

الاجابة النموذجية للأمتحان النهائي لمادة:

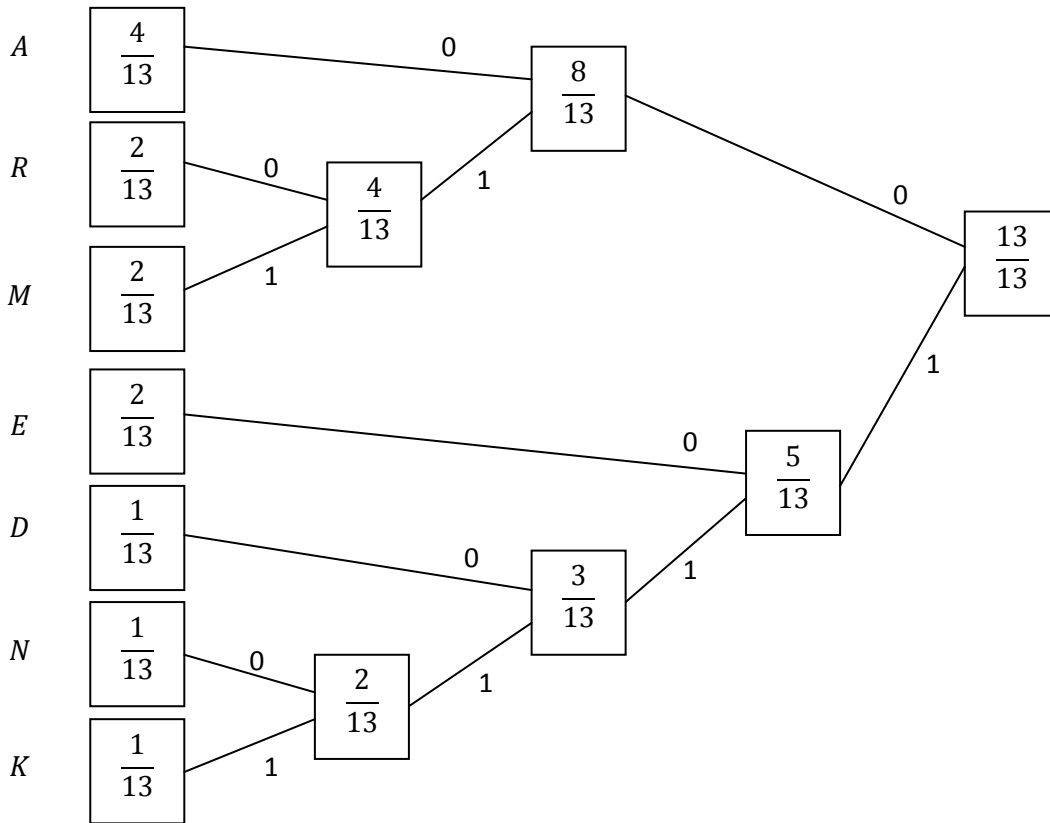
نظرية المعلومات والترميز

الفصل السادس اتصالات

الفصل الدراسي: خريف 2021-2022

تاريخ الامتحان: 2022-3-16

Q1-a (i)

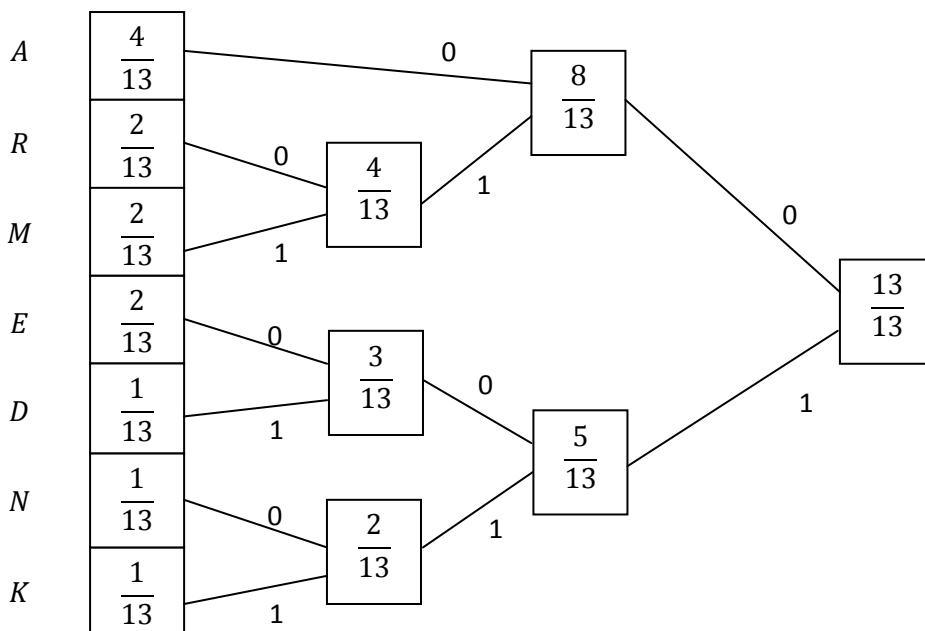


A	0	0		
R	0	1	0	
M	0	1	1	
E	1	0		
D	1	1	0	
N	1	1	1	0
K	1	1	1	1

(ii)

