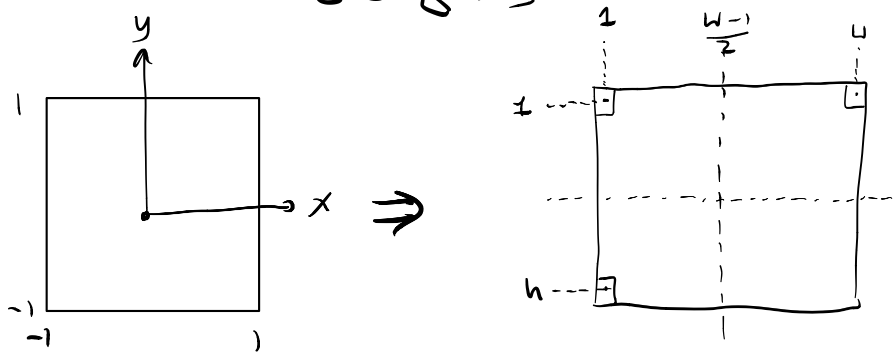
Viewport Matrix

In: $x, y, z \in [-1, 1]^3$

Out: $x \in [1, cw]$

$y \in [1, cH]$

$z \in [-1, 1]$ (unchanged)



1. Scale x, y

   $x: \frac{w-1}{2}$

   $y: \frac{h-1}{2}$ (flipped!)

2. Translate

   $0, 0 \to \frac{w-1}{2}, \frac{h-1}{2}$

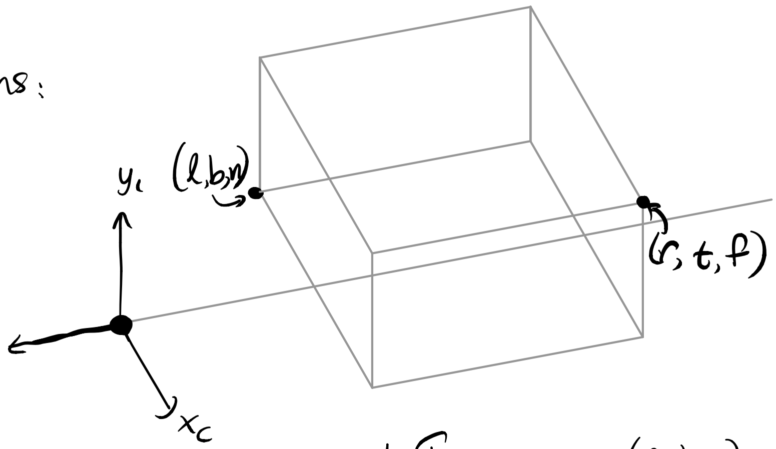
Projection Matrix: Orthographic

In: camera coordinates

Out: x, y, z in $[-1, 1]^3$

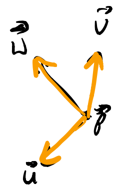
Viewport dims:

$x = l$
$x = r$
$y = b$
$y = t$
$z = n$
$z = f$

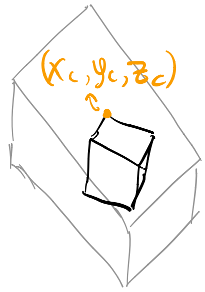


1. Translate $(l,b,n) \to (0,0,0)$
2. Scale $r-l \to 2$
   $t-b \to 2$
   $f-n \to 2$
3. Translate $(1,1,1) \to (0,0,0)$

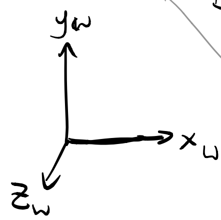
Camera Matrix



Given: $\vec{u}, \vec{v}, \vec{w}, \vec{p}$



$$\begin{bmatrix} x_w \\ y_w \\ z_w \end{bmatrix} = x_c\vec{u} + y_c\vec{v} + z_c\vec{w} + \vec{p}$$



$$\begin{pmatrix} x_w \\ y_w \\ z_w \\ 1 \end{pmatrix} = \begin{bmatrix} \vec{u} & \vec{v} & \vec{w} & \vec{p} \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_c \\ y_c \\ z_c \\ 1 \end{bmatrix}$$

frame-to-canonical!

Canonical-to-frame?

$$\text{inv}\left(\begin{bmatrix} \overbrace{\boxed{\vec{u} \quad \vec{v} \quad \vec{w}}}^{\text{orthogonal}} & p \\ 0 \quad 0 \quad 0 & 1 \end{bmatrix}\right) \qquad \begin{bmatrix} Q & p \\ 0 & 1 \end{bmatrix}^{-1} = \begin{pmatrix} \vec{u}^T & -\vec{u}^T p_x \\ \vec{v}^T & -\vec{v}^T p_y \\ \vec{w}^T & -\vec{u}^T p_z \\ \vec{0} & 1 \end{pmatrix}$$