

UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

B. Sc. Examination 2014

Computing

IS51016A/12C/17A Audio-Visual Computing,  
Audio-Visual Information Systems, Creative Audio-Visual  
Computing

Duration: 2 hours 15 minutes

Date and time:

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*There are five questions in this paper. You should answer THREE of them. Each question is marked out of 25. The marks available for each part of a question are indicated at the end of the part in [.] brackets.*

*Electronic calculators must not be programmed prior to the examination. Calculators which display graphics, text or algebraic equations are not allowed.*

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

## Question 1

- (a) In terms of Audio-Visual computing, what is a sine wave? [3]
- a) A form of digital signal
  - b) A probability function
  - c) A trigonometric function
  - d) A result of digital sampling
- (b) If you were using audio signal processing to alter a recording of a symphony, what would a high pass filter do? [3]
- a) increase the apparent amplitude of the bass drums
  - b) remove sounds made by mobile phones in the audience
  - c) reduce rumbling sounds made by passing vehicles
  - d) increase the frequency of high notes
- (c) You are writing a game with a robot whose position is represented by a PVector called robotPos. It is moving alongside a warehouse with position warehousePos. What does the following code do?: [3]
- ```
float angle = atan2(robotPos, warehousePos);
```
- a) moves the robot's position along a tangent, towards the warehouse
  - b) determines the angle to turn so the robot points in the direction of the warehouse
  - c) determines whether there has been a collision of the robot and the warehouse
  - d) calculates what angle to use for rotating the robot around the warehouse
- (d) If r, g and b are the red green and blue components of the original image pixel at location i, which of the following sets the image to greyscale image? [3]
- a) `img.pixels[i] = color(r, g, b);`
  - b) `img.pixels[i] = color(g, g, g);`
  - c) `img.pixels[i] = color(1.5*r, 1.5*g, 1.5*b);`
  - d) `img.pixels[i] = color((r+g+b)/3);`
- (e) You are creating an image editing application for a camera phone. You would like to create a new filter to enhance the quality of photos taken under low light conditions. Describe how you would implement the image filter. Your answer may include more than one technique. Use pseudocode to illustrate your ideas. [13]

## Question 2

- (a) In Processing what would you use a vertex for? [3]
- a) creating a smoothly changing texture
  - b) pushing a transformation to the matrix stack
  - c) changing pixels in kernel
  - d) drawing a complex irregular shape
- (b) In terms of Audio-Visual computing, what does 'phase' represent? [3]
- a) An array of pixels each of which is a colour value
  - b) A single representation of x and y coordinates
  - c) The corner of a shape drawn in 3D graphics
  - d) The starting point of a sine wave
- (c) What is the correct sequence of steps to point an arrow in the direction of a ball and move it towards the ball? [3]
- a) normalise, scale, find the direction vector, and accelerate
  - b) scale, find the direction vector, normalise, and accelerate
  - c) find the direction vector, normalise, scale, and accelerate
  - d) find the direction vector and scale
- (d) If you start at position  $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$  and travel with a velocity of  $\begin{pmatrix} 0.2 \\ 0.1 \end{pmatrix}$  for 5 seconds, what is your final position. [3]
- a)  $\begin{pmatrix} 10.2 \\ 15.1 \end{pmatrix}$
  - b)  $\begin{pmatrix} 3.5 \\ 5.3 \end{pmatrix}$
  - c)  $\begin{pmatrix} 3 \\ 3 \end{pmatrix}$
  - d)  $\begin{pmatrix} 3 \\ 3.5 \end{pmatrix}$
- (e) You are creating a space combat game in which the opposing players are operating spaceships within a planetary system. Explain how you would create this game and features you might include.

