Assignment 02 Modelling Viewing and Projection

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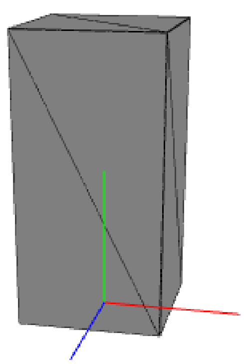
Q1.(a)

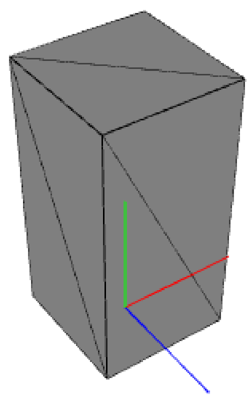
$$w = -\frac{g}{\|g\|} \qquad u = \frac{t \times w}{\|t \times w\|} \qquad v = w \times u$$

The above formulas form the basis of camera transformation, hance the coordinates of the modified camera position have been incremented or decremented in the factors of these equations.
u has been used as the basis when there is a change in the x-axis of camera position.
v has been used as the basis when there is a change in the y-axis of camera position.
w has been used as the basis when there is a change in the z-axis of the camera position.
Here g are the coordinates of camera, t is the up vector of the camera.

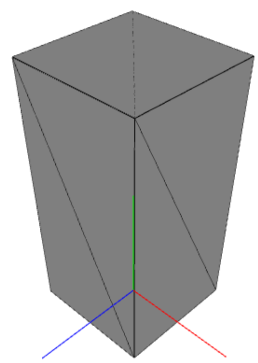
(b).



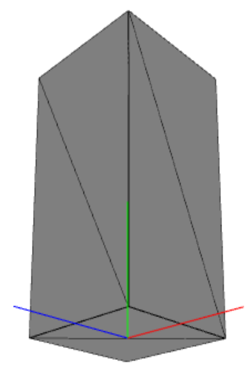
One Point Perspective



Two Point Perspective



Bird's eye view

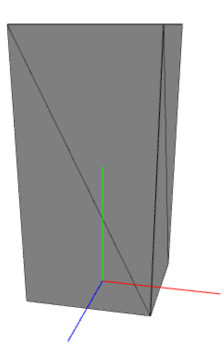


Rat's eye view

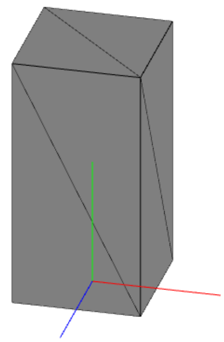
Three Point Perspective:

Q2:

1) We use the glm::ortho function to get the orthographic projection of the given figure. Click ‘O’ to get the orthographic projection and ‘P’ to get back the perspective projection.



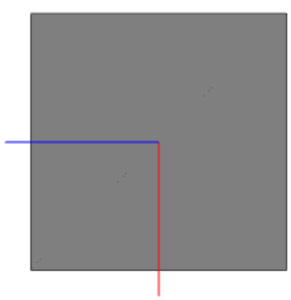
Perspective Projection



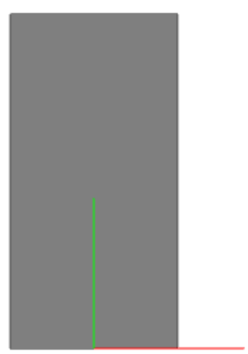
Orthogonal Projection

2) Modifier keys for different views are:
   - ‘S’ Key: Side elevation
   - ‘T’ Key: Top view
   - ‘F’ Key: Front elevation

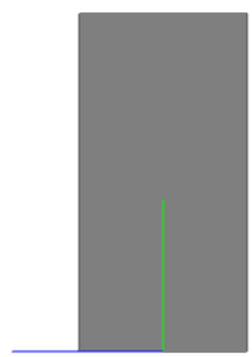
For this to work we give the desired camera coordinates and call the setupViewTranformation function.



Top View



Front elevation



Side elevation

Q3.

3). To find $\begin{bmatrix} R & t \\ 000 & 1 \end{bmatrix}^{-1}$, R is a 3×3 rotation matrix & t is a 3-vector.

From Section 6.4 (Inverses of tranformation matrices), we know that a matrix with $[0\ 0\ 0\ 1]$ in the bottom row has ~~an~~ $[0\ 0\ 0\ 1]$ at the bottom in its inverse as well.

Let the inverse be $\begin{bmatrix} A & B \\ 000 & 1 \end{bmatrix}$

we know that, for a matrix K, $KK^{-1} = I$ — (4)

$$\Rightarrow \begin{bmatrix} R & t \\ 000 & 1 \end{bmatrix} \begin{bmatrix} A & B \\ 000 & 1 \end{bmatrix} = \begin{bmatrix} I & 0 \\ 0 & I \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} R & t \\ 0^T & 1 \end{bmatrix} \begin{bmatrix} A & B \\ \cancel{000}\,0^T & 1 \end{bmatrix} = \begin{bmatrix} I & 0 \\ 0 & I \end{bmatrix}$$

$\Rightarrow$ $RA = I$ — (1) from (1), $A = R^{-1}$ (from (4))

$RB + t = 0$ — (2)

$1 = I$ — (3) from (2) ~~$RB = t \Rightarrow B =$~~

$RB + t = 0 \Rightarrow B = -t/R$

$$\Rightarrow \text{inverse is } \begin{bmatrix} R^{-1} & -t/R \\ 0^T & 1 \end{bmatrix}$$

for orthogonal vectors, $R^{-1} = \cancel{R^T}\ R^T$

$\frac{I}{R} = R^{-1}$

$\frac{I}{R} = R^T$

$$\Rightarrow \begin{bmatrix} R & t \\ 0^T & 1 \end{bmatrix}^{-1} = \begin{bmatrix} R^T & -tR^T \\ 0^T & 1 \end{bmatrix}$$

$$= \begin{bmatrix} R^T & -tR^T \\ 000 & 1 \end{bmatrix}$$