Grade: check

Activity 13

Simulation of 2D Ising

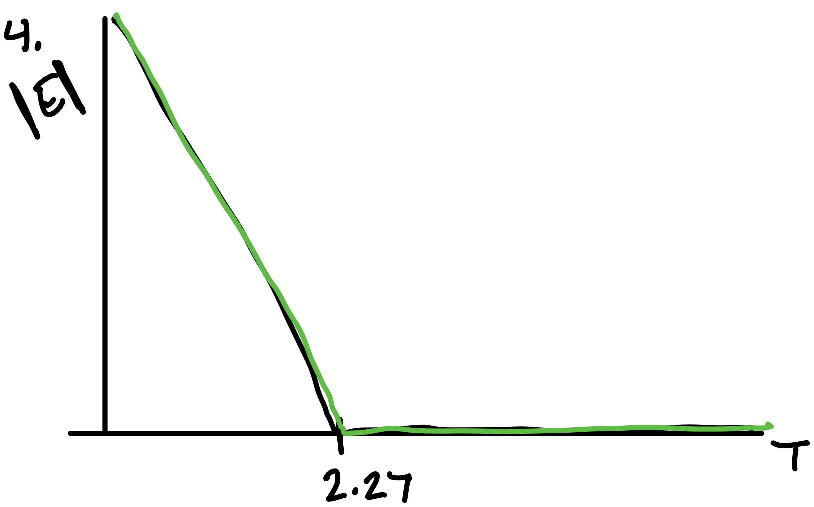
1. ✓

2. There seems to be an equal number of the two allignments. But, many of the neighboring pairs seem to be opposite spin. This means that @ $T=10$ the energy of the system is higher, and constant.

3. Mine did always end up in a uniform ferro magnetic state at low T, but not @ high T.

   for low T we had $E=+N$ or $-N$

   for high T we had $E \approx 0$

4. 

5. smaller sizes are more likely to be ferro mag, even around the critical point of 2.27.

Monte Carlo Sampling

1. • The code starts with $J = 1$, which is ferromagnetic, and $J = -1$ which is anti ferromagnetic. The lowest E has spins aligned with the field.

• add $-\Sigma H S_i$ to the "calculate_energy" portion of the code.

• microstates $= 20$

there are 2^{20} configurations

time $= \frac{2^{40}}{2^{20}}$ 2^{20} x longer?

• Max $E = +20$ min $E = -20$

or 0 when all unaligned.

I am going to guess all values between -20 and +20 are possible, so 41 Energies.

• Boundary conditions

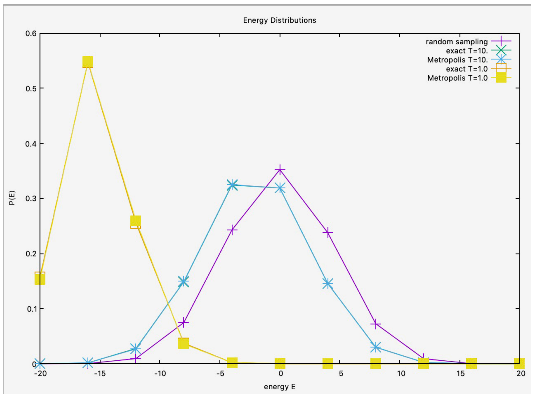
- we have a continuous band where site 20 wraps around to meet w site 1.

the other option would be to have site 1 and site 20 be disconnected, this way the endpoints only have 1 neighbor.

• Z_exact $= \Sigma ($E count$(i) \cdot e^{-E_i/kT}$

and later it adds the # of states w Energy

2. No, I definitely overcounted by not considering degenerate states.

3. 

- Ordinary random sampling is entirely random. All spin states have equal probability, the average E should be around 0 in this case. I'd guess T is infinitely high or where $H_{T=\infty}=0$

  ↳ T is infinitely high

- random sampling is done @ too high a T. It's not going to give physical results. Yes, metropolis lines up pretty close w/ the "exact" results.

