Lecture ~~19~~ MDW

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Q1. Derivation for window to viewport transformation in 2D and 3D.
Q2. ~~Ex~~ Explain cavalier and cabinet projection.
Q3. Distinguish b/w parallel & perspective projection.
Q4. ~~Describe~~ Derive transformation eqn for oblique parallel projection.
Q5. Liang-Barsky line clipping algo + examples / problems.
Q6. Clipping, window, & viewport transformation, workstation, isometric projection, vanishing pt, projection reference pt.

Perspective projection

- Set projection reference pt at position z_{prp} along z_v axis
- Place view plane at z_{vp}.
- Coordinates along the perspective projection line in parametric form

$$x' = x - xu$$
$$y' = y - yu$$
$$z' = z - (z - z_{prp})u$$

- Parameter u takes value from 0 to 1
- Coordinate position (x', y', z') represents a point along projection line.

$$z' = z_{vp} = z - (z - z_{prp})u$$
$$z_{vp} - z = (z_{prp} - z)u$$
$$\boxed{u = \left(\frac{z_{vp} - z}{z_{prp} - z}\right)}$$

$$\boxed{x_p = x\left(\frac{z_{prp} - z_{vp}}{z_{prp} - z}\right) = x\left(\frac{d_p}{z_{prp} - z}\right)}$$

When $u = 0$, $P = (x, y, z)$
When $u = 1$, we have projection ref. point $(0, 0, z_{prp})$
On the view plane, $z' = z_{vp}$
After substitution $[d_p = z_{prp} - z_{vp}]$

and $\boxed{y_p = y\left(\frac{z_{prp} - z_{vp}}{z_{prp} - z}\right) = y\left(\frac{d_p}{z_{prp} - z}\right)}$

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Using 3D homogeneous coordinate representation:

$$\begin{bmatrix} x_h \\ y_h \\ z_h \\ h \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -z_{vp}/d_p & z_{vp}(z_{prp}/d_p) \\ 0 & 0 & -1/d_p & z_{prp}/d_p \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Homogeneous factor $h = \dfrac{z_{prp} - z}{d_p}$

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