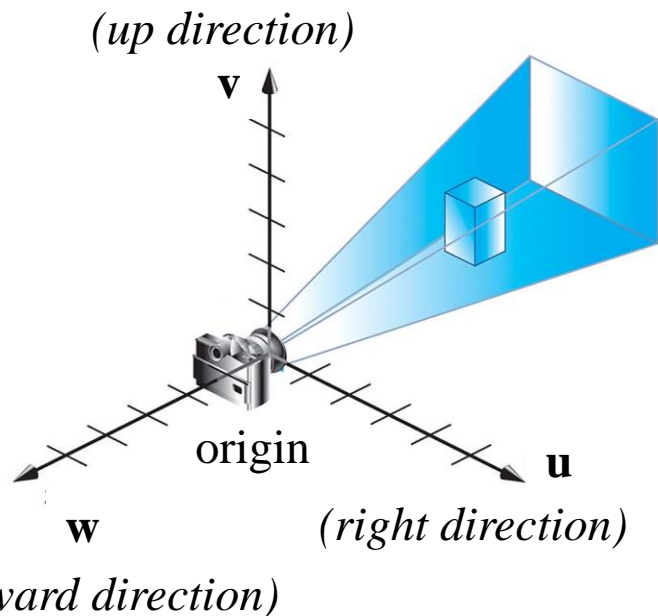


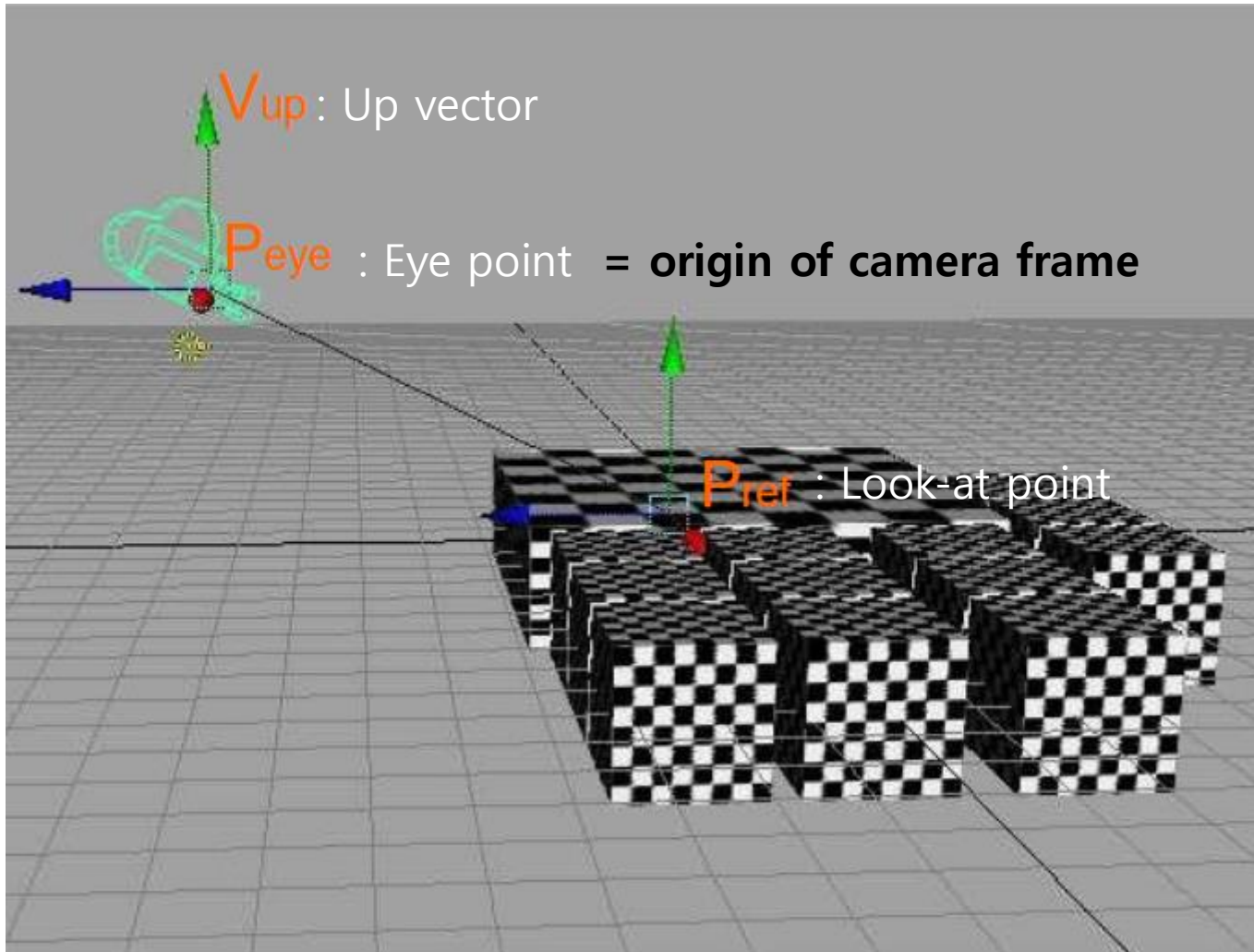
Defining Camera's Coordinate System

- From the given **eye point**, **look-at point**, **up vector**, we can compute the camera frame.
- **u**, **v**, **w** are commonly used for camera coordinates axes instead of x, y, z.

