

Mutual Information $I(X;Y)$

Comparing two distributions: $p(x,y)$ vs $p(x)p(y)$

$$I(X;Y) = \sum_{x,y} p(x,y) \log \frac{p(x,y)}{p(x)p(y)} = H(X) - H(X|Y) = H(Y) - H(Y|X)$$

Properties: $I(X;Y) \geq 0$; $I(X;Y) = I(Y;X)$; $I(X;Y) = 0$ iff X & Y are independent

Interpretations:

- Measures how much reduction in uncertainty of X given info. about Y
- Measures correlation between X and Y
- Related to the “channel capacity” in information theory

Examples:

$I(\text{Topic}; \text{“computer”})$ vs. $I(\text{Topic}; \text{“the”})$?

$I(\text{“computer”, “program”})$ vs $I(\text{“computer”, “baseball”})$?