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CS – 054

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

**PAPER ID : 1051**

Roll No.

**B. Tech.**

(SEM. VIII) EXAMINATION, 2006-07

**DATA COMPRESSION**

*Time : 3 Hours]*

*[Total Marks : 100*

*Note : Attempt all questions. All questions carry equal marks.*

**1** Attempt any **four** parts of the following : **5×4=20**

- (a) What do you mean by lossless compression? Compare lossless compression with lossy compression.
- (b) Explain Modeling and coding with the help of suitable examples.
- (c) Suppose **X** is a random variable that takes on values from M.letter alphabet show that  **$0 \leq H(x) \leq \log_2 M$**
- (d) What do you understand by information and entropy ? Find the first order entropy over an alphabet **A = {a<sub>1</sub>,a<sub>2</sub>,a<sub>3</sub>,a<sub>4</sub>}** where  **$p(a_1) = p(a_2) = p(a_3) = p(a_4) = 1/4$**
- (e) What do you understand by Prefix code ?
- (f) The joint probabilities of the transmitted and received messenges of a communication system is given as

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|       | $Y_1$ | $Y_2$ | $Y_3$ | $Y_4$ |
|-------|-------|-------|-------|-------|
| $x_1$ | 1/4   | 0     | 1/10  | 0     |
| $x_2$ | 0     | 1/4   | 0     | 1/20  |
| $x_3$ | 0     | 0     | 1/10  | 1/20  |
| $x_4$ | 0     | 1/20  | 0     | 1/10  |
| $x_5$ | 0     | 0     | 0     | 1/20  |

Calculate  $H(x)$  and  $H(y)$

2 Attempt any **four** parts of the following : **5×4=20**

- What are two observations on which Hyffman procedure is based regarding optimum prefix code ?
- What are the various applications of Huffman Coding?
- What is Redundency of code? How can we define and calculate it?
- Consider source alphabet of **A,B,C...G,H** having probabilities  $P(x_i)$  given as  **$P(x_1) = 1/2, 1/4, 1/16, 1/16, 1/32, 1/32, 1/32, 1/32$**

Design the Huffman code. Also calculate average length of codewords and code efficiency.

- For an Alphabet  $A = \{a_1 a_2 a_3\}$  with probabilities  $P(a_1) = 0.7, P(a_2) = 0.2, P(a_3) = 0.1$

Design a 3-bit Tunstall Code.

- Write short notes on the following :
  - Golomb Code
  - Non binary Huffman Code.

3 Attempt any **four** parts of the following : **5×4=20**

- (a) What do you mean by Binary Code? Compare Binary code with Huffman Code.
- (b) Where we use the dictionary techniques of Encoding? Also explain various types of dictionary techniques.
- (c) Explain the Run-Length Coding with the help of suitable example.
- (d) A sequence is encoded using **LZW** algorithm and the initial dictionary shown in table

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The output of **LZW** encoder is the following sequence

**3,1,4,6,8,4,2,1,2,5,10,6,11,13,6**

Decode this sequence.

- (e) Find the real valued tag for the sequence  **$a_1 a_1 a_3 a_2 a_3 a_1$**  over letter  **$\{a_1 a_2 a_3\}$**  with probabilities  **$\{0.2, 0.3, 0.5\}$**
- (f) Write short notes on the following :
  - (i) Dynamic Markov Compression
  - (ii) Graphic Interchange Format.

4 Attempt any **two** parts of the following : **10×2=20**

- (a) What do you understand by Adaptive quantization? Explain the various approaches to adapting the quantizer parameters.

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- (b) What is conditional entropy and Mutual Information and Average Mutual Information? For two Random variables  $\mathbf{X}$  and  $\mathbf{Y}$  show that
- (a)  $\mathbf{H}(\mathbf{x}/\mathbf{y}) \leq \mathbf{H}(\mathbf{x})$
  - (b)  $\mathbf{I}(\mathbf{x};\mathbf{y}) = \mathbf{I}(\mathbf{y};\mathbf{x})$
- (c) What is Rate distortion theory? Drive the Rate distortion function for the
- (i) Binary Source
  - (ii) Gaussian Source.

**5** Attempt any **two** parts of the following : **10×2=20**

- (a) What do you understand by vector quantization? Also explain the procedure of vector quantization.
- (b) What is tree-structured vector quantization? Explain the design process of tree-structured vector quantizer. What is pruning? How it helps to improve the rate distortion performance?
- (c) Explain the following quantization techniques in detail :
  - (a) Structured vector quantization
  - (b) Pyramid vector quantization.