FINAL EXAM - Mallare, Edelynn BSSE 3

1. a.) Translate +7 units in the x direction:

$$T = \begin{bmatrix} 1 & 0 & 0 & 7 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

b.) Rotate by 60° about the x-axis

$$R = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(60°) & -\sin(60°) & 0 \\ 0 & \sin(60°) & \cos(60°) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

c.) Rotation, followed by translation above, followed by scaling by a factor of 2.

$$R \cdot T \cdot S = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(60°) & -\sin(60°) & 0 \\ 0 & \sin(60°) & \cos(60°) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 7 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 & 0 & 7 \\ 0 & \cos(60°) & -\sin(60°) & 0 \\ 0 & \sin(60°) & \cos(60°) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 0 & 0 & 7 \\ 0 & 2\cos(60°) & -2\sin(60°) & 0 \\ 0 & 2\sin(60°) & 2\cos(60°) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

2. $S_1 = 0$, $S_2 = 0$, $S_3 = \frac{(100-95)}{100} = 0.05$

$$S = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0.05 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

3. $S_1 = 0$, $S_2 = \left(\frac{100-95}{100}\right) = 0.05$, $S_3 = 1$

$$S = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0.05 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

4. $\frac{\theta}{F} = \frac{300^\circ}{60} = \frac{5^\circ}{1}$ $\theta$ = rotation in degrees, $F$ = frame per second

$$\text{Rotation} = \begin{bmatrix} \cos(5^\circ) & 0 & \sin(5^\circ) & 0 \\ 0 & 1 & 0 & 0 \\ -\sin(5^\circ) & 0 & \cos(5^\circ) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

5. $S_x = 10$; $S_y = 10$; $S_z = 10$

R around x-axis:

FPS = 60 $\quad \theta = \frac{360 \times 24}{60}$

Rotation/s = 24

1 revolution = 360° $\quad \theta = 144^\circ$

$T_z = +240$

$$T \cdot R \cdot S = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 240 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(144) & -\sin(144) & 0 \\ 0 & \sin(144) & \cos(144) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(144) & -\sin(144) & 0 \\ 0 & \sin(144) & \cos(144) & 240 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 10 & 0 & 0 & 0 \\ 0 & 10 & 0 & 0 \\ 0 & 0 & 10 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 10 & 0 & 0 & 0 \\ 0 & 10\cos(144) & -10\sin(144) & 0 \\ 0 & 10\sin(144) & 10\cos(144) & 240 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$