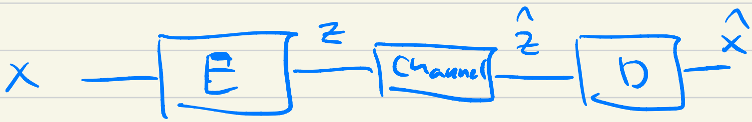
Lloyd-Max quantizer: codebook $\mathcal{C} = \{y_0, y_1\}$

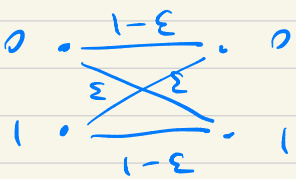
$$y_0 = -\sqrt{\frac{2}{\pi}}, \quad y_1 = \sqrt{\frac{2}{\pi}} \qquad R_0 = (-\infty, 0)$$

$$R_1 = [0, \infty)$$

$$E : \mathbb{R} \to \{0, 1\} \qquad E(x) = \begin{cases} 0 & \text{if } x < 0 \\ 1 & \text{if } x \geq 0 \end{cases}$$

$$D : \{0, 1\} \to \mathbb{R} \qquad D(i) = y_i, \quad i \in \{0, 1\}$$





Generate test samples $x_1, x_2, \ldots, x_M$

$$\text{Dist} = \frac{1}{M} \sum_{i=1}^{M} (x_i - \hat{x}_i)^2$$

let $P(e=0) = 1-\varepsilon$, $P(e=1) = \varepsilon$

$$\hat{z} = z \oplus e$$

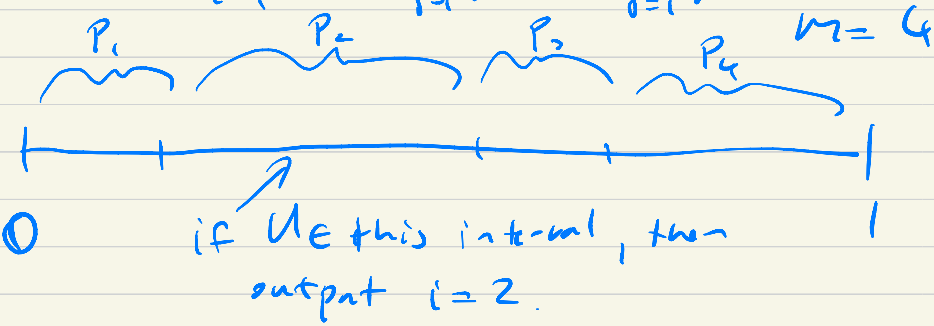
Generate e: let $U \sim \mathcal{U}([0,1])$

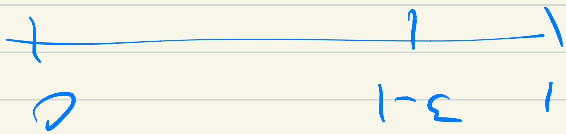
$P(U \leq y) = y$, $0 \leq y \leq 1$. let $\Big(P(U > 1-\varepsilon) = 1 - P(U \leq \varepsilon) = 1-(1-\varepsilon) = \varepsilon \Big)$

$$e = \begin{cases} 0 & \text{if } U \leq 1-\varepsilon \\ 1 & \text{if } U > 1-\varepsilon \end{cases}$$

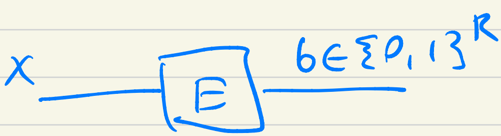
Simulate discrete r.v. $V \in \{1, \dots, m\}$
with distribution $P(V=i) = p_i$, $i = 1, \dots, m$.
$\left(\sum_{i=1}^{m} p_i = 1 \right)$.

$$\sum_{i=1}^{m} i \, I_{\left\{ \sum_{j=1}^{i-1} p_j \le U < \sum_{j=1}^{i} p_j \right\}}$$





$N = 2^R$, $R \ge 1$.



Instead of indexing the codepoints
as $y_0, y_1, \dots, y_{N-1}$, are the
binary form of integer i, $i \in \{0, \dots, N-1\}$

Transition probabilities. BSC(ε).

$b \in \{0,1\}^K$, $\quad b = b_1 b_2 \cdots b_K$

$$p(\underbrace{\hat{b}}_{\in\{0,1\}^K} \mid b) = \prod_{i=1}^{K} \underbrace{p(\hat{b}_i \mid b_i)}$$

$= 1-\varepsilon$ if $b_i = \hat{b}_i$

$= \varepsilon$ if $b_i \neq \hat{b}_i$

$$= \varepsilon^{d_H(\hat{b}, b)} (1-\varepsilon)^{K - d_H(\hat{b}, b)}$$