

UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

Department of Computing

B. Sc. Examination 2014

IS53032A

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 PAPER MUST NOT BE REMOVED
FROM THE EXAMINATION ROOM**

Question 1 Transformations, projections and rasterisation

- (a) All modern computers have a graphics pipeline – the sequence of steps used to create a 2D representation of a 3D scene. Draw a diagram of this and explain each stage in the pipeline. [10]
- (b) In a typical graphics program we may need to deal with a number of different coordinate systems. Describe three of these. [15]

Question 2 Surfaces and shading

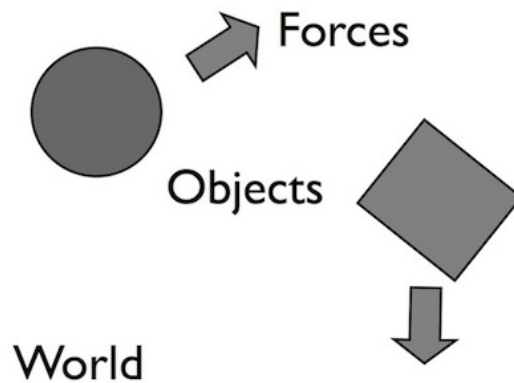
- (a) What is hidden surface removal and why is it necessary? [3]
- (b) Describe two methods of achieving hidden surface removal. [10]
- (c) Gouraud shading computes an intensity for each vertex and then interpolates the computed intensities across the polygons. Briefly describe the steps involved in this. [4]
- (d) Why does Gouraud shading not handle specular highlights very well? Use diagrams to illustrate your answer where appropriate. [8]

Question 3 Textures

- (a) Briefly explain the following terms:
- i. texel [2]
 - ii. texture coordinates [2]
 - iii. bounding box [2]
 - iv. procedural textures [2]
 - v. height field [2]
- (b) Generally speaking, there are two types of procedural texture. What are they and why might they be used together? [4]
- (c) Describe the concept of environment (reflection) mapping. [5]
- (d) Describe the process of environment mapping. [6]

Question 4 Representing the real world

- (a) There are four types of lights in Unity. Describe THREE of them, giving an example of each. [6]
- (b) Describe the difference between local and global illumination. Explain the advantages and disadvantages of each. [8]
- (c) What is the bidirectional reflectance distribution function (BRDF)? Explain, using a diagram, and state why BRDFs are important in computer graphics. [4]
- (d) A physics engine is a piece of software for simulating physics in an interactive 3D graphics environment. The image below shows the components of a physics simulation.



- i. Describe the three components shown in the diagram above. [3]
- ii. Describe two types of force that can be simulated in a physics simulation. [4]

Question 5 Post-processing and display

- (a) Give three examples of applications that use electronic display devices and which require images to be faithful to the original. [3]
- (b) Explain what is meant by the dynamic range of an image and of a display. Give an example. [6]
- (c) What is tone mapping? Why is it used? [6]
- (d) Why is a linear scaling not appropriate for accurate tone reproduction? [6]
- (e) How might the viewing conditions affect our perception of an image? Explain the principles behind this. [4]