Reconstruction
Q3 solution discussion

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Textbook Chapter 18

Several slides courtesy of M. Kim

Today

- Announcements
  - The last class will be Friday April 10.
  - W 8 and F 10 will be devoted to course review.
- Quiz 3 solutions
- Reconstruction and Resampling
Quiz 3 solutions

- Q3 (these example answers. Equivalent statements are acceptable.
  - a. loss of precision in depth value.
    - “overflow” got partial credit. But it is just the extreme case. Can lose precision without overflow
  - b. perspective-correct interpolation of textures. Not enough to say “to get correct texture coordinates”
  - c. (from L21)

\[
\begin{align*}
K & = \begin{pmatrix} 3 & 3 & 3 & 3 \\
1 & 1 & 1 & 1 \\
1 & 1 & 1 & 1 \\
1 & 1 & 1 & 1 
\end{pmatrix}
\end{align*}
\]

- Q3 continued
  - d. from L28, the viewport matrix:
    \[
    \begin{bmatrix}
    x_w \\
y_w \\
z_w
    \end{bmatrix} = 
    \begin{bmatrix}
    W/2 & 0 & 0 & (W-1)/2 \\
    0 & H/2 & 0 & (H-1)/2 \\
    0 & 0 & 1/2 & 1/2 \\
    0 & 0 & 0 & 1
    \end{bmatrix} 
    \begin{bmatrix}
    x_n \\
y_n \\
z_n
    \end{bmatrix}
    \]
    substitute $W=512$ $H=256$ (Ok if you exchanged $W$ and $H$)
  - e. because (Answer given in class when describing A4)
Q4

triangle. The \((s,t)\) texture coordinates of \(P_1\), \(P_2\), and \(P_3\) are \((0.5,0.5)\), \((1.0,0.5)\), and \((0.8,1.0)\), respectively. Draw the textured triangle.

Q5. pixel A: 0, B: 3/8, C: ½

-1 if forgot to scale by 0.5
Question asks for "fragment color", not final color of pixel. Some assumed there is a default pixel color.
Some did not normalize by the number of samples

Q6

a. \([0 -1 0; 1 0 -4; 0 0 1]\) (for 2D view matrix)
many did not have a rotation part.
Some didn't have the position oriented properly
B. answer = 1/6. Many drew figure but didn't have right logic.
Chapter 17

RECONSTRUCTION
(DISCRETE \rightarrow CONTINUOUS)

- Nehe Texture Demo. Check effects of texture magnification and minification filters
Reconstruction

- Given a discrete image $I[i][j]$, how do we create a continuous image $I(x,y)$?
- Is central to resize images and to texture mapping.
  - How to get a texture colors that fall in between texels.
- This process is called reconstruction.
- We already know the key idea, from L20-L21: Interpolation! So we will go over this quickly.

Constant reconstruction

- The resulting continuous image is made up of little squares of constant color.
- Each pixel has an influence region of 1-by-1.
Linear and Bilinear interpolation

We already know how to interpolate in 1D
- Linear (1D)
- Bilinear (2D):

Bilinear reconstruction

- Can create a smoother looking reconstruction using bilinear interpolation.
- Bilinear interpolation is obtained by applying linear interpolation in both the horizontal and vertical directions.

Pseudocode (not needed for WebGL)

```
color bilinearReconstruction(float x, float y, color image[][]) {
    int intx = (int) x;
    int inty = (int) y;
    float fracx = x - intx;
    float fracy = y - inty;

    color colorx1 = (1-fracx) * image[intx][inty] +
        (fracx) * image[intx+1][inty];
    color colorx2 = (1-fracx) * image[intx][inty+1] +
        (fracx) * image[intx+1][inty+1];
    color colorxy = (1-fracy) * colorx1 +
        (fracy) * colorx2;

    return(colorxy);
}
```
Bilinear properties

- At integer coordinates, we have \( l(x,y) = l[i][j] \); the reconstructed continuous image \( l \) agrees with the discrete image \( l \). => Interpolation
- In between integer coordinates, the color values are blended continuously.
- Each pixel influences, to a varying degree, each point within a 2-by-2 square region of the continuous image. => Local Support
- The horizontal/vertical ordering is irrelevant.
- Color over a square is bilinear function of \((x,y)\).