GB500 – Tópicos Especiais em Animação de Fluidos e Visualização Científica

Tópico para Projeto de Curso

Rendering Foto-Realista de Fluidos via PBRT

Web Page:

http://virtual01.lncc.br/~giraldi/GB500-FluidVis

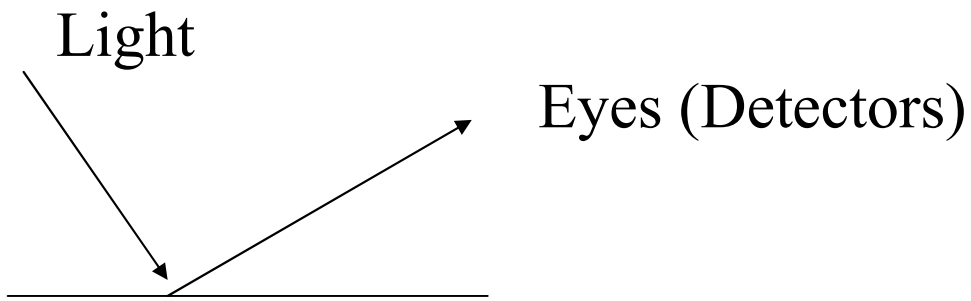
Indice

- Fundamentos de Rendering
- Classificação e Técnicas de Rendering
- Modelos Locais de Iluminação
- Modelos Globais de Iluminação
- Biblioteca PBRT

Rendering

- Process of producing “realistic” images or pictures

- Elements:
  - Electromagnetic Radiation
  - Materials (optical properties)
  - Human visual system



Light-Material interaction

Rendering

•Classification

1. Photo-Realistic Rendering
2. Non-Photo-Realistic Rendering
3. Scientific Visualization Rendering

2. Techniques
2.1 Surface Rendering
2.2 Volume Rendering
2.3 Image Based Rendering
2.4 Texture Based Rendering

Photo-Realistic Rendering via Surface Rendering

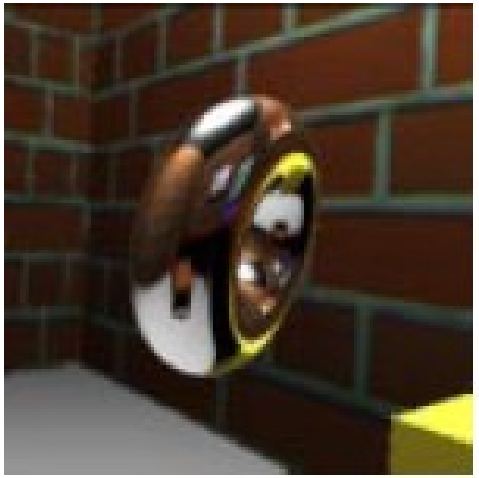


Photo-Realistic Rendering
Reflection, Shadows and Refraction effects

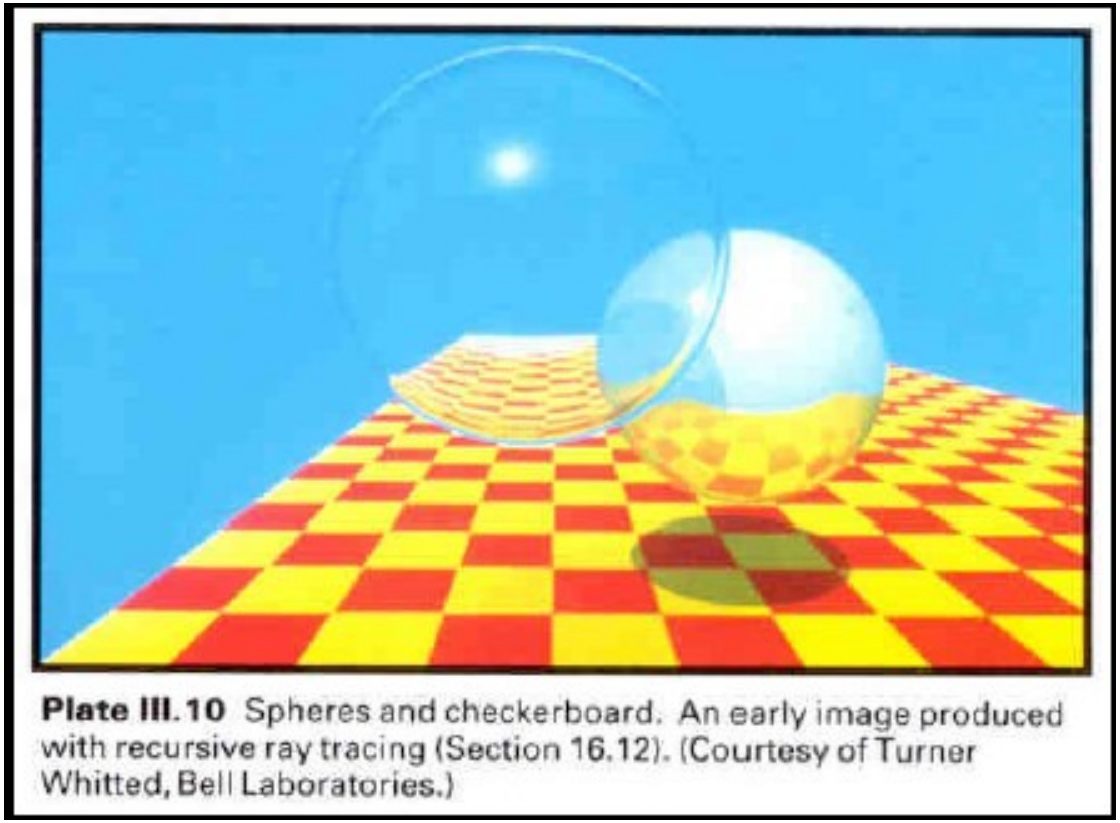
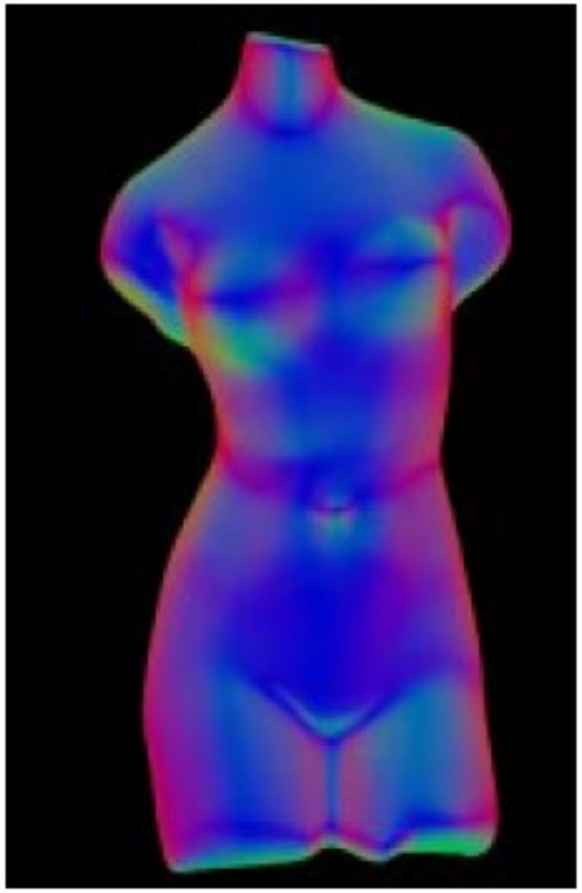
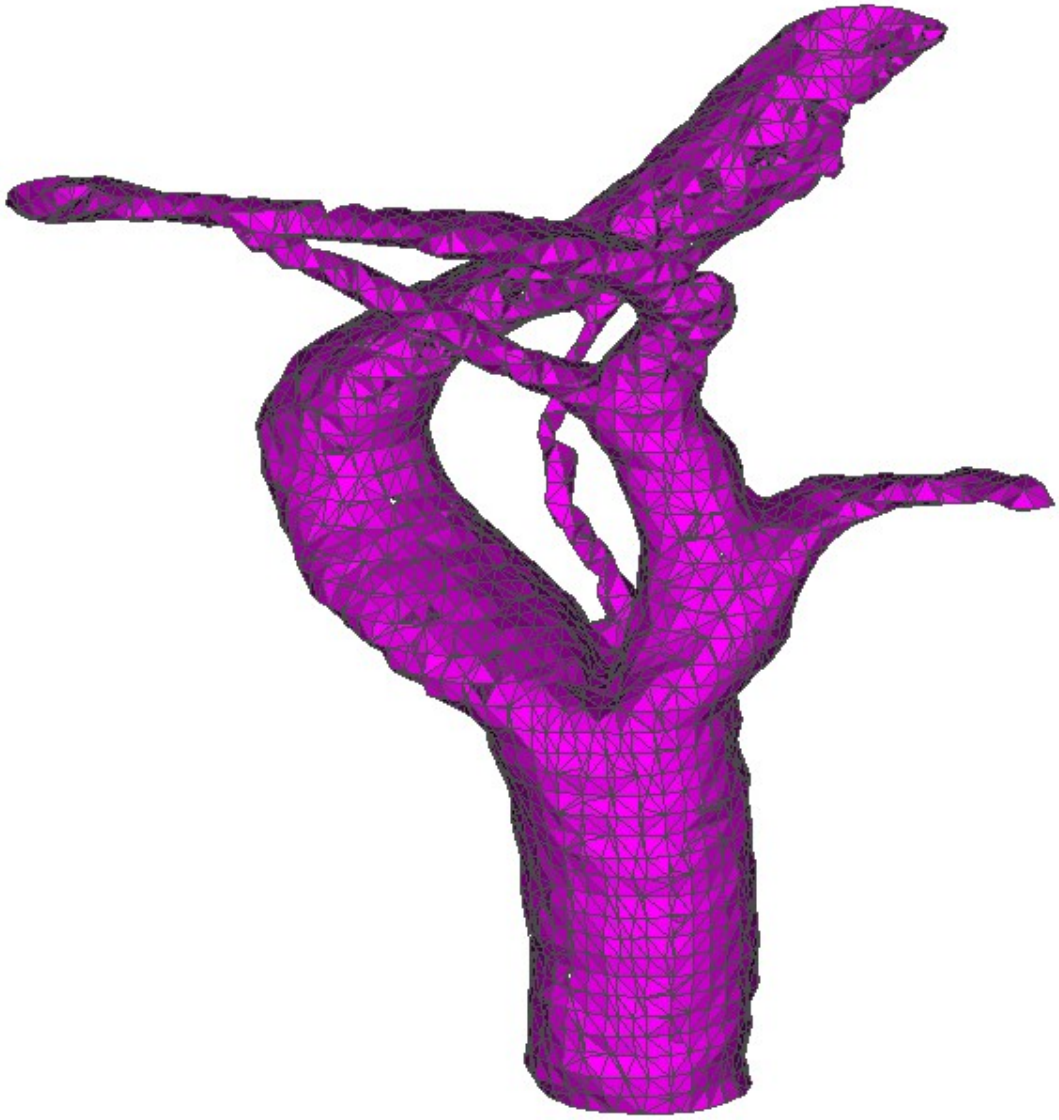


