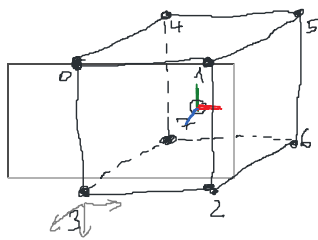


# Lecture 03

Wednesday, October 13, 2021 18:32



## Vertices

-1	1	1
1	1	1
1	-1	1
-1	-1	1
-1	1	-1
1	1	-1
1	-1	-1
-1	-1	-1

## Polygons

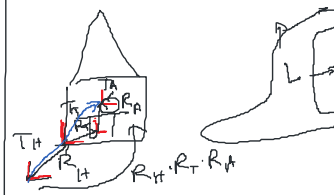
0	3	2	1
1	2	6	5
5	6	7	4
4	7	3	0
2	3	7	6
4	0	1	5

## Normals

0	0	1
1	0	0
0	0	-1
-1	0	0
0	-1	0
0	1	0

## Object Position (Shape)

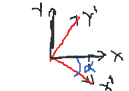
- it is the pos. of the obj. frame of ref.



## Rotation

- axis's angle:  $(\alpha, x, y, z)$

$$(i, j, k) = \begin{pmatrix} x_i & x_j & x_k \\ y_i & y_j & y_k \\ z_i & z_j & z_k \end{pmatrix}$$



$$X' = \begin{pmatrix} \cos \alpha \\ -\sin \alpha \end{pmatrix}$$

$$Y' = \dots$$

## Rotation matrix

$$\begin{pmatrix} V_x \\ V_y \\ V_z \end{pmatrix} \cdot (R) = \begin{pmatrix} V_x' \\ V_y' \\ V_z' \end{pmatrix}$$

## Transform matrix

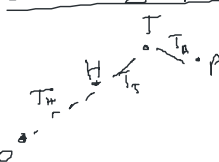
$$T = \begin{pmatrix} R & P \\ 0 & 0 & 0 & 1 \end{pmatrix} \text{ or } \begin{pmatrix} R & 0 \\ P & 1 \end{pmatrix}$$

$$\begin{pmatrix} R_H & P_H \\ 0 & 0 & 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} R_T & P_T \\ 0 & 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} R_H \cdot R_T & R_H \cdot P_T + P_H \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

## Scaling

$$\begin{pmatrix} 0.5 & 0 & 0 & 0 \\ 0 & 0.5 & 0 & 0 \\ 0 & 0 & 0.5 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} V_x \\ V_y \\ V_z \\ 1 \end{pmatrix} = \begin{pmatrix} 0.5 \cdot V_x \\ 0.5 \cdot V_y \\ 0.5 \cdot V_z \\ 1 \end{pmatrix}$$

## Scene graph



Euler angles  $z' y' z''$

Gimbal Lock

Quaternions  
(w, x, y, z)

