

UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

B. Sc. Examination 2011

Computer Science

IS51012C/16A/17A Audio-Visual Information Systems,
Audio-Visual Computing, Creative Audio-Visual
Computing

Duration: 1 hour 30 minutes

Date and time:

There are three questions in this paper. You should answer all of them. Each question is marked out of 100. The marks for each part of a question are indicated at the end of the part in [.] brackets.

No calculators should be used.

**THIS PAPER MUST NOT BE REMOVED
FROM THE EXAMINATION ROOM**

Question 1

- (a) What is a kernel and how is it used in image filtering? [10]
- (b) Explain what the following lines of code do. [10]
- ```
beginShape ();
 vertex (100, 100);
 vertex (200, 100);
 vertex (200, 200);
endShape (CLOSE);
```
- (c) Explain the difference between the following pieces of code. [10]
- i. `translate (100, 200);`  
`rotate (radians (90));`
- ii. `rotate (radians (90));`  
`translate (100, 200);`
- (d) Describe one of the three elements of the boids flocking algorithm. [10]
- (e) Explain the difference between point lights and directional lights. [10]
- (f) Consider the Red Book CD Audio format, which uses 2 channels of 16 bit samples, sampled at 44,100Hz. What are the technical limitations imposed by this bit depth and sampling rate and what is the approximate maximum length in seconds of audio that could be stored on a 650 megabyte disc? Show your working. [10]
- (g) Why is wavetable synthesis more efficient than FM synthesis? Which can produce the largest variety of waveforms and why? [10]
- (h) Describe a MIDI note on message. [10]
- (i) Explain why higher order filters are more computationally expensive than lower order ones. [10]
- (j) What is the difference between content based and meta data based music information retrieval? Give two examples of each type of data. [10]

## Question 2

The following Processing code draws a smiley face:

```
void setup()
{
 size(640, 480);
 strokeWeight(6);
}

void draw()
{
 background(255);

 ellipse(40, 40, 80, 80);
 point(30, 30);
 point(50, 30);
 arc(40, 40, 50, 50, radians(0), radians(180));
}
```

Describe, with examples of code, how you would edit the programme to:

- (a) Position it at the bottom left of the window ensuring that the whole face remains visible. [10]
- (b) Make it move across the screen horizontally at constant speed. [20]
- (c) Make it bounce off when it hits the edge of the screen. [20]
- (d) Make it rotate as it moves. [25]
- (e) Make it move more realistically and/or expressively, for example how would you get the speed to change realistically or add squash and stretch? [25]

### Question 3

The following Processing code fills an array using the sin function:

```
float [] signal;
float phase;

void setup(){
 signal = new float [44100];
 phase = 0f;
 for (int i=0;i<signal.length;i++){
 signal[i] = sin(phase);
 phase = phase + (TWO_PI / signal.length);
 }
}
```

- (a) State the frequency of this waveform if the sampling rate of the system is 44,100Hz. Write a new version of the for loop which generates a signal with a frequency of 500Hz. [10]
- (b) Write a new version of the for loop which generates an ascending sawtooth waveform in the range 0-1 with a frequency of 1Hz. [20]
- (c) Write a draw function which plots the signal array so that it fits into the Processing window. You should also set the size of the window in an appropriate part of the sketch. [25]
- (d) Write a function with the following signature:

```
float [] averagingFilter(float [] signal)
```

It should apply the filter defined with the following difference equation to the incoming signal and return the resulting array:

$$y[n] = \sum_{i=1}^3 \frac{x[n-i]}{3}$$

where  $y$  is the output signal,  $x$  is the input signal and  $n$  is the current sample.

- [25]
- (e) Write the difference equation for a delay with feedback effect. Define any terms you use. [20]