

Shading

1. Light sources
2. Basic illumination models
3. Phong shading
4. Polygon shading
5. Global illumination (later)

Photorealistic rendering

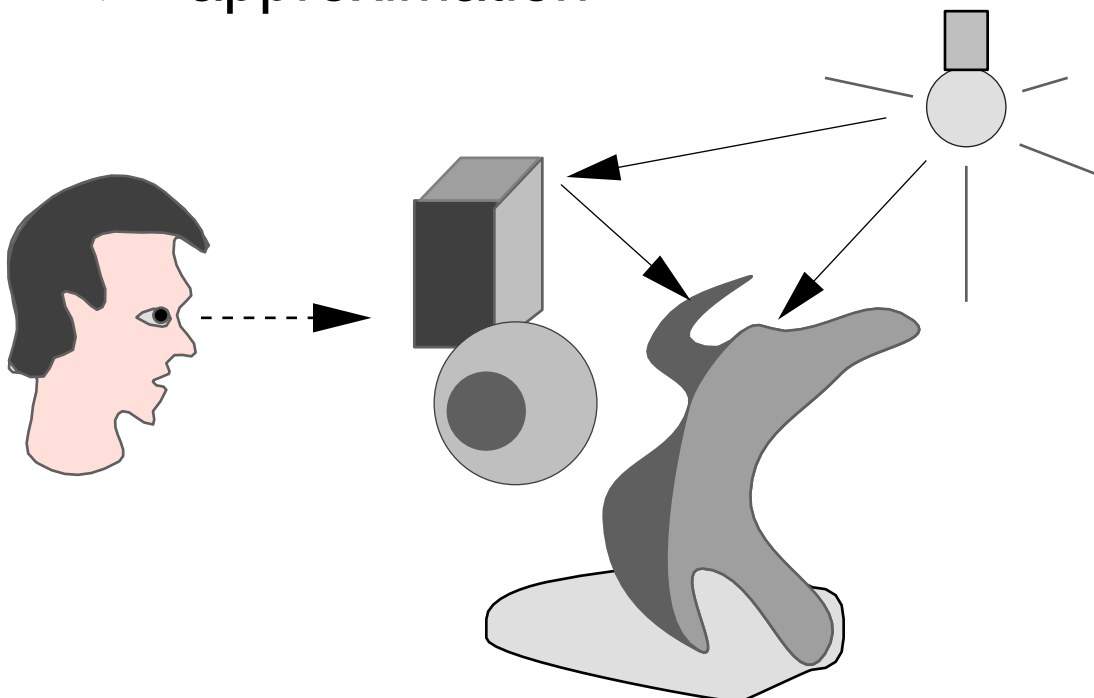
1. accurate graphical representations of objects
2. good physical descriptions of the lighting effects in a scene

Lighting effects:

- light reflection
- transparency
- surface texture
- shadows

Modeling the colors and lighting effects that we see on an object is a complex process

→ approximation



Light sources

Sun, light bulbs, and any other light-emitting sources

How about light-reflected sources?

Point light sources

- emits light equally in all directions

$$I(p, p_0) = \frac{1}{|p - p_0|^2} I(p_0)$$

Spotlights

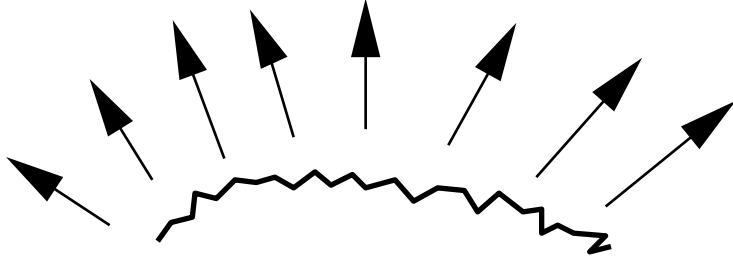
- a narrow range of angles through which light is emitted

Distant light sources

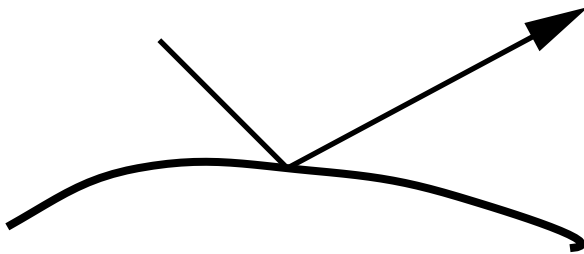
- parallel light
- sun

Surface types

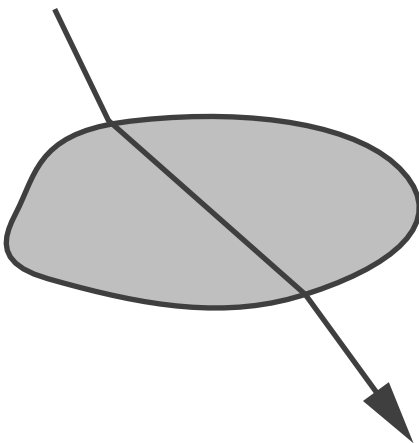
- Rough, grainy surfaces tend to scatter light



