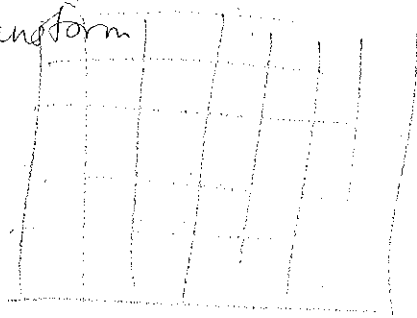
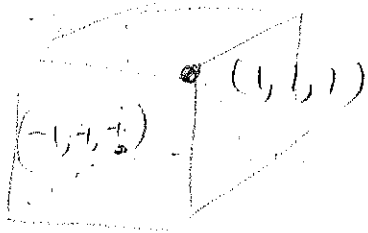


~~LECTURE 5~~

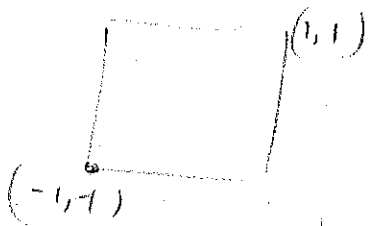
Viewport Transform



$$[-1, 1] \times [-1, 1]$$



$$[-.5, n_x - .5] \times [-.5, n_y - .5]$$



- ① translate lower left corner to origin

$$\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$



- ② scale to new width/height

$$\begin{pmatrix} n_x/2 & 0 & 0 \\ 0 & n_y/2 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$



- ③ translate

$$\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

Compose

$$\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} n_x/2 & 0 & 0 \\ 0 & n_y/2 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} n_x/2 & 0 & 0 \\ 0 & n_y/2 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

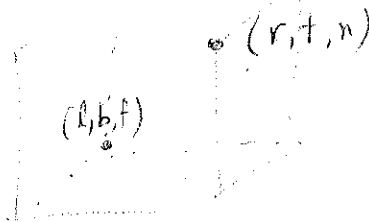
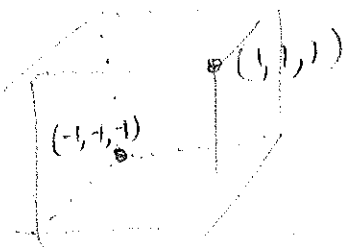
$$= \begin{pmatrix} n_x/2 & 0 & n_x/2 - 1 \\ 0 & n_y/2 & n_y/2 - 1 \\ 0 & 0 & 1 \end{pmatrix}$$

3D:

$$\begin{pmatrix} n_x/2 & 0 & 0 & n_x/2 - 1 \\ 0 & n_y/2 & 0 & n_y/2 - 1 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

LECTURE 6

(8712) M orth



① translate

$$\begin{pmatrix} 1 & & & -l \\ & 1 & & -b \\ & & 1 & -f \\ & & & 1 \end{pmatrix}$$

$$(l, b, f) \rightarrow (0, 0, 0)$$

② scale

$$\begin{pmatrix} \frac{2}{r-l} & & & 0 \\ & \frac{2}{t-b} & & 0 \\ & & \frac{2}{n-f} & 0 \\ & & & 1 \end{pmatrix}$$



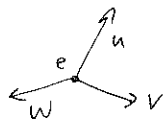
③ translate

$$\begin{pmatrix} 1 & & & -1 \\ & 1 & & -1 \\ & & 1 & -1 \\ & & & 1 \end{pmatrix}$$

