Name : Abdallah Bin Noman Tabid

Student ID : 2120180031

Course Title : Mobile and Telecommunication

Course Code : CSE-443

"final Assessment"

Ans to the Q No 3(a)

e	f	o	p	b	c
↓	↓	↓	↓	↓	↓
57	51	33	20	12	3

N = 57 + 51 + 33 + 20 + 12 + 3

= 176

~~e = 000 , b =~~

e = 000

b = 001

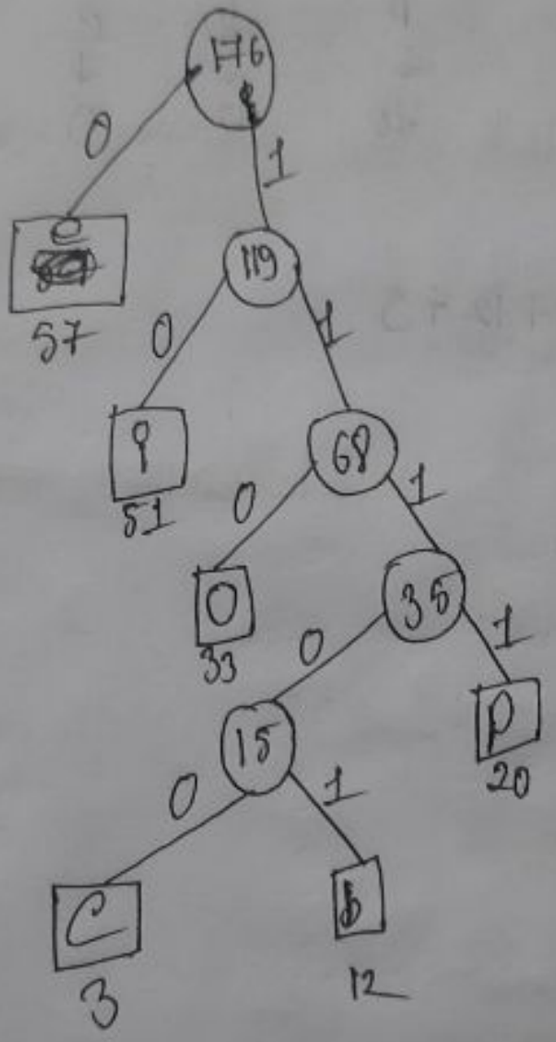
o = 010

p = 011

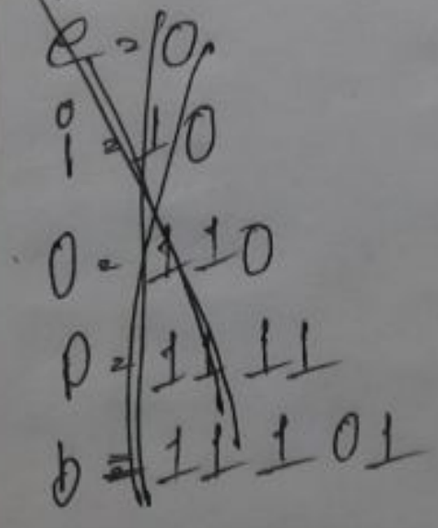
b = 100

c = 101

Now,


176
0
1
57
119
0
1
9
51
68
0
1
0
33
35
0
1
15
20
0
1
C
3
b
12

Now,


e = 0
i = 10
o = 110
p = 111
b = 1101

~~c = 11100~~

Again,

c = 0 ,	57 × 1 = 57
i = 10 ,	51 × 2 = 102
o = 110 ,	33 × 3 = 99
p = 1111 ,	20 × 4 = 80
b = 11101 ,	12 × 5 = 60
c = 11100 ,	3 × 5 = 15
	413 bits

Now,

Average bits required to represent each characters = $\frac{413}{176}$

= 2.34 bits / character

efficiency:

e	q	o	p	b	c
↓	↓	↓	↓	↓	↓
57	51	33	20	12	3

Solution:

message	Probability	1st Reduction	2nd Reduction	3rd Reduction	4th Reduction
e	57 00	57 00	57 00	68 1	100 0
q	51 01	51 01	51 01	57 00	68 1
o	33 11	33 11	35 10	51 01	
p	20 100	20 100	33 11		
b	12 1010	15 101			
c	3 1011				

