

3D Transformation

Course Code: CSC 3224

Course Title: Computer Graphics



Dept. of Computer Science
Faculty of Science and Technology

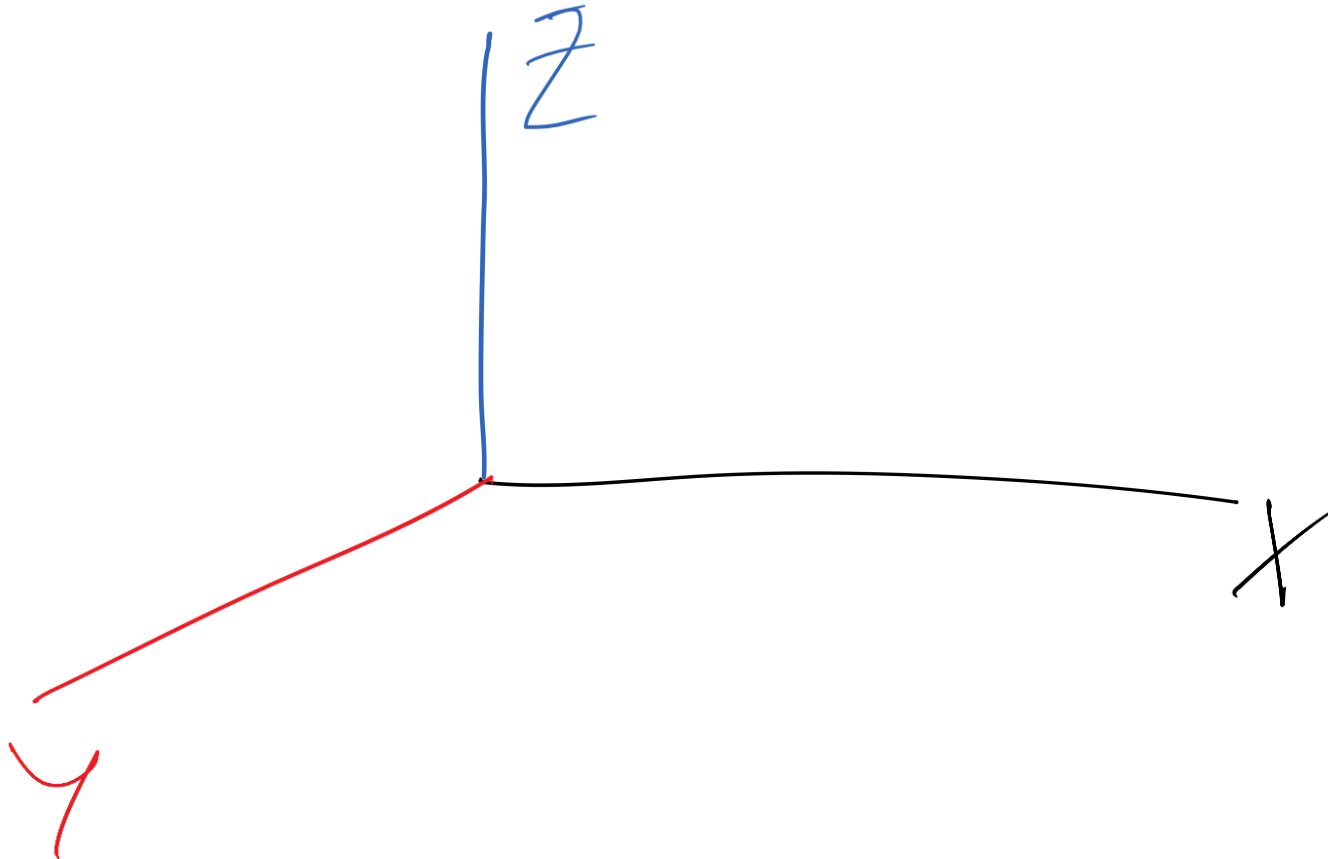
Lecturer No:	8	Week No:	07	Semester:	
Lecturer:					

Transformations



- * Translation \rightarrow Moving Object
- * Scaling \rightarrow Resizing Object

3D Axis



3D Transformations



* Translation $\rightarrow t_x, t_y, t_z$

* Scaling $\rightarrow s_x, s_y, s_z$

* Rotation \rightarrow Rotating with ' θ '

- x rotation
- y rotation
- z rotation

* Reflection \rightarrow Rotate with -180°

- xy plane
- yz plane
- zx plane

3D Translation



$$\rightarrow t_x \quad x' = x + t_x$$

$$\rightarrow t_y \quad y' = y + t_y$$

$$\rightarrow t_z \quad z' = z + t_z$$

$$\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} t_x \\ t_y \\ t_z \end{bmatrix} + \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

3D Scaling



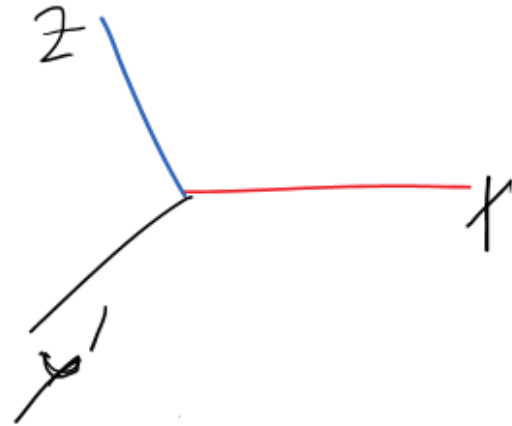
$$S_x \quad x' = x * S_x$$

$$S_y \quad y' = y * S_y$$

$$S_z \quad z' = z * S_z$$

$$\begin{matrix} x' \\ y' \\ z' \end{matrix} = \begin{bmatrix} S_x & 0 & 0 \\ 0 & S_y & 0 \\ 0 & 0 & S_z \end{bmatrix} * \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

3D Rotation



- x Roll → Rotation respect x Axis
- y Roll → Rotation respect y Axis
- z Roll → Rotation respect z Axis

3D Rotation



Z ROLL \rightarrow

$$z' = z$$

$$x' = x \cos \theta - y \sin \theta$$

$$y' = x \sin \theta + y \cos \theta$$

$$\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} \cos \theta & -\sin \theta & 0 \\ \sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$



Y Roll

$$y' = y$$

$$z' = z \cos \theta - x \sin \theta$$

$$x' = z \sin \theta + x \cos \theta$$

$$\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} \cos \theta & 0 & \sin \theta \\ 0 & 1 & 0 \\ -\sin \theta & 0 & \cos \theta \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

3D Scaling



Reflection

- XY Plane:

$$\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

- YZ Plane

$$\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

ZX Plane

$$\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$



Books

- Foley, van Dam, Feiner, Hughes, Computer Graphics: principles and practice, Addison Wesley, Second Edition.
- Schaum's Outline of Theory & Problems of Computer Graphics.
- Peter Shirley Steve Marschner , “Fundamental of computer graphics”, Third Edition.



References

1. <https://www.gatevidyalay.com/3d-translation-in-computer-graphics-definition-examples/>
2. https://en.wikipedia.org/wiki/Transformation_matrix
3. <https://www.javatpoint.com/computer-graphics-3d-transformations>
4. <https://www.slideshare.net/DelwarHossain8/3d-transformation-computer-graphics>
5. <https://en.ppt-online.org/31501>
6. <https://www.slideserve.com/thomas-kirby/2d-and-3d-transformation-powerpoint-ppt-presentation>
7. <https://slideplayer.com/slide/5061630/>