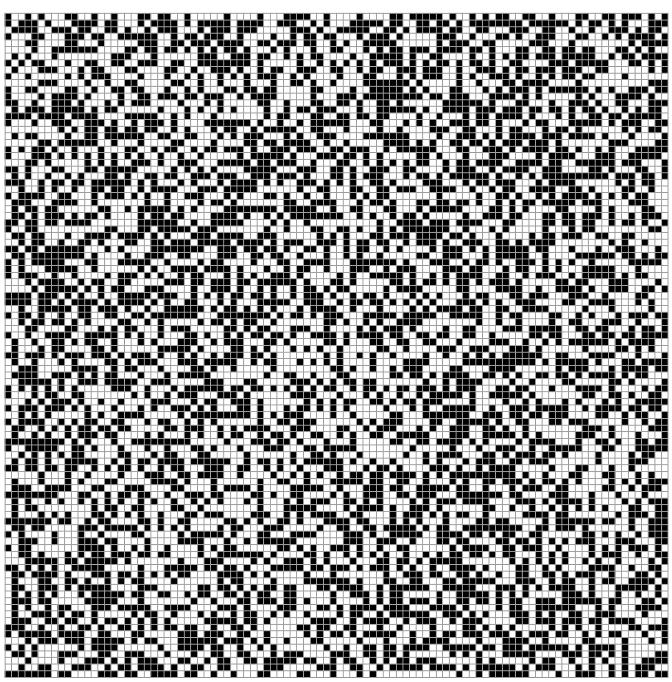

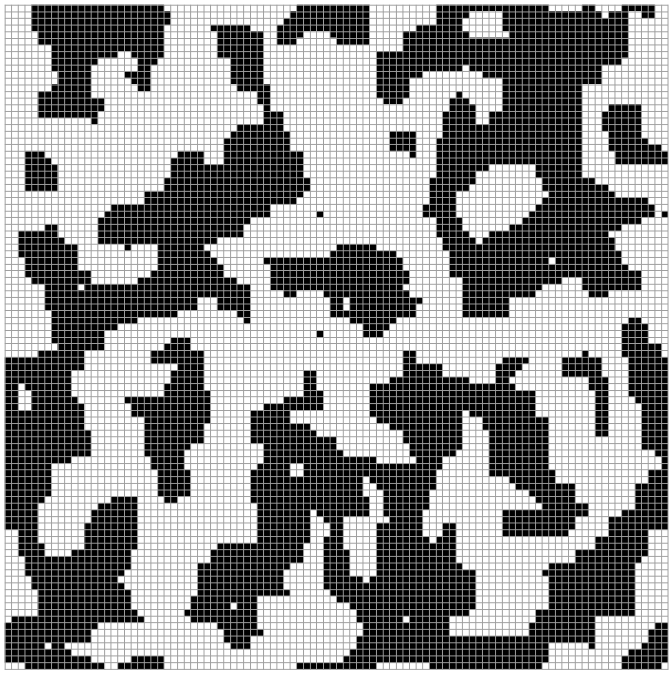

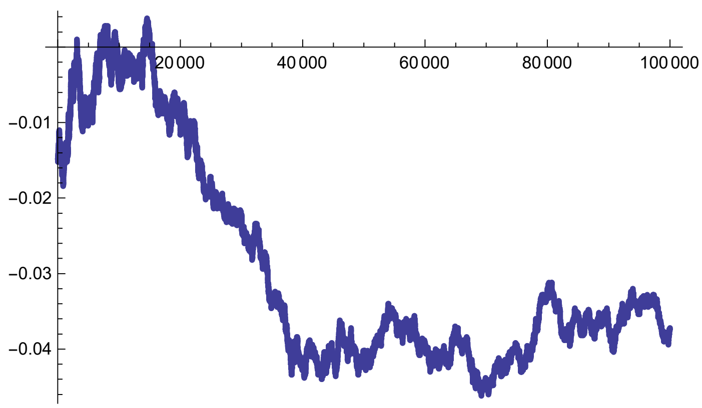
20000
40000
60000
80000
100000
-0.01
-0.02
-0.03
-0.04