

CT4201/EC4215: Computer Graphics

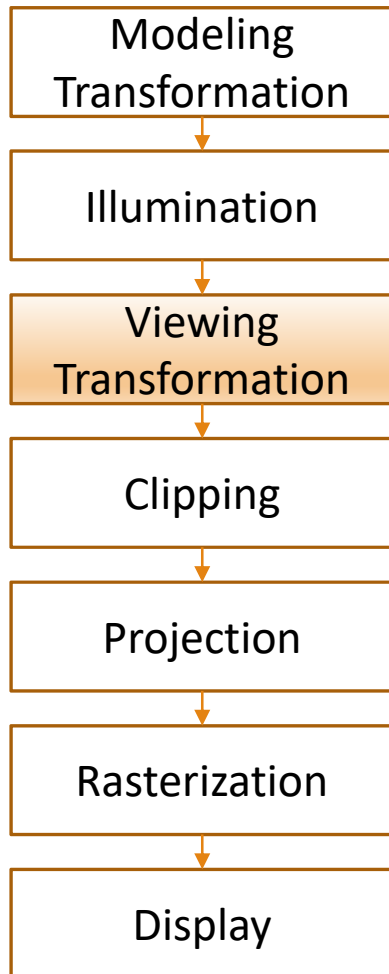
# Viewing Transformation

---

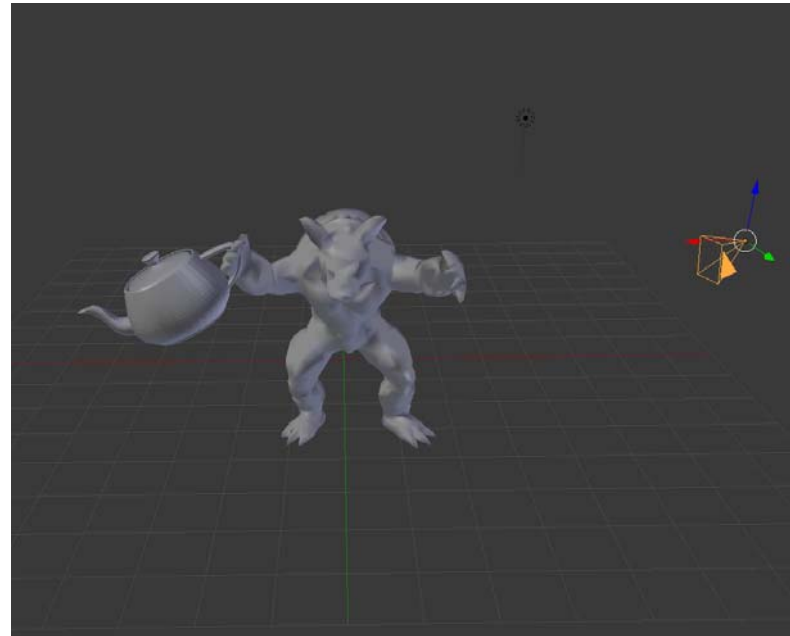
BOCHANG MOON



# Viewing Transformation



- Transform all points from world space to *eye space*
  - Camera position transforms into the origin



