B.Tech.

EIGHTH SEMESTER EXAMINATION, 2005-2006

DATA COMPRESSION

Time : 3 Hours   *Total Marks : 100*

Note : (i)   *Answer ALL questions.*

(ii)   *All questions carry equal marks.*

(iii)   *In case of numerical problems assume data wherever not provided.*

(iv)   *Be precise in your answer.*

1.   Attempt *any four* parts of the following :   (5x4=20)

(a)   What is the difference between Lossy & Loseless Compression ? How can a compression algorithm be evaluated ?

(b)   What are different approaches for building Mathematical models ?

(c)   Prove the following Theorem :

Given a set of integers $L_1, L_2 \ldots\ldots\ldots L_N$, that satisfy the inequality

$$\sum_{q=1}^{N} 2^{-4^\circ} \leq 1$$

we can always find a prefix code with code word lengths $L_1, L_2 \ldots\ldots L_N$.

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(d) Show that for the case where elements of an observed sequence are iid, the entropy is equal to the first-order entropy.

(e) Determine whether the following codes are uniquely decodable :

{ 0, 01, 11, 111 }

{ 0, 10, 110, 111 }

(f) Explain the two main phases of development of data compression algorithms for a variety of data.

2. Attempt *any four* parts of the following :   (5x4=20)

(a) A sources emits letters from an Alphabet

$A = \{a_1, a_2, a_3, a_4, a_5\}$ with probabilities

$P(a_1) = 0.15$, $P(a_2) = 0.04$, $P(a_3) = 0.26$, $P(a_4) = 0.05$, and $P(a_5) = 0.50$.

(i) Calculate the entropy of this source.

(ii) Find the Huffman code for this source.

(iii) Find the average length of the code in (ii) & its redundancy.

(b) With the help of a flowchart/steps explain the Encoding & Decoding Procedure.

(c) What are Golomb Codes, Rice Codes & Tunstall Codes ? Explain in brief.

(d) The message [a a r d v a r k] is to be encoded, and it is assumed that our alphabet consists of the 26 lower case letters of the English alphabet. Develop the Adaptive Huffman tree when the sequence [a a r d r] is transmitted.

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(e) What are the various applications of Huffman coding ?

(f) Explain Adaptive Huffman Coding. How is it different from Conventional Huffman Coding ?

3. Attempt *any four* parts of the following : (5x4=20)

(a) Explain Arithmetic coding in brief. What are its applications ?

(b) How LZ77 algorithm works ? What are the problems with LZ77 ? Explain with an example.

(c) For the text string DIDIDDIDI$DIDIA$DIDI, show all the steps of LZW compression including dictionary information. List the sequence of output tokens in LZW compression.

(d) What is facsimile encoding ? Explain run-length coding technique used earlier for facsimile.

(e) Give a brief comparison of MH, MR, MMR and JBIG.

(f) Suppose we want to transmit 512×512, 8-bits-per.pixel image over a 9600 bits per second line-if we want to transmit this image using raster scan order, after 15 seconds how many rows of the image will the user have received ? To what fraction of the image does this correspond ?

4. Attempt *any two* parts of the following : (10x2=20)

(a) Explain in brief the block diagram of a generic compression scheme. What is the distortion criteria to measure the closeness of a reconstructed source sequence to the original ?

(b) What is the Quantization Problem ? Explain Uniform & Adaptive Quantization.

(c) Design a 3-bit uniform quantizer (specify the decision boundaries & representation levels) for a source with a Laplacian pdf, with a mean of 3 & a variance of 4.

5. Attempt *any two* parts of the following : (10x2=20)

(a) Explain in detail the Vector Quantization procedure. What are the advantages of using vector quantization over scalar quantization ?

(b) Describe the Tree-Structured Vector Quantizers ?

(c) Discuss the Linde-Buzo-Gray Algorithm in detail.

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