SOLUTIONS

Module:	Interactive Media Design and Production		
Module Code	EBU5305	Paper	A
Time allowed	2hrs	Filename	Solutions_1415_EBU5305_A
Rubric	ANSWER ALL QUESTIONS		
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Question 1

b) The following questions refer to digitisation.

i) Describe the potential effects of sampling errors and of quantisation errors in a reconstructed image. (4 marks)

Solution: sampling errors, also called aliasing incur distortions that can modify the shapes of objects in an image; quantisation errors incur a loss of details, for example less colour available in the reconstructed image.

ii) How can you make sure you do not have sampling errors? (2 marks)

Solution: we can follow the Nyquist theorem which tells us to use a sampling rate equal to at least twice the higher frequency in the signal.

c) The following questions refer to the representation of colour.

i) Describe the best you can a dark pink colour using the following three properties: hue, saturation and brightness. (3 marks)

Solution: the hue is red; the colour is unsaturated, the brightness is low.

ii) Give values in the RGB colour model that correspond to dark pink. (3 marks)

Solution: R = 100 (values between 20 and 127 are acceptable); G = B = 20 (depending on R, values between 10 and 80 are acceptable)

iii) Explain why K has been added to the CMY model used in printing. (3 marks)

Solution: to obtain black in CMY, the three inks must be put on paper in large quantity which is a waste of ink and does not allow a perfect black in practice.

Question 2

a) Consider the 8 bits gray scale image shown in Figure 1. It contains 1050 x 780 pixels. Calculate the maximum compression rate you can achieve on that image by using Run Length Encoding. Explain your calculations. (6 marks)

Hint1: the compression rate CR is defined as follows:

$$\frac{uncompressed\_size\_in\_bytes}{compressed\_size\_in\_bytes} = CR$$

Hint2: a run is encoded as follows: a flag (e.g. exclamation mark), size of the run, value of the pixels in that run

Remark: we studied a different RLE encoding scheme this year!

Figure 1

Solution: the uncompressed size is: 1050 x 780 x 1 = 819000 bytes. One scanline of the image contains 350 pixels black, 350 pixels white and 350 pixels gray for a total of 1050 pixels per scan line. This makes 3 runs of 4 bytes each: 1 byte for the flag (exclamation mark), 2 bytes for the size, 1 byte for the pixel value. The compressed size is thus: 3 x 4 x 780 = 9360 bytes. The compression rate is 819000/9360 = 87.5

b) The following questions refer to the JPEG image compression standard.

i) What known limitations of the human visual system are used in JPEG to achieve compression? (2 marks)

Solution: fine variations of colour are not easily perceivable and so can be removed to achieve compression.

ii) Is JPEG always lossy? Discuss your answer. (4 marks)

Solution: JPEG is lossy if some of the AC components are rounded to zero during the quantisation step. However, the human viewer may not be able to perceive the details that have been removed and think that the reconstructed image is the same as the original one.

iii) In general, does JPEG achieve greater compression rates on colour images or on gray scale images? Explain your answer. (4 marks)

Solution: It achieves greater compression rates on colour images. This is because chroma sub sampling, which only applies to colour images, can achieve extra compression. It works by removing some of the colour information in the image data while preserving all the brightness information. It does this after converting the mage from RGB to YUV.

c) The following questions refer to the MPEG video compression standard.

i) An MPEG1 encoded video consists of a repeating GOP (Group Of Pictures) structure. What is contained in a typical GOP? Give a valid example of a GOP structure. (3 marks)

Solution: A GOP always contains a single I frame and a number of P and B frames. A typical GOP structure might be: IPBBPBBPBBP.

ii) Explain how the choice of GOP structure affects the size of the MPEG video file. (3 marks)

Solution: When GOP structures are long (many P and B frames), the total number of I frames in the video will be small. Since I frames are the biggest, the video files containing a small number of them will tend to be smaller in size.

iii) Explain why the frames of any GOP structure need to be re-ordered before transmission. (3 marks)

Solution: The B frames contained in a GOP need two reference frames in order to be reconstructured. One of these references is a "future" frame, i.e. it normally comes later in the GOP structure. To make it available for decoding the B frame, it has to be sent before, hence the need to re-order the data stream.