EDELYNN P. MALLARE BSSE-3

HOMEWORK - TRANSFORMS MATH

Part 0:

The multiplication rule of matrices works from right to left, so the right-most matrix is multiplied first with the original vector. In the given code, the object was first scaled, rotated, then translated, following the rule.

Multiplication of matrices is not commutative because we take the row elements of the first matrix and multiply it to the columns of the second matrix. Exchanging the order of the matrices will result to a different element value; therefore the order is important, otherwise they would negatively affect each other.

Part 1:

1. nodding your head - X-axis
2. shaking your head to say "no" - Y-axis
3. tilting your head - Z-axis
4. doing a cartwheel - Z-axis
5. doing a backflip - X-axis
6. spinning like a ballerina - Y-axis
7. falling dead backwards - X-axis
8. falling dead sideways - Z-axis

Part 2: Math

original Vector (5, 12, 8) :

1. Buff by 30% :

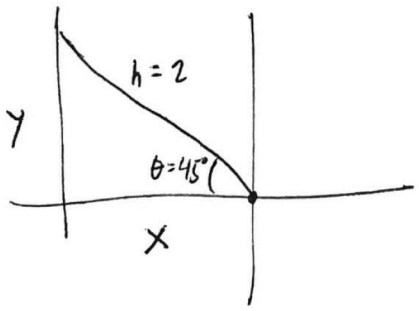
$$\begin{bmatrix} 1.3 & 0 & 0 & 0 \\ 0 & 1.3 & 0 & 0 \\ 0 & 0 & 1.3 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{pmatrix} 5 \\ 12 \\ 8 \\ 1 \end{pmatrix} = \begin{pmatrix} 6.5 \\ 15.6 \\ 10.4 \\ 1 \end{pmatrix}$$

2. Move 2 units to Left & 2 units downward

$T_x = -2$; $T_y = -2$; $T_z = 0$

$$\begin{bmatrix} 1 & 0 & 0 & -2 \\ 0 & 1 & 0 & -2 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{pmatrix} 5 \\ 12 \\ 8 \\ 1 \end{pmatrix} = \begin{pmatrix} 3 \\ 10 \\ 8 \\ 1 \end{pmatrix}$$

3.



$\sin(45^\circ) = \frac{Y}{2}$ $\quad$ $\cos(45^\circ) = \frac{X}{2}$

$Y = 1.4142$ $\quad$ $X = 1.4142$

$$\begin{bmatrix} 1 & 0 & 0 & -1.4142 \\ 0 & 1 & 0 & 1.4142 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{pmatrix} 5 \\ 12 \\ 8 \\ 1 \end{pmatrix} = \begin{pmatrix} 3.5858 \\ 13.4142 \\ 8 \\ 1 \end{pmatrix}$$

4. $\theta = -70°$

$$\begin{bmatrix} \cos(-70°) & 0 & \sin(-70°) & 0 \\ 0 & 1 & 0 & 0 \\ -\sin(-70°) & 0 & \cos(-70°) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{pmatrix} 5 \\ 12 \\ 8 \\ 1 \end{pmatrix} = \begin{pmatrix} \cos(-70)(5) + \sin(-70)(8) \\ 12 \\ -\sin(-70)(5) + \cos(-70)(8) \\ 1 \end{pmatrix}$$

$$= \begin{pmatrix} -5.8074 \\ 12 \\ 7.4346 \\ 1 \end{pmatrix}$$

5. $\theta = 78°$

$$\begin{bmatrix} \cos(78) & 0 & \sin(78) & 0 \\ 0 & 1 & 0 & 0 \\ -\sin(78) & 0 & \cos(78) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{pmatrix} 5 \\ 12 \\ 8 \\ 1 \end{pmatrix} = \begin{pmatrix} 8.86 \\ 12 \\ -3.23 \\ 1 \end{pmatrix}$$

6. $V = \begin{bmatrix} 5 \\ 12 \\ 8 \\ 1 \end{bmatrix}$, $\theta = 90°$

$$\bar{T} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & -3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

R = at x-axis $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta & 0 \\ 0 & \sin\theta & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

$$R \cdot \bar{T} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & -3 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 3 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 3 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 5 \\ 12 \\ 8 \\ 1 \end{bmatrix} = \begin{bmatrix} 5 \\ -5 \\ 12 \\ 1 \end{bmatrix}$$

7. Trans · Scale $= \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 25 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0.9 & 0 & 0 & 0 \\ 0 & 0.9 & 0 & 0 \\ 0 & 0 & 0.90 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

$= \begin{bmatrix} 0.9 & 0 & 0 & 0 \\ 0 & 0.9 & 0 & 25 \\ 0 & 0 & 0.9 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 5 \\ 12 \\ 8 \\ 1 \end{bmatrix} = \begin{bmatrix} 4.5 \\ 35.8 \\ 7.2 \\ 1 \end{bmatrix}$

8. S.R.T $= \begin{bmatrix} 0.5 & 0 & 0 & 0 \\ 0 & 10 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \cos(15^\circ) & 0 & \sin(15^\circ) & 0 \\ 0 & 1 & 0 & 0 \\ -\sin(15^\circ) & 0 & \cos(15^\circ) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

$= \begin{bmatrix} 0.5(\cos(15^\circ)) & 0 & 0.5(\sin(15^\circ)) & 0 \\ 0 & 10 & 0 & 0 \\ -\sin(15^\circ) & 0 & \cos(15^\circ) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & -12 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

$= \begin{bmatrix} 0.5(\cos(15^\circ)) & 0 & 0.5(\sin(15^\circ)) & 0 \\ 0 & 10 & 0 & -120 \\ -\sin(15^\circ) & 0 & \cos(15^\circ) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 5 \\ 12 \\ 8 \\ 1 \end{bmatrix}$

$= \begin{bmatrix} 3.4500 \\ 0 \\ 6.4333 \\ 1 \end{bmatrix}$