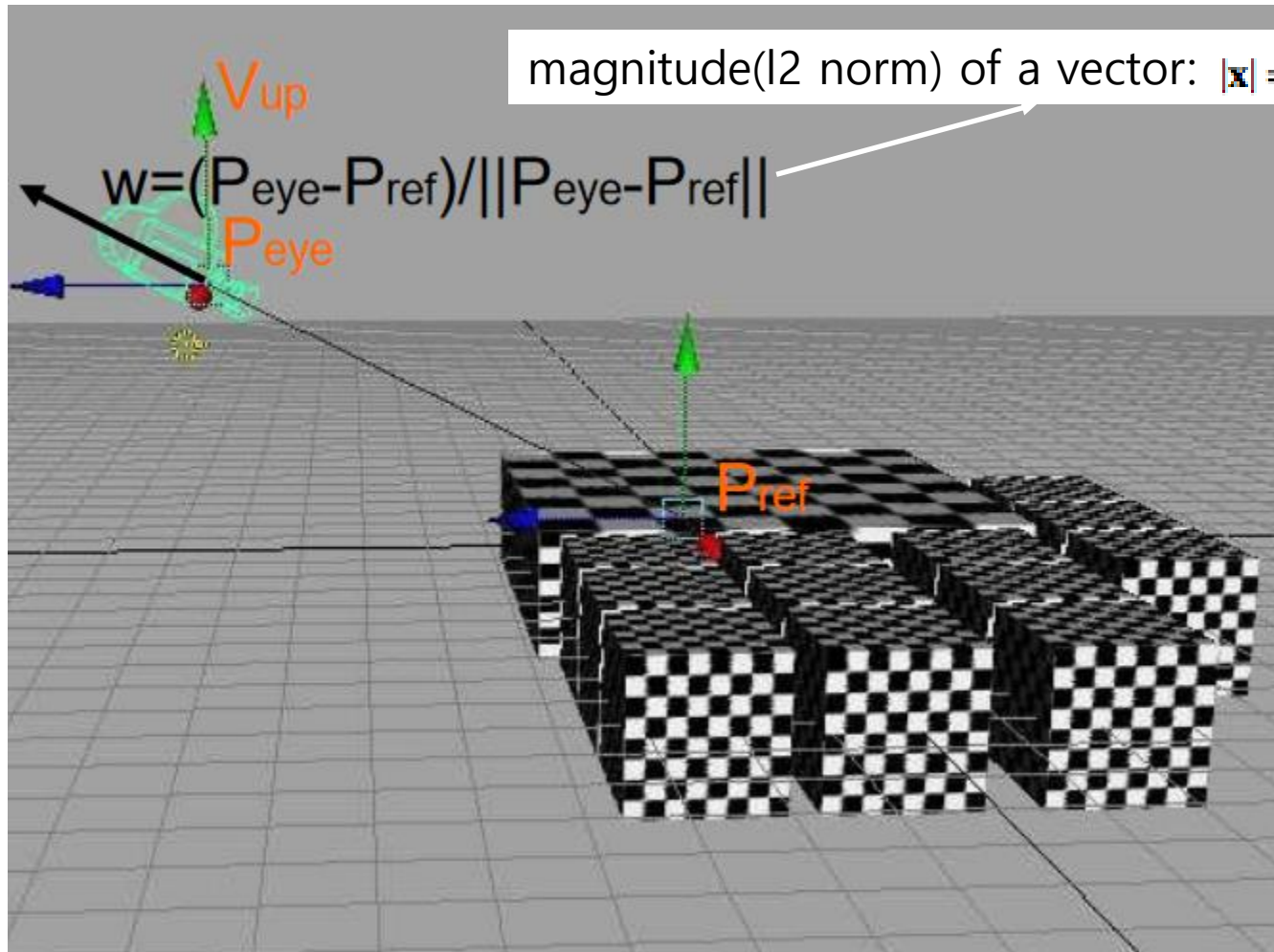


- What we have to do to define the coordinate system:
- Finding **u**, **v**, **w** vectors
- Finding the **origin** point
- (expressed in global frame)

