Please also take a look at the earlier review questions available on the course resources page.

**Projector Texture Mapping**

A projector is at \((5, 3, 3)\) looking at \((5, 3, -3)\). The near plane is at \(z = 2\). The left and right of the rectangle in the eye frame are at \(x = -1\) and \(x = 1\). The top and bottom of the rectangle are at \(y = 2\) and \(y = -2\). Construct the model-view matrix and the projection matrix. If the texture in Figure 1 to be projected is shown in the picture, what is the colour to be projected on the point at \((9, 4, -10)\)?

![Figure 1](image)

**Interpolation**

The control points for a Bézier curve are: \(C_0 = (0, 0, 0)\), \(C_1 = (2, 5, 3)\), \(C_2 = (5, 1, 3)\), \(C_3 = (0, 2, 3)\). What is the point at \(t = 0.5\)?
Depth

The near plane is at $z = -5$, the far plane is at $z = -20$, the top, bottom, left and right of the near plane are at $y = 6$, $y = -6$, $x = -10$, $x = 10$.

Construct the projection matrix. What are the clip coordinates of the points $P_1 = (2, 2, -6)$, and $P_2 = (3, 3, -15)$? What is the depth value that would be stored in the depth buffer, for each point?

Sampling

A single fragment is shown in Figure 2, along with the colours from a texture image that would map on to it. Suppose we use over-sampling at points $P_1 = (0.4, 0.6)$, $P_2 = (0.3, 0.3)$, $P_3 = (0.2, 0.7)$, what is the output colour? What if the sampling points are 9 points on a 3 by 3 grid at $x = 0.25, 0.5, 0.75$, and $y = 0.25, 0.5, 0.75$? Assume the colours for red, green, blue are $(1, 0, 0)$, $(0, 1, 0)$, $(0, 0, 1)$ respectively.

Figure 2

Compositing

On a completely opaque black background, with colour $(0,0,0,1)$, we draw a foreground fragment with the colour $(1,1,1,0.7)$ i.e. white with alpha value 0.7. What is the output colour of the pixel?

Bilinear interpolation

If the value at $P_1 = (1,1)$ is 0, $P_2 = (2,1)$ is 1, $P_3 = (2,2)$ is 1, $P_4 = (1,2)$ is 1. What is the bilinearly interpolated value at $P_5 = (1.5,1.5)$? What if $P_5$ was $(1.25,1.75)$? What if the value at $P_3$ is 2?
Assignment Related Questions

1. What does the following line of code do?

   
   ```
   glUniform3fv(glGetUniformLocation(w_state->getCurrentProgram(), "gem_pos"),
   1, glm::value_ptr(gem_position));
   ```

2. In assignment 1, we asked you to deform the armadillo by the following scheme: If a given vertex of the armadillo is within gem_radius of gem_position, translate it along the vector between it and the gem until it lies on the surface of the sphere. You are given the following:

   ```
   vec4 Position;
   uniform vec4 gem_position;
   uniform float gem_radius;
   ```

   Fill in the important pieces of the vertex shader below:

   ```
   //...
   int main()
   {
   ```
   ```
   ```
   ```
   //...
   ```