$$L_{ave} = 2\left(\frac{4}{13}\right) + 3\left(\frac{2}{13}\right) + 3\left(\frac{2}{13}\right) + 2\left(\frac{2}{13}\right) + 3\left(\frac{1}{13}\right) + 4\left(\frac{1}{13}\right) + 4\left(\frac{1}{13}\right) = 2.69$$

OR



A	0	0	
R	0	1	0
M	0	1	1
E	1	0	0
D	1	0	1
N	1	1	0
K	1	1	1

$$L_{ave} = 2\left(\frac{4}{13}\right) + 3\left(\frac{2}{13}\right) + 3\left(\frac{2}{13}\right) + 3\left(\frac{2}{13}\right) + 3\left(\frac{1}{13}\right) + 3\left(\frac{1}{13}\right) + 3\left(\frac{1}{13}\right) = 2.69$$

Q1-b

(i)

$$H = - \sum p \log_2 (p)$$

$$H = -0.37 \log_2(0.37) - 0.63 \log_2(0.63) = 0.951 \text{ bits}$$

(ii)

The percentage of the postgraduate students which have children is:

$$\frac{20}{100} \times \frac{37}{100} = \frac{7.4}{100}$$

$$H = - \sum p \log_2 (p)$$

$$H = -0.074 \log_2(0.074) - 0.926 \log_2(0.926) = 0.3807 \text{ bits}$$

(iii)

$$H = - \sum p \log_2 (p)$$

$$H = -0.6 \log_2(0.6) - 0.4 \log_2(0.4) = 0.97 \text{ bits}$$

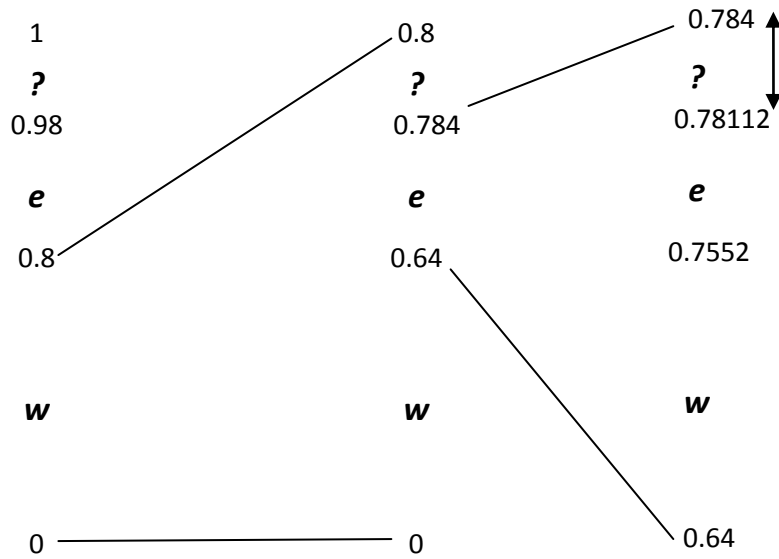
Q2-A

1	A
2	B
3	C
4	D
5	R
6	CA
7	AD
8	DA
9	AB
10	BR
11	RA
12	AC
13	CAD
14	DAB
15	BRA
16	AA
17	ABR

P = - C = C C	P = C C = A CA	P = A C = D AD	P = D C = A DA	P = A C = B AB	P = B C = R BR
P = R C = A RA	P = A C = C AC	P = C C = A CA	P = CA C = D CAD	P = D C = A DA	P = DA C = B DAB
P = B C = R BR	P = BR C = A BRA	P = A C = A AA	P = A C = B AB	P = AB C = R ABR	P = R C = A RA
P = RA C = -					

3 1 4 1 2 5 1 6 8 10 1 9 11

Q2-b



d=0.8	d=0.144
$R(w)=0:0+0.8(0.8)=0:0.64$	$R(w)=0.64:0.64+0.144(0.8) = 0.6:0.7552$
$R(e)+0.64:0.64+0.8(0.18)=0.64:0.784$	$R(e)= 0.7552: 0.7552+0.144(0.18) = 0.7552:0.78112$
$R(?)=0.784:0.784+0.8(0.02)=0.784:0.8$	$R(?)=0.78112:0.78112+0.144(0.02)=0.78112:0.784$

