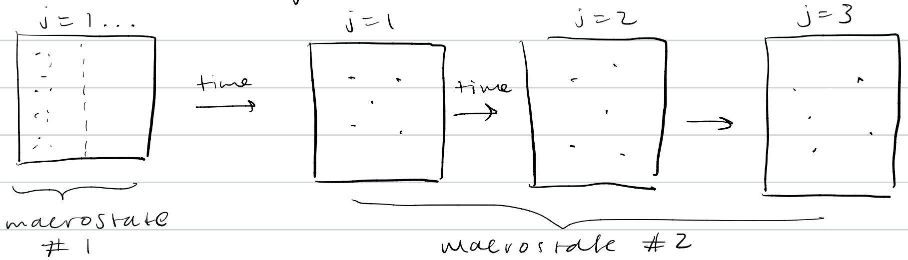
Lecture 18

Last Time: Stat mech.

"understanding microstates"

ex:



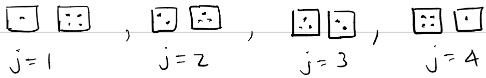
- microstates j = 1, 2, 3, ... know all positions and velocities of every particle.
- macrostates: know state functions like E, V, N, color
- in macrostate #1, volume occupied by particles is less than in macrostate #2.

Some more vocab:

- Ensemble: the collection of all microstates consistent w/ a given macrostates

ex: Let the dots rolled on N dice ("molecules") be their energy E.

For $N = 2$, $E = 5$



- Partition function: W = number of microstates in a macrostate

Ex: above, for $N = 2$ dice, $E = 5$,

$W = 4$.

- Extensive: linear w/ system size; E, V, N, etc
- Intensive: independent of system size;

$\frac{E}{N} \sim T$, $\frac{V}{N}$, color

The Postulates of Statistical Mechanics

1) The microscopic laws (eg $F = ma$, $H\Psi = E\Psi$) apply to isolated systems specified by extensive state functions E, V, N, ...

   ex: if roll a die and it's fair, then rolling a mole of die is also fair

   Def: 1 mole = $6.02214076 \times 10^{23}$

2) Principle of equal probability:

   - weak form (I): All microstates of a system that satisfies postulate 1 have equal probability per microstate.

     $$\rho_j = \frac{1}{W}$$

     ex: N = 2 dice, E = 5, $\rho_1 = \rho_2 = \rho_3 = \rho_4 = \frac{1}{4}$

     we call these microstates the "microcanonical ensemble"

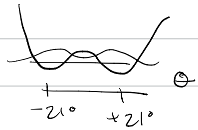
   - Strong form (II): for an ensemble that satisfies postulate 1 and postulate 2 part I

     $$\Rightarrow \langle p_j \rangle_{ensemble} = \langle p_j \rangle_{time}$$

     ex: pitch drop in Australia, window glass

Averages and Counting

HW S 2.1



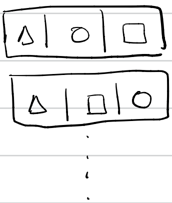
$\theta_i = -27°, +16°,$

$+20°, -12°, +8°, -12°$

$\langle \theta \rangle = \bar{\theta} = \frac{1}{3}(-12) + \frac{1}{6}(-27) + \frac{1}{6}(16) + \ldots$

$= 1.16°$

Counting S.2.2



How many arrangements?

$3! = 3 \cdot 2 \cdot 1 = 6$