Major concepts in Leonard Susskind's Statistical Mechanics

Lecture 1 2 3 4 5 6 7 8 9 10

Basic Probability

Entropy (**S**) & Information

"-1st Law": Conservation of Information (Liouville's Thm.)

Phase space

Boltzmann Constant

Temperature **T**

Boltzmann-Gibbs Distribution (distribution of energy levels)

Derivation of Boltzmann dist From total probability and energy.

Partition Function **z** (sum of counts at all energy levels)

Energy as derivative of partition function

0th Law: Thermal equilibrium "transitive"

Entropy in terms of average energy and partition function

1st law: Energy is conserv

Ideal Gas Partition Function

2nd Law: Entropy increases

Temperature, Equilibrium

Stirling's Approximation Of Factorial

Lagrange Multipliers

Pressure of Ideal Gas

Helmholz Free Energy

Adiabatic: "slowly", No heat added, Reversible, Stable energy levels

Theorem relating Change in energy, entropy, volume

Fluctuations (Variance)

Exact/ Inexact, curl

Total heat to change state is path dependent

Hamiltonian: System energy description e.g. kinetic + potential

Boltzmann Distribution Of Harmonic Oscillator

Quantum Mechanical Harmonic Oscillator

Entropy:
- property of system
- what you know about system

Chaotic system can fill phase space = maximum entropy

Poincare recurrence & Reversibility

Ising Model

Phase Transition

Liquid-Gas Transition In Ising Model

How to find z, partition function:
- find Hamiltonian (energy equation)
- integrate over dp, dx of E
  - (position, momentum)
- plug in to $z = \int e^{-\beta E_i}$
- gives **Boltzmann distribution** of energy:

$$p_i = \frac{1}{z} e^{-\beta E_i}$$

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