# Viewing Transformation

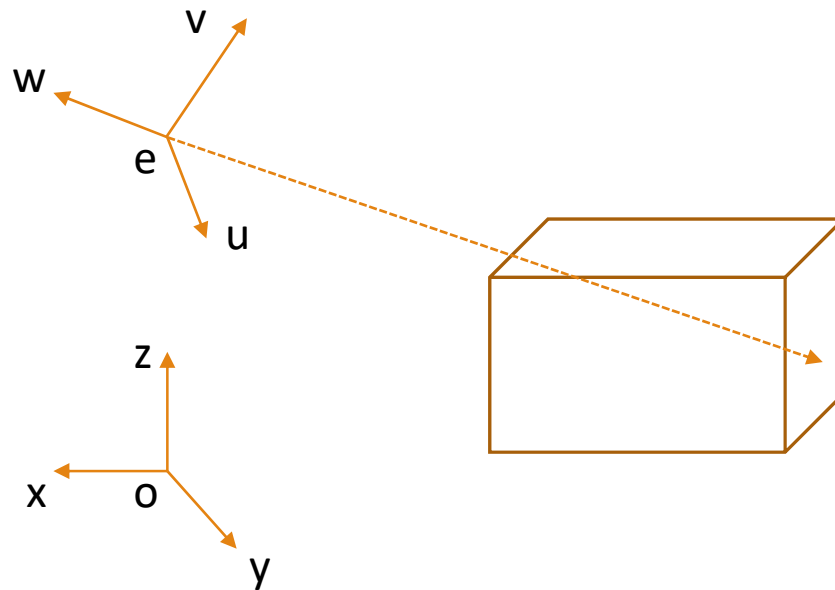
---

- Define camera position and its orientation
- Specify the following:
  - Location of the camera,  $\mathbf{e} = (x_e, y_e, z_e)$
  - Direction where the camera is aiming at, vector  $\mathbf{g} = (x_g, y_g, z_g)$
  - Upward direction of the camera, vector  $\mathbf{t} = (x_t, y_t, z_t)$ 
    - Roughly orthogonal to  $\mathbf{g}$  (not necessary)
- A user specifies these variables.
- These variables are defined in *world space*.

# Viewing Transformation

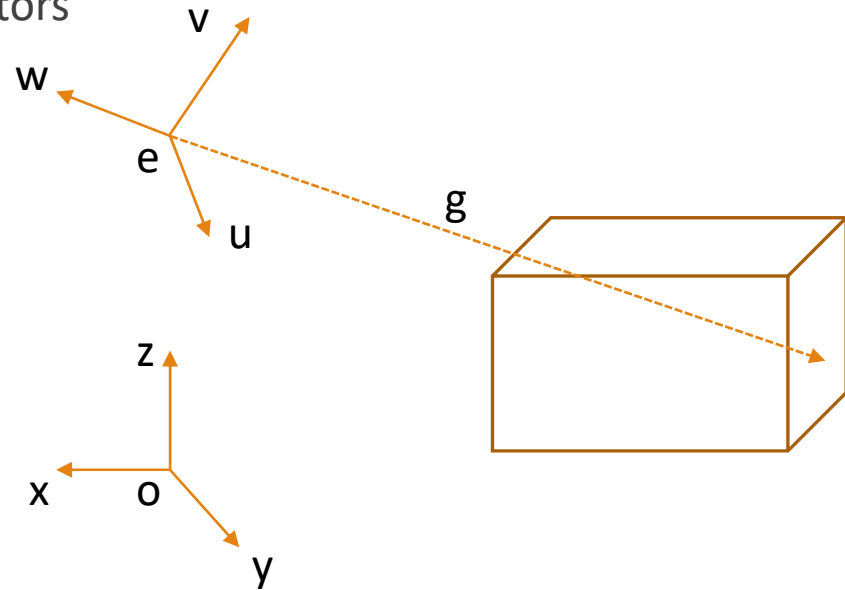
---

- Our task: transform all points defined in world space into new points in eye space
- Need to build a coordinate system (eye space) from the specifications of the camera



# Viewing Transformation

- Our task: transform all points defined in world space into new points in eye space
- Need to build a coordinate system (eye space) from the specifications of the camera
  - Construct basis vectors from two input vectors
  - $\mathbf{w} = -\frac{\mathbf{g}}{\|\mathbf{g}\|}$
  - $\mathbf{u} = \frac{\mathbf{t} \times \mathbf{w}}{\|\mathbf{t} \times \mathbf{w}\|}$
  - $\mathbf{v} = \mathbf{w} \times \mathbf{u}$



# Viewing Transformation in OpenGL

---

- This can be considered as the following matrix transformations:
  - Step 1: translate the camera position  $\mathbf{e}$  to the origin in world space
  - Step 2: rotate  $\mathbf{u}, \mathbf{v}, \mathbf{w}$  to be aligned to  $\mathbf{x}, \mathbf{y}, \mathbf{z}$

- $$\mathbf{M}_{view} = \begin{bmatrix} \mathbf{u} & \mathbf{v} & \mathbf{w} & \mathbf{e} \\ 0 & 0 & 0 & 1 \end{bmatrix}^{-1}$$
$$= \begin{bmatrix} x_u & y_u & z_u & 0 \\ x_v & y_v & z_v & 0 \\ x_w & y_w & z_w & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & -x_e \\ 0 & 1 & 0 & -y_e \\ 0 & 0 & 1 & -z_e \\ 0 & 0 & 0 & 1 \end{bmatrix}$$