Reflections

CSCI 4830/7000
Advanced Computer Graphics
Spring 2009

Mirror Reflection

- Natural in ray tracing
  - Rays bounce off objects
  - Adds significant effort
- Can be done in raster images
  - Environment maps
  - Virtual objects
  - Inter-reflections are hard

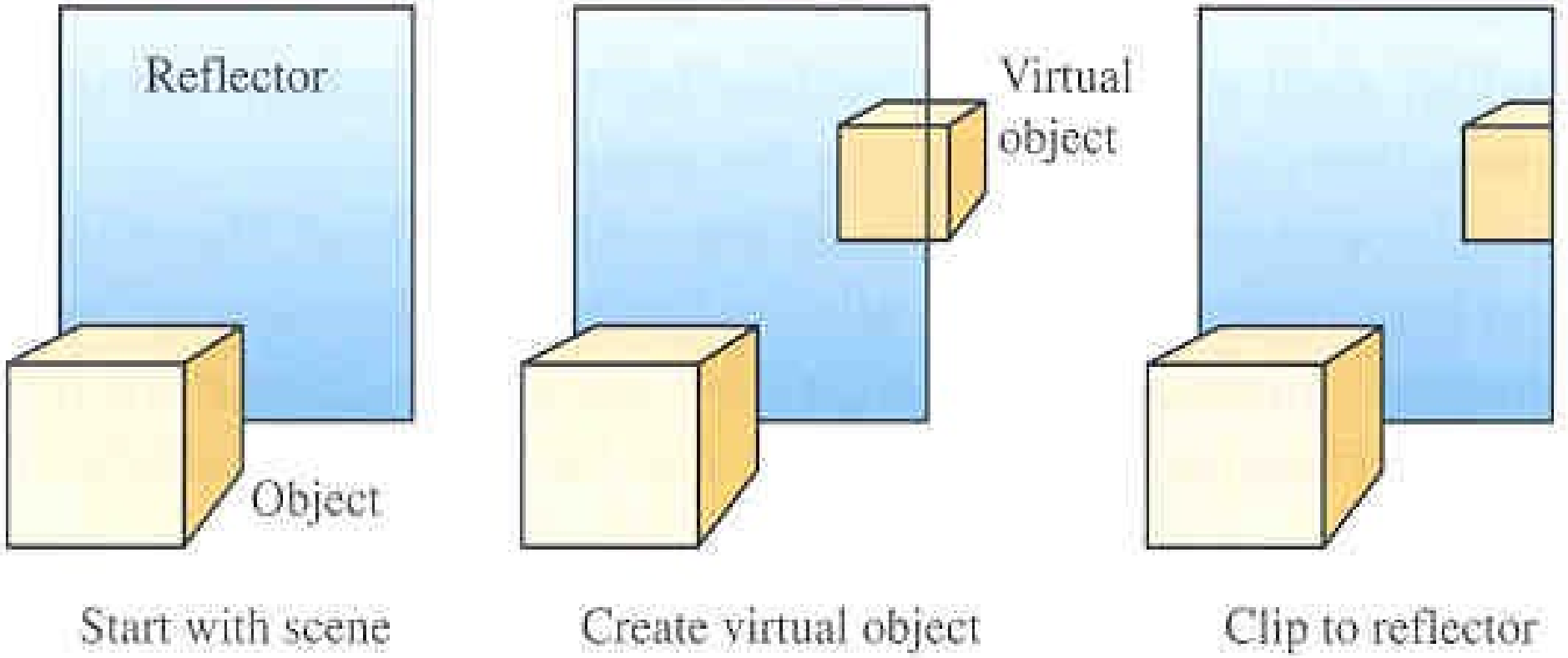
Reflective spheres by Burt Flugleman, Rundle Street Mall, Adelaide. Photograph by Kevin Suffern.

Reflections in Raster Methods

- Two possible approaches
  - Textures (image space)
  - Virtual objects (object space)
- Both approaches requires rendering the scene multiple times
- Mirrors can be planar or curved
- Mirrors are “windows”to the virtual scene

Virtual Objects

- Draw object where they seem to appear
- Clip to reflector



Planar Reflection Equation

- Point on mirror *P*
- Normal vector *V*

$$R = \begin{pmatrix} 1-2V_x^2 & -2V_xV_y & -2V_xV_z & 2(P\cdot V)V_x \\ -2V_xV_y & 1-2V_y^2 & -2V_yV_z & 2(P\cdot V)V_y \\ -2V_xV_z & -2V_yV_z & 1-2V_z^2 & 2(P\cdot V)V_z \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