Plate III.10 Spheres and checkerboard. An early image produced with recursive ray tracing (Section 16.12). (Courtesy of Turner Whitted, Bell Laboratories.)

Non-Photorealistic Rendering



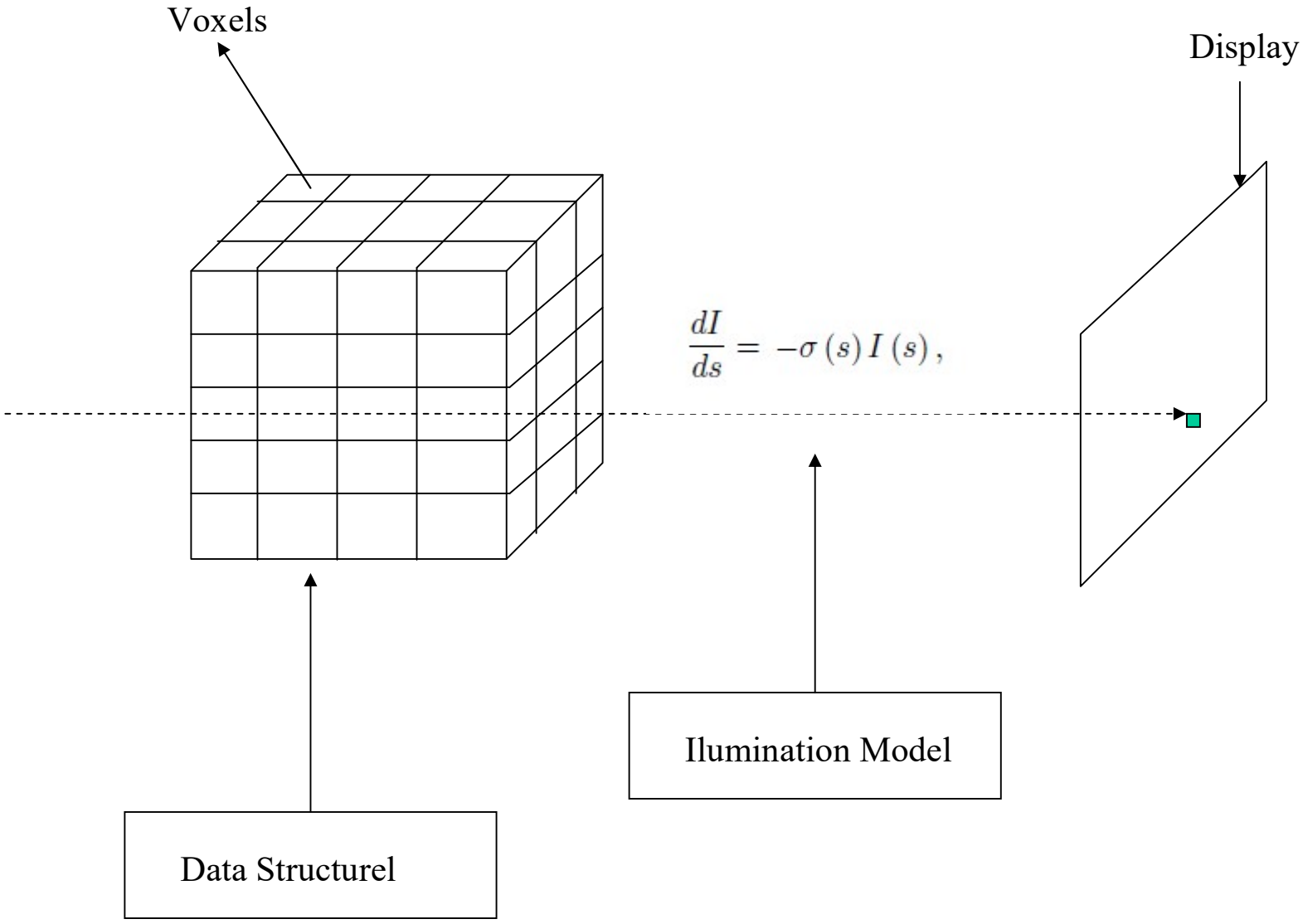
Scientific Visualization Rendering



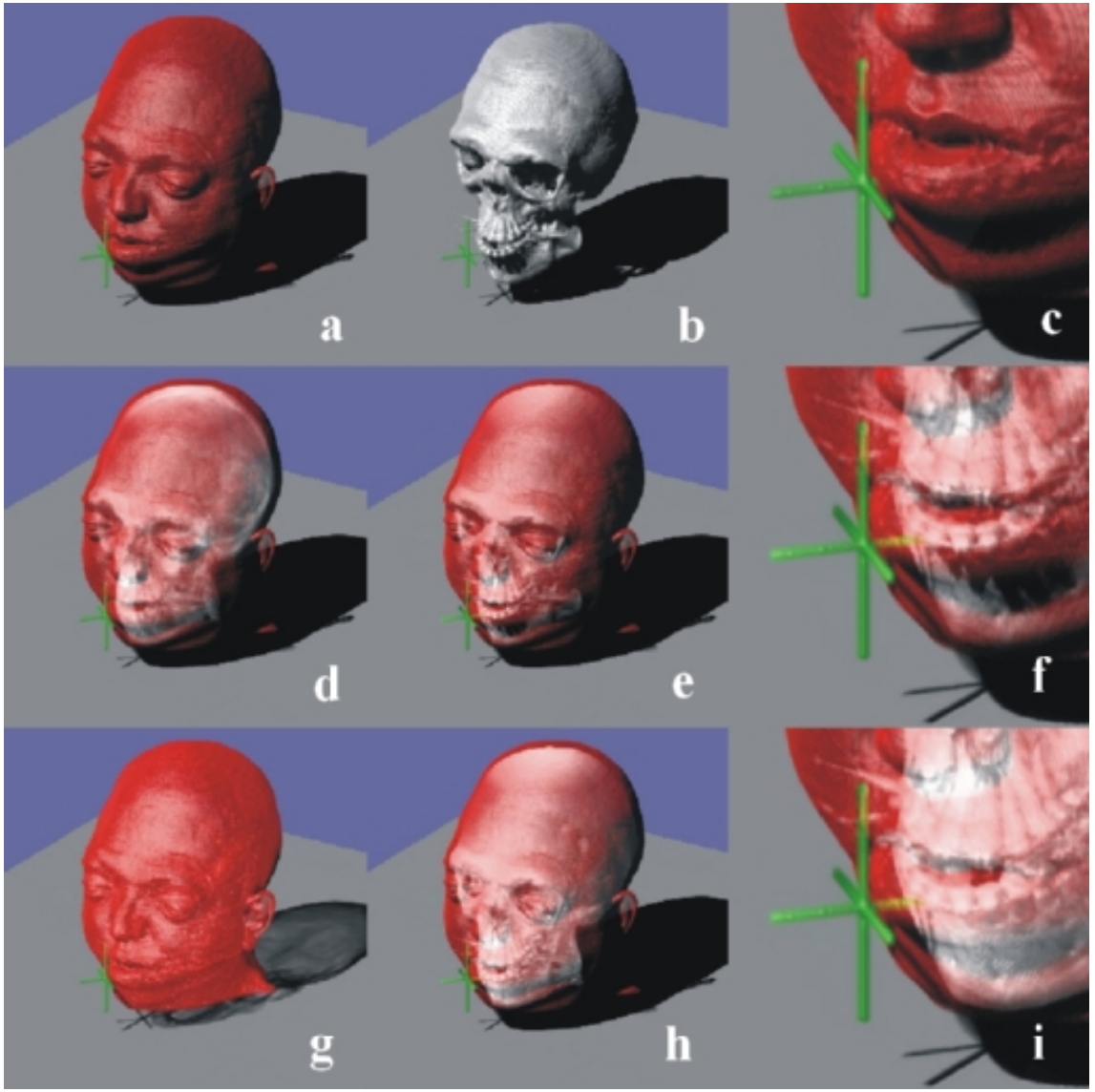
Rendering Techniques

2.1 Volume Rendering
2.2 Surface Rendering
2.3 Image Based Rendering
2.4 Texture Based Rendering

Volume Rendering



Volume Rendering Espectral



Models for
Surface Based Rendering

- Light propagation and scattering: geometric model
- Transport Model is Linear
- Energy conservation
- Light-Surface Interaction: geometric model
- Surface Representation : Polygonal, Splines, Implicit
- Local Illumination Models
- Global Illumination Models

