# Homogeneous Transformations

## Rotation Matrices

$$R_{x,\theta} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos(\theta) & -\sin(\theta) \\ 0 & \sin(\theta) & \cos(\theta) \end{bmatrix}$$

$$R_{y,\theta} = \begin{bmatrix} \cos(\theta) & 0 & \sin(\theta) \\ 0 & 1 & 0 \\ -\sin(\theta) & 0 & \cos(\theta) \end{bmatrix}$$

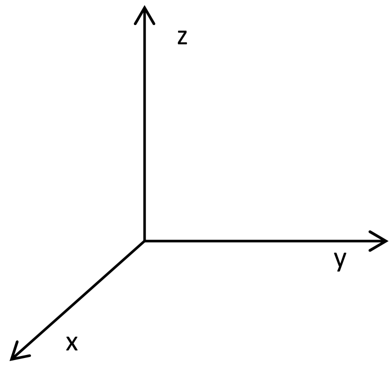
$$R_{z,\theta} = \begin{bmatrix} \cos(\theta) & -\sin(\theta) & 0 \\ \sin(\theta) & \cos(\theta) & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

## Homogeneous transformation Matrix

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

$$T^{-1} = \begin{bmatrix} R^T & -R^T d \\ 0 & 1 \end{bmatrix}$$

$$ {}_{From}^{To}R \qquad\qquad v_{To} = {}_{From}^{To}R\, v_{From} $$




Right Hand Rule: x crossed into y = positive z
z crossed into x = positive y
y crossed into z = positive x

Rotation/Translation Matrices Rotation Angle is:
Rotation of To's coordinate frame to get From's coordinate frame

Translation Matrices Translation vector is:
Translation in To's coordinates to get From's coordinate origin.

Always double check that result makes sense by testing with a simple vector.

Another way to check rotation matrix

$$ {}_{From}^{To}R = \begin{pmatrix} \text{From's x axis in To's coordinates} & \text{From's y axis in To's coordinates} & \text{From's z axis in To's coordinates} \end{pmatrix} $$