

UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

Department of Computing

B. Sc. Examination 2016

IS53032A

Advanced graphics and animation

Duration: 2 hours 15 minutes

Date and time:

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*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** What is the difference between raster graphics and vector graphics?  
List two file formats each

[4]

**Question 2** What is the difference between global illumination and local illumination?

[4]

**Question 3** Given a vector  $\mathbf{a}(x_a, y_a)$

Please write how to calculate the magnitude of  $\mathbf{a}$ , and how to normalise it.

[4]

**Question 4** What is the projection vector of  $\mathbf{u}(1,7)$  onto  $\mathbf{v}(8,6)$

(Please write down the steps)

[4]

**Question 5** Write down the rotation matrix for a 3D vector to rotate along its z axis

[4]

**Question 6** Why do we use matrix for transformation in graphics?

[4]

**Question 7** What is key-frame animation?

[4]

**Question 8** Name four properties that could be meaningfully animated using key-frame animation.

[4]

**Question 9** What is Forward Kinematics (FK), and what is Inverse Kinematics (IK)?

[4]

**Question 10** What is Newton's second law?

Write down the equation and explain its meaning

[4]

## Part B

**Question 11** Character Animation

- (a) What are the advantages and disadvantages of FK? What are the advantages and disadvantages of IK? In Character Body Animation, give an example of when IK is needed. [6]
- (b) Motion Capture is often used in Human Body animation. Please describe at least three methods to collect Motion Capture data. What are the pros and cons of each method? [9]
- (c) Why is Motion Editing needed some times? Please give at least one example of when motion editing is needed, and explain which motion editing method should be used. [5]
- (d) Why is creating realistic Character Animation a great challenge? [5]
- (e) Please briefly explain Uncanny Valley with a diagram. [5]

**Question 12** Illumination

- (a) What is image-order rendering? Explain with two for loops. [5]
- (b) Write down the Lighting Equation used in ray casting (include three components, assume we have one point light), and explain each component, and discuss how does the change in each parameter (k) influence the result? [10]
- (c) How is refraction calculated in ray-tracing? Write down the equation [5]
- (d) How does recursive ray tracing work? Write down the recursive algorithm to include both reflection and refraction [10]

**Question 13** Rasterisation and shading

- (a) What is line rasterisation? What are the desirable properties of line rasterisation? [5]
- (b) Given  $y = mx + b$ , the range of  $x$  is  $(x_0, x_1)$ , write down the algorithm for Bresenham's line rasterisation for  $m \in (0,1]$  [10]
- (c) Write the updated version for  $m < 0$  and  $m > 1$ . [5]
- (d) Explain flat shading, Gouraud shading, and phong shading [10]