SOLUTIONS

Module:	Interactive Media Design and Production		
Module Code	EBU5305	Paper	A
Time allowed	2hrs	Filename	Solutions_1314_EBU5305_A
Rubric	ANSWER ALL QUESTIONS		
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Question 1

a) Answer the multiple choice questions below by entering your choice (A, B, C or D) in the dedicated space (the small square that appear immediately on the right of each question). For each question, make only one choice.


Q1: A 200 by 300 pixel image has a size of 60 Kbytes. It is stored using:
   A. Black and white only (2 colours).
   B. Grayscale.
   C. A 4 bits indexed format.
   D. A 8 bits indexed format.
	B	**2 marks**

Q2: A sound file encoded with a 8 bits quantisation rate is likely to be:
   A. A piece of music.
   B. Natural sound (e.g. rain).
   C. Speech.
   D. A song.
	C	**2 marks**

Q3: Which of the following statements about a grey colour is not true?
   A. In RGB, the three values are equal.
   B. In CMY, the three values are equal.
   C. In CMYK, only K can be used.
   D. In HSV, S is equal to zero.
	C	**2 marks**

Q4: Which of the following sets (R, G, B) values correspond to a non-saturated dark green colour?
   A. (0, 255, 0)
   B. (100, 255, 100)
   C. (50, 100, 70)
   D. (50, 100, 50)
	D	**2 marks**

b) The following questions refer to the HSV colour model.

    i)   Explain how the three following colour properties: hue, saturation and brightness, are represented in the HSV model. Make a drawing to support your explanations. (5 marks)

    ii)   Where are the grayscale colours located on the graphical representation of the HSV model? (2 marks)

Solution:

    i)   **The Hue (H) is represented along the edge of the hexagone. The Saturation (S) is represented on the horizontal axis from the center of the hexagone to its edge. The brightness (V forValue) is represented on the vertical axis from the bottom to the top of the hexagone.**
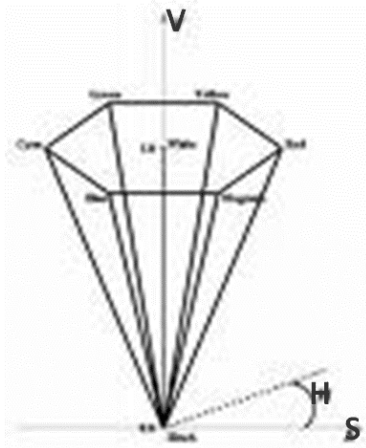
ii) **The grayscale is along the vertical V axis.**

c) Consider the three images shown in Figure 1. Image 1(a) is the original grayscale image.

   i) Image 1(b) is the same image as in 1(a) obtained with a lower sampling rate. Explain its appearance. (3 marks)

   ii) Image 1(c) is the same image as in 1(a) obtained with a lower quantisation rate. Explain its appearance. (3 marks)
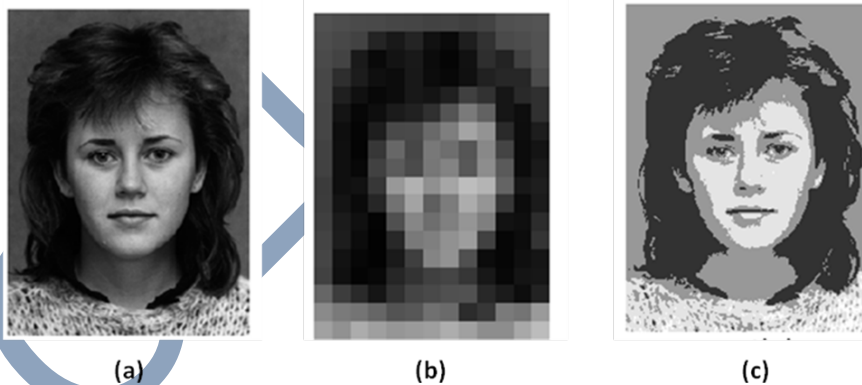

Figure 1

Solution:

   i) **The image appears blocky because missing pixel information must be interpolated over a number of pixels. This is a case of aliasing.**

   ii) **The image shows large areas of uniform gray level, this is because there is not enough bits to encode all the different shades of gray of the original image. Using dithering could improve its appearance.**

Question 2

a) Answer the multiple choice questions below by entering your choice (A, B, C or D) in the dedicated space (the small square that appears at the bottom right of each question). For each question, make only one choice.

