CS-733 Final Exam
December 13, 2023, 9:00 – 12:00, AH348
D. Hepting

This is a closed book exam. You must maintain the confidentiality of your examination; do not provide any opportunity for others to copy any of your work. Electronic devices are NOT permitted during the exam. Please turn off and put away all cell phones and other electronic devices during the exam period.

ANSWER ALL QUESTIONS. All answers must be written on this exam in the space provided. You have 180 minutes to complete the exam. Please plan your answers, favour quality over quantity, do not exceed the space provided, and do your best to write legibly. QUESTIONS ARE ON BOTH SIDES OF THE PAPER. This exam contributes 40 percent towards your final grade.

Name (printed): _____

Student Number: _____

Signature: _____

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Q1. (6 marks) Explain how sampling is involved in creating a computer-generated image using WebGL2.

Q2. (8 marks) From our discussion of RGB colours, explain the intuition behind HSV (Hue, Saturation, and Value).

Q3. (6 marks) What must be done to reconstruct an accurate approximation of a continuous phenomenon?

Q4. (4 marks) How would you change the centre of rotation for an animation of a rotating square? Give an example.

Q5. (8 marks) To see visible surfaces, why not just sort objects by distance from the camera and draw them in order from furthest to nearest? When will that approach work and when will it fail?

Q6. (6 marks) Why and how does the code snippet in input_rectangles.js (shown below) work?

```
canvas.addEventListener('mousedown', function(event) {
    if (rectangles < maxNumRectangles) {
      const bb = canvas.getBoundingClientRect();
      const relX = event.clientX - bb.left;
      const relY = event.clientY - bb.top;
      const mx = 2.0 * relX / canvas.width - 1.0;
      const my = 2.0 * (canvas.height - relY) / canvas.height - 1.0;
```

Q7. (2 marks) What command is needed in the render function to ensure a smooth animation?

Q8. (6 marks) What is the difference between passing through `vColor` from a vertex shader to `fColor` in a fragment shader and computing the `fColor` directly in a fragment shader? Explain the practical implications of this difference.

Q9. (6 marks) Describe the difference between the interaction of a point light source and a directional light source in determining ambient, diffuse, and specular components of the computed colour. What condition must be met for a surface to be lit?

Q10. (6 marks) What is the impact of the following statements in `instanced-cubes.js`, where there are 216 instances of cubes?

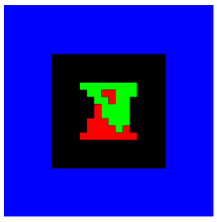
a) `gl.vertexAttribDivisor(colorLoc, 6);`

b) `gl.vertexAttribDivisor(colorLoc, 0);`

c) `gl.vertexAttribDivisor(colorLoc,3);?`

Q11. (4 marks) Describe, in general terms, how to model and animate a robot arm made of 2 cylinders.

Q12. (6 marks) Describe 3 features of framebuffer objects used to create this image from `render-FB.html`?



Q13. (4 marks) Describe bump mapping and its intent.

Q14. (2 marks) What is the purpose of texture coordinates?

Q15. (6 marks) Explain how the animated texture in `particle-diffusion.html` is done.

Q16. (4 marks) What is an advantage to creating models by instancing a single primitive? Explain with an example.