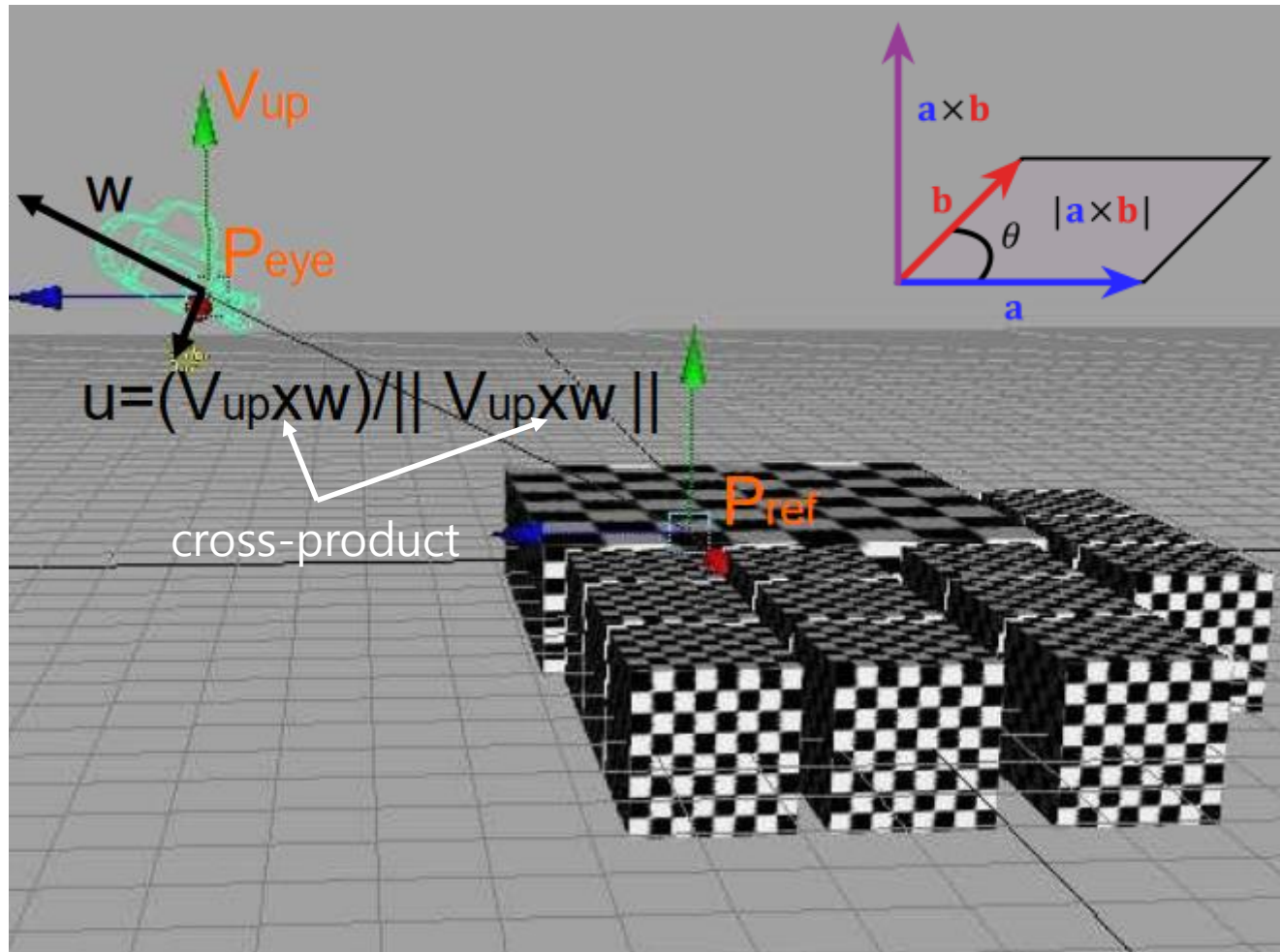
Given Eye point, Look-at point, Up vector,



