CARDIFF UNIVERSITY
EXAMINATION PAPER

Academic Year: 2011/2012

Examination Period: Autumn

Examination Paper Number: CM0340

Examination Paper Title: Multimedia

Duration: 2 hours

Do not turn this page over until instructed to do so by the Senior Invigilator.

Structure of Examination Paper:

There are 3 pages.
There are 4 questions in total.
There are no appendices.
The maximum mark for the examination paper is 81 and the mark obtainable for a question or part of a question is shown in brackets alongside the question.

Students to be provided with:

The following items of stationery are to be provided:
ONE answer book.

Instructions to Students:

Answer 3 questions.
The use of calculators is permitted in this examination.
The use of translation dictionaries between English or Welsh and a foreign language bearing an appropriate departmental stamp is permitted in this examination.

Q1. (a) What is *MIDI*? [1]

(b) What features of MIDI make it *suitable* for use in the *MPEG-4 audio compression standard*? [2]

(c) Briefly outline the MPEG-4 *structured audio* standard. [6]

(d) What *features* of MIDI make it suitable for *controlling* software or hardware devices? [6]

(e) Outline how you could utilise MIDI in the following situations:

- A MIDI controller that has to be able to accommodate a range of values in excess of 255. [2]
- A MIDI sampler has limited memory but needs to be configured to be play trumpet sounds at one instant but also violin sounds at other instants. [2]
- A MIDI controlled Avatar where the avatars limbs and facial features are required to be controlled via MIDI. [2]
- A MIDI controlled toy car where MIDI needs to control the starting and stopping of the car and also its speed. [3]
- A robot is to be controlled via MIDI. The robot has custom configurable circuitry that control its movement and sensors. The circuitry has to be initialised via MIDI. [3]

Q2. (a) How does the *human eye* sense colour? What characteristics of the human visual system can be exploited for the compression of colour images and video? [5]

(b) What is the *YIQ colour model* ? How is compression achieved with YIQ in Analog NTSC Video and Digital MPEG Video? [5]

(c) What is a *colour look-up table* and how is it used to represent colour? [5]
Give an advantage and a disadvantage of this representation with respect to true colour (24-bit) colour. [2]
How do you convert from 24-bit colour to an 8-bit colour look up table representation? [1]

(d) Describe how colour look-up tables can be used to implement simple computer animations. Illustrate you answer with the following example: In a 7x7 image you have to animate a 3x3 red square moving from left to right at a rate of 2 pixels per frame. The square is centred vertically within the image and the image background is black. [8]
Give a limitation of colour look-up table animation [1]

Q3. (a) GIF and JPEG are two commonly used image representations. Do they usually use lossless or lossy compression? State the major compression algorithm (for lossless) or the lossy steps of the algorithm (for lossy) for each. [4]

(b) Briefly describe the four basic types of data redundancy that data compression algorithms can apply to audio, image and video signals. [8]

(c) Encode the following steam of characters using decimal arithmetic coding compression:

MULTI

You may assume that characters occur with probabilities of M = 0.1, U = 0.3, L = 0.3, T = 0.2 and I = 0.1. [12]

(d) Describe how your solution to (c) would be decoded — you do not need to show a complete enumerated solution. [3]

Q4. (a) List *two* psychological phenomena that are exploited in MPEG audio compression. [2]
Briefly explain their meanings. [2]

(b) How does MPEG audio compression *implement* methods which use the above psychological phenomena? [8]

(c) What are the *fundamental differences* between *MPEG* and *Dolby audio compression* algorithms? [4]
Give an advantage and a disadvantage of Dolby with respect to MPEG audio compression. [2]

(d) Given two stereo channels of audio:

Left Channel: 112   102   113   114   115   127   136   144
Right Channel: 112   114   116   104   124   120   122   133

   i. Apply Middle/Side (MS) stereo coding to the sequence. [3]
  ii. How may this result be employed to achieve compression in MPEG Audio? Illustrate your answer with respect to the above data. [4]
 iii. Give two potential problems of this coding method. [2]