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06CS/IS663

Sixth Semester B.E. Degree Examination, June 2012

Data Compression

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Distinguish between lossless compression and lossy compression. **(04 Marks)**

b. Define i(A), the self information associated with an event A. If A and B are independent events, prove that i(AB) = i(A) + i(B). **(04 Marks)**

c. Let C be a code with N code words whose lengths are $l_1, l_2, l_3, \ldots\ldots, l_N$. If C is uniquely decodable, prove that $\sum_{i=1}^{N} 2^{-l_i} \le 1$. **(08 Marks)**

d. Determine whether the following codes are uniquely decodable:

i) {0, 01, 110, 111}

ii) {0, 01, 11, 111}. **(04 Marks)**

2 a. Design a minimum variance Huffman code for a source whose letters are chosen from the alphabet A = {a_1, a_2, a_3, a_4, a_5} with $p(a_1) = 0.3$, $p(a_2) = 0.16$, $p(a_3) = 0.12$, $p(a_4) = 0.205$ and $p(a_5) = 0.17$. Verify Kraft-Mc Millan inequality. **(10 Marks)**

b. Encode the following sequence using LZW algorithm:

x y z z y b̸ x y z z y b̸ x y z z y b̸ x y z z y b̸ x *l l* b̸ x *l l* b̸ x *l l*.

The alphabet for the source is {b̸, *l*, x, y, z}. The LZW dictionary initially looks as follows:

Index	1	2	3	4	5
Entry	b̸	y	z	*l*	x

(10 Marks)

3 a. Give an algorithm used by CALIC to form the initial prediction and explain this algorithm. **(06 Marks)**

b. Briefly explain run-length coding. **(04 Marks)**

c. Explain quantization problem by considering a quantizer with eight reconstruction values. **(06 Marks)**

d. Explain distortion criterion. **(04 Marks)**

4 a. With a neat diagram, explain vector quantization procedure. **(06 Marks)**

b. Give Lloyd algorithm to generate pdf-optimized scalar quantizer assuming that the distribution is known. Show how this algorithm can be generalized to the case where a training set is available. **(07 Marks)**

c. With an example, explain how basic differential encoding algorithm works. **(07 Marks)**

PART – B

5 a. With all necessary mathematical details, discuss discrete Fourier transform and device the expression $f_n = \frac{1}{N}\sum_{K=0}^{N-1} F_k e^{j} \frac{2\pi kn}{N}$. **(10 Marks)**

b. Obtain the inverse Z-transform of the function $F(z) = \frac{2z^4+1}{2z^3-5z^2+4z-1}$. **(10 Marks)**

6 a. By considering the example of encoding the sequence of values $\{x_n\}$ given below, explain in detail how subband coding works.
10 14 10 12 14 8 14 12 10 8 10 12. **(08 Marks)**

b. Define the following terms:
i) Filter
ii) Finite impulse response (FIR) filters.
iii) Number of taps in the filter.
iv) Infinite impulse response (IIR) filters. **(04 Marks)**

c. Consider a filter with a_0 = 1 and b_1 = 0.6. If the input sequence $\{x_n\}$ is given by $x_n = \begin{cases} 1 & n = 0 \\ 0 & n \neq 0 \end{cases}$, determine the impulse response of the filter. Is it an FIR filter or an IIR filter? **(04 Marks)**

d. Briefly explain bit allocation. **(04 Marks)**

7 a. With necessary details, derive multiresolution analysis. **(08 Marks)**

b. With necessary details and usual notations, derive the following:
i) $\sum_k h_k = \sqrt{2}$
ii) $\sum_k h_k^2 = 1$
iii) $\sum_k h_k h_{k-2m} = \delta m$ **(12 Marks)**

8 Explain the following:
a. Motion compensation. **(07 Marks)**
b. Video signal representation. **(07 Marks)**
c. Model based coding. **(06 Marks)**

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