Viewing Transformations
Viewing transformations

• Move objects from their 3D locations to their positions in a 2D view

The viewing transformation also projects any point along the pixel’s view ray back to the pixel’s position in image space
Decomposition of viewing transforms

Viewing transforms depend on: camera position and orientation, type of projection, field of view, image resolution

there are several names for these spaces: “camera space” = “eye space”, “canonical view volume” = “clip space”= “normalized device coordinates”, “screen space= pixel coordinates” and for the transforms: “camera transformation” = “viewing transformation”
Viewport transform

\[(x, y, z) \rightarrow (x', y', z')\]

\[(x, y, z) \in [-1, 1]^3 \quad x' \in [-0.5, n_x - 0.5] \quad y' \in [-0.5, n_y - 0.5]\]
Viewport transform

- Camera transform
- Projection transform
- Viewport transform

$M_{vp}$

<whiteboard>
Orthographic Projection Transform

Camera transform \rightarrow Projection transform \rightarrow Viewport transform

\begin{align*}
(r, t, h) & \quad (l, b, f) \\
M_{orth} & \quad (-1, -1, -1) \\
& \quad (1, 1, 1)
\end{align*}

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Line drawing algorithm

construct \( M_{vp} \)
construct \( M_{orth} \)
\( M = M_{vp}M_{orth} \)
for each line segment \((a_i, b_i)\) do
\[
p = M a_i
\]
\[
q = M b_i
\]
drawline \((x_p, y_p, x_q, y_q)\)

Shirley, Marschner 7.1
Camera Transform
Camera Transform

*How do we specify the camera configuration?*

(orthogonal case)
Camera Transform

How do we specify the camera configuration?

eye position
Camera Transform

How do we specify the camera configuration?

`gaze` direction
Camera Transform

How do we specify the camera configuration?

up vector
Camera Transform

How do we specify the camera configuration?
Camera Transform

\[ w = -\frac{g}{|g|} \]
\[ u = \frac{t \times w}{|t \times w|} \]
\[ v = w \times u \]

\[ M_{cam} \]
Line drawing algorithm

\[
\text{construct } M_{vp} M_{cam} \\
\text{construct } M_{orth} \\
M = M_{vp} M_{orth} M_{cam} \\
\text{for each line segment } (a_i, b_i) \text{ do} \\
\quad p = Ma_i \\
\quad q = Mb_i \\
\text{drawline } (x_p, y_p, x_q, y_q)
\]

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