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 Digital Images and Colour Spaces

(a) Briefly describe the following colour spaces, giving for each an example of a situation where they are used: [12]

i. HSB;

ii. CMYK;

iii. sRGB;

iv. CIE LAB.

(b) Write in a single sketch two *Processing* functions, one computing the x coordinate and one the y coordinate in the transformation from CIE XYZ colour coordinates to CIE xyY chromaticity-luminance coordinates. Your functions should each accept three floating point arguments corresponding to X, Y and Z, and return one floating point value. [5]

(c) Using your functions, or otherwise, transform the following CIE XYZ colour specifications to CIE xyY coordinates, and identify any colours confusable by those with tritanopic anomalous colour vision. [8]

i. {0.41, 0.25, 0.83};

ii. {0.25, 0.25, 0.095}; and

iii. {0.3, 0.5, 0.2}

Question 2 Multimedia Information Retrieval

(a) Define the following distance measures, and give examples of situations where their use is appropriate: [8]

i. Euclidean distance;

ii. Manhattan distance;

iii. Hamming distance.

(b) A collection of audio files is stored on disk; in addition, you may assume that each sound file has had its average (root-mean-square) amplitude precomputed.

i. Describe a data structure and an algorithm that will allow the retrieval of the sound file whose loudness is perceptually closest to the loudness of a query sound file. [7]

ii. Comment on the efficiency of your solution to part b.(i) above; [3]

iii. The disk store contains four sound files, with root-mean-square amplitudes {0.3, 0.25, 0.22, 0.19} corresponding to filenames {`first.wav`, `second.wav`, `third.wav`, `fourth.wav`} respectively. Which filename should be retrieved for a query audio file with a root-mean-square amplitude of 0.2348? Show your working. [7]

Question 3 Signals

(a) Write down a mathematical expression for a general sinusoidal oscillation as a function of time, and with reference to that expression or otherwise define the terms **amplitude**, **frequency** and **phase**. [8]

(b) Describe, as precisely as possible, the effect of playing simultaneously two sinusoidal audio signals, each having the same amplitude and phase, but one having a frequency of 220Hz and the other a frequency of 222Hz. [5]

(c) Suggest one application of the phenomenon in part (b). [2]

(d) Describe what is meant by Fourier analysis. [2]

(e) With particular reference to the structure of the inner ear, explain how the human hearing apparatus effectively performs Fourier analysis on sound waves. [8]

Question 4 Sound, Hearing and Music

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

i. melody, harmony and rhythm;

ii. digital music file formats.

Each essay is worth half the marks for this question.

Question 5 Systems and Filters

(a) In the context of systems and signal processing, define the following terms:

i. impulse response; [3]

ii. a linear system; [3]

iii. a time-invariant system; [3]

iv. an LTI system. [1]

(b) A filter for audio has the kernel

$$\frac{1}{2}\begin{pmatrix} 1 & 1 \end{pmatrix}$$

Using *Octave*, write a function to implement the processing of audio data with this filter. You may assume that your function receives a matrix argument representing the audio data, one vector per channel, and should return the new data in the same format. [8]

(c) Apply this filter to the data in the audio file provided, and save the resulting audio data to file in `wav` format. [5]

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

Question 6 Visual Perception

(a) In the context of cinematic projection, explain the difference between *frame rate* and *flicker rate*, including in your explanation the different perceptual effects causing the distinction to be necessary, and typical rates chosen in current systems. [8]

(b) Describe the perceptual effects known as *beta motion* and the *phi phenomenon*, with particular reference to typical timescales and the responses that they elicit. [8]

(c) Construct a *Processing* sketch illustrating at least one of the Gestalt Principles of grouping. Include, either in a written answer or in a comment section in your sketch the principle(s) illustrated, and how your sketch does so. [9]