Blake Savage — Assignment #3 Part 1

COSC 4345.001

1. Show the series of matrices needed for rotating a 2D object 45° around the point (5, 7)

$\begin{bmatrix} 1 & 0 & 5 \\ 0 & 1 & 7 \\ 0 & 0 & 1 \end{bmatrix}$ Translate x by 5 units and y by 7 units.

$\begin{bmatrix} \cos(\pi/4) & -\sin(\pi/4) & 0 \\ \sin(\pi/4) & \cos(\pi/4) & 0 \\ 0 & 0 & 1 \end{bmatrix}$ Rotate 45° about the origin

$\begin{bmatrix} 1 & 0 & -5 \\ 0 & 1 & -7 \\ 0 & 0 & 1 \end{bmatrix}$ Translate x back by 5 units and y back by 7 units.

The combined matrix is $\begin{bmatrix} \cos(\pi/4) & -\sin(\pi/4) & 5(1-\cos(\pi/4)) + 7\sin(\pi/4) \\ \sin(\pi/4) & \cos(\pi/4) & 7(1-\cos(\pi/4)) - 5\sin(\pi/4) \\ 0 & 0 & 1 \end{bmatrix}$

2. Show the series of matrices needed for reflecting a 2D object around the line $y = x + 4$.

$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 4 \\ 0 & 0 & 1 \end{bmatrix}$ Translate y by 4 units so that it passes through the origin.

$\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ Reflect about the line y = x

$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & -4 \\ 0 & 0 & 1 \end{bmatrix}$ Translate y back 4 units

The combined matrix is $\begin{bmatrix} 0 & 1 & -4 \\ 1 & 0 & 4 \\ 0 & 0 & 1 \end{bmatrix}$

3. Show the series of matrices needed for reflecting a 3D object about the line $y = 10$.

$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 10 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ Translate by 10 units in the y direction

$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ Reflect about xz-plane

$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & -10 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ Translate back 10 units in y direction

The combined matrix is $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 20 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$