- Glossy, shiny surfaces result in highlighting effect



- Transparent surfaces can transmit light



Basic illumination models

1. Ambient light
2. Diffuse reflection
3. Specular reflection

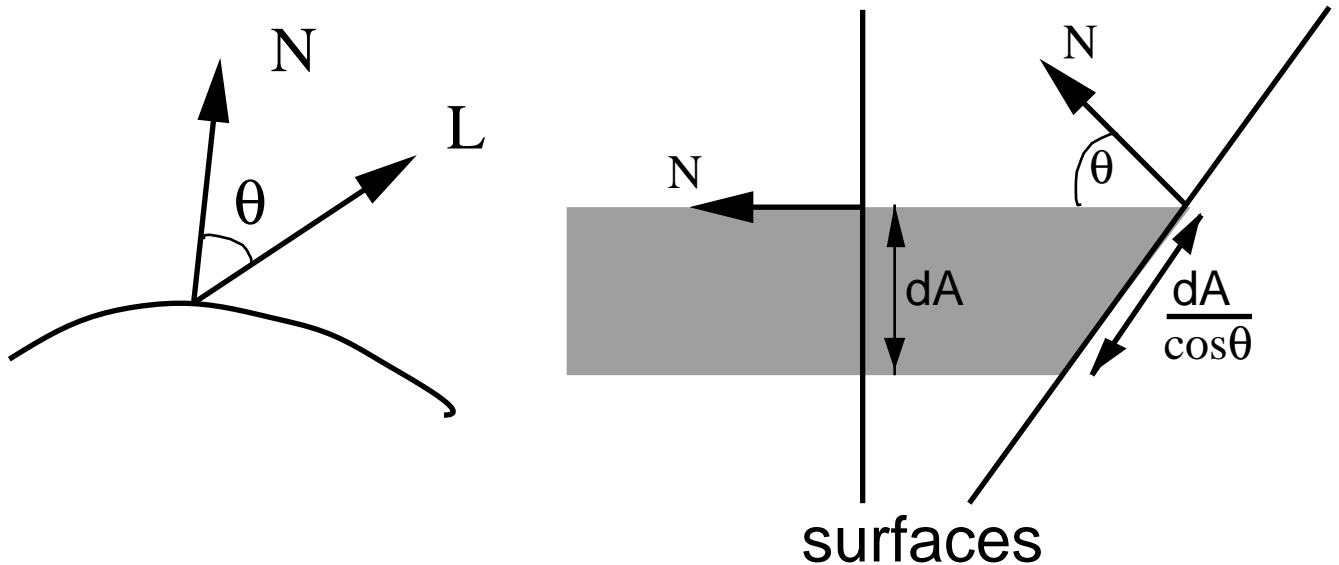
Ambient light

- model the combination of light reflections from surrounding objects in the scene
- no spatial or directional characteristics
- background light
- account for all the complex ways in which light can reach an object that are not addressed in the other parts of the illumination equation

$I = k_a I_a$ where I is the intensity of the ambient light, and k_a (the *ambient reflection coefficient*) is the percentage of ambient light reflected from the object's surface

Diffuse reflection (Lambertain reflection)

- Dull, matte surfaces
- Surfaces appear equally bright from all viewing angles since they reflect light with equal intensity in all directions
- Brightness depends only on the angle θ between the light direction L and the surface normal N .

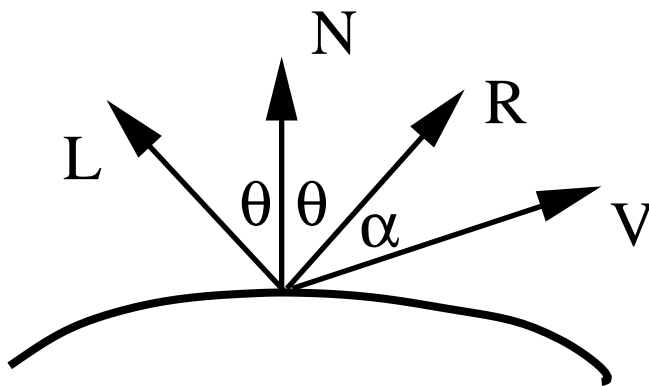


$$I = I_d k_d \cos\theta = I_d k_d (N \cdot L)$$

$$I = I_a k_a + I_d k_d (N \cdot L)$$

Specular reflection

- on any shiny surface
- appear white, the color of the incident light
- reflect light unequally in different directions
- on a perfectly shiny surface, light is reflected only in the mirrored direction of L about N.



$I = I_s k_s (R \cdot V)^n$ where n makes the specular highlight rapidly fall off

$$I = I_a k_a + I_d k_d (N \cdot L) + I_s k_s (R \cdot V)^n$$

This is the Phong shading model!!