Light-Surface Interaction

- Absortion, Reflexion and Transmission
- Reflexion: Diffuse and Specular

Simple Model

- Ambient Contribution: $I = I_a k_a$

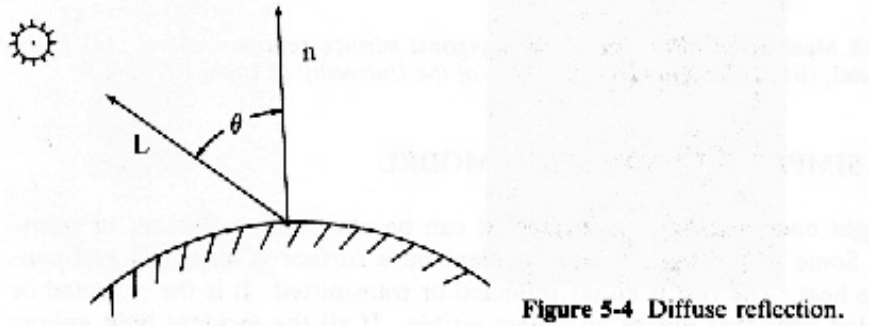


Figure 5-4 Diffuse reflection.

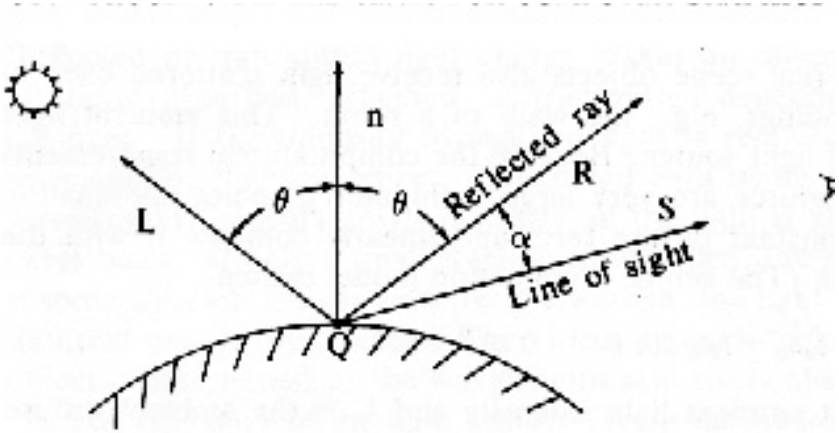
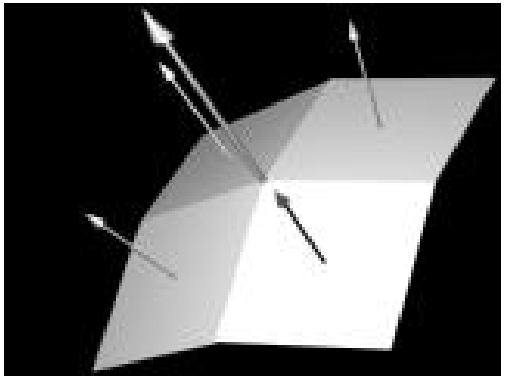


Figure 5-5 Specular reflection.

$$I = I_l k_d \cos\theta$$

$$I = I_l w(i,\lambda)\cos^n \alpha$$

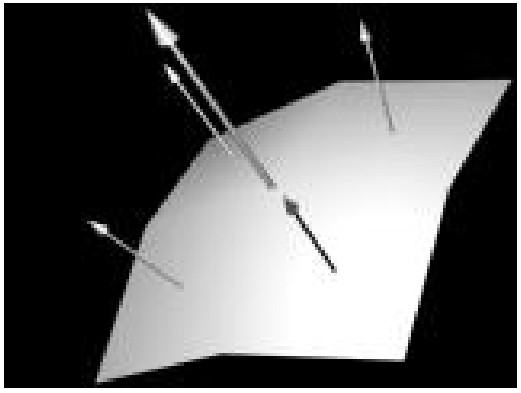
Flat Shading

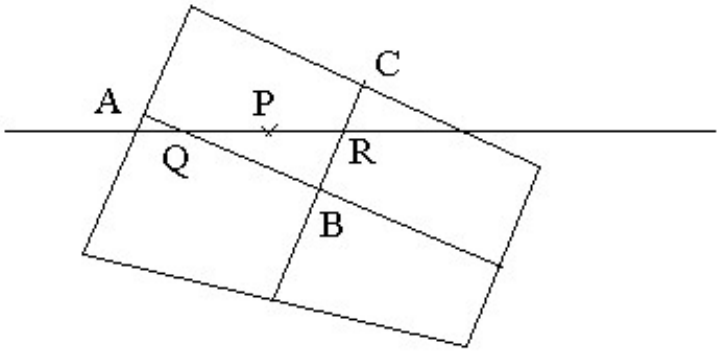


Simple Local Ilumination Model:

