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CSCI 4250/5250

Homework 5

1) Given the 3D cube example in programs: ortho.js and ortho.html (available on the course web

page), if the view position and the orthographic viewing volume is changed into each of the

following situations, how will the final 2D image change from its original image? Justify

your answer.

a. mvMatrix=lookAt(vec3(-4, 0, 0), at, up); // pMatrix does not change

It becomes yellow, aka looking from the back of the object, because the eye moves behind the object.

b. mvMatrix=lookAt(vec3(3, 3, 3), at, up); // pMatrix does not change

Look from the upper left of the object, showing red, cyan, and blue

c. mvMatrix=lookAt(vec3(3, 3, 3, at, up); pMatrix=ortho(-3, 3, -3, 3, -1, 1);

you get a blue square since the view volume gets smaller

d. pMatrix= ortho(-6, 6, -3, 3, 2, 10); // mvMatrix does not change

a blue, cyan, and magenta square that is squished, since the view volume gets wider

e. pMatrix=ortho(0, 4, 0, 3, 2, 10); // mvMatrix does not change

the upper edge of the blue, cyan, and magenta square, since the view volume moved to the upper right.

2) Given: mvMatrix=lookAt(vec3(4, 4, - 4), at, up);

pMatrix=ortho(-2, 2, -4, 4, -10, 10);

show:

• the mvMatrix

• the pMatrix

• the coordinates of a point F(1, 1, -1) when converted into the final clip coordinates.

(show intermediate steps in deriving the results)

mvMatrix = [ 1 0 0 4 ]

[ 0 1 0 4 ]

[ 0 0 1 -4 ]

[ 0 0 0 1 ]

pMatrix = [ 1/2 0 0 0 ]

[ 0 1/4 0 0 ]

[ 0 0 1/10 0 ]

[ 0 0 0 1 ]

P = [ 1/2 0 0 4 ]

[ 0 1/4 0 4 ]

[ 0 0 1/10 -4 ]

[ 0 0 0 1 ]

P \* F = [ 1/2 0 0 4 ] [ 1 ] = [ 2 ]

[ 0 1/4 0 4 ] \* [ 1 ] [ 1 ]

[ 0 0 1/10 -4 ] [ -1 ] [ 2/5]

[ 0 0 0 1 ] [ 1 ] [ 1 ]

3) Changing the orthographic viewing volume in problem 2) to a frustum with left=-2, right=2,

bottom=-4, top=4 for the near plane, and the near plane at distance 4 and far plane at distance

10 from the eye/camera. How would you call the perspective function to set up the

corresponding pMatrix in the .js program?

pMatrix=ortho(-2, 2, -4, 4, 4, 10);

pMatrix \*= [ 8 0 0 0 ]

[ 0 8 0 0 ]

[ 0 0 -6 -33.33 ]

[ 0 0 -1 1 ]

4) With the perspective viewing volume defined in problem 3), what will be the x and y

coordinates of the two points F(1, 1, -1) and B(1, 1, 1) when projected onto the near plane?

F = (-16, -8)

B = (16, 8)