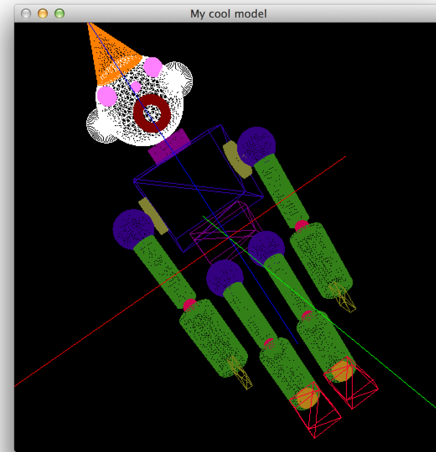
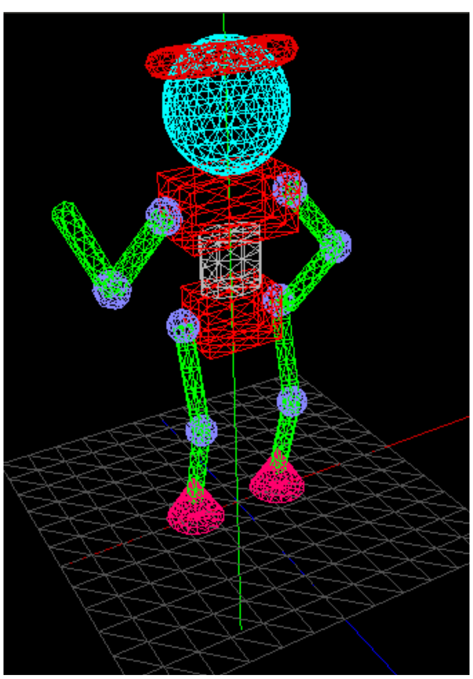
3D Viewing

Readings: Chapters 6 & 7

Announcement

- Proj 1 due in one week.
- Proj 2 and hw1 will be out in one week





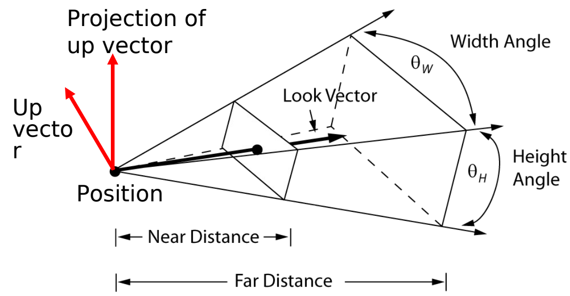
Viewing: from 3D to 2D

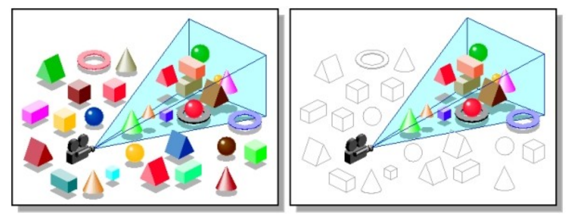
- So far we have learned how to construct a 3D scene from geometries and their transformations
- Next we will look at how to:
  - Start from a point in 3D
  - Compute its projection into the image on the 2D screen
- Central tool is matrix transformations (more math?! Ugh! ☺
  - Combines seamlessly with coordinate transformations used to position camera and model
  - Ultimate goal: multiply these matrix to map any 3D point to its correct screen location

Two typical classes of viewing

Perspective Projection

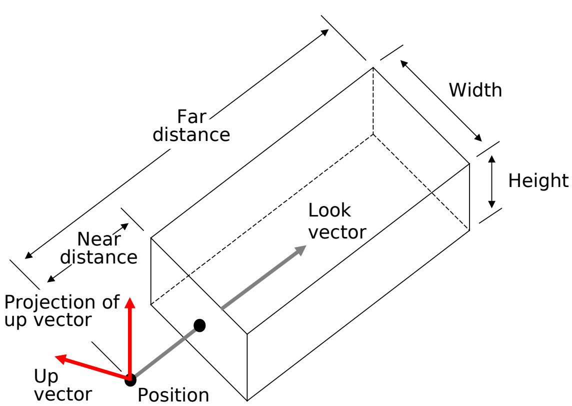
- Perspective projection: scale diminishes or increases with the distance to the camera
- Truncated view volume (view frustum)





Orthographic Parallel Projection

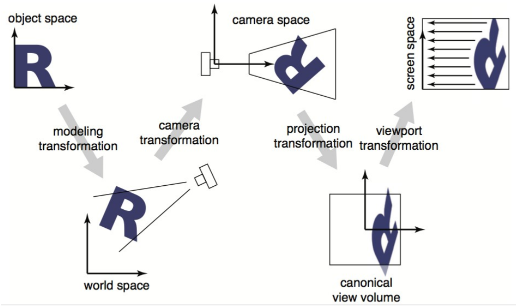
- A simple projection: just toss out the depth
- Orthographic parallel projection has width and height view angles of zero
- The same truncated viewing volume applies as the perspective projection.



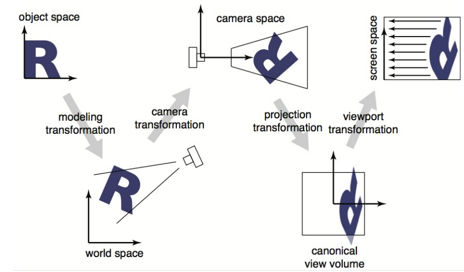
Mathematical representation

Viewing = Pipeline of transformations

- Standard sequence of transforms
  - Modeling tran:
  - Camera (eye) tran:
  - Projection tran:
  - Viewport or windowing tran:



Mathematical representation



- Modeling tran.: Tran. into world coord. Mm
- Camera tran.: Tran. into eye coords.Mcam
- Perspective tran.: perspective matrix P
- Orthographic projection: Morth
- Viewport tran.: Mvp

$$\mathbf{p}_s = \mathbf{M}_{\mathrm{vp}}\mathbf{M}_{\mathrm{orth}}\mathbf{P}\mathbf{M}_{\mathrm{cam}}\mathbf{M}_{\mathrm{m}}\mathbf{p}_o$$

$$\begin{bmatrix} x_s \\ y_s \\ z_c \\ 1 \end{bmatrix} = \begin{bmatrix} \frac{n_x}{2} & 0 & 0 & \frac{n_x-1}{2} \\ 0 & \frac{n_y}{2} & 0 & \frac{n_y-1}{2} \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \frac{2}{r-l} & 0 & 0 & -\frac{r+l}{r-l} \\ 0 & \frac{2}{t-b} & 0 & -\frac{t+b}{t-b} \\ 0 & 0 & \frac{2}{n-f} & -\frac{n+f}{n-f} \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} n & 0 & 0 & 0 \\ 0 & n & 0 & 0 \\ 0 & 0 & n+f & -fn \\ 0 & 0 & 1 & 0 \end{bmatrix} \mathbf{M}_{\mathrm{cam}}\mathbf{M}_{\mathrm{m}} \begin{bmatrix} x_o \\ y_o \\ z_o \\ 1 \end{bmatrix}$$

- This lecture is about constructing these matrices

Mathematical Construction and Implementation of Viewing

(see in-class notes)