

**Definition 10.36** The typical set  $W_{[X]_\epsilon}^n$  with respect to  $f(x)$  is the set of sequences  $\mathbf{x} = (x_1, x_2, \dots, x_n) \in \mathcal{X}^n$  such that

$$\left| -\frac{1}{n} \log f(\mathbf{x}) - h(X) \right| < \epsilon$$

or equivalently,

$$h(X) - \epsilon < -\frac{1}{n} \log f(\mathbf{x}) < h(X) + \epsilon$$

where  $\epsilon$  is an arbitrarily small positive real number. The sequences in  $W_{[X]_\epsilon}^n$  are called  $\epsilon$ -typical sequences.

**Empirical Differential Entropy:**

$$-\frac{1}{n} \log f(\mathbf{x}) = -\frac{1}{n} \sum_{k=1}^n \log f(x_k)$$

The empirical differential entropy of a typical sequence is close to the true differential entropy  $h(X)$ .