→ AQ = AU+AW

→ State ob entropy 1

9inn'n'

Relation Between Entropy and Probabilities

 " The Boltzmann formula shows the relationship between entropy and the number of ways the atoms or molecules of a thermodynamic system can be arranged."

 $S = k \log W$

"At equilibrium, the system will be in its most probable state and the entropy will be maximum."



Ludwig Boltzmann (1844 - 1906)

Statistical entropy:

S= -k & PilnPi

Whatis classical info:

-) Sun will rise on the east today

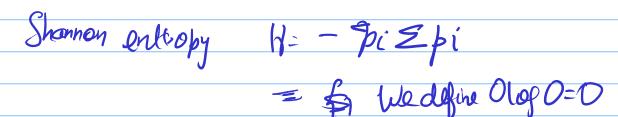
-) We may have rainfall tonight at Chemai.

> Stalement I is a centain event Coopent add to Knowledge)

Information is all about probabilities

- Statement 3: One-third of the world's population is India+ China population.
- Statement 4: Two-third of the earth's surface is covered by water.
- Is there any difference between the information contents of these two statements?.
- No! Given any person, our ignorance about his/her nationality is same as our ignorance about the character (viz. water or solid) of any given surface area of the Earth.
- So information is all about the probabilities of occurrences of different events: probability that a person (from all over the world) is (India + China) is 1 / 3, probability that a surface area of the Earth is solid is equal to 1 / 3, etc.

- Thus the amount of information about an event is the amount of ignorance (or, uncertainty) about that event.
- Ignorance increases with increase of the inverse of the probability p of occurrence of the event.
- Total amount of ignorance of two independent events is sum of the ignorance.
- So the amount of ignorance H(p) should be an additive function of p.



· Example of Shannon's noiseless coding theorem

Code 4 symbols {1, 2, 3, 4} with probabilities {1/2, 1/4, 1/8, 1/8}.

Code without compression:

$$[1,2,3,4] \xrightarrow{\text{withoutcompr.}} [00,01,10,11]$$

But, what happens if we use this code instead?

$$[1,2,3,4] \xrightarrow{\text{with compr.}} [0,10,110,111]$$

Average string length for the second code:

$$\langle lenght \rangle = \frac{1}{2}1 + \frac{1}{4}2 + \frac{1}{8}3 + \frac{1}{8}3 = \frac{7}{4} < 2$$

Note:
$$H\left(\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{8}\right) = -\frac{1}{2}\log_2\frac{1}{2} - \frac{1}{4}\log_2\frac{1}{4} - \frac{2}{8}\log_2\frac{1}{8} = \frac{7}{4}$$

Classical encodings don't work necessorily work in quantum

0-2 2-4 4-5 10-11

5-10

10-13