$$I = I_a k_a + I_l k_d \cos\theta + I_l w \cos^n \alpha$$

Gourand Shading



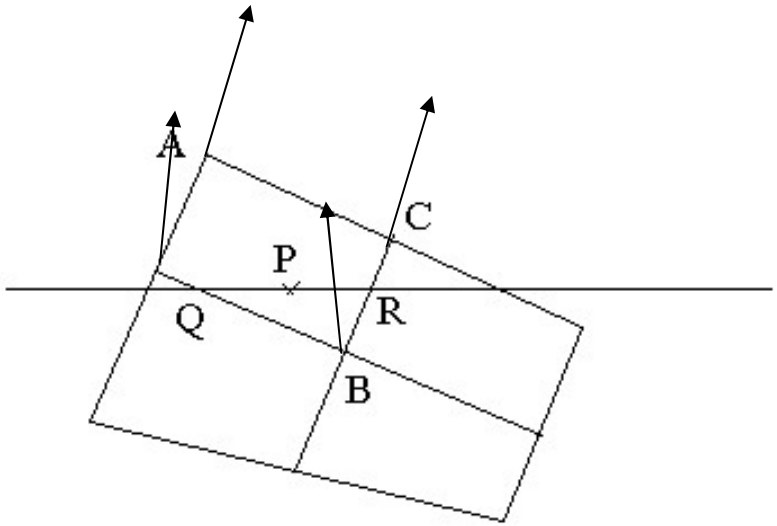


$$I_Q = uI_A + (1-u)I_B, \quad 0 \le u \le 1$$

$$I_R = wI_B + (1-w)I_C, \quad 0 \le w \le 1$$

$$I_P = tI_Q + (1-t)I_R, \quad 0 \le t \le 1$$

Phong Shading

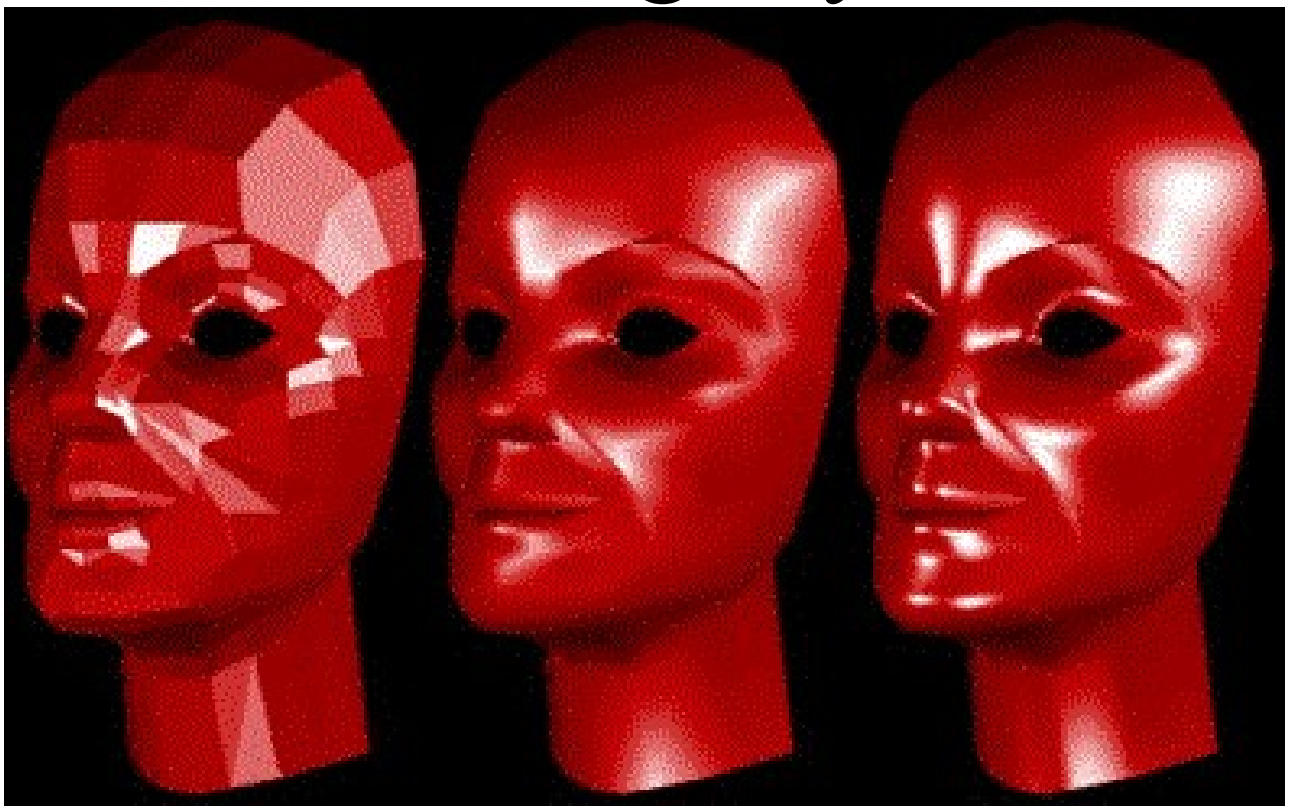


$$N_Q = uN_A + (1-u)N_B, \quad 0 \le u \le 1$$

$$N_R = wN_B + (1-w)N_C, \quad 0 \le w \le 1$$

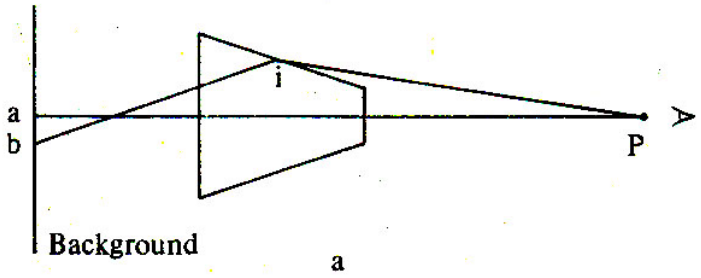
$$N_P = tN_Q + (1-t)N_R, \quad 0 \le t \le 1$$

