UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

Department of Computing

B. Sc. Examination 2016

IS51016B
Audio-Visual Computing

Duration: 2 hours 15 minutes

Date and time:

This paper is in two parts: part A and part B. You should answer ALL questions from part A and TWO questions from part B. Part A carries 40 marks, and each question from part B carries 30 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 PAPER MUST NOT BE REMOVED
FROM THE EXAMINATION ROOM

Part A

Please answer all questions

Question 1 If you want to move towards the direction (1,1) with the same speed as velocity (3,4), what is your velocity?

[4]

(a) (1,1)

(b) (5*sqrt(2), 5*sqrt(2))

(c) (5,5)

(d) None of the above

Question 2 PVector is the class in Processing which describes a two or three dimensional vector. It has several useful methods. Now given two vectors v1 and v2, what is are the return types of v1.dist(v2) and add(v1,v2)?

[4]

(a) v1.dist(v2) returns a float, add(v1,v2) returns a float.

(b) v1.dist(v2) returns a float, add(v1,v2) returns a vector.

(c) v1.dist(v2) returns a vector, add(v1,v2) returns a float.

(d) v1.dist(v2) returns a vector, add(v1,v2) returns a vector.

Question 3 What is the return type of the dot product of a(1,1) and b(4,-2)?

[4]

(a) Vector

(b) Matrix

(c) Array

(d) Float

Question 4 In the following equation, what is the frequency of the sine wave: a, b, c, or d: f (t) = a sin(bt + c) + d

[4]

Question 5 Write done correct sequence of steps 2-5 for motion detection (the first step is given).(Note that here you are expected to write down 'a,b,c,d' with the correct order)

[4]

```
Step 1:  Set a threshold for how different a pixel must be
Step 2:__
Step 3:__
```

```
Step 4:__
Step 5:__
```

(a) Only if different, display black, if not display white

(b) Compare current colour and previous colour

(c) Create an empty image as a buffer

(d) Step through all pixels to see if we've exceeded the threshold

Question 6 Indicate the most appropriate communication protocol MIDI, OSC, or neither for each of the following scenarios.

[4]

(a) Sending frequency and articulation data from a piano keyboard to a commercial music application.

(b) Sending control data between a sound application and a visualiser on the same computer.

(c) Sending control data between a sound application and a visualiser over a network.

(d) Sending realtime audio signal data over a network.

Question 7 What type of synthesis is performed by the following Processing/minim code?

```
Minim minim;
Oscil carrier;
Oscil modulator;

void setup()
{

     minim = new Minim(this);
     AudioOutput out = minim.getLineOut();

     modulator = new Oscil(65, 50, Waves.SINE );
     modulator.offset.setLastValue(300);
     carrier = new Oscil( 440, 0.2f, Waves.SINE );

     modulator.patch(carrier.frequency);
     carrier.patch(out);
}
```

[4]

(a) Additive synthesis

(b) Subtractive Synthesis

(c) Frequency Modulation

(d) Amplitude Modulation

Question 8 Calculate the sizes in MB of a 10 minute uncompressed recording in these formats.

[4]

(a) mono, 44.1k, 16 bit

(b) stereo, 96000 Hz, 24 bit

(c) mono, 22000 Hz, 8 bit

(d) mono, 11k, 8 bit

Question 9 In Digital Signal Processing a smaller buffer size results in

[4]

(a) A higher demand on the CPU and increased latency.

(b) A lower demand on the CPU and decreased latency.

(c) A lower demand on the CPU and increased latency.

(d) A higher demand on the CPU and decreased latency.

Question 10 What perceptual property of a sound corresponds to the frequency of a sound wave?

[4]

(a) Loudness

(b) Pitch

(c) Amplitude

(d) Timbre

Part B

Question 11 Physical Simulation

(a) The basis of physical simulation is Newton's second law. Write the mathematical formula of Newton's Second Law and explain its meaning. [4]

(b) Based on Newton's second law, how does the force of gravity influence an object (consider the situation where gravity is the only force that applies to this object, for instance, an object dropping from the sky to the ground when we ignore air resistance)? [4]

(c) Briefly explain how you would animate the position of an object that is dropping from the sky to the ground, under the influence of gravity. [6]

(d) Why do we need particle systems sometimes? Give two examples of applications of particle systems. [6]

(e) We discussed five steps that happen for each frame in a particle system. Write down and explain briefly the five steps with one of the examples you wrote above. [10]

Question 12 Filtering (joint question: visual and audio)

(a) Filtering is an important method in image processing. Explain the difference between local and neighbourhood filtering, and give two examples each. [8]

(b) In image processing, we often use kernels for filtering. Write down an example of a 3 by 3 kernel, and explain what does it do. Briefly explain whether your kernel preserves the brightness of the original image and why. [5]

(c) Is the kernel you wrote down in the previous question a high-pass or low-pass filter? Why? [2]

(d) What filter and parameter values would you use for a filter sweep on a looping drum sample which starts with the full frequency spectrum and gradually removes lower frequencies. For extra marks specify what type of envelop you might use. [4]

(e) An envelope object produces a linear sequence of values which move from 1.0 to 0.0 . Describe how you might convert the values so that they can be used to create a perceptually even fade out. [2]

(f) Describe how you might configure and use an FFT object to control an audio responsive visualisation in Processing. You can optionally use pseudo code and drawings, and can specify the type of audio input. [9]

Question 13 Audio: Synthesis

(a) Describe the perceptual and procedural differences between White Noise and Brown Noise? [3]

(b) Describe the perceptual and procedural differences between an audible sine wave and an audible saw wave. You may use drawings if you want ? [3]

(c) Draw an envelope for a bell-like sound. Give an indication of the timing of the various portions. [2]

(d) Draw and label an ADSR envelope giving values for each of the parameters and indicating for each of them whether they describe time or level. [2]

(e) Describe a number of synthesised instruments (eg. bass, drums, lead synth) that could be used for creating a retro 80s electropop band. You should describe your instruments in terms of details such as synthesis techniques, types of wave form, envelopes, and parametrical ranges. [10]

(f) Now you want to add vocals with a classic delay effect. Write pseudo code to implement a delay line with feedback at buffer level. [10]