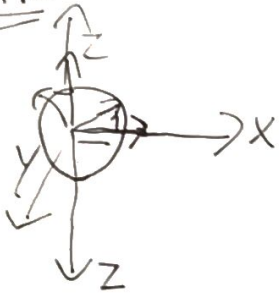


$$\begin{bmatrix} X_x & Y_x & Z_x & d_x \\ X_y & Y_y & Z_y & d_y \\ X_z & Y_z & Z_z & d_z \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \\ 1 \end{bmatrix} = \begin{bmatrix} aX_x + bY_x + cZ_x + d_x \\ aX_y + bY_y + cZ_y + d_y \\ aX_z + bY_z + cZ_z + d_z \\ 0 + 0 + 0 + 1 \end{bmatrix}$$

$X_n, Y_n, Z_n \rightarrow$ Vectors/points after transformation
 $d_n \rightarrow$ used to translate

Rotation around x

RHS



$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$\begin{bmatrix} \cos\theta \\ 0 \\ -\sin\theta \end{bmatrix}$$

$$\begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix} -\sin\theta \\ 0 \\ \cos\theta \end{bmatrix}$$

$$\begin{bmatrix} \cos\theta & 0 & -\sin\theta \\ 0 & 1 & 0 \\ -\sin\theta & 0 & \cos\theta \end{bmatrix}$$

LHS - x out

$$\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} \quad \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}$$

$$\downarrow \quad \downarrow$$

$$\begin{bmatrix} z \\ y \end{bmatrix} \quad \begin{bmatrix} \cos\theta \\ \sin\theta \end{bmatrix} \quad \begin{bmatrix} -\sin\theta \\ \cos\theta \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta & 0 \\ 0 & \sin\theta & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Create Transformation RHS CC Rotation

$X \left\{ \begin{array}{c} \text{Diagram: Rotation around X-axis} \end{array} \right. \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{bmatrix}$

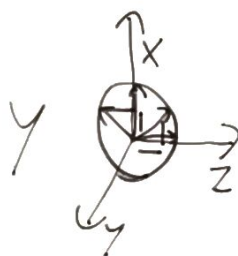
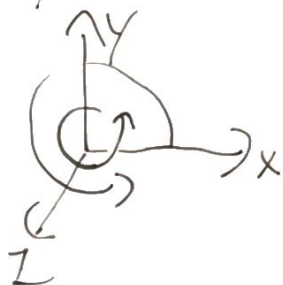
Unit test uses (LHS) Rotation Clockwise? X

$X \left\{ \begin{array}{c} \text{Diagram: Rotation around X-axis} \end{array} \right. \begin{bmatrix} \quad \quad \quad \end{bmatrix}$

$\begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} \rightarrow \begin{bmatrix} \sin\theta \\ \cos\theta \end{bmatrix}$
 $\begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \rightarrow \begin{bmatrix} 0 \\ -\cos\theta \\ \sin\theta \end{bmatrix}$



unit test uses RHS x to screen



$\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} \rightarrow \begin{bmatrix} \cos\theta \\ 0 \\ -\sin\theta \end{bmatrix}$

$\begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \rightarrow \begin{bmatrix} \sin\theta \\ 0 \\ \cos\theta \end{bmatrix}$

$\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} \rightarrow \begin{bmatrix} \cos\theta \\ \sin\theta \\ 0 \end{bmatrix}$

$\begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} \rightarrow \begin{bmatrix} -\sin\theta \\ \cos\theta \\ 0 \end{bmatrix}$