Course 565/665 Lecturer Prof. Cavagnero
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Chapter 6.

entropy S

Thermodynamic functions: q. w. U. T

$S \equiv k \ln W$ W: # of configurations

k: Boltzmann constant, $1.38062 \times 10^{-23} JK^{-1}$

Define s in terms of probability.

e.g. D a die with "t" faces, roll it N times.

2. ▭▭▭▭… • o… beads to fill

$$W = \frac{N!}{n_1!\, n_2! \cdots n_t!} \qquad p_i = \frac{n_i}{N}$$ need large N ?

Stirling approximation: $N! = N^N \cdot e^{-N} = \left(\frac{N}{e}\right)^N$

$$W = \frac{(N/e)^N}{\left(\frac{n_1}{e}\right)^{n_1}\left(\frac{n_2}{e}\right)^{n_2}\cdots\left(\frac{n_t}{e}\right)^{n_t}} = \frac{N^N}{n_1^{n_1} n_2^{n_2} \cdots n_t^{n_t}} = \frac{1}{p_1^{n_1} p_2^{n_2} \cdots p_t^{n_t}}$$

$$\ln W = -\left(n_1 \ln p_1 + n_2 \ln p_2 + \cdots n_t \ln p_t\right)$$

$$\frac{\ln W}{N} = -\sum_{i=1}^{t} p_i \ln p_i$$

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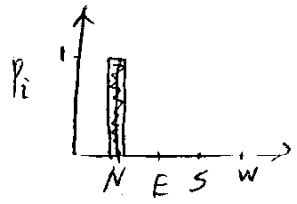
$$\frac{S_N}{kN} = -\sum_{i=1}^{t} P_i \ln P_i \geq 0 \quad , \quad S_N \geq 0$$

Flatter distribution have higher s than "more peaked" (biased) distribution

(ex):  magnetic dipole or pencile
-δ +δ
spin a pencile. and check its orientation in the end

$$W = \frac{N!}{n_N!\, n_S!\, n_W!\, n_E!} \quad , \quad P_N = \frac{n_N}{N} \; ; \; P_S = \frac{n_S}{N} \; \cdots$$

case 1. ordered



case 2 biased.