EECE 478: Computer Graphics

Vision and Viewing

Learning Objectives

- Real-world optics
  - Describe how images are formed by light in the world
  - Describe the roles of the eye, lens and retina in forming images
- Simulated optics
  - Define a pinhole/synthetic camera model
  - Define the simplifications made in the simple camera model used by OpenGL
  - Describe the internal and external camera parameters

Learning Objectives

- Modelling and Rendering
  - Describe how a 3D model is rendered to the screen
  - Describe the stages of a typical 3D graphics pipeline

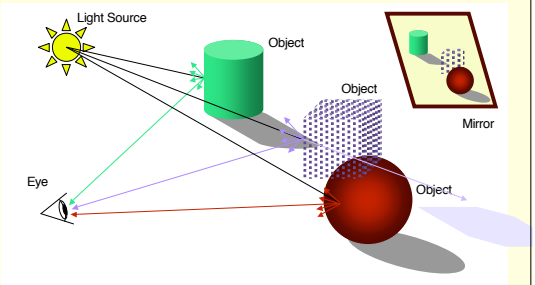
Vocabulary

- Image
- Viewer
- View
- Viewing geometry
- Eye
- Retina
- Lens
- Light field
- Pinhole camera
- Projection
- Centre of projection
- Field of view
- Focal length
- Projection plane
- Clipping
- Light source

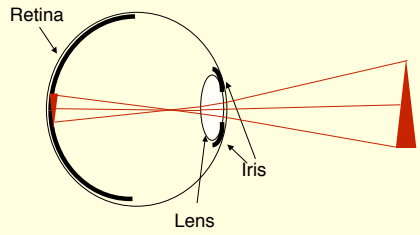
Vocabulary

- 3D Model
- Rendering
- Pixel
- Graphics pipeline
- Scene geometry
- Projection
- Rasterization

Real-world Images



The Eye



The Eye

Iris
- Restricts amount of light entering eye

Lens
- Focuses light rays onto retina

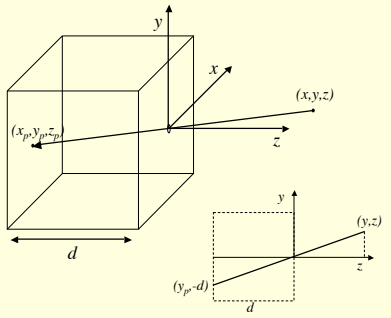
Retina
- Surface on which image is formed

Pinhole Camera Model

Simplifications:
- All rays pass through single point (*pinhole*)
- No lens (all rays are straight)
- Imaging surface is plane (*imaging plane*)

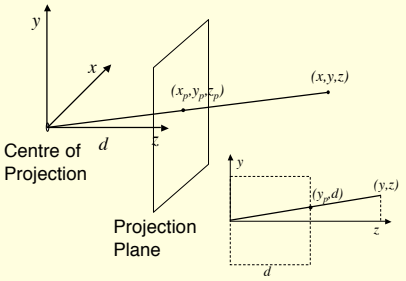
Pinhole Camera

$$z_p = -d$$
$$x_p = -\frac{x}{z/d}$$
$$y_p = -\frac{y}{z/d}$$



Pinhole Camera (plane forward)

$$z_p = d$$
$$x_p = \frac{x}{z/d}$$
$$y_p = \frac{y}{z/d}$$



Synthetic Camera Model

1. Viewer (*camera*) is defined separately from objects
2. Image computed with simple projective geometry
   - Project all object points through centre of projection onto projection plane
   - Image is rectangular subset of projection plane. Points that project outside of image are clipped

Clipping

- Projection plane is limited in size
  - If point projects outside of *image* it is not displayed (*clipped*)
  - w/h is *aspect ratio*
  - θ is *field of view*