

Proposition 2.16

$$H(X, Y) = H(X) + H(Y|X)$$

and

$$H(X, Y) = H(Y) + H(X|Y).$$

Proof

Consider

$$\begin{aligned} H(X, Y) &= -E \log p(X, Y) \\ &= -E \log [p(X)p(Y|X)] \\ &= -E \log p(X) - E \log p(Y|X) \\ &= H(X) + H(Y|X). \end{aligned}$$