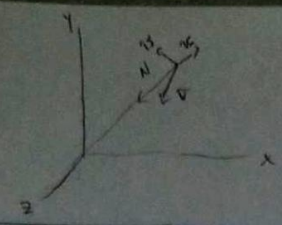

Q3) $P_{wv} = [10,10,10]^T$ $\quad \vec{V} = [0,0,1]^T$, $\vec{N} = [-1,-1,-1]^T$

$\vec{n} = \frac{-1[-1,-1,-1]}{\|[-1,-1,-1]\|} = \frac{\sqrt{3}}{3}[1,1,1]^T$ $\quad \vec{u} = \frac{-(\vec{V}\times\vec{N})}{\|\vec{V}\times\vec{N}\|} \rightarrow \det\begin{bmatrix} i & j & k \\ 0 & 0 & 1 \\ -1 & -1 & -1 \end{bmatrix} \rightarrow \frac{-[1,-1,0]}{\|[1,-1,0]\|} = \frac{\sqrt{2}}{2}[-1,1,0]^T$

$\vec{v} = \vec{n}\times\vec{u} = \frac{\sqrt{6}}{6}\det\begin{bmatrix} i & j & k \\ 1 & 1 & 1 \\ -1 & 1 & 0 \end{bmatrix} = \frac{\sqrt{6}}{6}[1,-1,2]^T$

$$M_{vw} = \begin{bmatrix} \vec{u}^T & -\vec{u}\cdot P_{wv} \\ \vec{v}^T & -\vec{v}\cdot P_{wv} \\ \vec{n}^T & -\vec{n}\cdot P_{wv} \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} -\sqrt{2}/2 & \sqrt{2}/2 & 0 & 0 \\ \sqrt{6}/6 & -\sqrt{6}/6 & \sqrt{6}/3 & -\frac{10}{3}\sqrt{6} \\ \sqrt{3}/3 & \sqrt{3}/3 & \sqrt{3}/3 & -10\sqrt{3} \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$d = 6$, $n = 5$, $s = 25$, $(x_{min}, y_{min}) = (-4,-4)$, $(x_{max}, y_{max}) = (4,4)$

$$M_{persp} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & \frac{-(d+n)}{s-n} & \frac{-ds}{(s-n)} \\ 0 & 0 & -1 & 0 \end{bmatrix} \begin{bmatrix} \frac{2d}{x_{max}-x_{min}} & 0 & 0 & 0 \\ 0 & \frac{2d}{y_{max}-y_{min}} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & \frac{x_{max}+x_{min}}{2d} & 0 \\ 0 & 1 & \frac{y_{max}+y_{min}}{2d} & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -3/2 & -25/2 \\ 0 & 0 & -1 & 0 \end{bmatrix} \begin{bmatrix} 3/2 & 0 & 0 & 0 \\ 0 & 3/2 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} - \begin{bmatrix} 3/2 & 0 & 0 & 0 \\ 0 & 3/2 & 0 & 0 \\ 0 & 0 & -3/2 & -25/2 \\ 0 & 0 & -1 & 0 \end{bmatrix}$$

scaling $\qquad$ shear

Viewport size: 200 x 200

$$M_{viewport} = \begin{bmatrix} 25 & 0 & 0 & 100 \\ 0 & -25 & 0 & 100 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

(scaling; ↑)

$25 = \frac{200}{4-(-4)}$ to get $(-4,4)$ to $(-100,100)$

Q4) $$\begin{bmatrix} \frac{1}{25} & 0 & 0 \\ 0 & -\frac{1}{25} & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & -100 \\ 0 & 1 & -100 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 20 \\ 50 \\ 1 \end{bmatrix} = \begin{bmatrix} (20-100)/25 \\ -(50-100)/25 \\ 1 \end{bmatrix} = \begin{bmatrix} -3.2 \\ 2 \\ 1 \end{bmatrix}$$