



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 given number of source symbols, and probabilities of the symbols, which assumption is CORRECT?

- A. It is possible to create Huffman code with smaller average code length than entropy of source symbols.
- B. It is possible to create Huffman code with larger average code length than entropy of source symbols.
- C. Not enough information to create Huffman code and to calculate entropy of source symbols.
- D. Both A and B

(Q2) Identify a prefix code

- A. 1 , 01 , 001 , 011
- B. 0 , 11 , 101 , 010
- C. 0 , 10 , 110 , 111
- D. None above

(Q3) Identify uniquely decodable code

- A. 1 , 10 , 100 , 1000
- B. 1 , 10 , 101 , 1001
- C. 0 , 01 , 010 , 0001
- D. Both A and B

(Q4) Which statement is NOT correct? (Without channel error)

- A. If a code is Huffman code, then this code is prefix code.
- B. If a code is prefix code, then this code is completely decodable.
- C. If a code is completely decodable, then this code is a prefix code.
- D. All above.

(Q5) What is(are) the purpose(s) of minimum variance Huffman code?

- A. Reduce entropy
- B. Reduce redundancy
- C. Reduce average code length
- D. Reduce variance of codeword
- E. Maintain optimum buffer design for fixed transmission rate (buffer is for the conversion from variable bit rate to constant bit rate)

Write or circle the answer(s) from the above list. _____

PART 2 Show all your works

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

Design a 4-bit Tunstall code. Given source alphabet and associated probabilities.
(Use conventional method to implement Tunstall code.)

Letter	Probability
<i>A</i>	0.4
<i>B</i>	0.2
<i>C</i>	0.1
<i>D</i>	0.15
<i>E</i>	0.15

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

Given a training sequence with length of 20,

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

(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 $S_1 S_1 S_3 S_2$

[20 Points] [Problem 8] LZ77

Given that $C(n)=1$, $C(o)=2$, $C(i)=3$, $C(e)=4$, $C(\emptyset)=5$. Encode the following message using LZ77 algorithm (write the encoded sequence of triples) (assume that window size is 20, look-ahead buffer is 10):

Source sequence: *on \emptyset onion \emptyset on \emptyset one*

[20 Points] [Problem 9] LZW

A sequence is encoded using LZW algorithm and the initial dictionary is shown in the table below:

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

The output of LZW encoder is the following sequence:

3	1	2	4	5	6	2	10	7	10	4
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Decode this sequence.

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

(B) **[10 Points]** Show the decoded message.

END OF TEST QUESTIONS