Beijing-Dublin International College

SEMESTER I EXAM EXAMINATION - 2020/2021

School of Computer Science

COMP 3033J Computer Graphics

Assoc Prof Chris Bleakley
Asst Prof Abraham Campbell

Time Allowed: 120 minutes

Instructions for Candidates

All questions carry equal marks. The distribution of marks in the right margin shown as a percentage gives an approximate indication of the relative importance of each part of the question.

Answer the 4 Mandatory Questions and 4 Optional Questions

BJUT Student ID: _____ **UCD Student ID:** _____

I have read and clearly understand the Examination Rules of both Beijing University of Technology and University College Dublin. I am aware of the Punishment for Violating the Rules of Beijing University of Technology and/or University College Dublin. I hereby promise to abide by the relevant rules and regulations by not giving or receiving any help during the exam. If caught violating the rules, I accept the punishment thereof.

Honesty Pledge： _____ **(Signature)**

Instructions for Invigilators

Non-programmable calculators are permitted.
No rough-work paper is to be provided for candidates.

Part 1: Mandatory Questions: Answer all questions

Question 1:

1. Describe **Ray Tracing** as a technique to generate computer graphics.

(5 marks)

2. What is **Hybrid Rendering**?

(4 marks)

3. Can Ray Tracing be used in **real time graphics engines** and if not why?

(3.5 marks)

Question 2:

1. Explain the need for a **front and back buffer** and explain how they can be used to create animation in computer graphics. Also describe what can happen if they are not correctly implemented.

(4.5 marks)

2. What are the **rods and cones** in Tri-stimulus Theory?

(4 marks)

3. How is **transparency** achieved in OpenGL and does the ordering of drawing matter?

(4 marks)

Question 3:

1. Explain the concept of **Depth of Focus** and how it can be achieved.

(4.5 marks)

2. How is **Fog** used in OpenGL and how can it be used to improve rendering speeds?

(4 marks)

3. What is an **Depth buffer** important and why would you turn it off ?

(4 marks)

Question 4:

1. Sketch an example of **2-point perspective**

(3 marks)

2. What is a **vanishing point**?

(3 marks)

3. Explain **foreshortening** and its effect on lines

(3 marks)

4. Discuss how you would define a **View Frustum** and sketch an example

(3.5 marks)

Part 2: Optional Questions / Choose 4 out of 6

Question 5:

1. Give pseudocode for the **Bresenham's Algorithm** to draw a line

(3 marks)

2. What is the **half-plane test**, give a diagram , and explain how it can be used for rendering a triangle

(3.5 marks)

3. Give pseudocode for a **Line-Circle Intersection**

(6 marks)

Question 6:

1. What is **texture caching** and why is it useful?

(4 marks)

2. What is a **Scan-Line interface** and why would it increase frame rates?

(3 marks)

3. What is the **front** and **back buffer**?

(2 marks)

4. What is **aliasing** and what can we do to reduce its impact

(3.5 marks)

Question 7:

1. Please write out a **4x4 Homogeneous Matrix**, marking where in the matrix, the following operations would act upon
    a. Perspective operations
    b. Rotational operations
    c. Translational operations

(3 marks)

2. Explain what the follow **transformation operations** would do in as much detail as you can

a. $\begin{bmatrix} 5 & 0 & 0 & 0 \\ 0 & 5 & 0 & 0 \\ 0 & 0 & 5 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

b. $\begin{bmatrix} 7 & 7 & 0 & 0 \\ 0 & 7 & 0 & 0 \\ 0 & 0 & 7 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

c. $\begin{bmatrix} 1 & 0 & 0 & 3 \\ 0 & 1 & 0 & 3 \\ 0 & 0 & 1 & 8 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

(6 marks)

3. **Homogeneous coordinates** are defined as (x,y,z,w) , if you had a point P at (5,2,5,2) and changed the "w" component from 2 to 1, what would be the corresponding change to other points if we wanted the point P to still refer to the same point in 3D space.

(3.5 marks)

Question 8:

1. Why is it important to **animate** at least higher than 24 frames a second and why does most Virtual Reality Head mounted displays actual run at 90 frames per second or more.

(5 marks)

2. How are **matrix stacks** used in OpenGL to support animation?

(3.5 marks)

3. Sketch a suitable **animation hierarchy** for a Dog

(4 marks)

Question 9:

1. Describe the **six standard coordinate systems** that are commonly used in Computer Graphics and name three of the matrices involved.

(4.5 marks)

2. What is the **Painters Algorithm** and what does it do? When does it break down?

(4 marks)

3. Describe the concept of **Alberti's Window**

(4 marks)

Question 10:

1. What is **CMYK Colour Space**?

(3 marks)

2. What is the **Phong model** of Lighting?

(7 marks)

3. How and why is surface normal and the eye position used to compute **specular reflections**?

(2.5 marks)