CARDIFF UNIVERSITY
EXAMINATION PAPER

Academic Year: 2007/2008

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 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.

Q1. (a) Why is *data compression* desirable for multimedia activities? [2]

(b) What is the distinction between lossy and lossless data compression? [2]

(c) What are the main *differences* between the target media for JPEG and GIF compression? [2]

(d) What improvement did the LZW algorithm make on previous LZ versions? [2]

(e) Describe the *LZW* algorithm for encoding an input sequence, giving suitable pseudocode. [7]

(f) Given an initial dictionary:

Index	Entry
1	a
2	b
3	h
4	i
5	s
6	t

and output of an *LZW encoder*:

6 3 4 5 1 3 1 6 2 9 11 16

decode the above sequence (which is not intended to represent meaningful English. [12]

Q2. (a) In a digital signal processing system, what is meant by *block* and *sample-by-sample* processing. [2]
Give **one** example of an application of **each type**. [2]

(b) In a digital signal processing system, what is meant by a *linear* and a *non-linear* time invariant system. [2]
Give **one** example of an application of **each type**. [2]

(c) Give the definition of an *impulse response*. [2]
Give **two** practical uses of an impulse response in digital signal processing. [2]

(d) List the three basic components used in constructing a *signal flow graph*. [3]
Why is it desirable to describe systems using these components. [3]

(e) What is the **main** distinction between an *infinite impulse response (IIR)* and a *finite impulse response (FIR)* filter. [1]

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

$$\begin{aligned} y(n) &= b_0x(n) + b_1x(n-1) + b_2x(n-2) \\ &\quad -a_1y(n-1) - a_2y(n-2) \end{aligned}$$

[8]

Q3. (a) List **six** broad classes of *digital audio effect*. Give an example effect of **each** type of effect. [6]

(b) Give a description, including a signal flow diagram and algorithm, of the *state variable filter*. [8]

(c) Give **two** advantages of the *state variable filter*. [2]

(d) A *band-reject* filter is a filter which passes all frequencies except those in a stop band centered on a center frequency. How can such a filter be implemented using **two** state variable filters? [4]

(e) How may a *phaser* effect be implemented using **two** state variable filters? [7]

Q4. (a) Give a definition of a *one-dimensional Fourier transform*. [2]

(b) Explain in detail how data is represented after the Fourier transform has been applied to a signal. [2]

(c) Outline the basic approach to performing data *filtering* with the Fourier transform. [4]

(d) Describe **one** application of Fourier transform filtering methods in multimedia data compression. [8]

(e) An *exciter* is a digital audio signal process that emphasises or de-emphasises certain frequencies in a signal in order to change its *timbre*. Describe how you could use the Fourier transform to implement such a process, giving a *practical example* and explaining how it works. [11]