

## The code length for arithmetic coding

- ▶ Given  $m$  bits of binary expansion we assume the rest are all zero.
- ▶ Distance between two  $m$  bit expansions is  $2^{-m}$
- ▶ If  $l_T - u_T \geq 2^{-m}$  then there must be a point  $x$  described by  $m$  expansion bits such that  $l_T \leq x < u_T$
- ▶ Required number of bits is  $\lceil -\log_2(u_T - l_T) \rceil$ .
- ▶  $u_T - l_T = \prod_{t=1}^T p(c_t | c_1, c_2, \dots, c_{t-1}) \doteq p(c_1, \dots, c_T)$
- ▶ Number of bits required to code  $c_1, c_2, \dots, c_T$  is  $\lceil -\sum_{t=1}^T \log_2 p_t(c_t) \rceil$ .