

**THE HONG KONG POLYTECHNIC UNIVERSITY**  
**DEPARTMENT OF COMPUTING**  
**EXAMINATION**

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Course : MSc Scheme - 61030

Subject : COMP5422 Multimedia Computing, Systems & Applications

Group : 201, 202, 203, 204, 2888

Session : 2009 / 2010 Semester II

Date : 6 May 2010

Time : 18:30-21:30

Time Allowed: 3 Hours

Subject Lecturer: Zhang Lei

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This question paper has 5 pages.

(Pages 1-2 not to be provided)

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**Instructions to Candidates:**

The question paper has 4 sections.

Section A: True/False (20 points);

Section B: Multiple choices (15 points);

Section C: Short answers (25 points);

Section D: Long answers (40 points);

There are totally 100 points.

For Section B, each question has at least 1 correct answer.

This is a closed book and closed notes examination.

Calculator is allowed.

**Do not turn this page until you are told to do so!**

**Section C. Short Answers (25 points)**

**Question 16.** Discrete Cosine Transform (DCT) is used in JPEG compression standard. Please explain why DCT is effective in JPEG (5 points)

**Question 17.** What are the main steps in JPEG image compression standard? (5 points)

**Question 18.** The embedded zerotree wavelet (EZW) algorithm is widely used wavelet based coding. What are the two problems that EZW aims to address? (4 points)

**Question 19.** Why could we do chroma subsampling for digital video? Please show the 4:1:1 chroma subsampling scheme? (5 points)

**Question 20.** Block matching based full search is a commonly used motion estimation techniques for video compression. Please briefly explain how it is implemented and what its main drawback is. (6 points)

## Section D. Long Answers (40 points)

### Question 21. JPEG-LS.

(10 points)

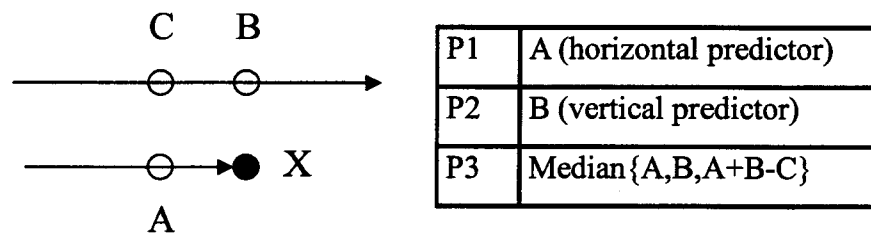
Suppose we have the following 4×4 image:

1	3	2	1
3	5	6	4
4	4	7	8
5	7	8	7

(a) What is the entropy of this image?

(2 points)

(b) Three of the predictors used in JPEG-LS are listed in the following table.



We code the image as follows:

1. Code the first row using P1
2. Code the first column using P2
3. Code the other pixels using P3

Please calculate the prediction error image.

(6 points)

(c) What is the entropy of prediction error image?

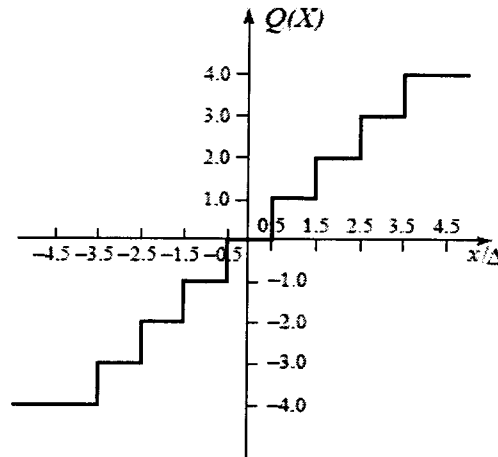
(2 points)

**Question 22. Quantization.**

(10 points)

Suppose the original signal is

$$x = [2.2, -3.8, 0.6, 3.3, -4.2, -1.7]$$

We quantize  $x$  based on the following quantizer:

- (a) What is the quantization output of  $x$ ? (5 points)
- (b) What is the mean square error of the quantized signal? (5 points)

**Question 23. DCT.**

(10 points)

The signal  $f = [40 \ 20 \ 10 \ -25 \ 40 \ -20 \ 80 \ 50]$ . Please calculate its discrete cosine transform (DCT) coefficients  $F(0)$  and  $F(1)$ .

**Question 24. 1D Haar Wavelet Transform**

(10 points)

Suppose the original signal is

$$f = [f_1, f_2, f_3, f_4, f_5, f_6, f_7, f_8]$$

We decompose it into 2 levels by using the Haar wavelet and the wavelet decomposition coefficients are

$$d = [9.5, 16.5, 0.5, -3.5, -2, 1, -2, 1]$$

Please reconstruct the wavelet coefficients at the first level and the original signal  $f$ .

**\* End \***