(Following Paper ID and Roll No. to be filled in your Answer Book)

**PAPER ID : 1051** Roll No. | | | | | | | | | | |

## B.Tech.

EIGHTH SEMESTER EXAMINATION, 2004-2005

## DATA COMPRESSION

*Time : 3 Hours* *Total Marks : 100*

**Note :** *(i) Attempt ALL questions.*

*(ii) All questions carry equal marks.*

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

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

(a) What do you understand by Compression ? Explain various Compression Techniques.

(b) What is the role of Reconstruction in data compression ?

(c) Let C be a code with N codewords with lengths $l_1$, $l_2$ _ _ _ _ $l_N$. If C is uniquely decodable, then prove Kraft-Mcmillan inequality.

$$K(C) = \sum_{i=1}^{N} 2^{-li} \leq 1$$

(d) Explain the several approaches to building mathematical models which are useful in estimating the entropy of the source.

(e) What is uniquelly decodable code ? Determine whether the given code is uniquely decodable.

{0, 01, 110, 111}

(f) Consider that two sources $S_1$ and $S_2$ emit messages $x_1\ x_2\ x_3$ and $y_1\ y_2\ y_3$ with the joint probability P(X,Y) as shown in the matrix form.

P(X,Y) =

| | $y_1$ | $y_2$ | $y_3$ |
|---|---|---|---|
| $x_1$ | 3/40 | 1/40 | 1/40 |
| $x_2$ | 1/20 | 3/20 | 1/20 |
| $x_3$ | 1/8 | 1/8 | 3/8 |

Calculate H(X) and H(Y).

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

(a) What do you mean by Coding ? Explain Huffman Coding Algorithm.

(b) What is the Role of Code efficiency in data compression techniques ?

(c) What are the necessary conditions for an optimal-variable-length binary code ?

(d) Consider Source Alphabet of A, B, C ..... G, H, having probabilities P(Xi) given as :

$P(Xi) = {}^1/_2, {}^1/_4, {}^1/_8, {}^1/_{16}, {}^1/_{32}, {}^1/_{32}$.

Design Huffman Code. Also find the average length of code words and code efficiency.

(e) Encode the following sequence of 16 values using the Rice Code with J = 8 and one split sample option 32, 33, 35, 39, 37, 38, 39, 40, 40, 40, 40, 39, 40, 40, 41, 40

for prediction use the previous value in the sequence $\hat{y}_i = y_i - 1$ and assume a prediction of zero for the first element of the sequence.

(f) Write short notes on the following :

(a) Adaptive Huffman Coding

(b) Extended Huffman Coding

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

(a) Explain the process to generate a Binary Code.

(b) Define and differentiate Static dictionary and Adaptive dictionary.

(c) What do you understand by facsimile encoding ?

(d) Explain LZW Algorithm of Encoding with the help of suitable example.

(e) For the probability model given in Table, decode a sequence of length 10 with the Tag 0.63215699.

| Letter | Probabilities |
|---|---|
| $a_1$ | 0.2 |
| $a_2$ | 0.3 |
| $a_3$ | 0.5 |

(f) Write short notes on the following :

(i) CALIC

(ii) Compression over modems-V.42 bis

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

(a) Explain various distortion criteria for lossy coding. For a Binary source with $P(0) = p$, $P(X = 0/Y = 1) = P(X = 1/Y = 0) = D$ and distortion measure $d(x_i\ y_j) = x_i \oplus y_j$ show that $I(X; Y) = H_b(p) - H_b(D)$.

(b) What is differential entropy ? Find the differential entropy of a Random variable X that has a Gausian PDF.

$$f_X(x) = \frac{1}{\sqrt{2\pi\sigma^2}} \exp - \frac{(x-\mu)^2}{2\sigma^2}.$$

(c) What is quantization problem ? Explain the working of uniform quantizer and non uniform quantizer.

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

(a) Explain the various steps of vector quantization procedure. List the advantages of vector quantization over scalar quantization.

(b) Explain the various functions involved in the Linde-Buzo-Gray (LBG) Algorithm. Also explain the initializing of LBG Algorithm.

(c) Explain the following quantization Techniques in detail.

(i) Lattice vector quantization

(ii) Polar and spherical vector quantization

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