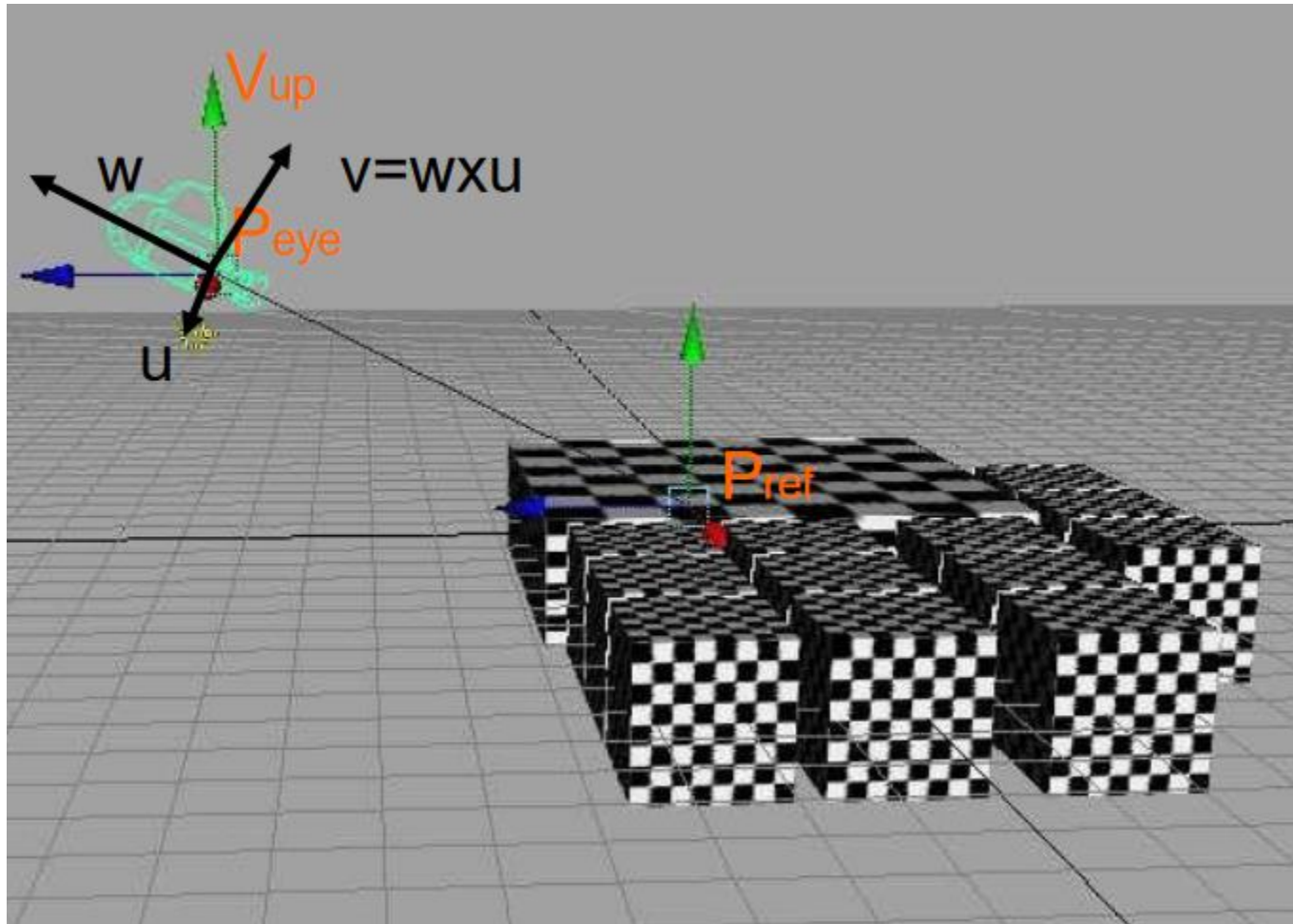
Getting “w” axis vector



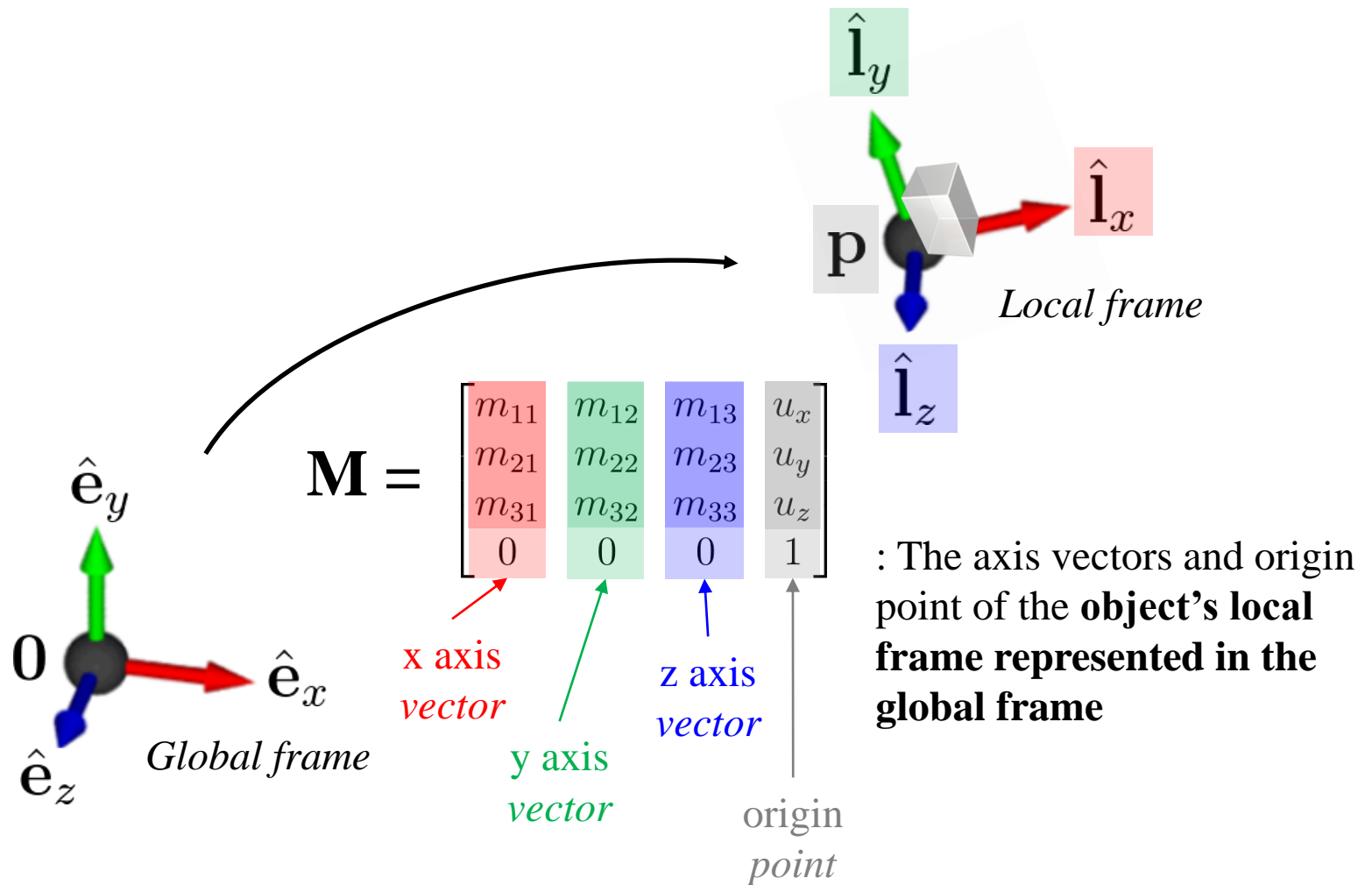
Getting “u” axis vector



