香 港 中 文 大 學
The Chinese University of Hong Kong

Course Examinations, 2nd term, 2009 – 2010

Course Code & Title : CSC3280 Introduction to Multimedia Systems

Time allowed : 2 hours minutes

Student I.D. No. : Seat No. :

Full Marks: 100
ANSWER ALL QUESTIONS

(1) (a) Given a network bandwidth of 10Mbps (mega bit per second). Note that 1M bits = 1024×1024 bits. What is the required minimal compression ratio for a smooth playback of a color (RGB) video stream of resolution 1080×720 and 30fps? **(4 marks)**

(b) Can we achieve that ratio using the lossless image compression format PNG by regarding each video frame as a separate image? Justify your answer. **(4 marks)**

(c) Consider each of the following cases and suggest the optimal image format (JPG or PNG) to store the image. The "optimal" is in terms of compression efficiency. Justify your answer for each case.

(i) A cartoon image (prepared in computer). **(3 marks)**

(ii) A cartoon image (scanned from magazine). **(3 marks)**

(iii) An image of natural scenery. **(3 marks)**

(2) (a) Consider the following bitstream:

0 1 0 0 1 1 1 1 0 1 0 0 0 1 1 0 0 1 1 0

Now compute the entropy for each case below:

(i) Suppose we consider every bit as a symbol. **(3 marks)**

(ii) Suppose we consider every 2 bits as a symbol. **(3 marks)**

(iii) Suppose we consider every 4 bits as a symbol. **(3 marks)**

(b) Draw the Huffman tree for (2)(a)(ii). Label each node and edge **(6 marks)**.

(c) What is the average bit per symbol of this Huffman code? **(3 marks)**

(3) (a) Given the following output from a LZ78 encoder. Decode it and draw the LZ78 tree. **R** denotes the root node. The numeric labelling of nodes starts from **1**. All other symbols are just alphabets. **(8 marks)**

R @ 1 & 2 # R # R & 5 # 2 @ 4 &

(b) Draw the LZW tree to encode the following input data. Put down the encoded output too. **R** is the root note, and the numeric labelling of the nodes starts from **1**. There are only 2 distinct alphabets in the data. **(8 marks)**

+ - - + + - + + + - - +

(c) LZW encoding is usually slow due to the searching of the longest matching prefix. Why don't people simply build the LZW-tree for fast searching? What is (are) the difficulty in practical applications? **(4 marks)**

(4) (a) Modern audio encoding technology like MP3 relies on removing audio samples that are not audible due to the inability of human hearing. Identify 2 of these inabilities. (**4 marks**)

(b) It seems that different implementations of the MP3 encoder may slightly vary in terms of compression ratio. But all of them rely on the same theory, how come there is such difference? (**4 marks**)

(c) We can observe realistic images or videos on our monitors (CRT or LCD). But we also know that our monitors cannot reproduce natural light spectrums in the natural world. Then, how can the displayed images and videos be so realistic? (**6 marks**)

(d) Comparing to sceneries we observe in real world, identify at least 2 inabilities of our current monitors (**4 marks**).

(e) Why modern image/video compression techniques seldom encode the data in RGB color space? (**4 marks**)

(5) (a) Suppose you are asked to design a threshold matrix in ordered dithering for the purpose for printing black-and-white newspaper. How will you design the matrix? Draw your design by showing an example matrix (the matrix needs not be too large). Justify your design. (**4 marks**)

(b) Comparing the image-based modeling to traditional computer graphics, what is the major advantage of image-based modeling? (**3 marks**)

(c) What is the difference between image morphing and simple image blending? (**3 marks**)

(6) (a) Suppose you are browsing a webpage containing a single large progressive JPEG image via a noisy network channel. What will you see if the network is suddenly disconnected when only half of the total data is transferred. (**4 marks**)

(b) What will happen if the zig-zag scan in the JPEG encoding is removed? (**4 marks**)

(c) When we increase the compression ratio of JPEG encoding from small to large, which of the artifacts (blocking or ringing artifacts) will appear first? Explain your answer. (**5 marks**)

- END OF QUESTION PAPER -