Shading Stytes

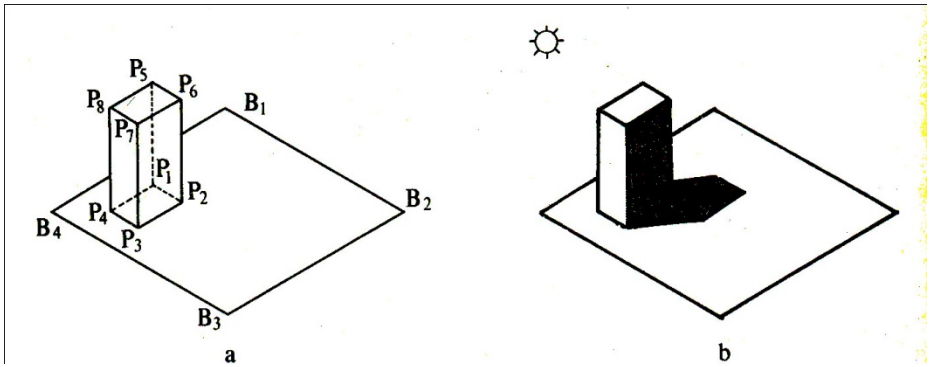


- Faceted Gouraud Phong

Rendering Effects



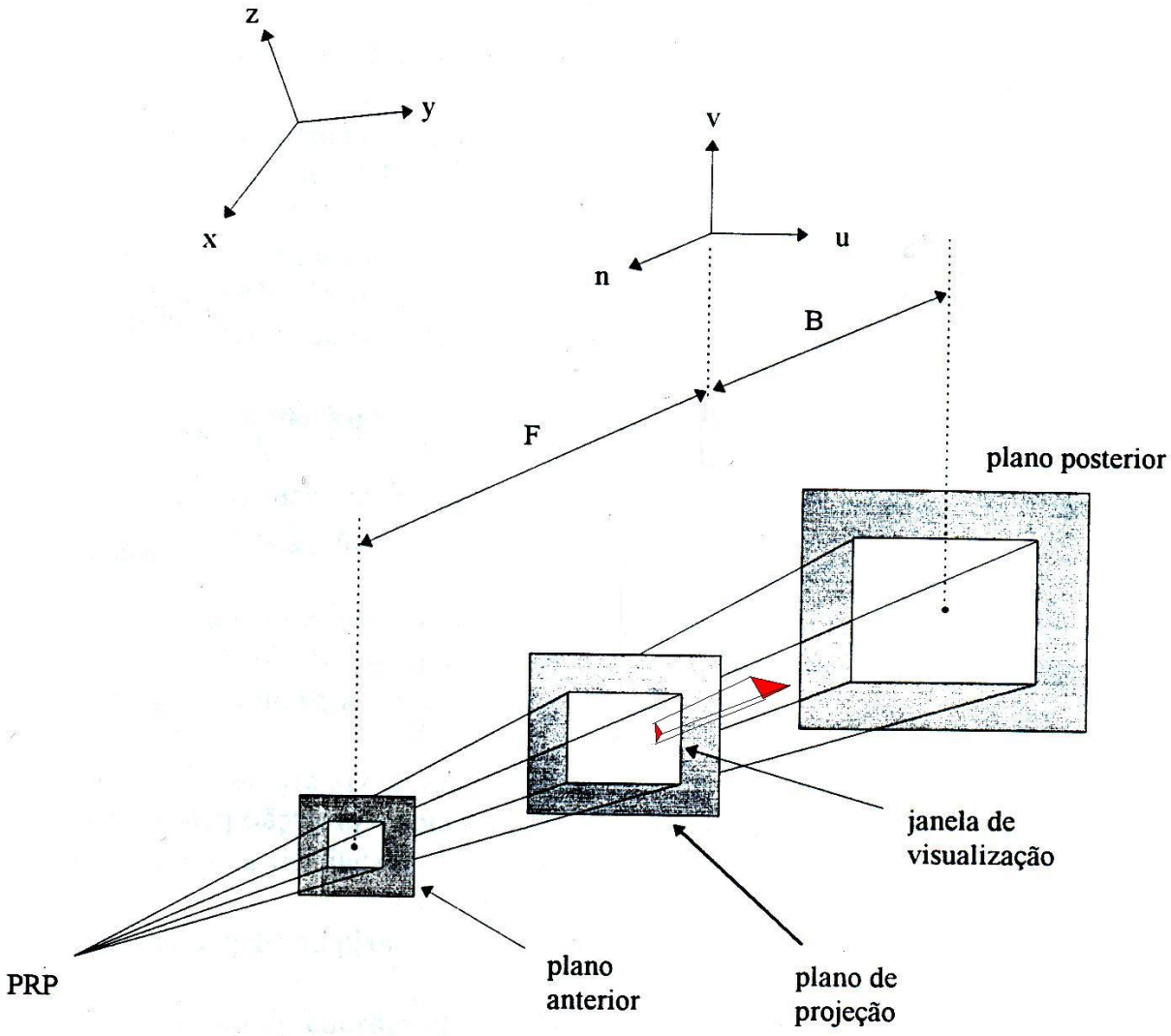
Refraction



Shadows

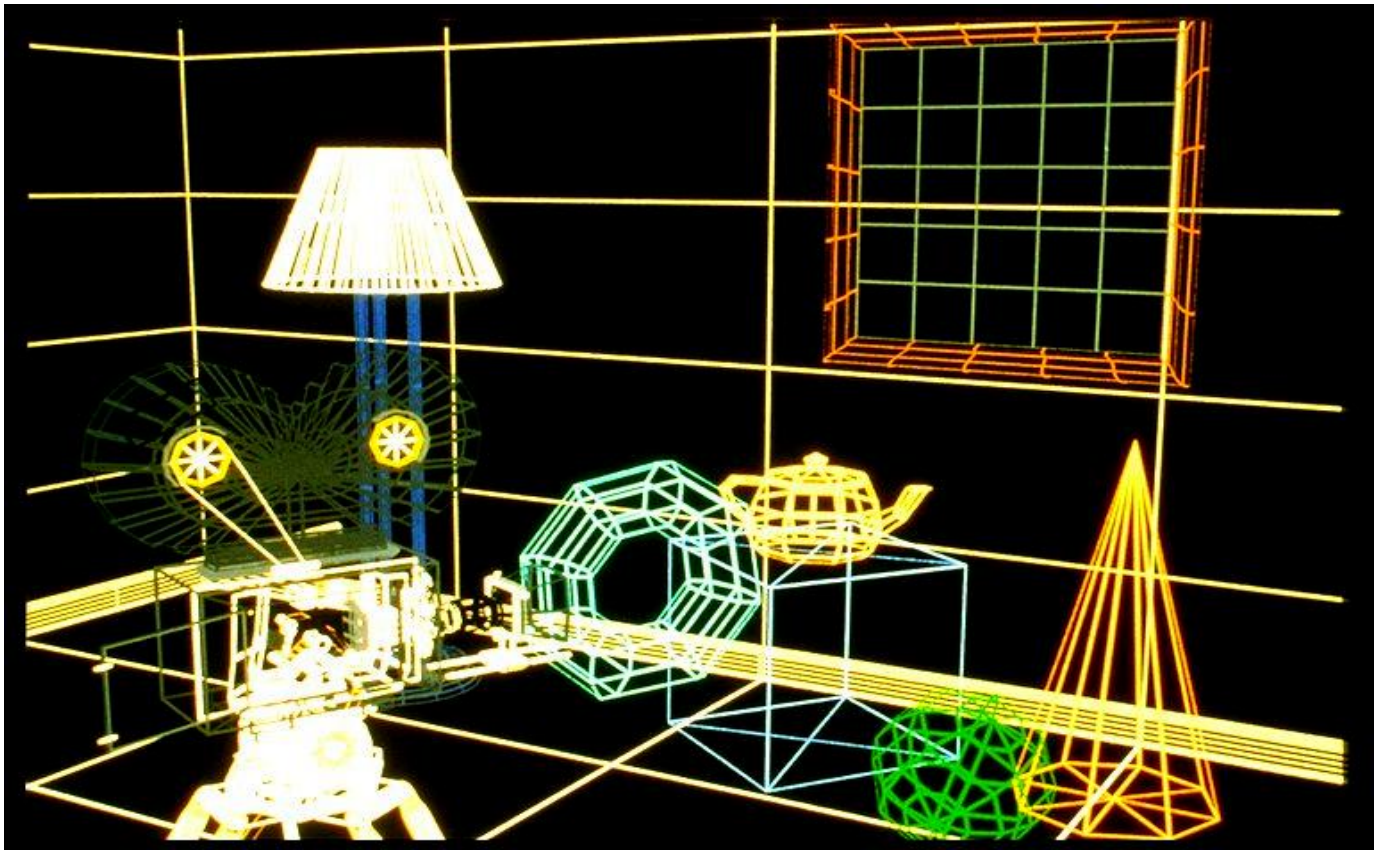
Light source, spectral effects, etc

3D Local Visualization Model:
Without transparency, shadows and global effects

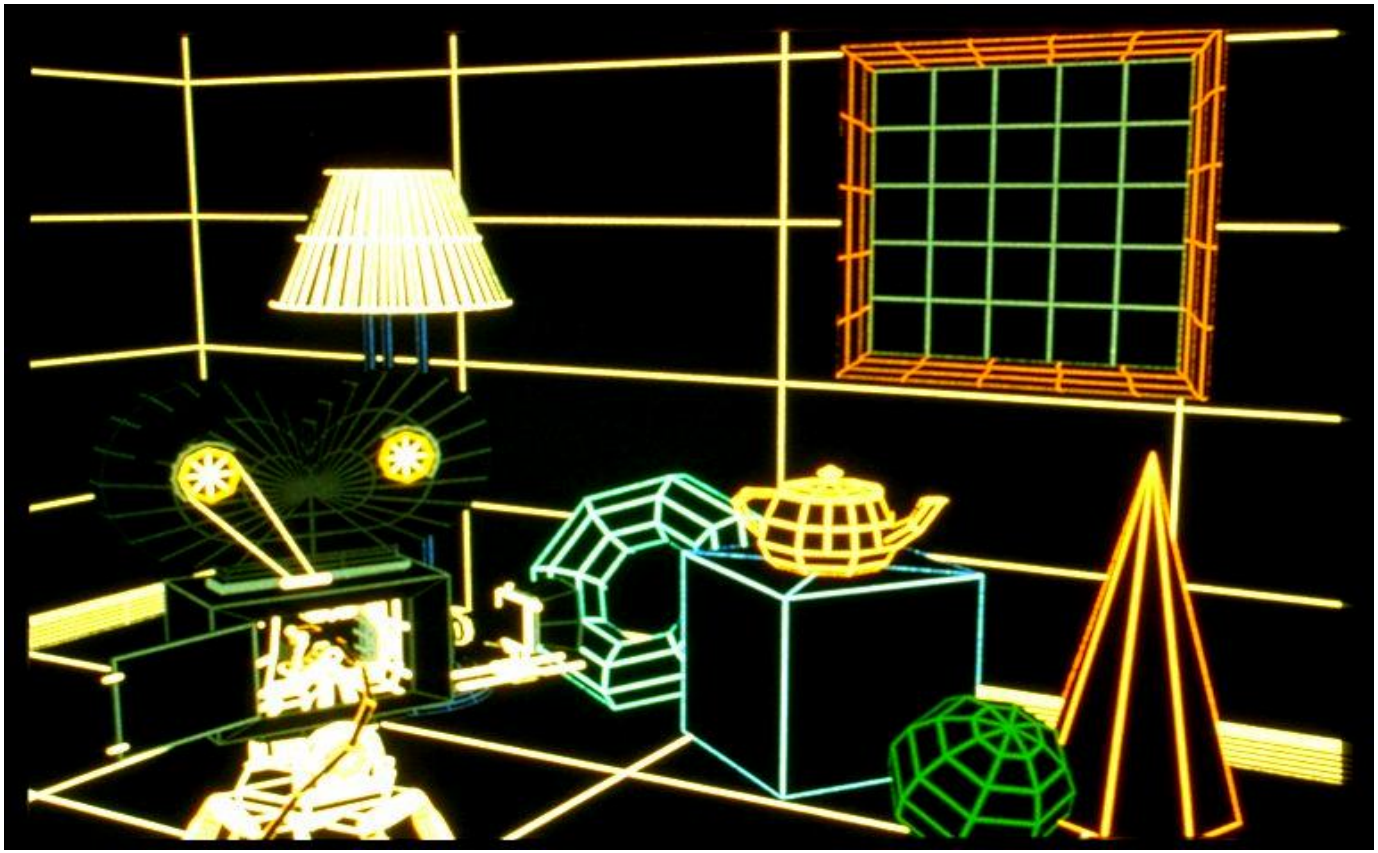


- Clipping 3D
- Hidden Surfaces
- Perspective Projection
- Clipping 2D
- Scan conversion
- Shadding for each pixel
- Display the result