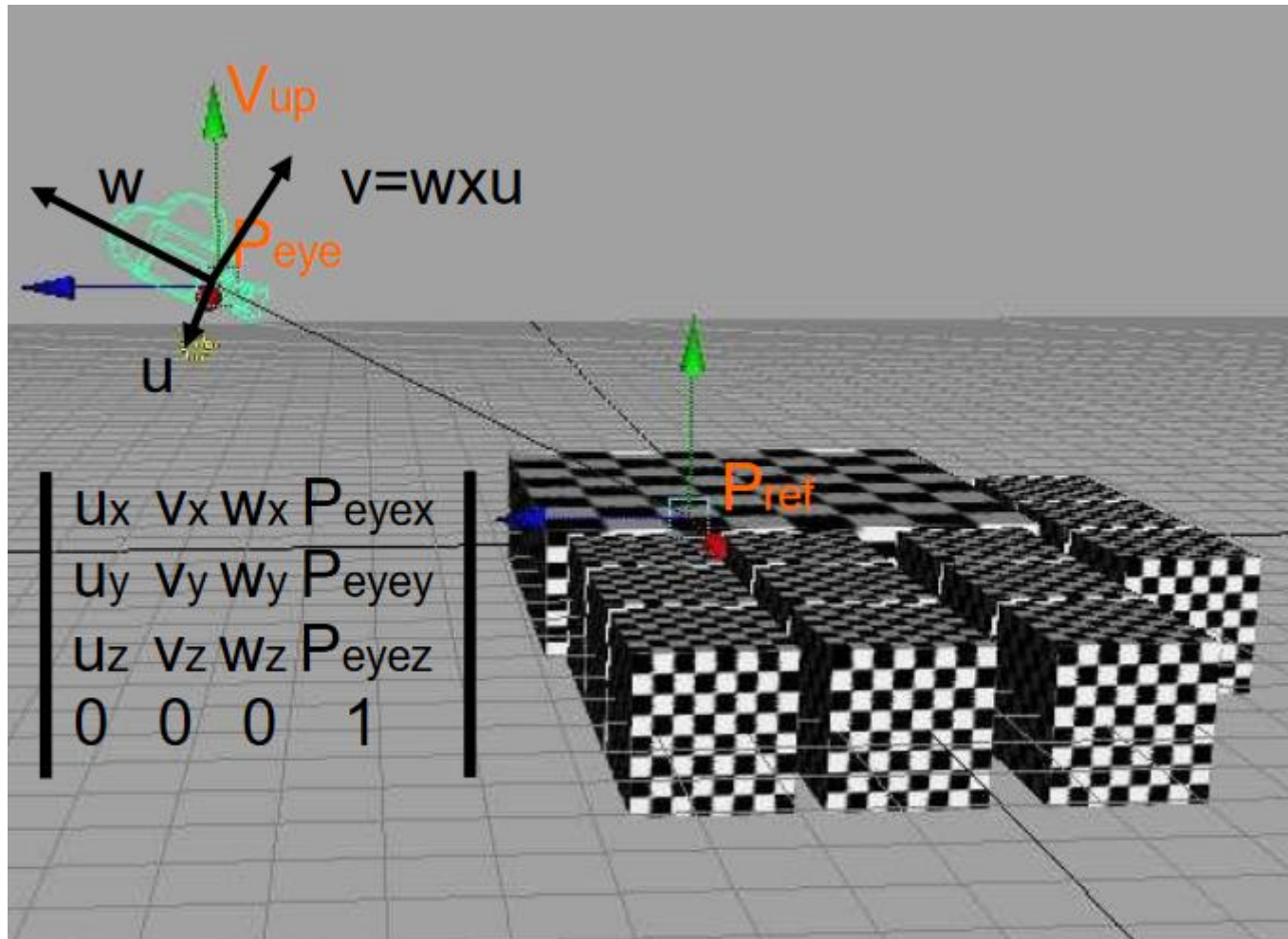
Getting “v” axis vector



2) A 4x4 Affine Transformation Matrix defines an Affine Frame w.r.t. Global Frame

