

COS457

GROUP WORK : (30 POINTS)

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1) Provide the projection matrix that performs an orthographic projection on a world space with parameters (near : -2, far : -20, left : -5, right : + 5, top = 2, bottom = -2) to a canonical view volume. Provide the points that get generated when you use this matrix to convert the points of square with vertices (-3,-1,-4) (3,-1,-8) (3,1,-8) (-3,1,-4). Does your result make sense ?

$$ST = \begin{bmatrix} \frac{2}{right-left} & 0 & 0 & -\frac{right+left}{right-left} \\ 0 & \frac{2}{top-bottom} & 0 & -\frac{top+bottom}{top-bottom} \\ 0 & 0 & -\frac{2}{far-near} & -\frac{far+near}{near-far} \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

In[47]:=

```
T =MatrixForm[{{2/10,0,0,0},{0, 2/4, 0, 0},{0,0,2/18,-22/18},{0, 0, 0, 1}}]
```

Out[34]//MatrixForm=

$$\begin{pmatrix} \frac{1}{5} & 0 & 0 & 0 \\ 0 & \frac{1}{2} & 0 & 0 \\ 0 & 0 & \frac{1}{9} & -\frac{11}{9} \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

In[52]:=

$$\text{MatrixForm}\left[\begin{pmatrix} \frac{1}{5} & 0 & 0 & 0 \\ 0 & \frac{1}{2} & 0 & 0 \\ 0 & 0 & \frac{1}{9} & -\frac{11}{9} \\ 0 & 0 & 0 & 1 \end{pmatrix} \cdot \{-3, -1, -4, 1\}\right]$$

Out[52]//MatrixForm=

$$\begin{pmatrix} -\frac{3}{5} \\ -\frac{1}{2} \\ -\frac{5}{3} \\ 1 \end{pmatrix}$$

In[53]:=

$$\text{MatrixForm}\left[\begin{pmatrix} \frac{1}{5} & 0 & 0 & 0 \\ 0 & \frac{1}{2} & 0 & 0 \\ 0 & 0 & \frac{1}{9} & -\frac{11}{9} \\ 0 & 0 & 0 & 1 \end{pmatrix} \cdot \{3, -1, -8, 1\}\right]$$

Out[53]//MatrixForm=

$$\begin{pmatrix} \frac{3}{5} \\ -\frac{1}{2} \\ -\frac{19}{9} \\ 1 \end{pmatrix}$$

In[54]:=

$$\text{MatrixForm}\left[\begin{pmatrix} \frac{1}{5} & 0 & 0 & 0 \\ 0 & \frac{1}{2} & 0 & 0 \\ 0 & 0 & \frac{1}{9} & -\frac{11}{9} \\ 0 & 0 & 0 & 1 \end{pmatrix} \cdot \{3, 1, -8, 1\}\right]$$

Out[54]//MatrixForm=

$$\begin{pmatrix} \frac{3}{5} \\ \frac{1}{2} \\ -\frac{19}{9} \\ 1 \end{pmatrix}$$

In[55]:=

$$\text{MatrixForm}\left[\begin{pmatrix} \frac{1}{5} & 0 & 0 & 0 \\ 0 & \frac{1}{2} & 0 & 0 \\ 0 & 0 & \frac{1}{9} & -\frac{11}{9} \\ 0 & 0 & 0 & 1 \end{pmatrix} \cdot \{-3, 1, -4, 1\}\right]$$

Out[55]//MatrixForm=

$$\begin{pmatrix} -\frac{3}{5} \\ \frac{1}{2} \\ -\frac{5}{3} \\ 1 \end{pmatrix}$$

This result makes sense since all of the resulting points lie inside the canonical view volume.

2) Provide the perspective projection matrix that converts a world space with parameters (view angle 90 degrees pointing down -z axis, near : -2, far : -10) to a canonical view volume. Provide the points that get generated when you use this matrix to convert the points of square with vertices (-3,-1,-4) (3,-1,-4) (3,1,-4) (-3,1,-4) Does your result make sense ?

$$\mathbf{P} = \mathbf{NSH} = \begin{bmatrix} \frac{2*near}{right-left} & 0 & \frac{right+left}{right-left} & 0 \\ 0 & \frac{2*near}{top-bottom} & \frac{top+bottom}{top-bottom} & 0 \\ 0 & 0 & -\frac{far+near}{far-near} & \frac{-2*far*near}{far-near} \\ 0 & 0 & -1 & 0 \end{bmatrix}.$$

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In[39]:= p=MatrixForm[{{(2*2)/4,0,0,0},{0, (2*2)/4, 0, 0},{0,0,-(12/8),-40/8},{0, 0, -1, 0}}]
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Out[39]//MatrixForm=
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$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -\frac{3}{2} & -5 \\ 0 & 0 & -1 & 0 \end{pmatrix}$$

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In[40]:=
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$$\text{MatrixForm}\left[\left(\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -\frac{3}{2} & -5 \\ 0 & 0 & -1 & 0 \end{pmatrix} \cdot \{-3, -1, -4, 1\}\right)/4\right]$$

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Out[40]//MatrixForm=
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$$\begin{pmatrix} -\frac{3}{4} \\ -\frac{1}{4} \\ \frac{1}{4} \\ 1 \end{pmatrix}$$

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In[44]:=
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$$\text{MatrixForm}\left[\left(\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -\frac{3}{2} & -5 \\ 0 & 0 & -1 & 0 \end{pmatrix} \cdot \{3, -1, -4, 1\}\right)/4\right]$$

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Out[44]//MatrixForm=
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$$\begin{pmatrix} \frac{3}{4} \\ -\frac{1}{4} \\ \frac{1}{4} \\ 1 \end{pmatrix}$$

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In[46]:=
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$$\text{MatrixForm}\left[\left(\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -\frac{3}{2} & -5 \\ 0 & 0 & -1 & 0 \end{pmatrix} \cdot \{3, 1, -4, 1\}\right)/4\right]$$

Out[46]//MatrixForm=

$$\begin{pmatrix} \frac{3}{4} \\ \frac{1}{4} \\ \frac{1}{4} \\ 1 \end{pmatrix}$$

In[43]:=

$$\text{MatrixForm}\left[\left(\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -\frac{3}{2} & -5 \\ 0 & 0 & -1 & 0 \end{pmatrix} \cdot \{-3, 1, -4, 1\}\right) / 4\right]$$

Out[43]//MatrixForm=

$$\begin{pmatrix} -\frac{3}{4} \\ \frac{1}{4} \\ \frac{1}{4} \\ 1 \end{pmatrix}$$

This result does make sense since it both produces homogenized points which line within the CVV.