Q1: Which of the following statements about lossless image encoding <u>is not</u> true?
    A. With lossless encoding, redundant data is not encoded.
    B. No information is lost in a compression and decompression cycle.
    C. For encoding to remain lossless, an image should be compressed only once.
    D. Lossless encoding is possible when some data appear more often than other.   **C**
	2 marks

Q2: Images of country flags can usually be compressed very efficiently using Run Length Encoding. Why?
    A. Because they contain a small number of colours.
    B. Because the colours are almost identical from one pixel to the next.
    C. Because of their statistical properties.
    D. Because they contain large areas of uniform colour.   **D**
	2 marks

Q3: In JPEG, which of the following steps contribute the most to compression?
    A. Dividing image into blocks.
    B. Colour conversion.
    C. Discrete Cosine Transform (DCT).
    D. DCT coefficients quantisation.   **D**
	2 marks

Q4: Which of the following statements describes best what is chroma sub-sampling?
    A. It is a process where colours are converted to a different model.
    B. It is a process where some colour information is thrown away.
    C. It is a process to separate colour from brightness information.
    D. It is a process to eliminate some of the pixels.   **B**
	2 marks

Q5: In JPEG, what is the effect of using quantisation tables that contain small values?
    A. It achieves great compression and loses much quality.
    B. It achieves little compression and preserves much quality.
    C. It achieves great compression and preserves much quality.
    D. It achieves little compression and loses much quality.   **B**
	2 marks

Q6: Which of the following statements describes best intra-frame coding?
    A. It uses one earlier frame in a sequence to compress the current frame.
    B. It uses only the current frame.
    C. It uses both earlier and later frames in a sequence to compress the current frame.
    D. It uses one later frame in a sequence to compress the current frame.   **B**
	2 marks

b) Consider the following sequence S of symbols: AABBBBCDDDAAAAA.

   i)   How would you encode the above sequence using Run Length Encoding? (2 marks)

   ii) Consider the following Huffman codes: 00, 01, 10, 110. Explain how you would use these
        codes to encode the sequence S. (3 marks)

Solution:

   i)   **AA!4BCDDD!5A**

        <u>Remark: we studied a different RLE encoding scheme this year!</u>

   ii) **Assign shorter codes to high frequency symbols, e.g. 00 to A, 01 to B, and 10 to D. C is
        the les frequent and should be encoded with the longer code: 110.**

        00000101010111010101000000000000

c) Figure 2 shows three consecutive frames (F1, F2 and F3) of a video. In the middle frame (F2),
four macroblocks (MB1, MB2, MB3 and MB4) are shown. For each of these four macroblocks,
briefly explain how it should be encoded in MPEG1 to achieve the highest compression. (8 marks)
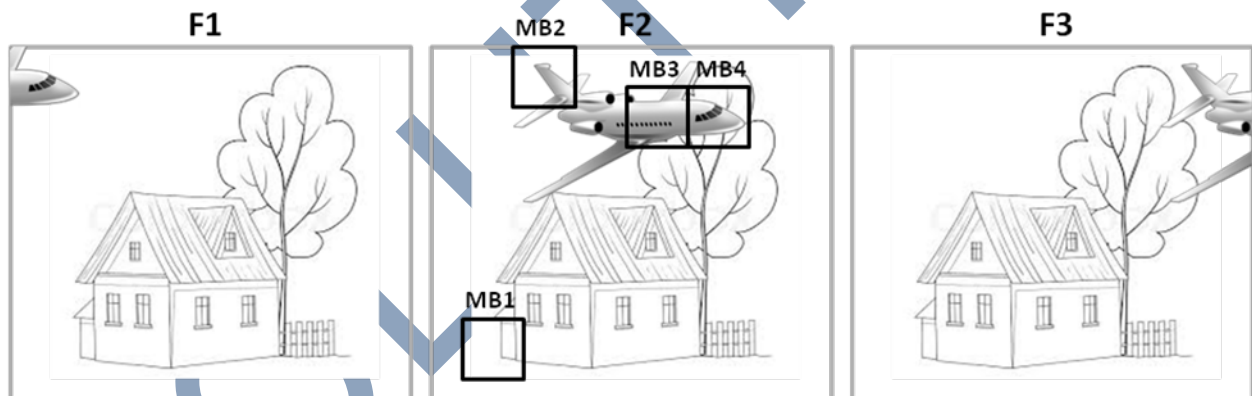

Figure 2

Solution:

MB1: this macroblock is exactly the same than in F1, nothing needs to be encoded.

**MB2: a similar (although not identical) macroblock can be found in F3 so this should be a B
(forward prediction) macroblock.**

**MB3: this macroblock cannot be matched with any other, it must be an I (intra coded)
macroblock.**

**MB4: a similar (but not identical) macroblock can be found in F1 at a different position, this
can be a P (predicted macroblock).**