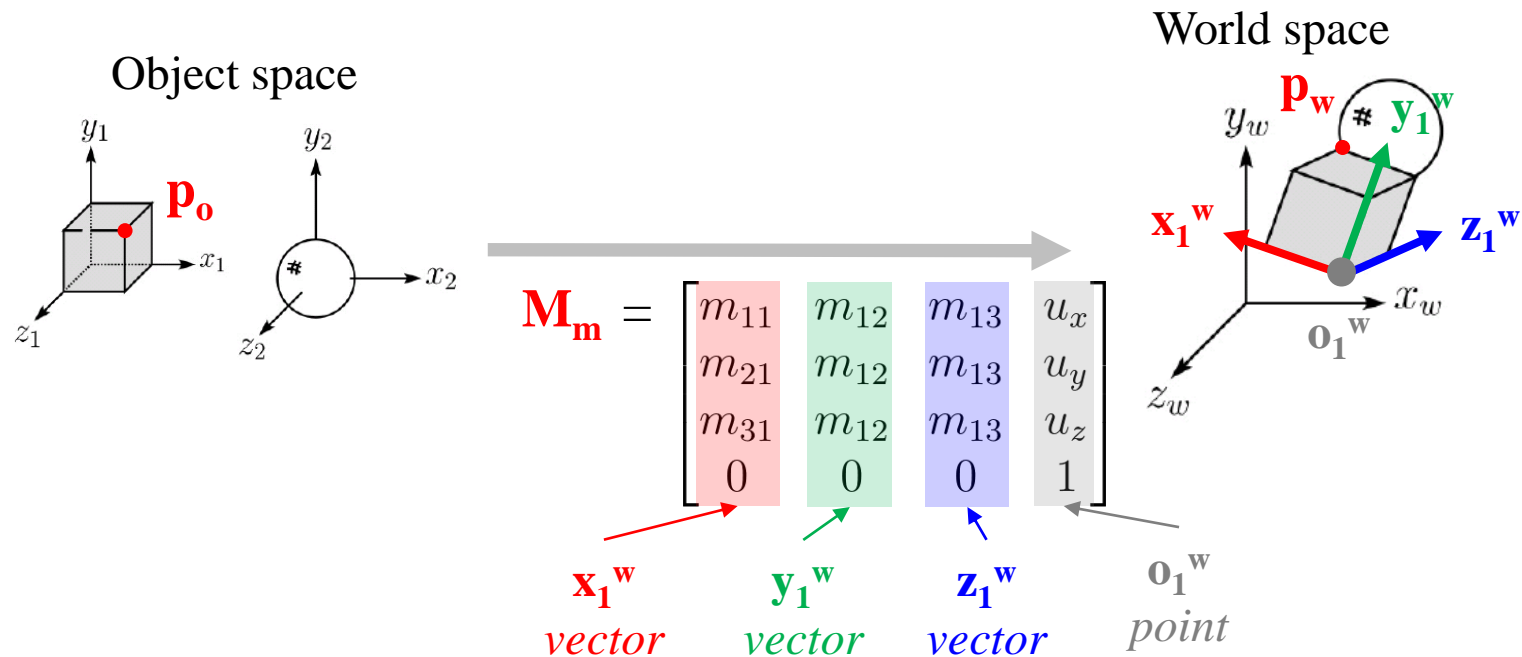


Thus, the Camera Frame is defined by



How can we get viewing matrix M_v from this camera frame?

