4160 Lecture 6

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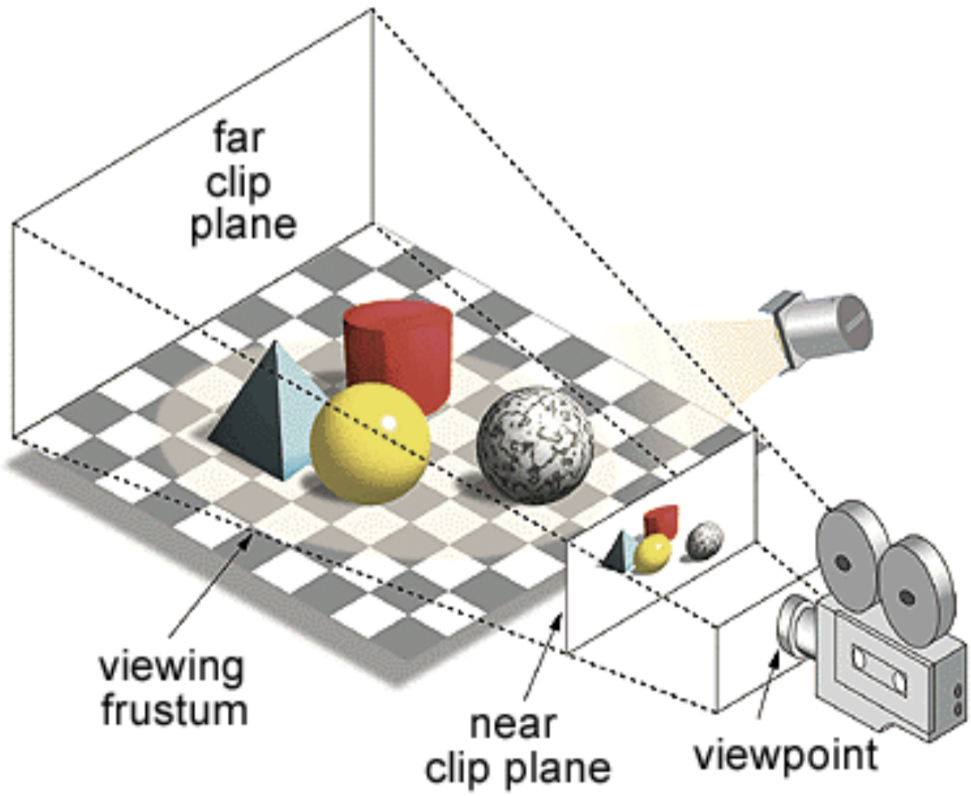
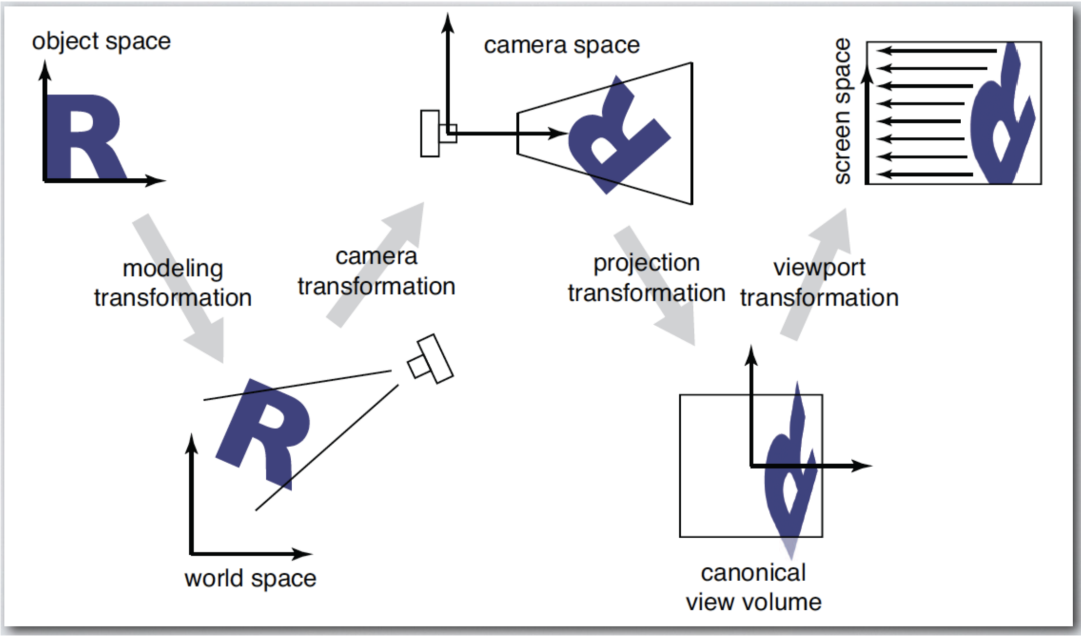
Viewing

- Typical model
    - 

- Pipeline of transformations

- 

- Transformation Step
  - Object Space -> World Space -> Canonical Space -> Screen Space

$$p_s = M_{vp} M_{proj} M_{world} M_{model} p$$

- Image-to-Pixel Mapping (Viewport transformation)

$$M_{vp} = \begin{bmatrix} \frac{n_x}{2} & 0 & 0 & \frac{n_x - 1}{2} \\ 0 & \frac{n_y}{2} & 0 & \frac{n_y - 1}{2} \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

  - Keep the depth information by third rows.
- Porjection transformation
  - Orthographic Projection: Get rid of z
    - $\begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix} \Rightarrow \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$
    - To keep track the depth: scale into a cube
    - $\left[\frac{2}{l-r} \right]$
  - Perspective Projection
    - Similar triangles: $\frac{y'}{d} = \frac{y}{-z}$
    - Allow arbitrary w:

$$\begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix} \rightarrow \begin{bmatrix} xw \\ yw \\ zw \\ w \end{bmatrix}$$

- $$\begin{bmatrix} -xd/z \\ -yd/z \\ 1 \end{bmatrix} \rightarrow \begin{bmatrix} xd \\ yd \\ -z \end{bmatrix} = \begin{bmatrix} d & 0 & 0 & 0 \\ 0 & d & 0 & 0 \\ 0 & 0 & -1 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

- Camera Matrix
  - Inverse of basis transfer matrix
  - $\begin{bmatrix} \vec{u} & \vec{v} & \vec{w} & \vec{e} \\ 0 & 0 & 0 & 1 \end{bmatrix}^{-1}$