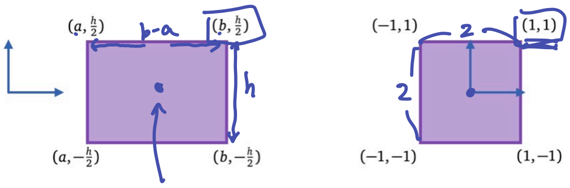
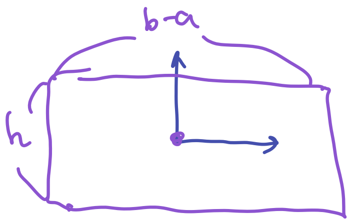
Find the transformation that transforms the following 2D box to a square with side length 2 centered at the origin.



center of the box is $\left(\frac{a+b}{2}, 0\right)$

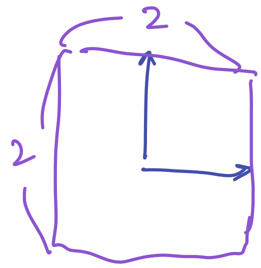
Step 1 translation

$$T = \left[\begin{array}{cc|c} 1 & & -\frac{a+b}{2} \\ & 1 & 0 \\ \hline 0 & 0 & 1 \end{array}\right]$$



Step 2 Scaling

$$S = \left[\begin{array}{cc|c} \frac{2}{b-a} & 0 & 0 \\ 0 & \frac{2}{h} & 0 \\ \hline 0 & 0 & 1 \end{array}\right]$$



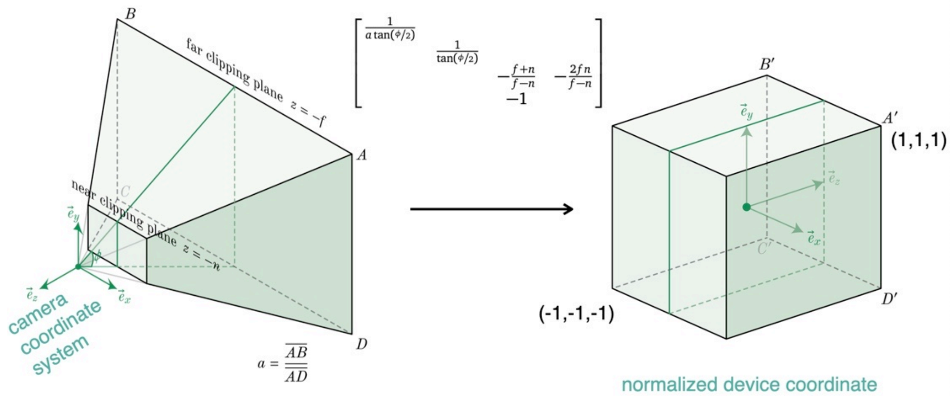
Finally the transf matrix is

$$ST = \begin{bmatrix} \frac{2}{b-a} & 0 & 0 \\ 0 & \frac{2}{h} & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & -\frac{a+b}{2} \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \underline{\begin{bmatrix} \frac{2}{b-a} & 0 & \frac{a+b}{a-b} \\ 0 & \frac{2}{h} & 0 \\ 0 & 0 & 1 \end{bmatrix}}$$

Verify

$$\begin{bmatrix} \frac{2}{b-a} & 0 & \frac{a+b}{a-b} \\ \cdot & \frac{2}{h} & \\ & & 1 \end{bmatrix} \underbrace{\begin{bmatrix} b \\ \frac{h}{2} \\ \hline 1 \end{bmatrix}} = \begin{bmatrix} \overbrace{\frac{2b}{b-a} + 0 + \frac{a+b}{a-b}} \\ \frac{2}{h} \cdot \frac{h}{2} \\ \hline 1 \end{bmatrix} \begin{matrix} = \frac{2b-(a+b)}{b-a} = 1 \\ = 1 \\ = 1 \end{matrix}$$

$$= \begin{bmatrix} 1 \\ 1 \\ \hline 1 \end{bmatrix}$$


far clipping plane $z=-f$
near clipping plane $z=-n$
$\begin{bmatrix} \frac{1}{a\tan(\phi/2)} & & & \\ & \frac{1}{\tan(\phi/2)} & & \\ & & -\frac{f+n}{f-n} & -\frac{2fn}{f-n} \\ & & -1 & \end{bmatrix}$
$a = \frac{\overline{AB}}{\overline{AD}}$
camera coordinate system
(1,1,1)
(-1,-1,-1)
normalized device coordinate