

Homework 1 Solution (By Alisa Burdeyny)

1)

A - Mvp - viewport transformation

B - Morth - orthographic projection

C - P - perspective transformation

D - Mcam - transform into eye coordinates

E - Mm - modeling transformation matrix

$$A - \begin{vmatrix} n_x/2 & 0 & 0 & (n_x-1)/2 \\ 0 & n_y/2 & 0 & (n_y-1)/2 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix} \quad n_x = \text{width of screen/image}, n_y = \text{height of screen/image}$$

$$B - \begin{vmatrix} 2/(r-l) & 0 & 0 & -(r+l)/(r-l) \\ 0 & 2/(t-b) & 0 & -(t+b)/(t-b) \\ 0 & 0 & 2/(n-f) & -(n+f)/(n-f) \\ 0 & 0 & 0 & 1 \end{vmatrix} \quad \begin{aligned} r &= n_d \cdot \tan(\theta_w/2), l = n_d \cdot \tan(-\theta_w/2) \\ t &= n_d \cdot \tan(\theta_h/2), b = n_d \cdot \tan(-\theta_h/2) \\ n &= \text{near}, f = \text{far} \\ n_d &= \text{distance to near plane} \end{aligned}$$

$$C - \begin{vmatrix} n & 0 & 0 & 0 \\ 0 & n & 0 & 0 \\ 0 & 0 & n+f & -fn \\ 0 & 0 & 1 & 0 \end{vmatrix} \quad n = \text{near}, f = \text{far}$$

$$D - \begin{vmatrix} x_u & y_u & z_u & 0 \\ x_v & y_v & z_v & 0 \\ x_w & y_w & z_w & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix} \begin{vmatrix} 1 & 0 & 0 & -x \\ 0 & 1 & 0 & -y \\ 0 & 0 & 1 & -z \\ 0 & 0 & 0 & 1 \end{vmatrix} \quad \begin{aligned} w &= -\text{look}/\text{mag}(\text{look}) \\ u &= \text{up} \times w/\text{mag}(\text{up} \times w) \\ v &= w \times u \end{aligned}$$

E - modeling transformation, translate, rotate, scale (t*r*s <- order)

2)

One unit right:

$$\begin{vmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix} * e$$

One unit down:

$$\begin{vmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & -1 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix} * e$$

One unit forwards:

$$\begin{vmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 \end{vmatrix} * e$$

Yaw θ clockwise:

$$\begin{bmatrix} \cos\theta & 0 & \sin\theta & 0 \\ 0 & 1 & 0 & 0 \\ -\sin\theta & 0 & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} |u| \\ |v| \\ |w| \\ |1| \end{bmatrix}$$

Pitch θ up:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta & 0 \\ 0 & \sin\theta & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} |u| \\ |v| \\ |w| \\ |1| \end{bmatrix}$$

Spin θ right:

$$\begin{bmatrix} \cos\theta & -\sin\theta & 0 & 0 \\ \sin\theta & \cos\theta & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} |u| \\ |v| \\ |w| \\ |1| \end{bmatrix}$$