Rendering Order

- Reflections are difficult when the mirror is an object inside the scene
  - Mirror on wall is easier

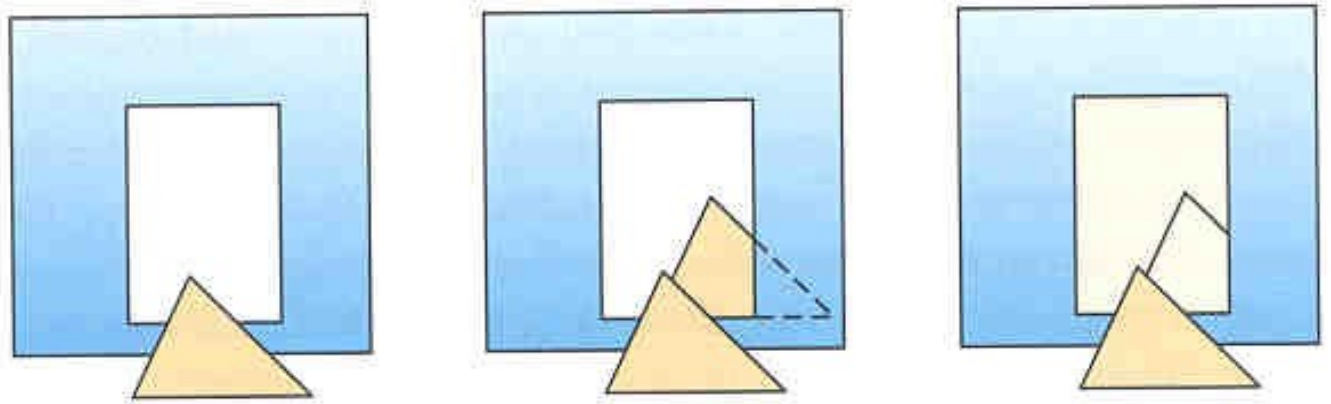


Figure 17.3 Masking reflections with depth buffering.

Limiting the Reflector

- User defined clipping volume
  - Front and back clipping planes
  - Frustrum
- Stencil buffer
- Special cases
  - Scissors test
  - Alpha blending

Reflections using Textures

- Quads
  - Simple mirrors
- Environment maps
  - Cube map
  - Sphere map

Figure 17.4 Masking reflections using projective texture.

Reflections from Curved Surfaces

- Cannot be done using virtual objects
- Readily done by distorting textures

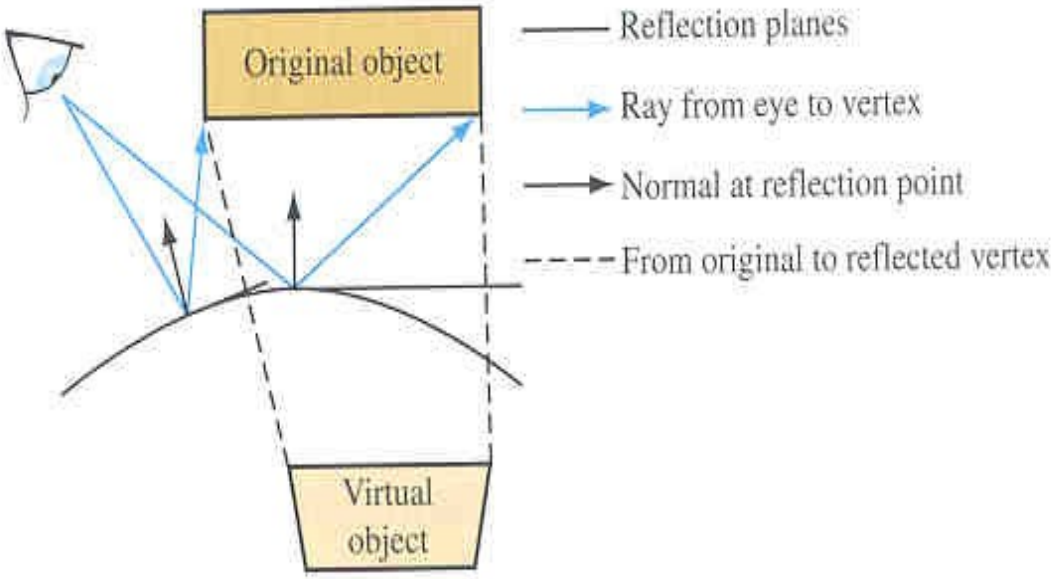


Figure 17.5 Normals and reflection vectors in curved reflectors.

Inter-reflections

- Hall of mirrors requires multiple passes
  - Similar to max-levels

Figure 17.13 Clipping multiple interreflections with stencil.