Now,

e = 57	,	$C_1 = 00$	, $n_1 = 2$
q = 51	,	$C_2 = 01$	, $n_2 = 2$
o = 33	,	$C_3 = 11$	, $n_3 = 2$
p = 20	,	$C_4 = 100$	, $n_4 = 3$
b = 12	,	$C_5 = 1010$	, $n_5 = 4$
c = 3	,	$C_6 = 1011$	, $n_6 = 4$

efficiency (η) = $\frac{H(x)}{L}$

$\therefore H(x) = -\sum_{k=1}^{6} P_k \log_2 P_k$

$= -P_1 \log_2 P_1 - P_2 \log_2 P_2 - P_3 \log_2 P_3 - P_4 \log_2 P_4$

$- P_5 \log_2 P_5 - P_6 \log_2 P_6$

$= -57 \log_2 57 - 51 \log_2 51 - 33 \log_2 33 - 20 \log_2 20$

$- 12 \log_2 12 - 3 \log_2 3$

~~$= 332.47 + 289.29 + 166.46$~~

$= -332.47 - 289.29 - 166.46 - 86.45 - 43.01$

$- 4.75$

$= -922.41$

~~$= (922.41)$ (-1 দিয়ে গুণ করা)~~

~~$= 922.41$~~

$$L = \sum_{K=1}^{6} = P(x_1)n_1 + P(x_2)n_2 + P(x_3)n_3 + P(x_4)n_4 + P(x_5)n_5 + P(x_6)n_6$$

$$= (57\times2 + 81\times2 + 33\times2 + 20\times3 + 12\times4 + 3\times4)$$

$$= (114 + 102 + 66 + 60 + 48 + 12)$$

$$= 402$$

$$\text{efficiency} = \frac{H(x)}{L}$$

$$= \frac{-922.41}{402}$$

$$= -2.294$$

∴ efficiency $= -2.294$.

7

Ans to the Q No 3

(b)

Given,

$m_1 = \frac{1}{2}$, $m_2 = \frac{1}{8}$, $m_3 = \frac{1}{8}$, $m_4 = \frac{1}{4}$

Now,

Source entropy $= \sum_{k=1}^{M=4} p_k \log_2 \frac{1}{p_k}$

$\therefore$ Source entropy $= \sum_{k=1}^{M=4} m_k \log_2 \frac{1}{m_k}$

$= m_1 \log_2 \frac{1}{m_1} + m_2 \log_2 \frac{1}{m_2} +$

$m_3 \log_2 \frac{1}{m_3} + m_4 \log_2 \frac{1}{m_4}$

$= \frac{1}{2} \log_2 2 + \frac{1}{8} \log_2 8 + \frac{1}{8} \log_2 8$

$+ \frac{1}{4} \log_2 4$

$= 1.75$ bits/symbol

$\therefore$ System entropy $= 1.75$ bits/symbol.

Ans to the Q No 4

(a)

Solution:

$P(m_1)=0.4$, $P(m_2)=0.2$, $P(m_3)=0.12$, $P(m_4)=0.08$, $P(m_5)=0.08$, $P(m_6)=0.06$, $P(m_7)=0.06$.

message	Probability P(m)	step 1	step 2	step 3	step 4	code	no. of bits (n_i)
m_1	0.4	0	0			00	2
m_2	0.2	0	1			01	2
m_3	0.12	1	0			10	2
m_4	0.08	1	1	0	0	1100	4
m_5	0.08	1	1	0	1	1101	4
m_6	0.06	1	1	1	0	1110	4
m_7	0.06	1	1	1	1	1111	4

Coding efficiency = $\frac{H(X) \rightarrow \text{entropy}}{L \rightarrow \text{code length}}$

$$H(X) = -\sum_{k=1}^{7} P_k \log_2 P_k$$

$$= -0.4 \log_2 0.4 - 0.2 \log_2 0.2 - 0.12 \log_2 0.12$$
$$- 0.08 \log_2 0.08 - 0.08 \log_2 0.08 - 0.06 \log_2 0.06$$
$$- 0.06 \log_2 0.06$$

$$= 0.5281 + 0.464 + 0.367 + 0.291 + 0.291$$
$$+ 0.243 + 0.243$$

$$= 2.427 \text{ bits/symbol}$$

∴ Code Length (L) = $\sum_{K=1}^{7} P(x_i) n_i$

$= (0.4 \times 2) + (0.2 \times 2) + (0.12 \times 2) +$

$(0.08 \times 4) + (0.08 \times 4) + (0.06 \times 4) + (0.06 \times 4)$

$= 2.56$ Letters/message

Now,

Coding efficiency $= \frac{2.427}{2.56}$

$= 0.94$

$= 0.94 \times (100)\%$

$= 94\%$

∴ Coding efficiency 94%.

