جامعة العلوم والتقانة
كلية علوم الحاسوب وتقانة المعلومات
بكلاريوس تكنولوجيا المعلومات و الإتصالات

إمتحانات نهاية الفصل للعام 2017-2018
السنة **الثالثة** الفصل **الخامس** الدفعة ICT2015/2016
المقرر : نظرية المعلومات

التاريخ : 8 /1/2018م

الزمن 3: ساعات

الإسم .... الرقم ....

أجب عن جميع الأسئلة
ورقـة الإمـتحـان تـشتمـل علـى 5 صفـحات

Question One (10 Marks)

Put (T) in front of correct answer and (F) in front of incorrect one

(………) 1. Events A and B are called independent if P(A∩B)=P(A)*P(B)

 (………) 2. I (E) = 1 if P(E) = 1

 (………) 3. One bit equal 0.301 hartly

(………) 4. H (X|Y) is greater than entropy of X

 (………)5. Huffman code is optimum but not unique

 (………)6. H (X|Y) equal Entropy of X if and only if X and Y are independent.

(………)7. Optimum code is one with maximum average codeword length not exceed H(X)

 (………)8. The codeword length of a prefix-free code lower bounded by the entropy

 (………)9. H(X,Y) less than H(Y,X)

(………)10. For binary code with q symbols and word length l1,l2,….lq, Kraft inequality equation becomes
$\sum_{i=1}^{q} 2^{-li} > 1$

Question Two (10 Marks)

Draw a circle around the letter of correct answer

1. In experiment of flip a coin twice, A≡ outcomes is head in first flip and B ≡ outcomes is Tail in second flip. Amount of information in A∩B is …………
   a) 0.25 bit   b) 0.5 bit
   c) 1 bit   d) 2 bits

2. For a prefix-free code:
      (a)   H(S) $\leq \overline{L}$ (b) H(S) $\geq \overline{L}$ (c) H(S) $\neq \overline{L}$ (d) H(S) $= \overline{L}$

3. One hartly equal _____bits
      (a) 3.32   (b) 0.301   (c) 4.32   (d) 2.56

4. If X and Y are independent events the Mutual Information of X and Y is
   a) H(X)   b) H(X|Y)
   c) H(Y|X)   d) Zero

5. Mutual Information is :
   e) H(X)-H(X|Y)   f) H(X)+H(X|Y)
   g) H(X)-H(Y|X)   h) H(X)*H(X|Y)

6. Which of the following is incorrect

   a) H(X,Y)=H(X)+H(Y|X)
   b) I(X;Y)=H(X)-H(X|Y)

   c) H(Y|X)=H(X,Y)-H(X)
   d) I(X;Y)=H(X)+H(Y)-H(X,Y)

7. Which of the following is true

   a) H(A|B)≥H(A)
   b) H(A|B)≤ H(A)

   c) H(A,B)≠ H(B,A)
   d) H(A)≥H(B,A)

8. Which of the following sequences of integers could be the codeword lengths for a binary prefix code (or in other words satisfy Kraft's inequality)?

   (a) 1, 2, 2, 3   (b) 1, 2, 3, 3   (c) 1, 2, 2, 2   (d) 1, 2, 2, 3

9. Which of the following sets of codeword could be the Huffman code for some 4 symbol source alphabet?

   (a) 01, 10, 00, 111   (b) 0, 10, 110, 111

   (c) 1, 01, 10, 001   (d) 0, 110, 111, 101

10. If H(X)= 5 hartlys, then the equivalent value in hartleys is:

    (a) 16.6   (b) 4.301   (c) 5   (d) none of the above

Question Three (15 Marks)

A. Let X and Y two random variables which respective sets of possible outcomes X={1,2,3,4} and Y={0,1,2} are described by p(X) and p(Y) and by joint probability mass function p(X,Y)

P(X,Y)		X				
		1	2	3	4	P(Y)
Y	0	?	0.03	0	0	0.03
	1	0.34	?	0.16	0	0.8
	2	0	0	0.04	?	?
	P(X)	?	0.33	?	0.13	1

1. Make a copy of table and fill in the missing cells

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2. Calculate the marginal entropy of Y in hartlys?

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3. Calculate the marginal entropy of X in hartlys?

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4. Calculate the Joint entropy of X and Y H(X|Y) in Hartlys?

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5. Calculate the Conditional Entropy H (X|Y) in bits?

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B. Suppose X can take K values. Show that the entropy maximized when X is uniformly distributed on these K values and in this case **H(X) = log K**

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Question 4: (15 Marks)

A. Fill the gaps using the following words   (5 Marks)

Entropy, Joint Entropy, Conditional probability, Conditional Entropy, Mutual Information

1. ………………………… is uncertainty of X that another random variable Y are Known.

2. ………………………… is a measure of the amount of information that one random variable contains about another random variable

3. ………………………… that one event occurs given that another event occurs

4. ………………………… is a measure of uncertainty of random variable

5. ………………………… is uncertainty of two random variables.

2. Let X random variable with the following probability mass function: (6 Marks)

x	1	2	3	4	5
P(x)	0.3	0.1	0.2	0.25	0.15

a. Compute the H(X) in hartly?

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b. Compute the second Extension Entropy of X in bits? (4 Marks)

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Question 5 (20 Marks)

The following codes are given:

Symbol Si	Probabilities	Code 1	Code 2	Code 3	Code 4
S1	0.30	00	0	000	0
S2	0.25	01	01	010	10
S3	0.15	00	11	101	110
S4	0.12	11	0111	110	1110
S5	0.10	10	111	001	11110
S6	0.08	111	01111	111	11111

Part 1: (10 Marks)

   a) Which of the given codes is/are singular and why?

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   b) Which of the given codes is/are Uniquely Decodable and why?

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   c) Does code 3 is efficient Code and why?

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Part 2:   **(10 Marks)**

    For S1, S2, … , S6 in the above table do the following:

  a) Derive binary code using Huffman coding?

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   b) Does the above Huffman Code is optimal prefix-free code? (5 Marks)

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Best wishes