


**VIT**

Vellore Institute of Technology

**Final Assessment Test – November 2024**

Course: CSI3019

- Advanced Data Compression Techniques

Class NBR(s): 1860

Slot: F1+TF1

Max. Marks: 100

Time: Three Hours

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

 Answer ALL Questions

(10 X 10 = 100 Marks)

1. a) Prove that relative entropy is not symmetric with the following data. Let the random variable  $x$  have four possible outcomes  $\{w, f, y, z\}$ . Consider two distributions on this random variable. [5]

Symbol	$p(x)$	$q(x)$
w	1/4	2/7
f	2/5	3/8
y	1/3	1/4
z	1/6	1/4

- b) Assume the event of flipping a coin and A & B be the outcome of getting Head and Tail, respectively. Then find the information values associated with outcomes A and B for the following scenarios. [5]

- i) The flipping of the coin is fair, i.e., the probability of getting head and tail is the same.
- ii) The flipping of the coin is not fair, i.e., the probability of getting a head and tail is not the same, which are  $P(A) = 0.60$  and  $P(B) = 0.40$ .

2. a) For the symbols  $\{a_1, a_2, a_3, a_4\}$  two different code are generated [5]  
 $\{0, 01, 11, 111\}$  and  $\{0, 10, 110, 111\}$ .

- i) Which code is UDC?
- ii) Calculate Kraft inequality for the above code

- b) Decide whether the following transition matrices are regular or not. [5]

i)  $\begin{vmatrix} 0.55 & 0.21 & 0 \\ 0 & 0.33 & 0.44 \\ 0.81 & 0 & 0.24 \end{vmatrix}$

ii)  $\begin{vmatrix} 0.55 & 0.21 & 0 \\ 0 & 0 & 0.44 \\ 0.81 & 0 & 0.24 \end{vmatrix}$

3. Describe the steps involved in Huffman encoding using the given symbols A,B,C,D and E with probabilities 0.15, 0.9, 0.24, 0.33 and 0.13 respectively. Draw the Huffman tree for these symbols and compute the average code size, efficiency and redundancy. Encode the following input "CAD CAB" using generated code words.

4. Write the algorithm for Golomb code. Construct the Golomb code for the odd number that are present between 6 to 16 and the even number present between 15 to 25 by using the M values 6 and 7. Analyze how the M value affect the average length of the code for the above numbers and justify it.

5. Given the following initial dictionary and the received sequence below, build an LZW dictionary and decode the transmitted sequence.

**Received sequence message:**

**6, 3, 4, 5, 2, 3, 1, 6, 2, 9, 11, 16, 14, 20, 10, 8, 23, 13.**

**Initial dictionary**

Index	Entry
1	a
2	space
3	h
4	i
5	s
6	t

6. a) Briefly explain the term Distortion. Infer in detail the list of different Distortion measures that are used to evaluate the image compression with a suitable mathematical form. [5]

b) Given a series of temperature readings {-3.5, 2.0, 0.2, -2.8, 3.2, -1.7, 3.5...}, quantize the readings using a uniform quantizer with a range of (-4.0, 4.0) and 4 levels. Generate the quantized sequence and error. [5]

7. Draw and explain in detail the H.264 encoder for video compression.

8. Draw the neat JPEG2000 Compression Engine architecture including all the functional elements. Interpret in detail the functional elements of JPEG2000 Compression Engine and address their role in encoding and decoding the input images in detail.

- 9.a) i) Discuss the steps involved in Linde-Buzo-Gray (LBG) algorithm. [5]
- ii) Consider an image of size 1024 X 1024 with pixel values ranges from 0 to 255. [5]  
It is required to compress the image in a way that the codebook is created with 16 code words and calculate the compression ratio. Encode the following values 16, 45, 68, 96, 114, 130, 157 and 175 using 16 code words.

OR

- 9.b) i) Compare and contrast between temporal and spatial prediction techniques in video compression? [5]
- ii) Write a short notes on Discrete Cosine Transformation. [5]
- 10.a) i) Describe the role of Modeling and Coding in achieving an effective compression process. Generate a suitable model to achieve better compression ratio for the sequence of input 9, 11, 11, 12, 14, 13, 15, 17, 16, 17, 20 and 21. [7]
- ii) Discuss the advantages and disadvantages of the lossless and lossy compression process. [3]

OR

- 10.b) Encode the following messages using Shannon Fano Algorithm and calculate the Entropy value for the given message.

"Dhoni is a good batsman"

Note: Space should be considered as a character.

⇒⇒⇒ I/L/TX ⇒⇒⇒