

UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

Department of Computing

B. Sc. Examination 2017

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 meant by “rendering” in 3D graphics? [4]
- Question 2**     What is parallel projection and when is it used? [4]
- Question 3**     What is z-buffer algorithm and when is it used? [4]
- Question 4**     What is Lambert’s cosine law and when is it used? [4]
- Question 5**     Briefly explain the similarities between stop motion animation and computer animation. [4]
- Question 6**     Write down the equation for linear interpolation. [4]
- Question 7**     List four examples where physical simulation is used. [4]
- Question 8**     In Unity, when you attach a “Physics → Rigid body” component to a game object, by default, what happens? [4]
- Question 9**     List four application areas where virtual characters are used. [4]
- Question 10**    What is the difference between agents and avatars? [4]

## Part B

**Question 11** Graphics

- (a) Briefly explain the tension between realism and real-time in graphics rendering. [3]
- (b) Explain the concept of illumination. Give an example where illumination serves a practical function in VR. [6]
- (c) Write down the Phong lighting equation (with three components) and briefly explain each component. [8]
- (d) Write down the raycasting algorithm (in pseudocode) used in rendering 3D graphics where the above lighting equation is used. [5]
- (e) What is ray tracing? How do we adapt the above algorithm for recursive ray tracing (write the pseudocode)? [8]

**Question 12** Animation

- (a) In animation, a lot of effort is put in to make it look expressive yet less time consuming to produce. List one animation principle used to produce expressive animations, and explain with an example of how it is used. [6]
- (b) As part of character animation, we introduced two methods in inverse kinematics. Write down the name of these two methods and explain the pros and cons of each. [8]
- (c) In order to create believable and expressive virtual characters, there are a few non-verbal features we can animate. Write down 3 of these features. [6]
- (d) Suppose you now need to create a Virtual Reality experience where a Virtual Character gives a presentation (for instance, in order to sell a product) to the user. Explain the steps (model, animation, interaction) you will take to achieve this [10]

**Question 13** Virtual Reality

- (a) In Virtual Reality the interaction happens in a 3D space. Explain the challenges in designing interactions in 3D. [4]
- (b) Name and explain briefly the basic tasks (non-social) in 3D interaction. [6]
- (c) There are two methods through which the user can “travel” in VR: physically or virtually. Explain these two methods and discuss the pros and cons of each. [10]
- (d) Discuss the measures that can be used to assess the quality of locomotion in VR. [10]