BRANDON TIPTON

CSCI 4250/5250 Homework 5 (Due beginning of class, Tuesday Oct 31st)
You are required to type your answers. Submit to the D2L Dropbox labeled "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
   b. mvMatrix=lookAt(vec3(3, 3, 3), at, up); // pMatrix does not change
   c. mvMatrix=lookAt(vec3(3, 3, 3, at, up);
      pMatrix=ortho(-3, 3, -3, 3, -1, 1);
   d. pMatrix= ortho(-6, 6, -3, 3, 2, 10); // mvMatrix does not change
   e. pMatrix=ortho(0, 4, 0, 3, 2, 10); // mvMatrix does not change

a.) For vec3(-4, 0, 0), we can only see the right side (yellow BFHD), rotated 90°
b.) For vec3(3, 3, 3) we can see 3 sides: top side (EFBA, light blue), back side (red, EFHG) and left side (dark blue, EACG), rotated 45° in x axis and 135° in y axis
c.) Nothing can be seen due to low near/far plane values
d.) ortho(-6, 6, -3, 3, 2, 10) cube looks slightly scaled in x axis due to first 2 values of ortho, view box is wider, and box size stayed the same, so it looks smaller in that dimension
e.) Only part of the cube is visible because ortho left and bottom starts at 0, and cube left, bottom starts at -1

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

$$\begin{bmatrix} -0.7071067811865476 & 0 & -0.7071067811865476 & 0 \\ -0.4082482904638631 & 0.8164965809277261 & 0.4082482904638631 & 0 \\ 0.5773502691896258 & 0.5773502691896258 & -0.5773502691896258 & -6.9282032302755105 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

pMatrix

$$\begin{bmatrix} 0.5 & 0 & 0 & 0 \\ 0 & 0.25 & 0 & 0 \\ 0 & 0 & -0.1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Coordinates: (1, 1, -1)

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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?

frustum(left, right, bottom, top, near, far)

perspective(viewAngle, aspect, near, far)

aspect = (right − lef t)/(top − bottom) = (2 + 2)/(4 + 4) = 0.5

viewAngle = 2 ∗ arctan(1/2 ∗ (top − bottom)/near) = 2 ∗ arctan(1/16/4) = 1.5707963267948966

perspective(viewAngle, aspect, near, far) = perspective(1.5707963267948966, 0.5, 4, 10)

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: (4, 4)

B: (-4, -4)