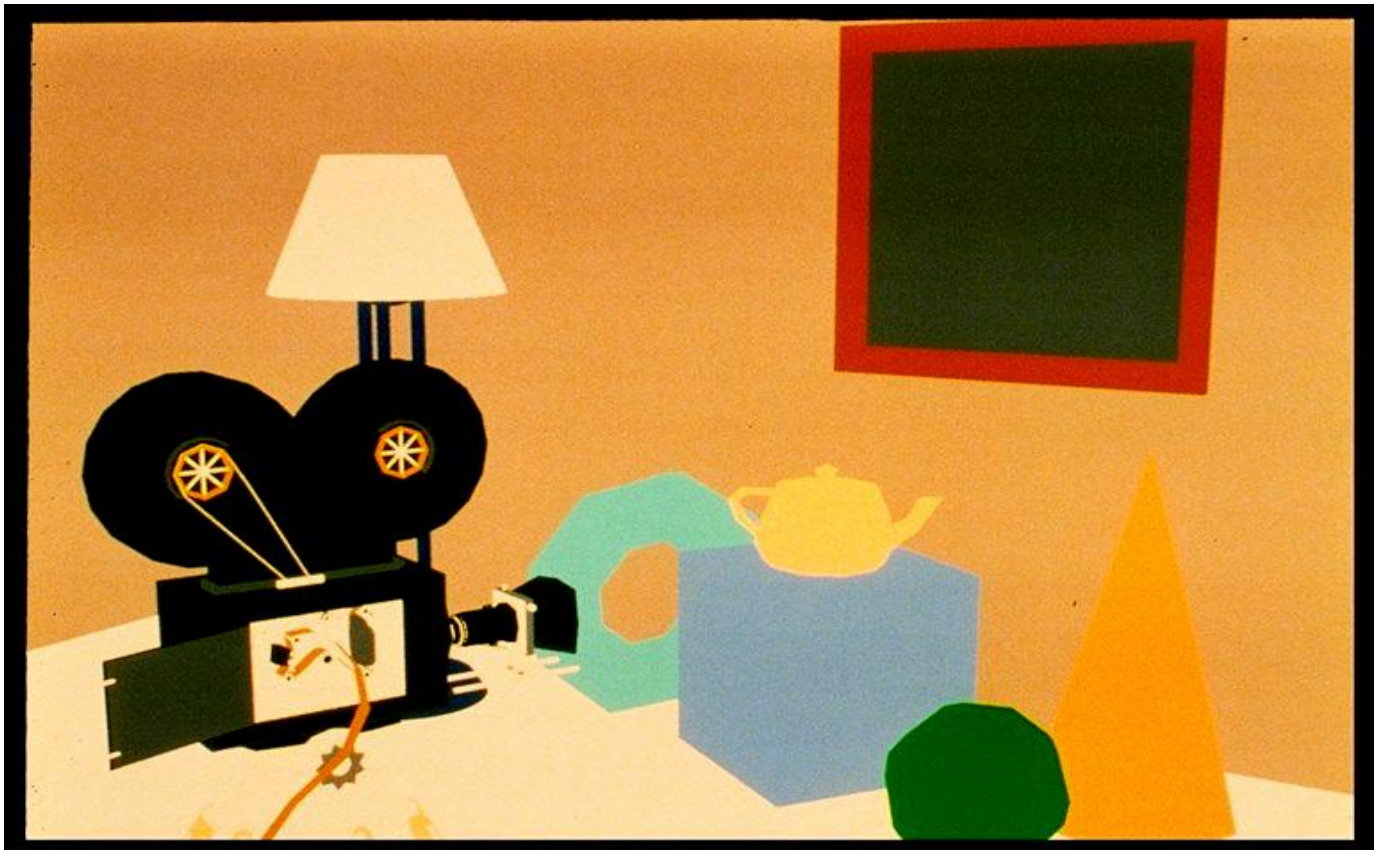
Colored Wireframes



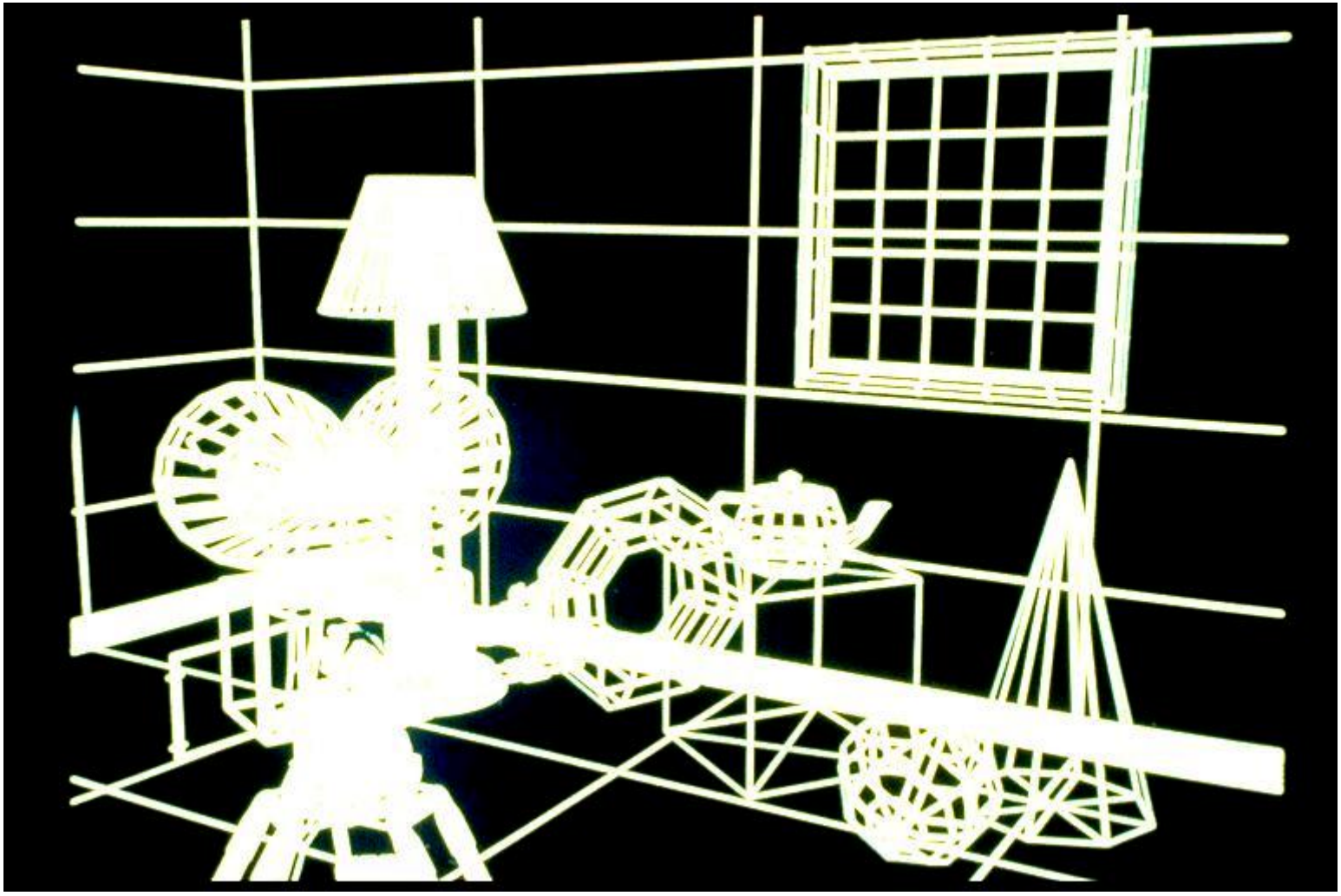
Hidden Line Removal



Hidden Surface Removal

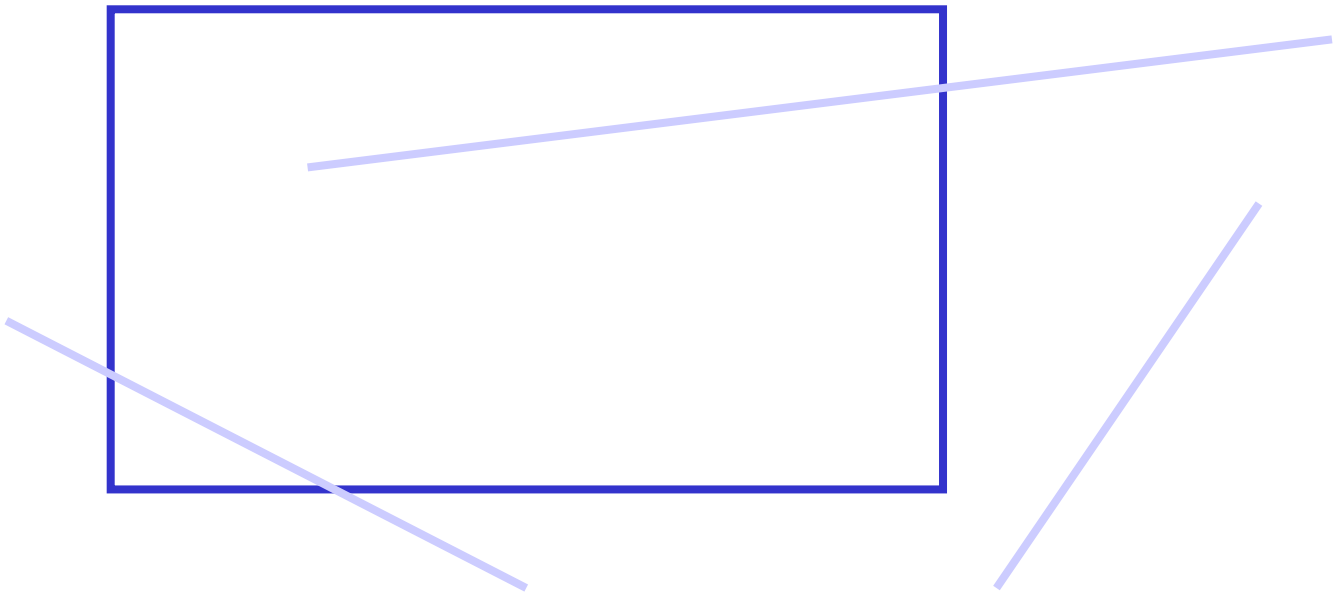


Perspective Projection



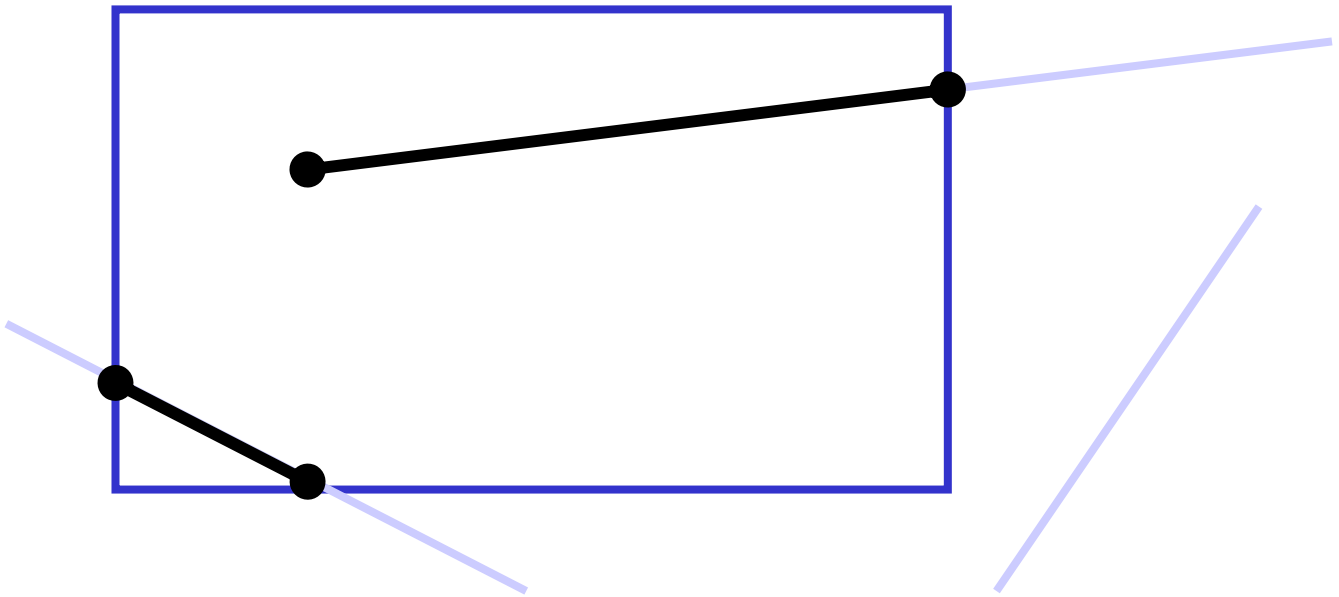
Clipping 2D

- we've been assuming that all primitives (lines, triangles, polygons) lie entirely within the *viewport*
  - in general, this assumption will not hold:

