Tutorial Lecture 13

Q/ A symbols (x_1, x_2, x_3, x_4, x_5, x_6 and x_7), with a prpbabilities of (0.11, 0.04, 0.12, 0.13, 0.45, 0.1 and 0.05) respectively. Develop Hufmman code to obtain the binary code for each symbol.

Solution:

X_5	0.45	0.45	0.45	0.45	0.45	0.55	1	1
X_4	0.13	0.13	0.19	0.23	0.32	0.45	000	3
X_3	0.12	0.12	0.13	0.19	0.23		010	3
X_1	0.11	0.11	0.12	0.13			011	3
X_6	0.10	0.10	0.11				0000	4
X_7	0.05	0.09					00010	5
X_2	0.04						00011	5

Q/ Given a source that produces the following symbols {$a_1,a_2,a_3,a_4,a_5,a_6,a_7$} with probabilities (0.25, 0.35, 0.03, 0.12, 0.07, 0.18} respectively,

(a) Design Huffman code.
(b) Calculate the code efficiency

Solution:

a-

a2	0.35	→ 0.35	→ 0.35	0.4	0.6	1
a1	0.25	→ 0.25	→ 0.25	0.35	0.4	
a6	0.18	→ 0.18	0.22	0.25		
a4	0.12	→ 0.12	0.18			
a5	0.07	0.1				
a3	0.03					

A	Code	l_i
a2	00	2
a1	01	2
a6	11	2
a4	100	3
a5	1010	4
a3	1011	4

b.

$$\eta = \frac{H(x)}{L_c} \times 100$$

$$H(x) = \sum \log_2 P(x_i) \times P(x_i)$$

$$H(x) = \frac{(0.35\times\ln(0.35)+0.25\times\ln(0.25)+0.18\times\ln(0.18))+0.12\times\ln(0.12)+0.07\times\ln(0.07)+0.03\times\ln(0.03)}{\ln(2)} = 2.26279\,\frac{bits}{symbol}$$

$$L_C = \sum_i l_i \times P(x_i) =$$

$$= 2 \times (0.35 + 0.25 + 0.18) + 3 \times 0.12 + 4 \times (0.07 + 0.03)$$

$$= 2.23 \frac{bits}{message}$$

$$\eta = \frac{2.26279}{2.23} \times 100 = 97.75\%$$