(i) If the sequence is random with P(0) = 0.8, compute the rate and distortion for M = 1,2,4,8,16. Compare your results with the rate distortion function for binary sources.

(ii) Repeat assuming that the output of the encoder is encoded at a rate equal to the entropy of the output.

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

(c) (i) Describe all four Probability models commonly used in the design and analysis of lossy compression systems.

(ii) What is Quantization ? Draw the Additive noise model of a quantizer.

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

(a) Write down the advantages of Vector Quantization over Scalar Quantization. Also give the procedure for vector Quantization.

(b) What is pdf-optimized quantizer ? Give the Linde –Buzo-Gray Algorithm.

(c) Write a note on :

(i) Tree structured Vector Quantizers.

(ii) Lattice Vector Quantizers.

Printed Pages—4 **TCS034**

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

PAPER ID : 0108 **Roll No.**

B.Tech.

(SEM. VII) ODD SEMESTER THEORY EXAMINATION 2010-11

DATA COMPRESSION

Time : 3 Hours *Total Marks : 100*

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

(ii) All questions carry equal marks.

(iii) Be precise in your answer.

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

(a) What is data compression? Differentiate between Lossless and Lossy Compression techniques.

(b) How the different characterizations of data will lead to different compression schemes ? Justify your answer.

(c) Define briefly the theory of self-information. How this self-information is associated with the occurrence of events.

(d) What is a model in terms of data compression ? Explain adaptive model and how can we reduce the entropy.

(e) Define two-state Markov model for binary images. Also define ignorance model and how it is related with probability models ?

(f) What is the simple way to check prefix codes ? Explain by giving examples. Also describe the procedure for coding a uniquely decodable code. Are the following codes {0, 01, 11, 111}, {1, 10, 110, 111} are uniquely decodable ?

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

(a) Design a Huffman code for a source that puts out letters from an alphabet $A = \{a_1, a_2, a_3, a_4, a_5\}$ with

$P(a_1) = P(a_3) = 0.2$, $p(a_2) = 0.4$, and $P(a_4) = P(a_5) = 0.1$.

The entropy for this source is 2.122 bits/symbol.

(b) Design a 3-bit Tunstall code for memoryless source with the alphabet: $A = \{A, B, C\}$ with probabilities $P(A) = 0.7$, $P(B) = 0.2$, $P(C) = 0.1$.

(c) 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.

(d) Give the flowchart of the encoding procedure.

(e) Draw a Huffman Tree for the following symbols whose frequency of occurrence in a message is stated along with the symbol below :

A: 15, B: 6, C: 7, D: 12, E: 25, F: 4, G: 6, H: 10, I: 15

Decode the message 1110100010111011.

(f) What is the use of the phenomenon of Temporal Masking in audio coding ?

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

(a) Consider the source from the alphabet $A = \{a_1, a_2, a_3\}$ Given the probability model $P(a_1) = 0.2$, $P(a_2) = 0.3$, $P(a_3) = 0.5$. Find the real valued tag for the sequence

$a_1\ a_1\ a_3\ a_2\ a_3\ a_1$.

(b) Encode the following sequence using the LZ77

barrayar¢bar¢by¢barrayar¢bay

Assume you have a window size of 30 with look-ahead buffer of size 15. Given that C(a) = 1, C(b) = 2, C(¢) =3 C(r) = 4, C(y) = 5.

(c) Briefly summarize the CALIC algorithm. Why CALIC looks like JPEG-LS standard ?

(d) Compare and contrast Huffman and arithmetic coding.

(e) How the Burrows-Wheeler Transform (BWT) algorithm encode a symbol in different way for lossless compression ?

(f) Write short notes on :

(i) Dynamic Markov Compression.

(ii) Predictive Coding.

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

(a) Consider the following lossy compression scheme for binary sequences. We divide the binary sequence into blocks of size M. For each block we count the number of 0s. If this number is greater than or equal to M/2, we send as 0;otherwise, we send a 1.