

# what is entropy?

## ENTROPY

"YOU SHOULD CALL IT 'ENTROPY'...  
NO ONE KNOWS WHAT ENTROPY  
REALLY IS, SO IN A DEBATE YOU  
WILL ALWAYS HAVE THE ADVANTAGE."

— JOHN VON NEUMANN, TO  
CLAUDE SHANNON, ON WHY HE  
SHOULD BORROW THE PHYSICS  
TERM IN INFORMATION THEORY  
(AS TOLD TO MYRON TRIBUS)

# univariate entropy

statistical entropy is a measure of uncertainty of random variables

for a discrete random variable  $X$  with a finite range space of size  $r_X$

$$H(X) = \sum_x p(x) \log_2 \frac{1}{p(x)} \quad p(x) > 0, \quad \sum_x p(x) = 1$$

- ☑ minimal zero entropy has no uncertainty
- ☑ maximum entropy  $\log_2(r_X) \implies$  uniform distribution

