SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECB301 – ANALOG AND DIGITAL COMMUNICATION

III B.E. ECE$_1$/ V SEMESTER

UNIT 5 – INFORMATION THEORY AND ERROR CONTROL CODING

TOPIC – HUFFMAN CODING

HUFFMAN CODING

- The most popular technique for removing coding redundancy is due to Huffman (1952)

- When coding the symbols of an information source individually, Huffman coding yields the smallest possible number of code symbols per source symbol

- In terms of the noiseless coding theorem, the resulting code is optimal for a fixed value of n, subject to the constraint that the source symbols be coded one at a time

HUFFMAN CODING

The first step in Huffman's approach is

- To create a series of source reductions by ordering the probabilities of the symbols under consideration

- Combining the lowest probability symbols into a single symbol that replaces them in the next source reduction
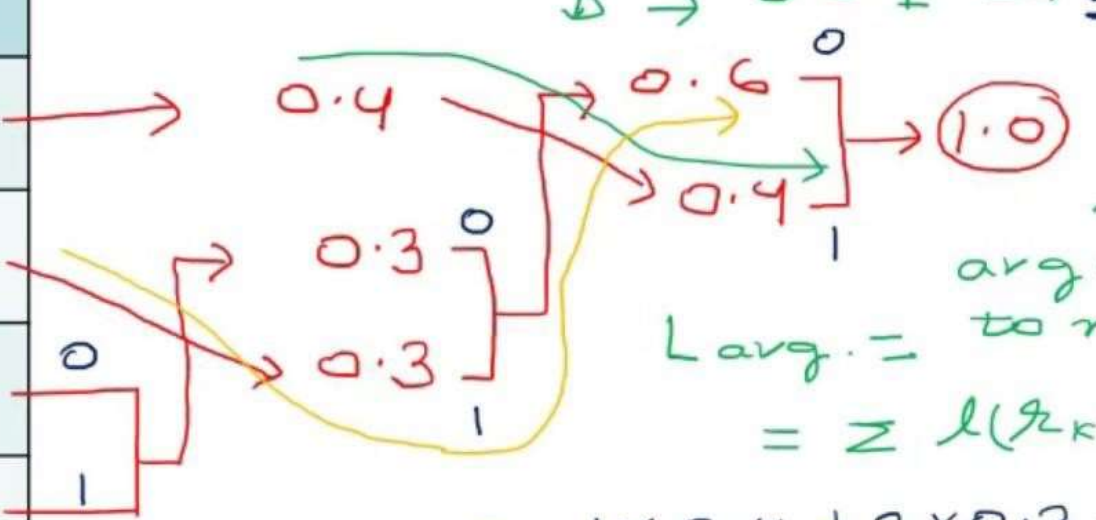
HUFFMAN CODING

Huffman Coding

Example: Calculate the Huffman Codes for the set of symbols as shown in table.

Symbols	A	B	C	D
Probability	0.4	0.3	0.2	0.1

Solution:

Symbol	Probability
A	0.4
B	0.3
C	0.2
D	0.1

$l(x_K)$

Codewords → length of code word

A → 1 → 1
B → 01 → 2
C → 000 → 3
D → 001 → 3

0.4 → 0.6 ⎤
       0.4 ⎦ → 1.0

0.3 → 0.3
0.3

no.
avg. of bits used to represent message

$L_{avg} = \sum l(x_K) \, P(x_K)$

$= 1 \times 0.4 + 2 \times 0.3 + 3 \times 0.2 + 3 \times 0.1$

$= 1.9 \text{ bits/symbols}$

HUFFMANN CODING

1. To Find the average code word Length

$$L = \sum_{k=1}^{5} P_k \left[\text{length of } m_k \text{ in bits} \right]$$

2. To Find the Entropy of the Source

$$H = \sum_{k=1}^{5} P_k \log_2 \left(\frac{1}{P_k} \right)$$

3. Code efficiency $\eta = \frac{H}{L} \times 100 \%$