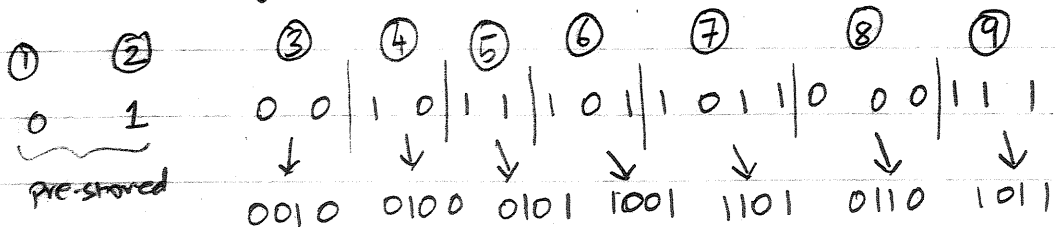


1. Encoding and Decoding using Lempel-Ziv:

Given bit stream:

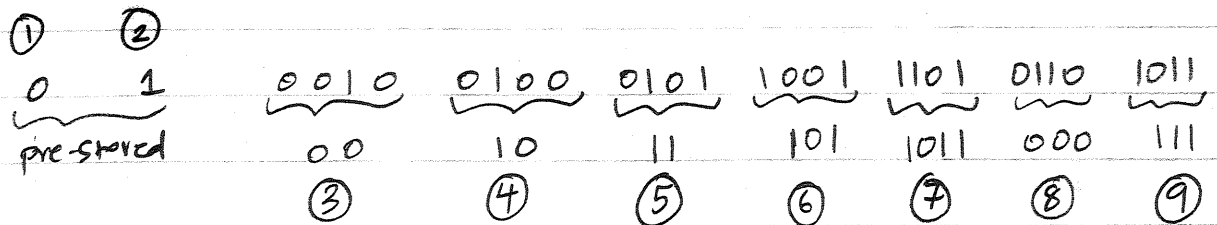
0 0 1 0 1 1 1 0 1 1 0 1 1 0 0 0 1 1 1

(a) Sender: (Encoding)

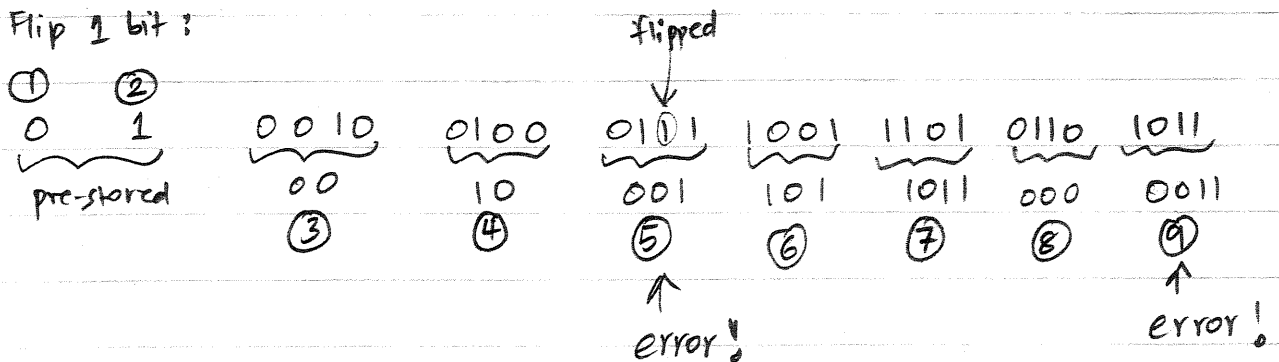


(b) Receiver: (Decoding)

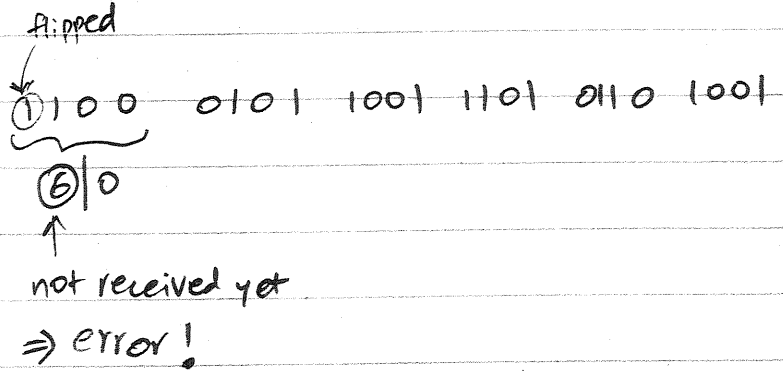
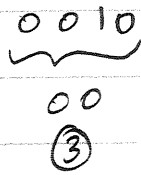
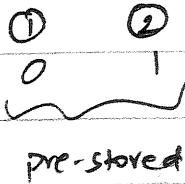
* No noise:



* Flip 1 bit:



* Flip 1-bit



$$\frac{2}{9.15}$$

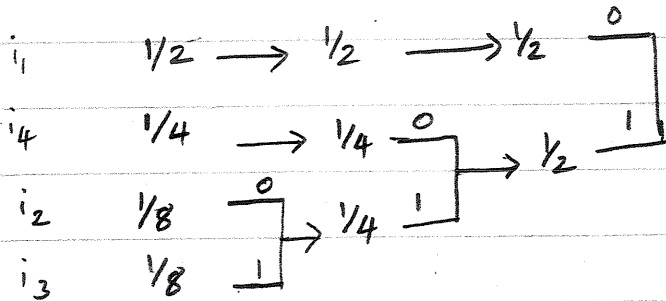
$$S = \{i_1, i_2, i_3, i_4\}$$

$$P = \left\{ \frac{1}{2}, \frac{1}{8}, \frac{1}{8}, \frac{1}{4} \right\}$$

Represented by: $\{00, 01, 10, 11\}$

Avg. codeword length = 2 bits

Huffman code:



- $i_1 : 0$
- $i_4 : 10$
- $i_2 : 110$
- $i_3 : 111$

$$\begin{aligned} \text{Avg. codeword length} &= \left(1 \times \frac{1}{2}\right) + \left(2 \times \frac{1}{4}\right) + \left(3 \times \frac{1}{8}\right) \times 2 \\ &= 1.75 \text{ bits} \end{aligned}$$

$$\text{Improvement} = \frac{0.25}{2} \times 100 = 12.5\%$$