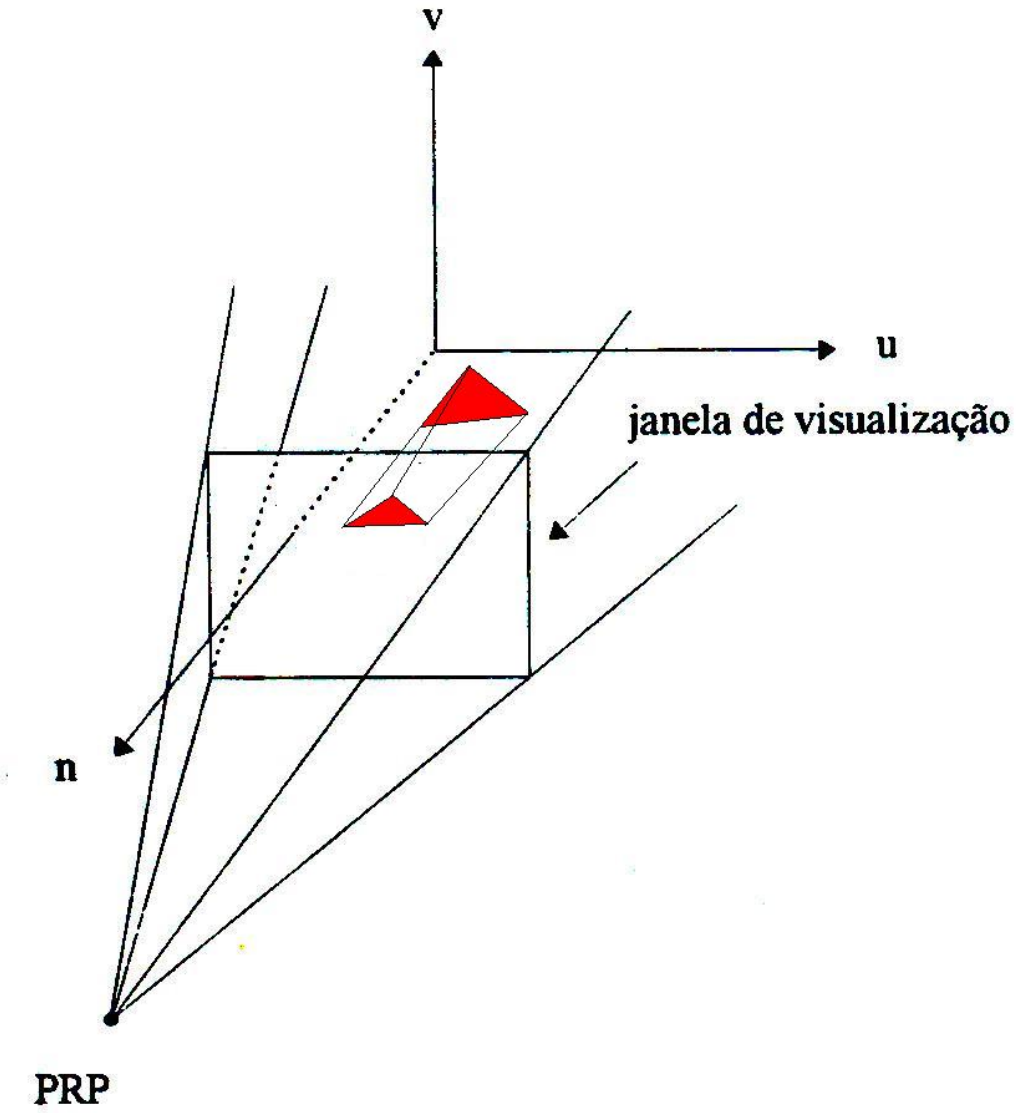


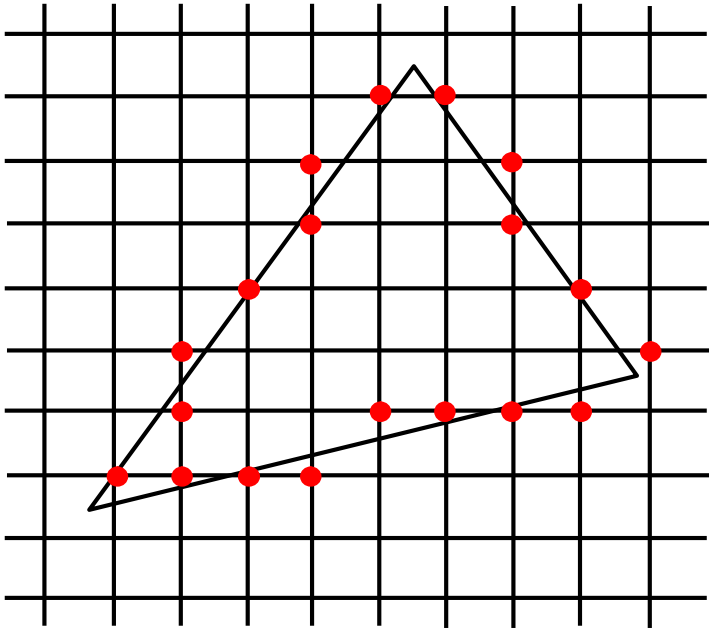
Clipping 2D

- analytically calculating the portions of primitives within the viewport

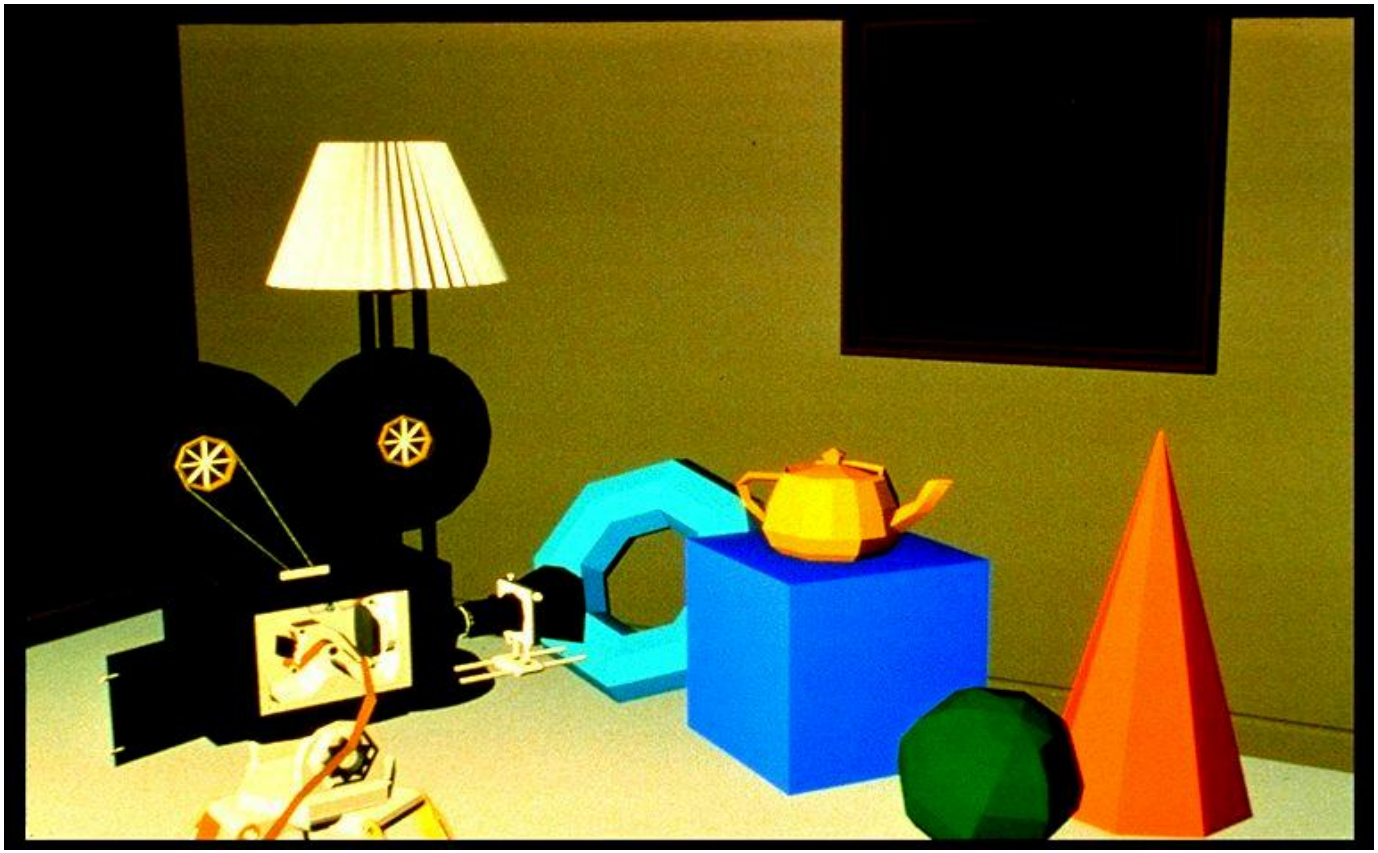


Rasterization: Scan Convertion





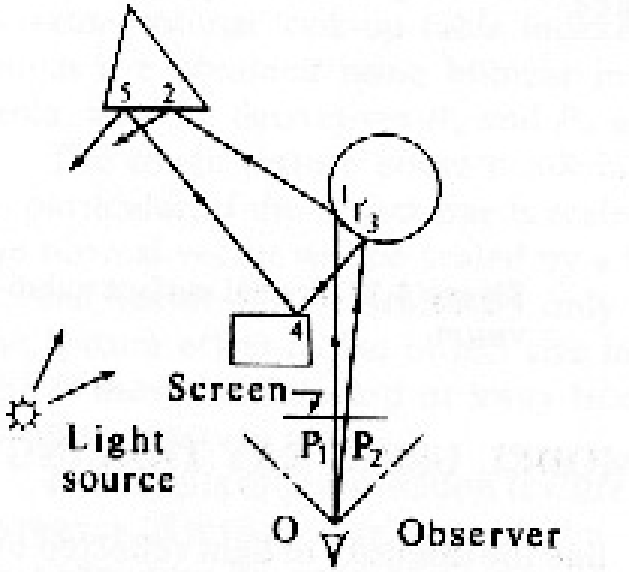
Rendering

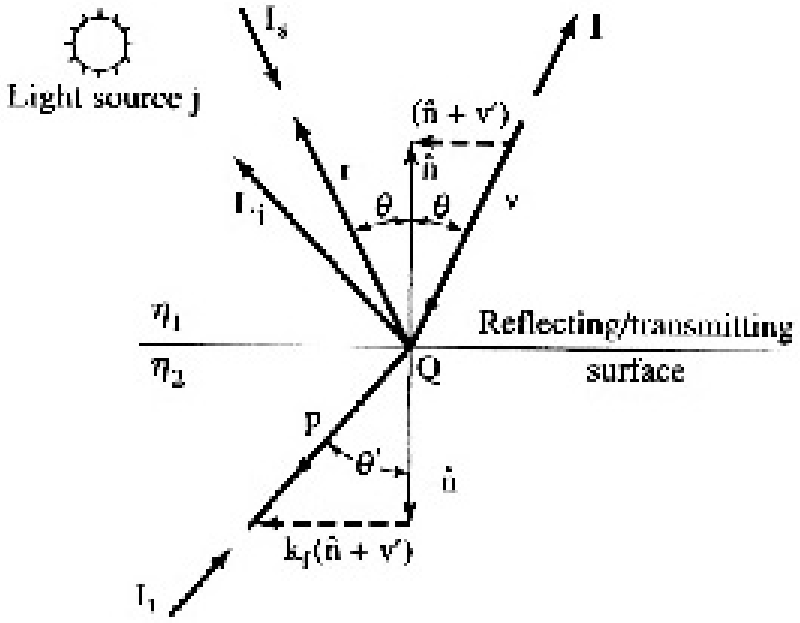


Complex Lighting and Shading

Texture Mapping

Global Illumination Model by Ray Tracing





$$I = k_a I_a + k_d \sum_j I_{l_j} \left(\hat{n} \cdot \hat{L}\right) + k_s \sum_j I_{l_j} \left(\hat{S} \cdot \hat{R}\right)^n$$

Ray Tracing with Global Illumination Model

Reflection, Shadows and Refraction effects

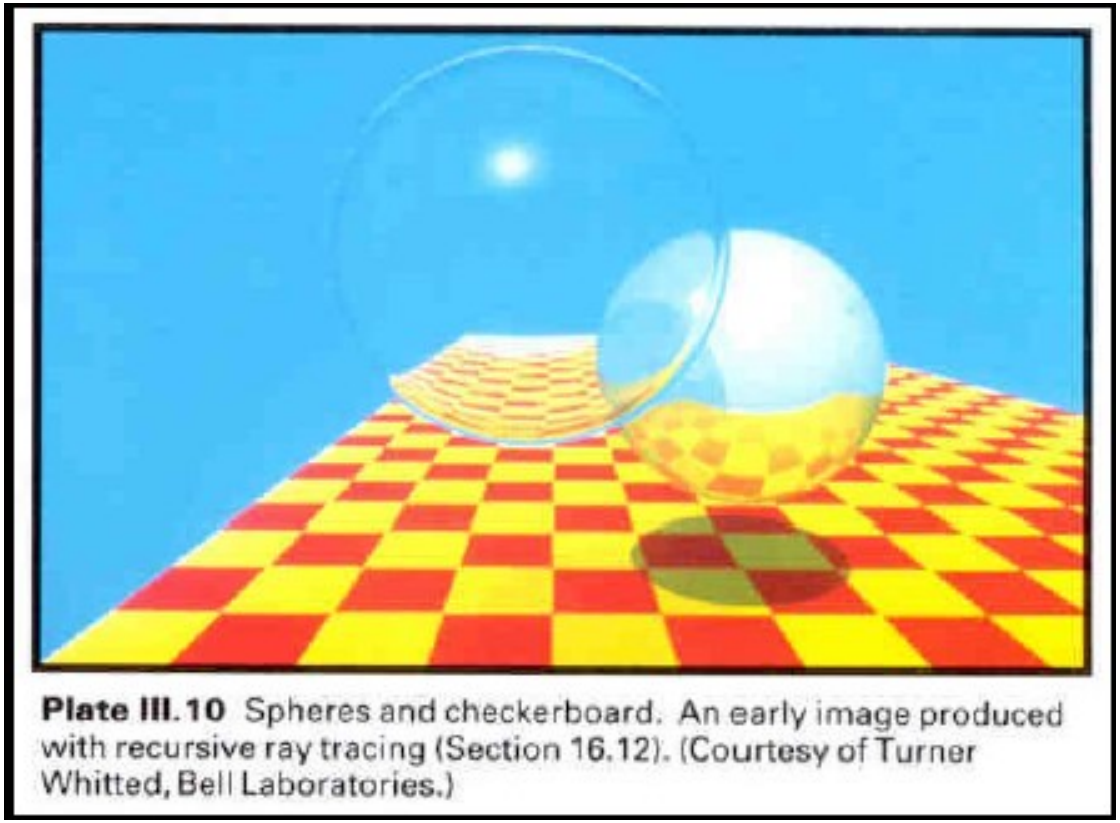