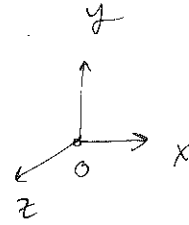
④ compose

$$\begin{pmatrix} 1 & & & -1 \\ & 1 & & -1 \\ & & 1 & -1 \\ & & & 1 \end{pmatrix} \begin{pmatrix} \frac{2}{r-l} & & & 0 \\ & \frac{2}{t-b} & & 0 \\ & & \frac{2}{n-f} & 0 \\ & & & 1 \end{pmatrix} \begin{pmatrix} 1 & & & -l \\ & 1 & & -b \\ & & 1 & -f \\ & & & 1 \end{pmatrix} = \begin{pmatrix} 1 & & & -1 \\ & 1 & & -1 \\ & & 1 & -1 \\ & & & 1 \end{pmatrix} \begin{pmatrix} \frac{2}{r-l} & & & 0 \\ & \frac{2}{t-b} & & 0 \\ & & \frac{2}{n-f} & 0 \\ & & & 1 \end{pmatrix} \begin{pmatrix} -2l & & & 0 \\ & -2b & & 0 \\ & & -2f & 0 \\ & & & 1 \end{pmatrix}$$

$$= \begin{pmatrix} \frac{2}{r-l} & & & -\frac{2l}{r-l} - 1 \\ & \frac{2}{t-b} & & -\frac{2b}{t-b} - 1 \\ & & \frac{2}{n-f} & -\frac{2f}{n-f} - 1 \\ & & & 1 \end{pmatrix} = \begin{pmatrix} \frac{2}{r-l} & & & -\frac{(r+l)}{r-l} \\ & \frac{2}{t-b} & & -\frac{(t+b)}{t-b} \\ & & \frac{2}{n-f} & -\frac{(n+f)}{n-f} \\ & & & 1 \end{pmatrix}$$



M_{cam}
 \rightarrow



① translate $e \rightarrow o$

$$\left(\begin{array}{ccc|c} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & -e \\ 0 & 0 & 1 & 1 \\ \hline 0 & 0 & 0 & 1 \end{array} \right)$$

② rotate

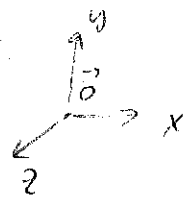
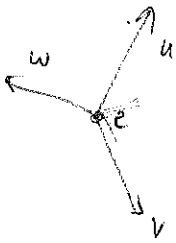
$$\left(\begin{array}{ccc|c} - & u^T & - & 0 \\ - & v^T & - & 0 \\ - & w^T & - & 0 \\ \hline 0 & 0 & 0 & 1 \end{array} \right)$$

Compose:

$$\left(\begin{array}{ccc|c} - & u^T & - & 0 \\ - & v^T & - & 0 \\ - & w^T & - & 0 \\ \hline 0 & 0 & 0 & 1 \end{array} \right) \left(\begin{array}{ccc|c} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & -e \\ 0 & 0 & 1 & 1 \\ \hline 0 & 0 & 0 & 1 \end{array} \right)$$

(87.1.3) Mcam

LECTURE 6.



A_1 The transformation that rotates $x \rightarrow u$
 $y \rightarrow v$
 $z \rightarrow w$

$$\begin{pmatrix} | & | & | \\ u & v & w \\ | & | & | \end{pmatrix}$$

A_2 translate $0 \rightarrow e$

$$\left(\begin{array}{ccc|c} & & & e \\ \hline & & & \\ & & & \\ & & & \end{array} \right)$$

So $A = \left(\begin{array}{ccc|c} & & & e \\ \hline & & & \\ & & & \\ & & & \end{array} \right) \begin{pmatrix} | & | & | & | \\ u & v & w & 0 \\ | & | & | & 0 \\ \hline 0 & 0 & 0 & 1 \end{pmatrix} = \left(\begin{array}{ccc|c} | & | & | & | \\ u & v & w & e \\ | & | & | & | \\ \hline 0 & 0 & 0 & 1 \end{array} \right)$

$$M_{cam} = A^{-1} = \left(\begin{array}{ccc|c} | & | & | & | \\ u & v & w & e \\ | & | & | & | \\ \hline 0 & 0 & 0 & 1 \end{array} \right)^{-1}$$

$$M_{cam} = \left(\begin{array}{ccc|c} -u^T & & & 0 \\ -v^T & & & 0 \\ -w^T & & & 0 \\ \hline 0 & 0 & 0 & 1 \end{array} \right) \left(\begin{array}{ccc|c} & & & -e \\ \hline & & & \\ & & & \\ & & & \end{array} \right)$$