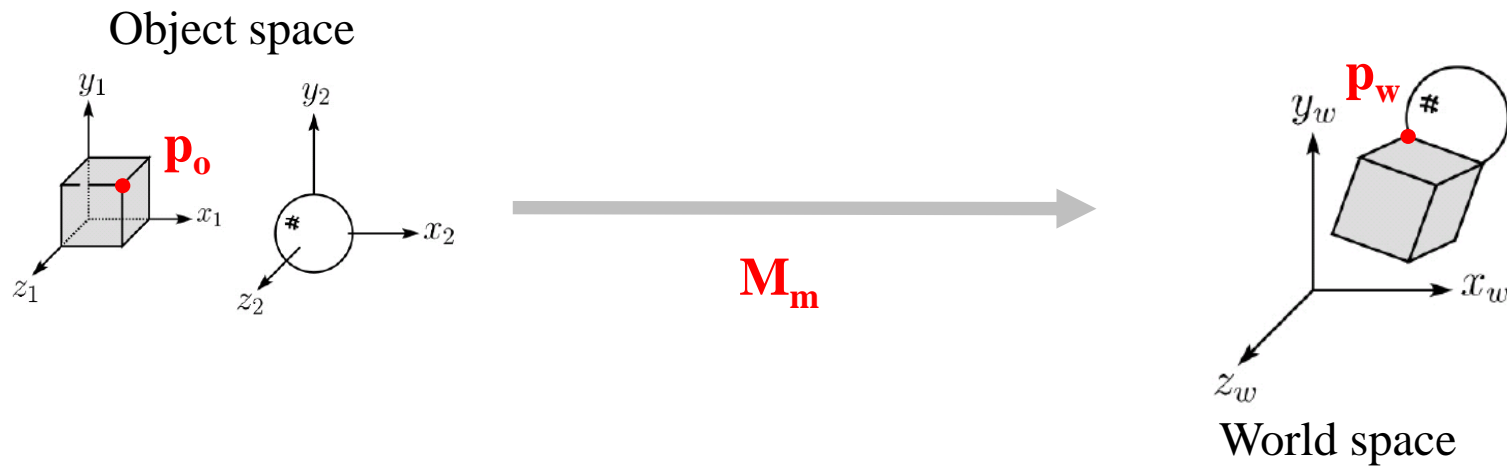
- Recall the modeling transformation:



: The axis vectors and origin point of the **object's local frame represented in the global frame**

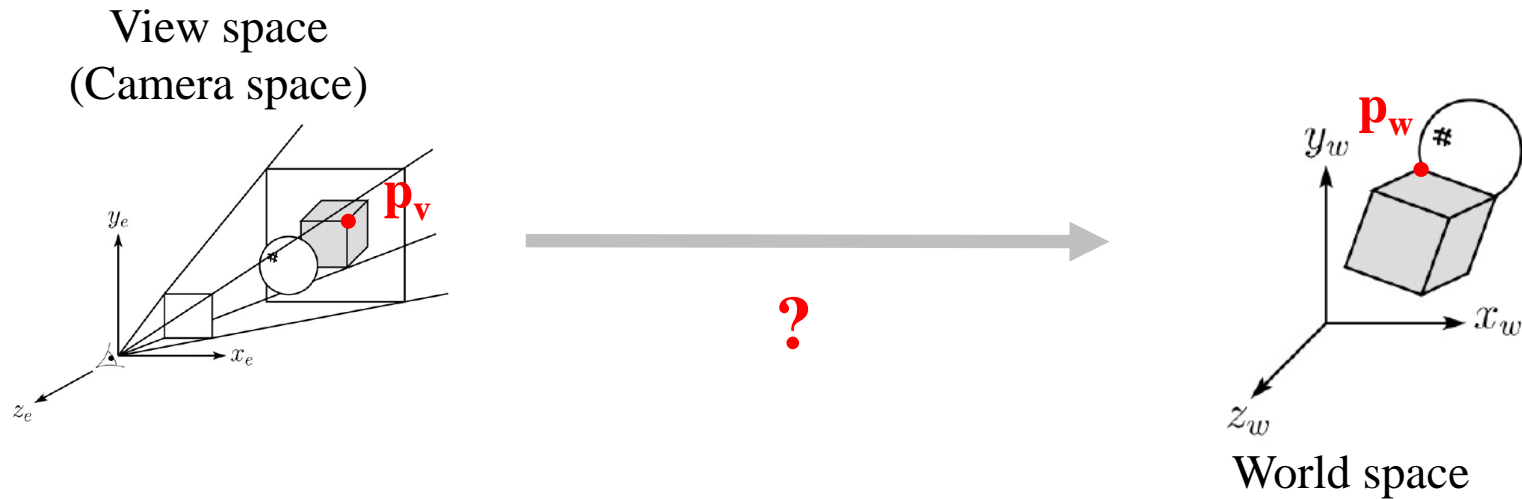
How can we get viewing matrix M_v from the camera frame?

- If we replace *object space* to *camera space*, what should be the transformation matrix?



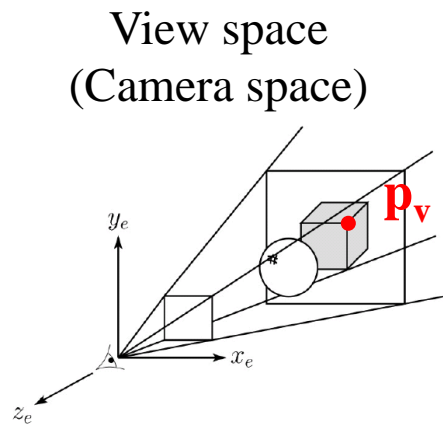
How can we get viewing matrix M_v from the camera frame?

- If we replace *object space* to *camera space*, what should be the transformation matrix?