Focus your answer on the the objects in the game, their movements, effects they have on one another, and visual elements. Provide pseudocode to illustrate your ideas. [13]

### Question 3

(a) How would you increase the pitch of a sound wave? [3]

- a) increase its sample rate
- b) increase its bit depth
- c) increase its frequency
- d) increase its phase

(b) What is a convolution kernel? [3]

- a) A buffer for samples in an audio file
- b) A terrain generation algorithm
- c) An image filtering technique
- d) A computer vision technique

(c) What would you use gravity simulation for? [3]

- a) Adding more bass to an audio sample
- b) Animating a bouncing ball
- c) Animating an explosion
- d) Simulating air resistance

(d) What is the result of the following matrix multiplication? [3]

$$\begin{bmatrix} 1,0 \\ 2,1 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

- a)  $\begin{bmatrix} 1 \\ 2 \end{bmatrix}$
- b)  $\begin{bmatrix} 3 \\ 2 \end{bmatrix}$
- c)  $\begin{bmatrix} 1 \\ 3 \end{bmatrix}$
- d)  $\begin{bmatrix} 3 \\ 1 \end{bmatrix}$

(e) You are developing a game that generates landscapes for planets. The current terrain synthesis code is focused on generating large, flat, open spaces, like plains and fields. You have been asked to enhance the terrain synthesis code so that it can simulate mountains, canyons, and rocky areas? Explain how you would implement this new feature. Use pseudocode to illustrate your ideas. [13]

#### Question 4

(a) In terms of an audio file, what does bit depth affect? [3]

- a) how many samples are contained in a sound
- b) how low the sound is
- c) the number of samples taken per second
- d) how large an audio file is

(b) What would you use a neighbourhood filter for? [3]

- a) Degrading the sound of a vocal performance
- b) Adding the appearance of skin to a 3D character
- c) Creating undulations on a surface
- d) Blurring an image

(c) What is matrix for a 3D rotation of  $30^\circ$  about the z axis [3]

a) 
$$\begin{bmatrix} 1,0,0,0 \\ 0,0,1,0 \\ 0,1,0,0 \\ 0,0,0,1 \end{bmatrix}$$

b) 
$$\begin{bmatrix} 0.866, 0, 0, 0 \\ 0, 0.866, 0, 0 \\ 0, 0, 0.866, 0 \\ 0, 0, 0, 1 \end{bmatrix}$$

c) 
$$\begin{bmatrix} 1, 0, 0, 0 \\ 0,0.866, 0.5, 0 \\ 0,-0.5,0.866,0 \\ 0, 0, 0, 1 \end{bmatrix}$$

d) 
$$\begin{bmatrix} 0.866, 0.5, 0,0 \\ -0.5,0.866,0,0 \\ 0, 0, 1,0 \\ 0, 0, 0,1 \end{bmatrix}$$

(d) What is the formula for the distance between point  $(x_1, y_1)$  and  $(x_2, y_2)$  [3]

- a)  $\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$
- b)  $\sqrt{(x_2 - x_1) + (y_2 - y_1)}$
- c)  $(\sqrt{(x_1 - x_2)} + \sqrt{(y_1 - y_2)})^2$
- d)  $\sqrt{((x_1 + x_2) - (y_1 + y_2))}$

- (e) Compare and contrast the use of MIDI and OSC as tools for controlling audio. Your answer should define both MIDI and OSC, describe how the two protocols communicate messages, and discuss the benefits and drawbacks of each. Give an example of when you would use MIDI and when you would use OSC.

[13]

### Question 5

- (a) What would you use to record CD quality audio? [3]
- a) A high pass filter
  - b) A high bit depth
  - c) A homogeneous matrix
  - d) A convolution kernel
- (b) What would you use an analogue to digital converter for? [3]
- a) Converting between bitmap and vector images
  - b) Making an audio file sound clearer
  - c) Recording from a microphone to a computer
  - d) Resampling a digital audio file
- (c) What is the probability of throwing 2 heads in two coin tosses? Show your calculation work. [3]
- a)  $\frac{1}{4}$
  - b)  $\frac{1}{2}$
  - c)  $\frac{3}{4}$
  - d)  $\frac{1}{8}$
- (d) What is the length of the vector (8,6)? Show your work. [3]
- a) 10
  - b) 6.298
  - c) 48
  - d) 14
- (e) Compare and contrast bitmap and vector file formats. You should discuss all of the following concepts for full marks:
- i) how a bitmap image is stored
  - ii) how a vector image is stored
  - iii) a situation when it would be better to use a bitmap
  - iv) a situation when it would be better to use vectors
  - v) aliasing and its implications for both formats [13]