CARDIFF UNIVERSITY
EXAMINATION PAPER

Academic Year: 2008/2009

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 5 pages.
There are 4 questions in total.
There are no appendices.
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 translation dictionaries between English or Welsh and a foreign language bearing an appropriate departmental stamp is permitted in this examination.

PLEASE TURN OVER

Q1. (a) Briefly outline *four* broad classes of approach that one may exploit to compress multimedia data. **Do not detail any specific compression algorithms**. [8]

Give *one example* of a compression algorithm for *each class*. [4]

(b) What *advantage* does arithmetic coding offer over Huffman coding for data compression? [2]

(c) *Briefly state an algorithm for arithmetic decoding*. [5]

(d) Given the following table of frequency counts, probabilities and probability ranges for the following characters:

Char	Freq	Prob.	Range
A	2	0.5	[0.0, 0.5)
B	1	0.25	[0.5, 0.75)
C	1	0.25	[0.75, 1.0)

What is the *4 character sequence* for the arithmetic coding: 0.59375? [4]

It is possible for the decoder to return a zero value which corresponds to the symbol in a probability range rather than the end of the decoding process. How can this problem be avoided in the arithmetic decoder?

[4]

Q2. (a) In a digital signal processing system, what are meant by *block* and *sample-by-sample* processing? [2]

Give **one** example of a process of **each type**. [2]

(b) Give definitions of the *transfer function* and *frequency response* of a digital system, in terms of its impulse response. [2]
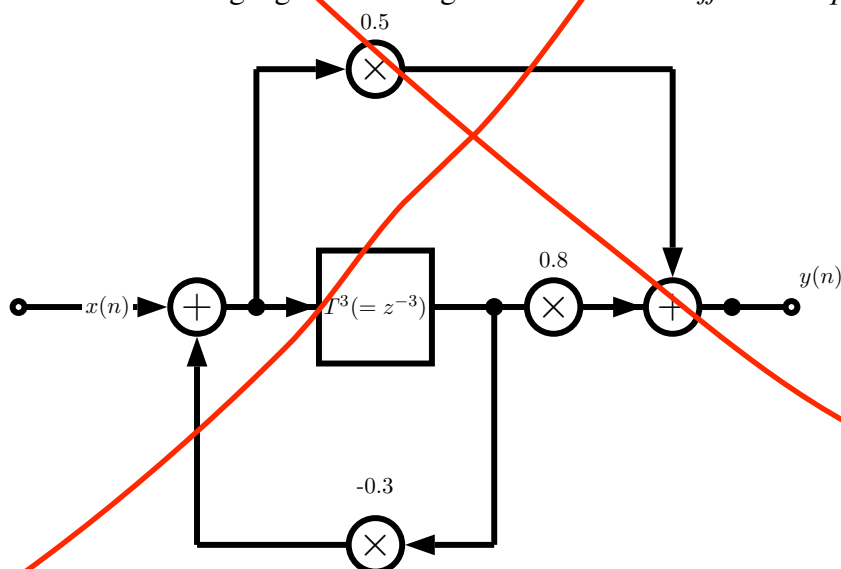
(c) Briefly discuss *three* algorithmic approaches to implementing *filtering* in a digital system [9]

(d) Given the following difference equation construct its *signal flow diagram*:

$$y(n) = 6x(n) + 3x(n-1) + 1x(n-2)$$
$$-5y(n-1) - 4y(n-2)$$

[6]

(e) Given the following signal flow diagram construct its *difference equation*, $y(n)$:

[6]

Q3. (a) What is the *difference* between *reverb* and *echo*? [2]

(b) Give the names of *two filter based* approaches to simulating the *reverb effect* in digitial audio.

[2]

Comment on how one approach builds on the other and how filters are used to achieve the desired effect. [6]

(c) State *one alternative* approach to *reverb simulation* that does not employ filters.

[1]

Briefly, giving **no** mathematical detail, describe how this approach is implemented. [4]

(d) For each of the *three reverb* methods you have described above discuss how, in the following two scenarios, the sounds recorded by the microphone could be *modelled*:

i. A long hallway where the long walls are lined with a high frequency absorbing acoustic panels. The sound source is placed at one end of the hallway and a microphone is placed at the other end. [6]

ii. A *cardoid microphone* is a microphone that accepts sound from the front and sides but not the back of the microphone.
In a square recording studio, with uniform surfaces, a cardoid microphone is placed directly facing a sound source a few feet away. [6]

Q4. (a) Briefly outline the basic principles of *Intra-Frame (I-Frames) Coding* in Video Compression, as used in MPEG-2.

[8]

(b) What is the key *difference* between *I-Frames*, *P-Frames* and *B-Frames*? [3]

(c) Why are I-frames inserted into the compressed output stream *relatively frequently*?

[2]

(d) Given the following coding order of a group of frames in MPEG-2:

I P B B B P B B B I B B B I P B P
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

What is *display order* of the frames? [7]

(e) The following macroblock window has a best sum of absolute difference (SAD) match of 1 to a given MPEG Interframe search:

4	2
3	5

Should *inter or intra-frame* coding be employed to code this macroblock, and why? [7]

END OF EXAMINATION