UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

B. Sc. Examination 2010

Creative Computing

IS52020A (CC227) Creative Computing 2

Duration: 3 hours

Date and time:

There are six questions in this paper. You should answer no more than four questions. Full marks will be awarded for complete answers to a total of four questions. Each question carries 25 marks. The marks for each part of a question are indicated at the end of the part in [.] *brackets.*

There are 100 marks available on this paper.

This is a practical examination; each answer requiring code or other computational material should be named according to question number, part and sub-part: for example, `Q5_b_2.pde` *for a Processing sketch in answer to part (b) sub-part (ii) of question 5. Save your answer to the exam submission folder. You are responsible for ensuring that your answers have been saved in the correct location.*

THIS PAPER MUST NOT BE REMOVED
FROM THE EXAMINATION ROOM

Question 1 Ambiguity

(a) Give an example of ambiguity in **each** of language, image and sound, explaining in each case the nature of the ambiguity. [9]

(b) A sound signal is measured using a microphone at a sampling frequency of 8kHz, and the measurements stored in an *Octave* vector named `s`. If the recorded sound signal in continuous time is given by

$$\frac{1}{6}\sin(880\pi t) + \frac{1}{15}\sin(1760\pi t)$$

and the first sample is taken at $t = 0$, give an *Octave* expression to construct the same measured values for a sampling period of two seconds. [5]

(c) Compute the value of the following *Octave* expressions, where `s` names the signal measurement vector as above.

i. `s[1];`

ii. `s[2];`

iii. `s[50];`

iv. `s[8001];`

[6]

(d) For the continuous-time signal given by

$$\frac{1}{6}\sin(16880\pi t) - \frac{1}{15}\sin(14240\pi t)$$

sampled as above and stored in the *Octave* vector `v`, compute the values of `v[2]` and `v[50]` that would be measured, and comment on your answer. [5]

Question 2 Multimedia Information Retrieval

(a) Describe the **fingerprinting** and **recommendation** tasks in the context of Multimedia Information Retrieval. [6]

(b) Define the terms **true positive**, **false negative** and **false positive**, and use those terms to explain the **precision** and **recall** performance measures of an Information Retrieval system. [6]

(c) An Information Retrieval system retrieves 10 items for a given query. If 6 of those items are relevant results, and there were another 6 relevant items which were not retrieved, compute the precision and recall of the system for this query. [4]

(d) A company wishes to set up a music recommendation service, offering suggestions of tracks a listener might like based on a set of example tracks. Explan what retrieval results should be considered relevant in this context, and hence which of precision and recall is more important when evaluating this system. [9]

Question 3 Colour Mixing

(a) Explain what is meant by colour mixture by averaging, and briefly describe the physiological mechanisms by which the effect of colour mixture by averaging occurs. [6]

(b) Construct *Processing* sketches to illustrate the mixture of equal amounts of the sRGB colours {255, 0, 0} and {0, 255, 0} for averaging by

i. area; and [4]

ii. time. [4]

(c) Explain why the perceived mixture colour as a result of the mixture is close to neither {255, 255, 0} nor {127, 127, 0}. [4]

(d) Given that the sRGB colour space value of γ (gamma) can be approximated by about 2.2, compute the approximate mixture colour for an equal amount of sRGB colours {255, 0, 0} and {0, 255, 0}. (You may wish to check your answer in a temporary sketch; you may but need not submit that sketch as part of your working.) [7]

Question 4 Audio Perception

Write a short essay on **each** of the following topics: [25]

i. sound source location;

ii. harmony, consonance and dissonance.

Each essay is worth half the marks for this question.

Question 5 Systems and Image filtering

(a) In the context of signal processing, what is a *system*? Give one example of a system commonly used in musical audio effects. [4]

(b) Define, either in words or in symbols, the convolution of two one-dimensional signals x and h. [3]

(c) Describe how a Finite Impulse Response filter can be implemented using the convolution operator. [3]

(d) A filter for images has the kernel

$$\frac{1}{4}\begin{pmatrix} 0.25 & 0.5 & 0.25 \\ 0.5 & 1 & 0.5 \\ 0.25 & 0.5 & 0.25 \end{pmatrix}$$

Using *Octave*, write a function to implement the processing of a grayscale image with this filter. You may assume that your function receives a two-dimensional matrix argument representing the pixel data, one element per pixel, and should return the new image in the same format. [8]

(e) Apply this filter to the data in the image file provided, and save the resulting image data to file in `png` format. [5]

(f) What effect does the filter in part (d) represent? [2]

Question 6 Visualization

(a) Describe the purpose of visualisation, and give two examples of visualisations of audio signals, explaining how those visualisations address the stated purpose. [9]

(b) The table below tabulates the carbon emissions for a particular year by region of the world. Describe a suitable visualisation for this kind of data, and construct, using *Processing* or otherwise, a simple example or mockup of your visualisation. [12]

Region	Carbon Emissions / Mton
Africa	1,020
Central & South America	1,140
Middle East	1,470
Eurasia	2,870
Europe	4,450
North America	6,980
Asia & Oceania	10,270

(c) Suggest extra data which if it were available would allow for a more informative visualisation, and explain how you would make use of it. [4]