

الاجابة النموذجية للأمتحان النهائي لمادة :  
نظرية المعلومات والترميز  
الفصل الدراسي: ربيع 2019  
الفصل : السادس  
القسم : الاتصالات  
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Q1.

$$(i) H(X) = -\sum_k p_k \log_2(p_k)$$

$$= -\left[\frac{1}{4} \log_2\left(\frac{1}{4}\right) + \frac{3}{16} \log_2\left(\frac{3}{16}\right) + \frac{3}{16} \log_2\left(\frac{3}{16}\right) + \frac{1}{8} \log_2\left(\frac{1}{8}\right) + \frac{1}{16} \log_2\left(\frac{1}{16}\right) + \frac{1}{16} \log_2\left(\frac{1}{16}\right) + \frac{1}{8} \log_2\left(\frac{1}{8}\right)\right]$$

$$H(X) = 2.655 \text{ bits}$$

(ii)

A	1/4	0	0		
B	3/16	0	1		
C	3/16	1	0	0	
D	1/8	1	0	1	
G	1/8	1	1	0	
E	1/16	1	1	1	0
F	1/16	1	1	1	1

(iii)

$$L_{min} = \frac{H(X)}{\log_2(s)} = \frac{2.655}{1} = 2.655$$

(iv)

$$L_{ave} = \sum_i p_i l_i = (1/4)2 + (3/16)2 + (3/16)3 + (1/8)3 + (1/8)3 + (1/16)4 + (1/16)4$$

$$L_{ave} = 2.6875$$

(v)

$$\mu = \frac{L_{min}}{L_{ave}} = \frac{2.655}{2.6875} = 98.81\%$$





Q2 a.

(i)

(0,0)a

(0,0)b

(0,0)r

(3,1)a

(4,3)c

(2,1)d

(7,4)

(ii)

01902265

Q2 b.

10000007000000000003





Q3- a

(i)

$$\begin{bmatrix} 1/3 & 2/3 & 0 \\ 0 & 2/3 & 1/3 \end{bmatrix}$$

(ii)

$$H(X) = - \sum_k p_k \log_2(p_k)$$

$$H(X) = - \left[ \frac{1}{4} \log_2 \left( \frac{1}{4} \right) + \frac{3}{4} \log_2 \left( \frac{3}{4} \right) \right] = 0.811$$

(iii)

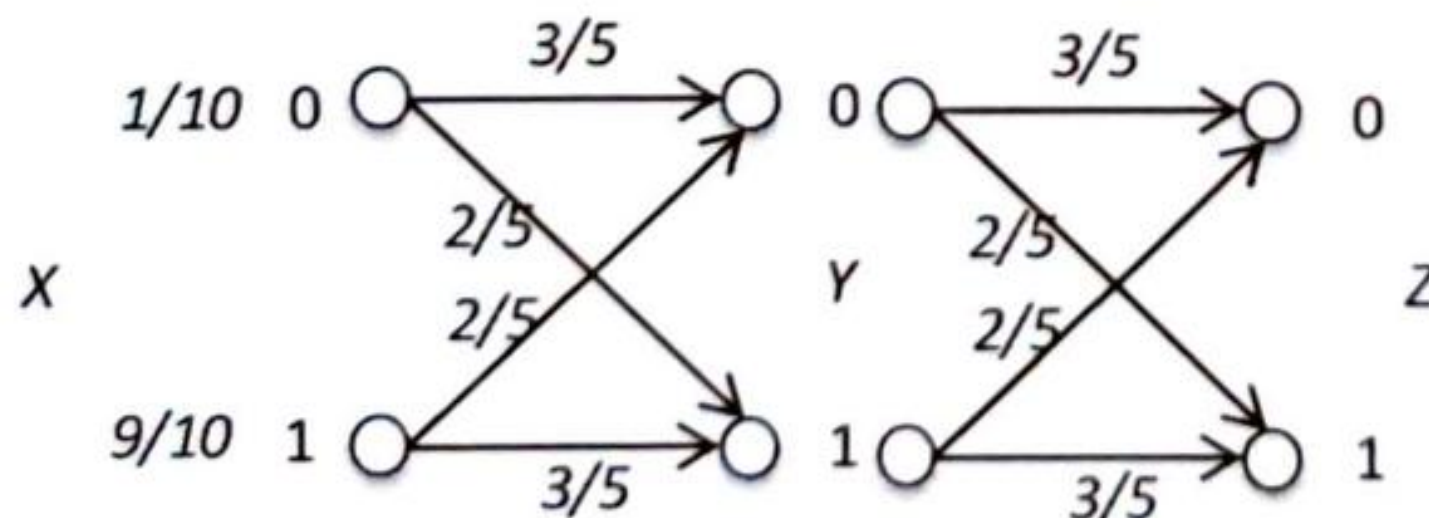
$$p(Y=1|X=0) = 0$$

$$p(Y=0, X=1) = 0$$

$$p(Y=U) = (1/4)(2/3) + (3/4)(2/3) = 2/3$$

Q3- b

(i)



(ii)

$$p(Y=1|X=0) = \frac{2}{5}$$

$$p(Y=1, X=0) = (1/10)(2/5) = 1/25$$

$$p(Y=1) = (1/10)(2/5) + (9/10)(3/5) = 29/50$$

(iii)

$$p(Z=0|X=0) = (3/5)(3/5) + (2/5)(2/5) = 13/25$$

$$p(Z=1, X=1) = (9/10)(2/5)(2/5) + (9/10)(3/5)(3/5) = 117/250$$

$$p(Z=1) = (9/10)(3/5)(3/5) + (9/10)(2/5)(2/5) + (1/10)(2/5)(3/5) + (1/10)(3/5)(2/5) = 129/250$$



Q4- a

$$d_{min} = 5$$

$$d_d = d_{min} - 1 = 4$$

$$d_c = \frac{d_{min} - 1}{2} = 2$$

Q4- b

(i)

$$H = [-P^T | I_{n-k}] =$$

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

(ii)

$$c H^T = [101101000101001] \begin{bmatrix} 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 0 \\ 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = 1110$$

Error vector = 000000100000000

(iii) Codeword = 101101100101001