

UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

B. Sc. Examination 2011

Computer Science

IS53032A (CC349) Advanced Graphics and Animation

Duration: 2 hours 15 minutes

Date and time:

There are five questions in this paper. You should answer no more than three questions. Full marks will be awarded for complete answers to a total of three 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 75 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

- (a) What is a surface Normal? How is it used in lighting calculations? [10]
- (b) Write a complete vertex shader that calculates diffuse illumination from a directional light source. [15]

Question 2

- (a) What is keyframe animation? What are its benefits? [10]
- (b) Give a case where it would be better to use linear interpolation rather than spline interpolation for inbetweening keyframes. [5]
- (c) Given a point with initial position vector p write Processing code to move it towards the current mouse position with constant speed 2 pixels per frame. [10]

Question 3

(a) State which of these is a rotation matrix, a scale matrix and a translation matrix? [6]

i.

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

ii.

$$\begin{bmatrix} 0.93 & 0 & -0.36 & 0 \\ 0 & 1 & 0 & 0 \\ 0.36 & 0 & 0.93 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

iii.

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

(b) Describe the skeletal animation method. [9]

(c) Describe how you would apply the Cyclic Coordinate Descent method of inverse kinematics to making sure a character's feet stay on the ground when walking over bumpy terrain. [10]

Question 4

- (a) Explain the following computer graphics terms:
- i. pixel [2]
 - ii. graphics pipeline [2]
 - iii. wireframe [2]
 - iv. rasterisation [2]
- (b) Describe, using diagrams where appropriate, an algorithm that draws a straight line between screen co-ordinates (x_0, y_0) and (x_1, y_1) using only integer arithmetic. Assume that the line is in the first octant. [9]
- (c) Describe an effect that would typically be produced using: [8]
- i. A vertex shader.
 - ii. A fragment shader.

Question 5

- (a) Define texture mapping and describe how it works and what it is used for. [11]
- (b) Describe the two following methods and how they differ from ordinary texture mapping.
 - i. Bump mapping [7]
 - ii. reflection mapping [7]