From World To View Coordinates

CS116A

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Outline

- Transformations From World To Viewing Coordinates
- Projection Transformations
- Orthogonal Projections

Transformations From World To Viewing Coordinates

The basic idea:

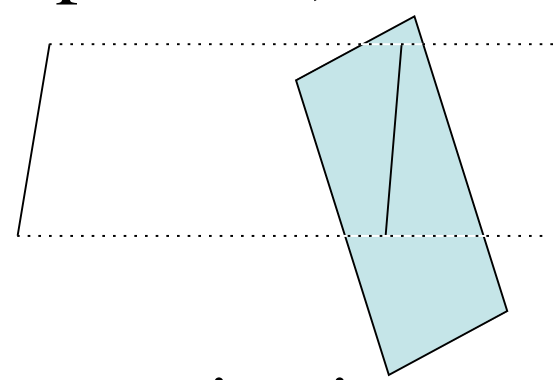
- Translate the viewing coordinates origin to the origin of the world-coordinate system
- Apply rotations to align the xview, yview, zview axis with the world xw, yw, zw.

Let u,v,n be unit vectors in each direction in the view system. Then the matrices will be:

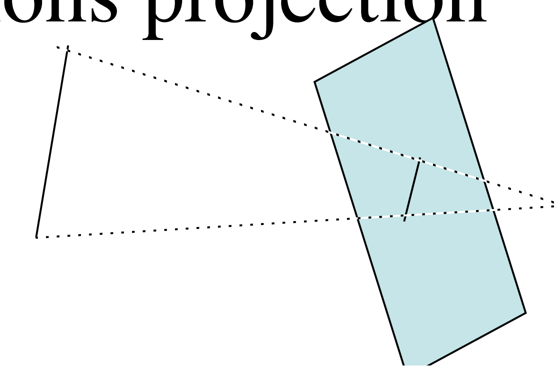
$$\begin{bmatrix} ux & uy & uz & 0 \\ vx & vy & vz & 0 \\ nx & ny & nz & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad \begin{bmatrix} 1 & 0 & 0 & -x\_0 \\ 0 & 1 & 0 & -y\_0 \\ 0 & 0 & 1 & -z\_0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Projection Transformations

- In a **parallel transformation** coordinate positions are transformed to view plane along parallel lines (dotted line parallel):

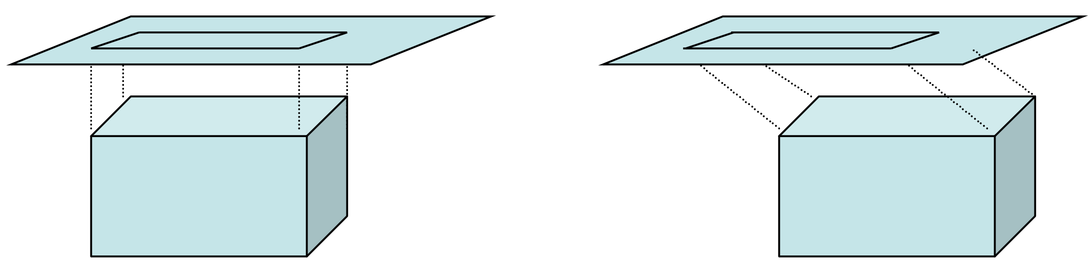


- In a perspective transformations projection converge to a common point



Orthogonal Projections

- A transformation to a view plane along lines that are all parallel to its normal vector is called an **orthogonal projection.**
- So any orthogonal projection is a parallel projection but not vice versa.



- Left is orthogonal, right is parallel but not orthogonal

Axonometric versus Isometric

- Front, side, and rear orthogonal projections are often called **elevations.**
- Also, can make orthogonal projections that project more than one face of an object. Such views are called **axonometric** orthogonal projections**.**
- If such a projection is generated by aligning the projection plane so as to cross each axis of the figure at the same distance, the projection is called **an isometric projection**. Example, box drawn on board.

Orthogonal Projection Coordinates

- Suppose wanted to do an orthogonal projection along the z-axis .
- Then any point (x,y,z) maps to (x,y) in the projection plane.
- We don’t forget the value of z, though -- it is used in doing visibility tests.

Clipping Window and View Volume

- In a camera, the type of lens determines how much of the scene gets transferred to the picture.
- In computer graphics the clipping window is used for this purpose.
- As with 2D viewing, OpenGL only allows clipping normal to z axis.
- We can set the lower left, upper right coordinates of this clipping window.
- In the z-direction we can say where our plane is and also say what the near and far clipping planes are.
- Fancier kinds of viewing arrangements must be implemented by us.

Normalization

- The clipping window and near and far clipping planes define an orthogonal projection view volume.
- Often this view volume is mapped to a normalized volume with x,y,z values between -1 and 1.
- To do this transformation can use M_{ortho, norm}:

$$\begin{bmatrix} 2/(xwmax-xwmin) & 0 & 0 & -(xwmax+xwmin)/(xwmax-xwmin) \\ 0 & 2/(ywmax-ywmin) & 0 & -(ywmax+ywmin)/(ywmax-ywmin) \\ 0 & 0 & 2/(zwmax-zwmin) & -(zwmax+zwmin)/(zwmax-zwmin) \\ 0 & 0 & 0 & 1 \end{bmatrix}$$