Reconstruction
Q3 solution discussion

Dinesh K. Pai

Textbook Chapter 18

Several slides courtesy of M. Kim

1

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

2

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)

3

- Q3 continued
  - d. from L28, the viewport matrix:

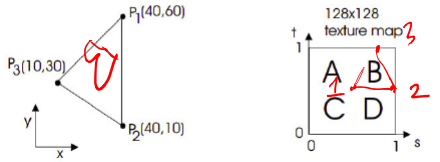
$$\begin{bmatrix} x_w \\ y_w \\ z_w \\ 1 \end{bmatrix} = \begin{bmatrix} W/2 & 0 & 0 & (W-1)/2 \\ 0 & H/2 & 0 & (H-1)/2 \\ 0 & 0 & 1/2 & 1/2 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_n \\ y_n \\ z_n \\ 1 \end{bmatrix}$$

  substitute W=512 H=256 (Ok if you exchanged W and H)
  - e. because (Answer given in class when describing A4)

4

- 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.

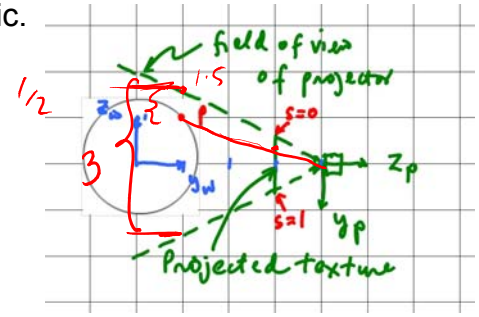


-1 for not flipping B

- 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

5

- 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.



$s = \frac{1}{2} / 3$

$= \frac{1}{6}$

6

Chapter 17

RECONSTRUCTION
(DISCRETE → CONTINUOUS)

7

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

8

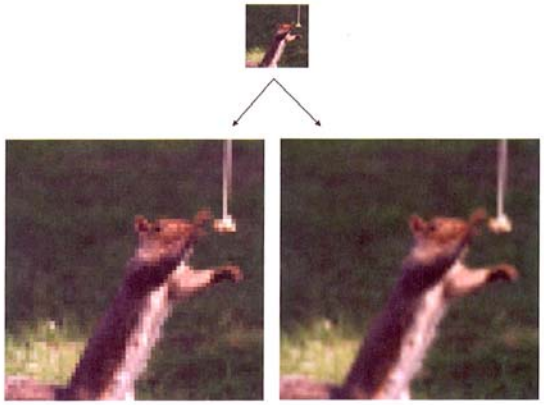
Reconstruction

- 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.

9

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

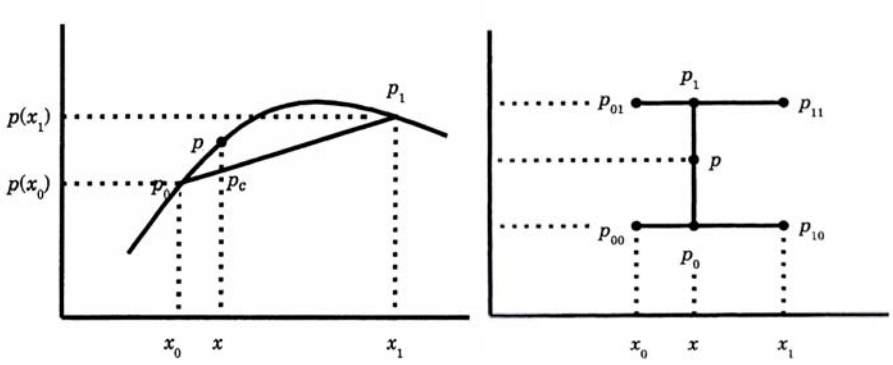


10

Linear and Bilinear interpolation

We already know how to interpolate in 1D

- Linear (1D) Bilinear (2D):



11

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);
```

12

Bilinear properties

- At integer coordinates, we have *I(x,y)*=I[i][j]; the reconstructed continuous image *I* agrees with the discrete image I. => 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).

13