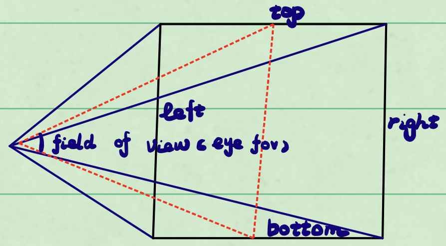
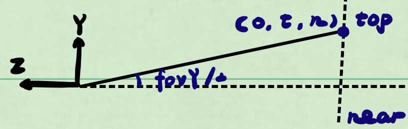


aspect ratio = width / height

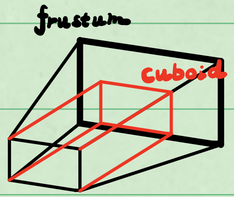


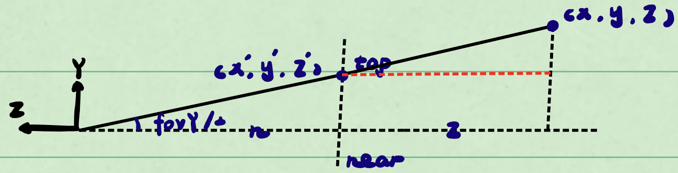
width = 2r

hight = 2t

aspect = $\frac{r}{t}$

$\tan(fovY/2) = \frac{t}{|n|}$





$$x' = \frac{n}{z}x$$

$$y' = \frac{n}{z}y$$

$$M_{perspective \to orthographic} \cdot \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix} = \begin{pmatrix} \frac{n}{z}x \\ \frac{n}{z}y \\ ? \\ 1 \end{pmatrix} = \begin{pmatrix} nx \\ ny \\ ? \\ z \end{pmatrix}$$

$$M_{perspective \to orthographic} = \begin{pmatrix} n & 0 & 0 & 0 \\ 0 & n & 0 & 0 \\ ? & ? & ? & ? \\ 0 & 0 & 1 & 0 \end{pmatrix}$$

近平面： $z = n$

$$\begin{pmatrix} x \\ y \\ n \\ 1 \end{pmatrix} = \begin{pmatrix} nx \\ ny \\ n^2 \\ n \end{pmatrix} \qquad (0, 0, A, B)\begin{pmatrix} x \\ y \\ n \\ 1 \end{pmatrix} = n^2$$

$$An + B = n^2$$

远平面的中心点： $z = f$

$$\begin{pmatrix} 0 \\ 0 \\ f \\ 1 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ f^2 \\ f \end{pmatrix} \qquad (0, 0, A, B)\begin{pmatrix} 0 \\ 0 \\ f \\ 1 \end{pmatrix} = f^2$$

$$Af + B = f^2$$

$$A(n-f) = n^2 - f^2 = (n+f)(n-f)$$

$$A = n + f \qquad B = -nf$$

$$M_{perspective \to orthographic} = \begin{pmatrix} n & 0 & 0 & 0 \\ 0 & n & 0 & 0 \\ 0 & 0 & n+f & -nf \\ 0 & 0 & 1 & 0 \end{pmatrix}$$

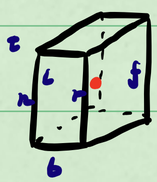
Orthographic Projection

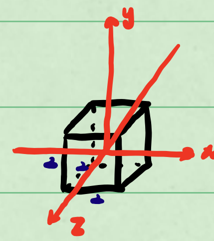
$[l, r] \times [b, t] \times [n, f]$ to $[1, 1]^3$

$$M_{orthographic} = \begin{bmatrix} \frac{2}{r-l} & 0 & 0 & 0 \\ 0 & \frac{2}{t-b} & 0 & 0 \\ 0 & 0 & \frac{2}{f-n} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & -\frac{r+l}{2} \\ 0 & 1 & 0 & -\frac{t+b}{2} \\ 0 & 0 & 1 & -\frac{n+f}{2} \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Translate then Scale

中心点 $\left(\frac{l+r}{2}, \frac{b+t}{2}, \frac{n+f}{2}\right)$





length = $r - l$

width = $t - b$

height = $f - n$