Expected code length

- Fix the messsage length T
- Suppose the message is generated at random according to the distribution $p(c_1, \ldots c_T)$
- Then the expected code length is

$$\begin{aligned} & \sum_{c_1, \ldots c_T} p(c_1, \ldots c_T) \lceil -\log_2 p(c_1, \ldots c_T) \rceil \\ \leq & \; 1 - \sum_{c_1, \ldots c_T} p(c_1, \ldots c_T) \log_2 p(c_1, \ldots c_T) \\ \doteq & \; 1 + H(p_T) \end{aligned}$$

- $H(p)$ is the entropy of the distribution p.