



## EE5351 Digital Video Coding

INSTRUCTOR: Dr. K.R. Rao

Summer 2008, Test 1

Thursday, 19 June 2008

6:00 – 7:45 PM (1 hour and 45 minutes)

(OPEN BOOK, OPEN NOTES)

(PREVIOUS EXAM PAPERS AND SOLUTIONS ARE NOT ALLOWED)

INSTRUCTIONS:

1. Open books and open notes.
2. Calculator is allowed.
3. Please show all the steps in your works.
4. You can work problems in any order.

At the end please rearrange as 6, 7, 8, and 9.

5. Please print your name and student ID.
6. No cheating, no talking.

Name \_\_\_\_\_

Student ID \_\_\_\_\_

PART 1 (Q1) to (Q5) with [4 Points] each

(Q1) For some number of source symbols, and for some probabilities of the symbols, which assumption is WRONG?

- A. It is possible to create Huffman code with average code length larger than entropy of source symbols.
- B. It is possible to create Huffman code with average code length equal to entropy of source symbols.
- C. It is possible to create Huffman code with average code length smaller than entropy of source symbols.
- D. It can always create Huffman code and calculate entropy of source symbols.

(Q2) Identify prefix code

- A. 1 , 01 , 001 , 000
- B. 1 , 00 , 010 , 101
- C. 0 , 10 , 110 , 100
- D. None above

(Q3) Identify uniquely decodable code

- A. 0 , 01 , 010 , 0110
- B. 0 , 01 , 011 , 0111
- C. 1 , 10 , 101 , 1110
- D. Both A and B

(Q4) Which assumption can be drawn? Given probability of each  $i$ th symbol is

$p_i = 2^{-n_i}$  ( $n_i$  is integer), and  $\sum_{i=1}^N p_i = 1$ , (N is total number of symbols.),

- A. Entropy < average Huffman code length
- B. Entropy = average Huffman code length
- C. Entropy > average Huffman code length
- D. Not enough information to calculate entropy and Huffman code

(Q5) Given a set of source alphabets with their probabilities and a line of text (to be encoded) composed of the given source alphabets, and a list of entropy code,

- A. Huffman code
- B. Golomb code
- C. Tunstall code
- D. LZW code
- E. Arithmetic code

Write or circle the entropy code(s) from the given list that CANNOT be used to encode the given sequence. \_\_\_\_\_

PART 2 Show all your works

**[20 Points]** [Problem 6] **Golomb code**

Using Golomb code with parameter  $m = 5$ , encode the following sequence and show details of encoding,

*Sequence to be encoded:* 21, 19, 28, 32, 10

**[20 Points]** [Problem 7] **Arithmetic code**

Given a training sequence with length of 10,

$S_3 S_3 S_2 S_1 S_3 S_3 S_2 S_2 S_3 S_3$

(A) **[10 Points]** Determine the probability of each letter in the table

Letter	Probability
$S_1$	
$S_2$	
$S_3$	

(B) **[10 Points]** Find the real valued tag (midpoint of the tag interval) for the sequence  $S_2 S_2 S_3 S_1$

**[20 Points]** [Problem 8] LZ77

A sequence is encoded using LZ77 algorithm (assume that window length is 20, look-ahead buffer is 10). Given that  $C(b)=1$ ,  $C(a)=2$ ,  $C(t)=3$ ,  $C(n)=4$ ,  $C(\emptyset)=5$ . Decode the following sequence of triples:

Sequence to be decoded:  $\langle 0,0,1 \rangle \langle 0,0,2 \rangle \langle 0,0,3 \rangle \langle 2,1,1 \rangle \langle 4,2,5 \rangle \langle 8,4,4 \rangle$

**[20 Points]** [Problem 9] LZW

Given an initial dictionary, encode the following message using LZW algorithm.

Index	Entry
1	<i>s</i>
2	$\emptyset$
3	<i>i</i>
4	<i>t</i>
5	<i>h</i>

Message to be encoded: *it $\emptyset$ hits $\emptyset$ his $\emptyset$ sit*

(A) **[10 Points]** Show dictionary up to at least 14 rows (indices).

(B) **[10 Points]** Show the encoded sequence.

**END OF TEST QUESTIONS**