BSc EXAMINATION

COMPUTER SCIENCE

3D Graphics and Animation

Release date: Monday 12 September 2022 at 12:00 midday British Summer Time

Submission date: Tuesday 13 September 2022 by 12:00 midday British Summer Time

Time allowed: 24 hours to submit

INSTRUCTIONS TO CANDIDATES:

Section A of this assessment paper consists of a set of **TEN** Multiple Choice Questions (MCQs) which you will take separately from this paper. You should attempt to answer **ALL** the questions in Section A. The maximum mark for Section A is **40**.

Section A will be completed online on the VLE. You may choose to access the MCQs at any time following the release of the paper, but once you have accessed the MCQs you must submit your answers before the deadline or within **4 hours** of starting whichever occurs first.

Section B of this assessment paper is an online assessment to be completed within the same 24-hour window as Section A. We anticipate that approximately **1 hour** is sufficient for you to answer Section B. Candidates must answer **TWO** out of the THREE questions in Section B. The maximum mark for Section B is **60**.

Calculators are not permitted in this examination. Credit will only be given if all workings are shown.

You should complete **Section B** of this paper and submit your answers as **one document**, if possible, in Microsoft Word or a PDF to the appropriate area on the VLE. Each file uploaded must be accompanied by a coversheet containing your **candidate number**. In addition, your answers must have your candidate number written clearly at the top of the page before you upload your work. Do not write your name anywhere in your answers.

SECTION A

Candidates should answer the **TEN** Multiple Choice Questions (MCQs) quiz, **Question 1** in Section A on the VLE.

SECTION B

Candidates should answer any **TWO** questions from Section B.

Question 2: GPU Shaders

This question asks you to describe your first peer review on GPU shaders.

In all of the following sub-questions you should:

- Describe your implementation
- Explain all the GPU and graphics techniques you used (e.g., give any mathematical equations and explain what they mean)
- Explain why you chose those methods.

(a) Using the work that you created during this module as context:
   a. Describe how a GPU shader functions.

(10 marks)

   b. Describe how you may create an animated effect using a shader.

(10 marks)

(b) If you implemented any of the following extensions, describe how you did it and explain the techniques you used.

(10 marks)

- Create a complex animated shader that includes both vertex definition and fragment-based patterns that work together.
- Normal Extrusion is a popular example of a vertex deformation, research it and implement it.
- A very useful vertex technique for a lot of visual effects is drawing an outline around an object. This is commonly done using vertex normals. Research outline shaders and implement one.

Question 3: Lighting

The second peer review asked you to implement either the standard lighting equation or an alternative lighting model.

In all of the following sub-questions you should:

- Describe your implementation
- Explain all of the GPU and graphics techniques you used (e.g. give any mathematical equations and explain what they mean)
- Explain why you chose those methods.

(a) Write and explain the full lighting equation that you used in your project.

(5 marks)

(b) Describe how you implemented the lighting equation in your project.

(15 marks)

(c) Describe an alternative lighting model to the lighting equation and how you implemented it on the GPU.

(10 marks)

Question 4: Textures

The third peer review asked you to implement texture mapping in a shader programme.

In all of the following sub-questions you should:

- Describe your implementation
- Explain all of the GPU and graphics techniques you used (e.g. give any mathematical equations and explain what they mean)
- Explain why you chose those methods.

(a) Describe and explain GPU colour and normal mapping and how you implemented them in a shader.

(10 marks)

(b) Explain one of the following techniques and give an example of how you implemented it in a GPU:

(10 marks)

- Procedural Texturing
- Animated Textures
- Transparent Textures.

(c) If you implemented any of the following extensions, describe how you did it and explain the techniques used.

(10 marks)

- Height maps are another texturing technique related to normal maps. Research and implement height maps in a shader
- Environment or reflection maps are a texturing technique that creates the appearance of reflections on an object. Research and implement environment or reflection maps
- Sketch shaders use textures to create the appearance of a hand drawn pen or pencil sketch. Research texture-based sketch shaders and implement one.

END OF PAPER