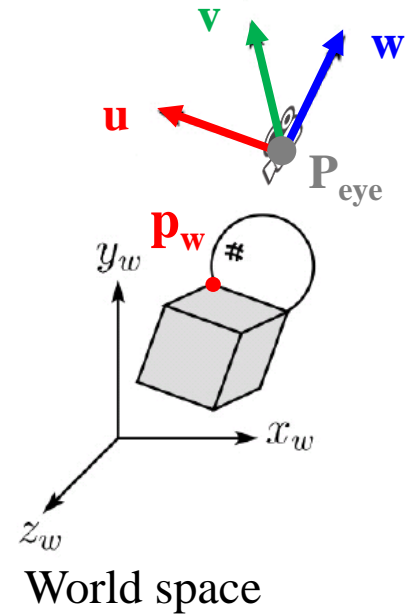


How can we get viewing matrix M_v from the camera frame?

- If we replace *object space* to *camera space*, what should be the transformation matrix?

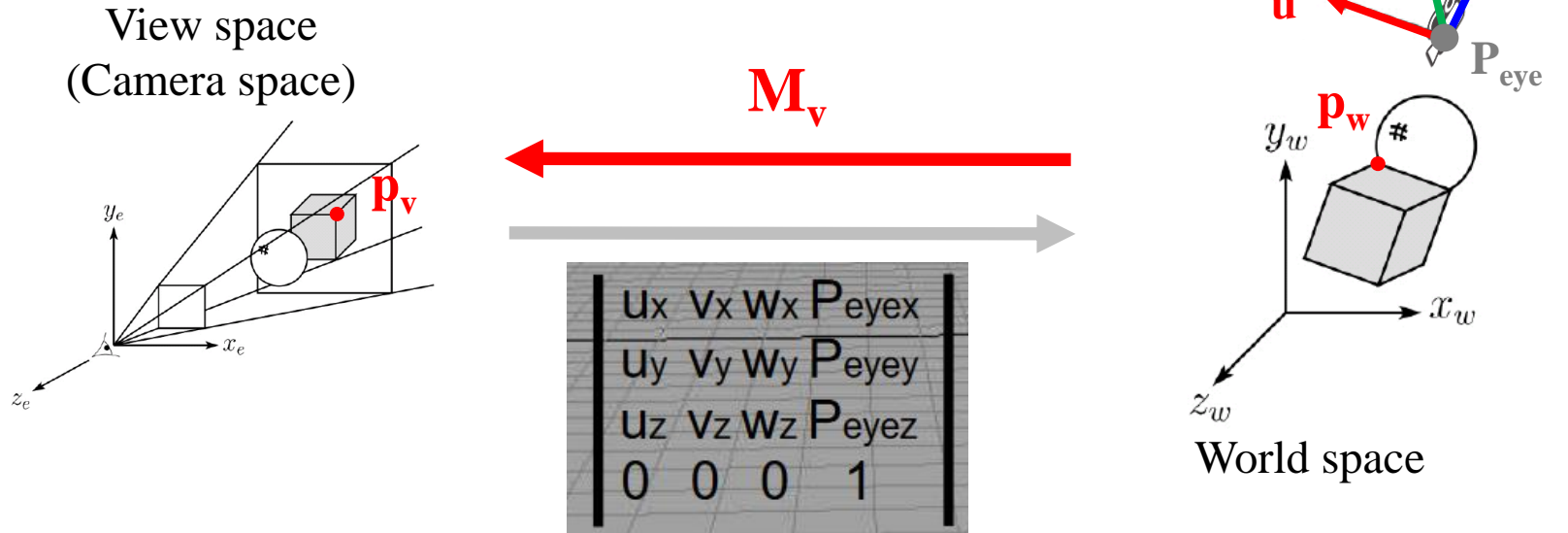


$$\begin{bmatrix} U_x & V_x & W_x & P_{eye_x} \\ U_y & V_y & W_y & P_{eye_y} \\ U_z & V_z & W_z & P_{eye_z} \\ 0 & 0 & 0 & 1 \end{bmatrix}$$



: The axis vectors and origin point of the **camera frame** represented in the global frame

Viewing Transformation is the Opposite Direction



$$M_v = \begin{bmatrix} u_x & v_x & w_x & P_{eyex} \\ u_y & v_y & w_y & P_{eyey} \\ u_z & v_z & w_z & P_{eyez} \\ 0 & 0 & 0 & 1 \end{bmatrix}^{-1} = \begin{bmatrix} u_x & u_y & u_z & -\mathbf{u} \cdot \mathbf{p}_{eye} \\ v_x & v_y & v_z & -\mathbf{v} \cdot \mathbf{p}_{eye} \\ w_x & w_y & w_z & -\mathbf{w} \cdot \mathbf{p}_{eye} \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Acknowledgement

- Acknowledgement: Some materials come from the lecture slides of
 - Prof. Karan Singh <http://www.dgp.toronto.edu/~karan/courses/418/>