0.784 > Codeword > 0.78112

ex : 0.782

Q3-a Signal 1 3 2 2 2 4 0 1

(i)

<u>1 3</u>	<u>2 2</u>	<u>2 4</u>	<u>0 1</u>
1+9=10	4+4=8	4+16=20	0+1=1←
1+4=5	0+1=1←	0+9=9	4+0=4
0+0=0←	1+1=2	1+1=2	1+4=5
0+1=1	1+4=5	1+0=1←	1+9=10

Code: 3 2 4 1

(ii) **Decode: 1 3 2 1 1 4 0 0**

Q3-b

$$(i) \quad D(0,0) = \frac{1}{M*N} \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} P(x,y)$$

$$D(0,0) = \frac{1}{4} [5 + 1 + 1 + 0] = \mathbf{1.75}$$

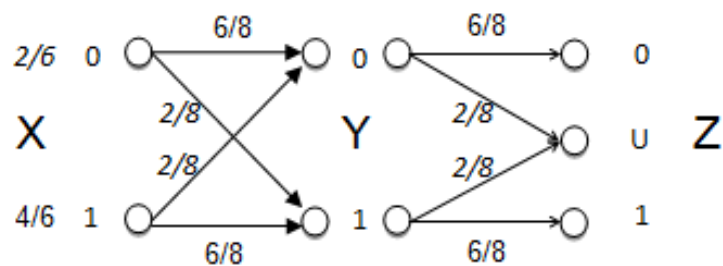
$$(ii) \quad D(u,v) = \frac{2}{M*N} \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} P(x,y) \times \cos\left(\frac{(2x+1)u\pi}{2M}\right) \times \cos\left(\frac{(2y+1)v\pi}{2N}\right)$$

$$D(0,1) = \frac{2}{4} \sum_{x=0}^1 \sum_{y=0}^1 P(x,y) \times \cos(0) \times \cos\left(\frac{(2y+1)\pi}{4}\right)$$

$$= \frac{1}{2} \left(\left(5 \times \cos\left(\frac{\pi}{4}\right) \right) + \left(1 \times \cos\left(\frac{3\pi}{4}\right) \right) + \left(1 \times \cos\left(\frac{\pi}{4}\right) \right) + (0) \right)$$

$$D(0,1) = \frac{5}{2\sqrt{2}}$$

Q4-



(i)

$$p(Y = 0, X = 1) = \binom{4}{6} \binom{2}{8} = \frac{1}{6}$$

$$p(Y = 0) = \binom{2}{6} \binom{6}{8} + \binom{4}{6} \binom{2}{8} = \frac{5}{12}$$

$$p(Z = 0, X = 1) = \binom{4}{6} \binom{2}{8} \binom{6}{8} = \frac{1}{8}$$

$$p(Z = U) = \binom{2}{6} \binom{6}{8} \binom{2}{8} + \binom{2}{6} \binom{2}{8} \binom{2}{8} + \binom{4}{6} \binom{6}{8} \binom{2}{8} + \binom{4}{6} \binom{2}{8} \binom{2}{8} = \frac{1}{4}$$

(ii)

$$\begin{bmatrix} p(Z1|X1) & p(Z2|X1) & p(Z3|X1) \\ p(Z1|X2) & p(Z2|X2) & p(Z3|X2) \end{bmatrix}$$

$$p(Z1|X1) = \binom{6}{8} \binom{6}{8} = \frac{9}{16}$$

$$p(Z2|X1) = \binom{6}{8} \binom{2}{8} + \binom{2}{8} \binom{2}{8} = \frac{1}{4}$$

$$p(Z3|X1) = \binom{2}{8} \binom{6}{8} = \frac{3}{16}$$

$$p(Z1|X2) = \binom{2}{8} \binom{6}{8} = \frac{3}{16}$$

$$p(Z2|X2) = \binom{6}{8} \binom{2}{8} + \binom{2}{8} \binom{2}{8} = \frac{1}{4}$$

$$p(Z3|X2) = \binom{6}{8} \binom{6}{8} = \frac{9}{16}$$

$$\begin{bmatrix} 9/16 & 1/4 & 3/16 \\ 3/16 & 1/4 & 9/16 \end{bmatrix}$$

Q4-

$$P = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \end{bmatrix}$$

$$H = -P^T I$$

$$H = \begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$$

$$H^T = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$[1 \ 0 \ 1 \ 0 \ 1 \ 0] \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = [0 \ 0 \ 1]$$

The Syndrome : 0 0 1

Error vector : 0 0 0 0 0 1

The codeword: 1 0 1 0 1 1