Ans to the Q No 2

(a)

(i)

a|a a|b|b b|ab|a b a|b a|b b b|b a a|a b ab|ab|
1 2 3 4 5 6 7 8 9 10 11

~~a → 0, b → 1~~ a → 0, b → 1

~~Position~~	~~1~~	~~2~~	~~3~~	~~4~~	~~5~~	~~6~~	~~7~~	~~8~~	~~9~~	~~10~~
~~Sequence~~	~~a~~	~~aa~~	~~b~~	~~bb~~	~~ab~~	~~aba~~	~~ba~~	~~bbb~~	~~baa~~	~~abb~~

Position	1	2	3	4	5	6	7	8	9	10	11
Sequence	a	aa	b	bb	ab	aba	ba	bbb	baa	abab	ab
Numerical rep.	0a	1a	0b	2b	1b	5a	3a	4b	7a	6b	5
Code	000	10	001	101	11	1010	110	1001	1110	1101	101

(ii)

Decoding the Lempel-Ziv encoded sequence —

P q 1P 2q 3q 4P 5P 4q 6P

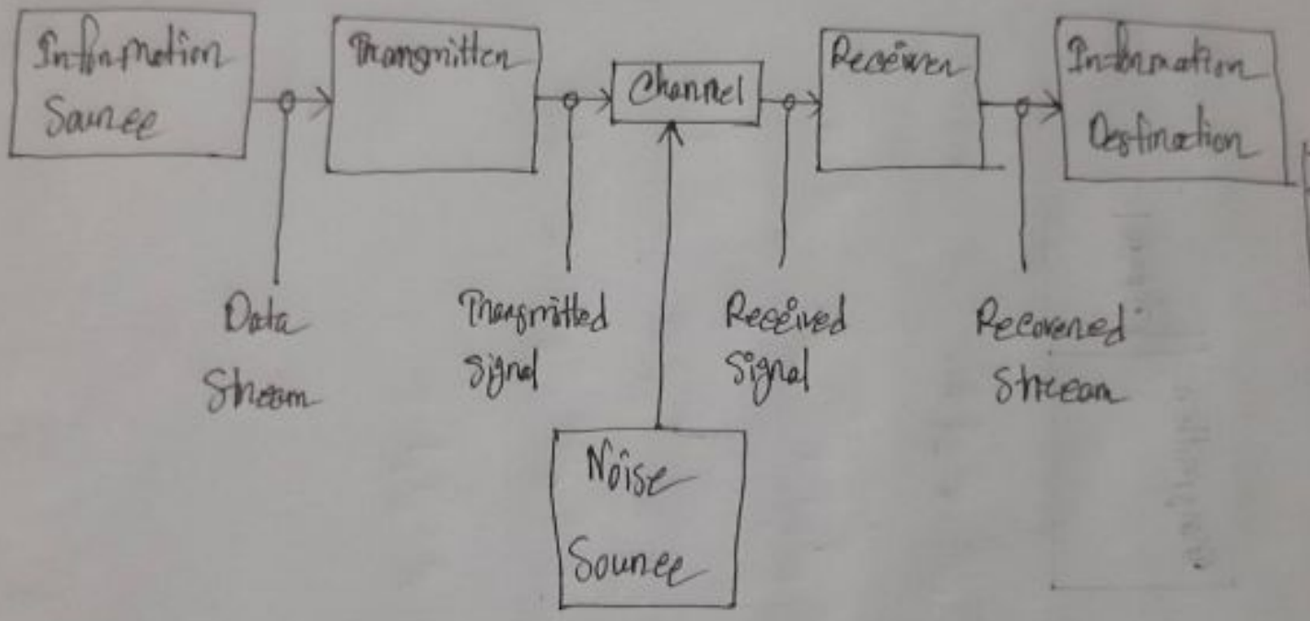
Codeword	Information bit	Location
P	P	1
q	q	2
1P	PP	3
2q	qq	4
3q	PPq	5
4P	qqP	6
5P	PPqP	7
4q	qqq	8
6P	qqPP	9

Now,
Information: P q PP qq PPq qqP PPqP qqq qqPP.

Ans to the Q No-1

(a)

Here is the drawing of basic Communication System



Ans to the Q No 1(a)

15

Figure: Block diagram of a basic communication System.

Definition:

The basic communication system is a system which describes the information exchange between two points. The process of transmission and reception of information is called communication. Major elements are transmitter, channel and the receiver.

Ans to the Q No-1

(b)

Here, given,

$$H = \frac{I_T}{L}$$

and also,

$$= \sum_{q=1}^{K} L P_i \log_2 \left(\frac{1}{P_i} \right)$$

Given,

$$H = \frac{I_T}{L}$$

$$\Rightarrow I_T = H \times L$$

$$\Rightarrow I_T = \left(L_1 P_1 \log_2\left(\frac{1}{P_1}\right) + L_2 P_2 \log_2\left(\frac{1}{P_2}\right) + L_3 P_3 \log_2\left(\frac{1}{P_3}\right) + L_4 P_4 \log_2\left(\frac{1}{P_4}\right) + L_5 P_5 \log_2\left(\frac{1}{P_5}\right) + \dots\dots\right) \times \left(L_1 P_1 \times n_1 + L_2 P_2 \times n_2 + L_3 P_3 \times n_3 + L_4 P_4 \times n_4 + L_5 P_5 \times n_5 + L_6 P_6 \times n_6 + \dots\dots\right)$$