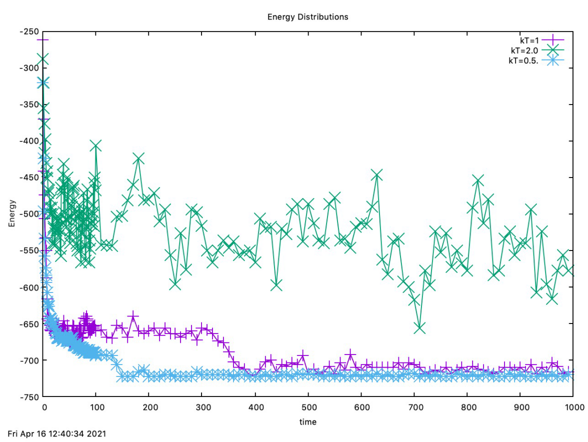
- line 179 looks like 2.1.39b. -and I switched it to a ✓ to check

5 change PE to KE = total E - PE

The Two-D Ising Model

1. 1D Ising models take into account only the two neighbors on either side. The 2D models require the 4 neighbors, two on either side, and the ones above and below.

2.



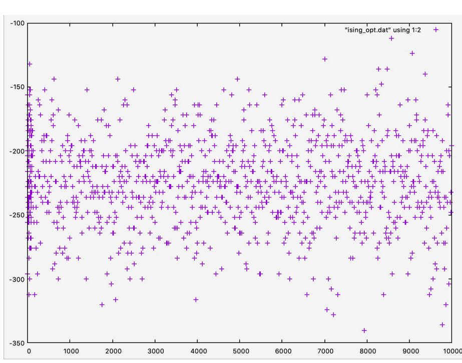
- I kept getting the final E to be around 710.
- High KT never really reached equilibrium, KT=0.5 reached equilibrium @ 150
- KT=1.0 would reache equilibrium at various times.

3. Change J_ising from +1 to -1

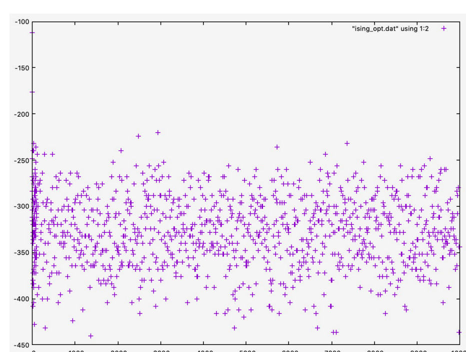
4. I do not have a clue how to implement this... (plus I am too late for office hours)

6.

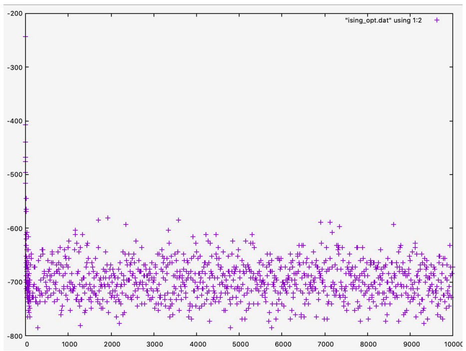
KT = 4



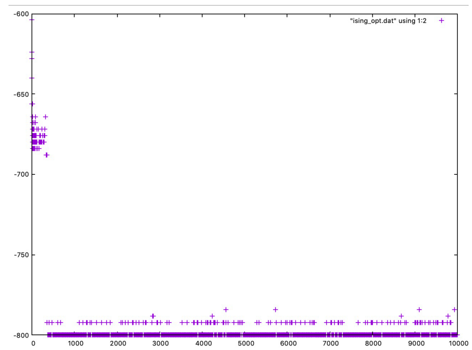
KT = 3



kT = 2



kT = 1



It seems to become magnetized

- use the absolute value because spin can be up or down.
- The larger the L, the larger the system and a better likelihood of reaching equilibrium