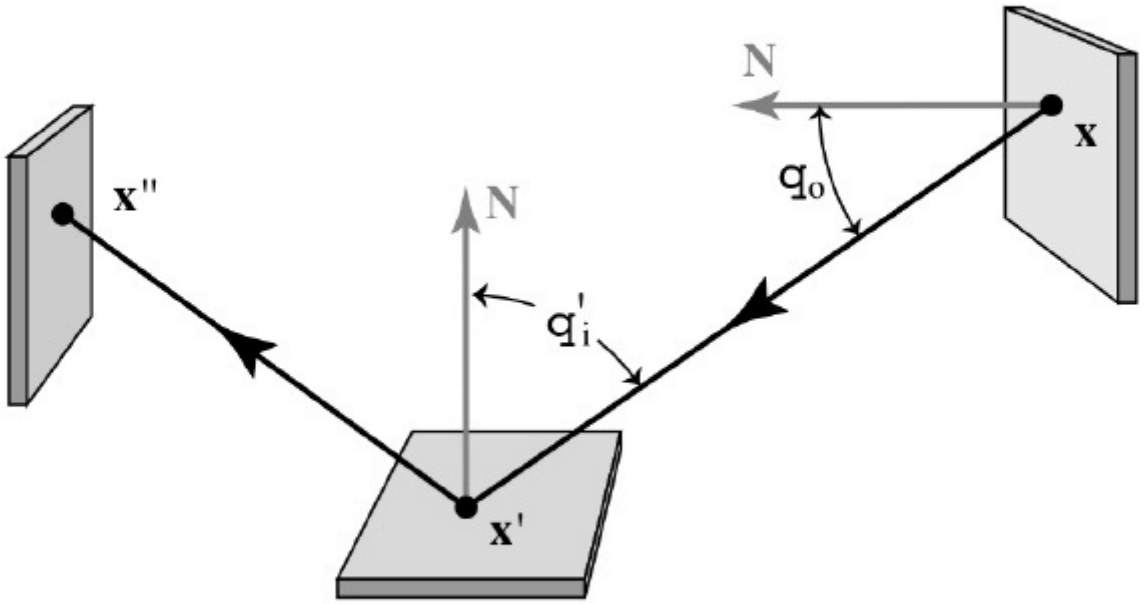


Plate III.10 Spheres and checkerboard. An early image produced with recursive ray tracing (Section 16.12). (Courtesy of Turner Whitted, Bell Laboratories.)

Physically Based Rendering – PBRT

Light Transport Equation



$$L(x' \to x'') = L_e(x' \to x'') + \int_M L(x \to x') f(x \to x' \to x'') G(x \leftrightarrow x')\, dA(x)$$

Temas para Projeto

- Photon Mapping
  - https://graphics.stanford.edu/courses/cs348b-00/course8.pdf
- Spectral Rendering
  - http://home.agh.edu.pl/~mradzisz/PUBS/spectrum.pdf
- A Comparison of Global Illumination Methods Using Perceptual Quality Metrics
  - DOI: 10.1109/SIBGRAPI.2015.52