Luxo jr., Pixar Films

CS461: Lighting

part I

C. Andrews

Local vs global illumination

Global illumination

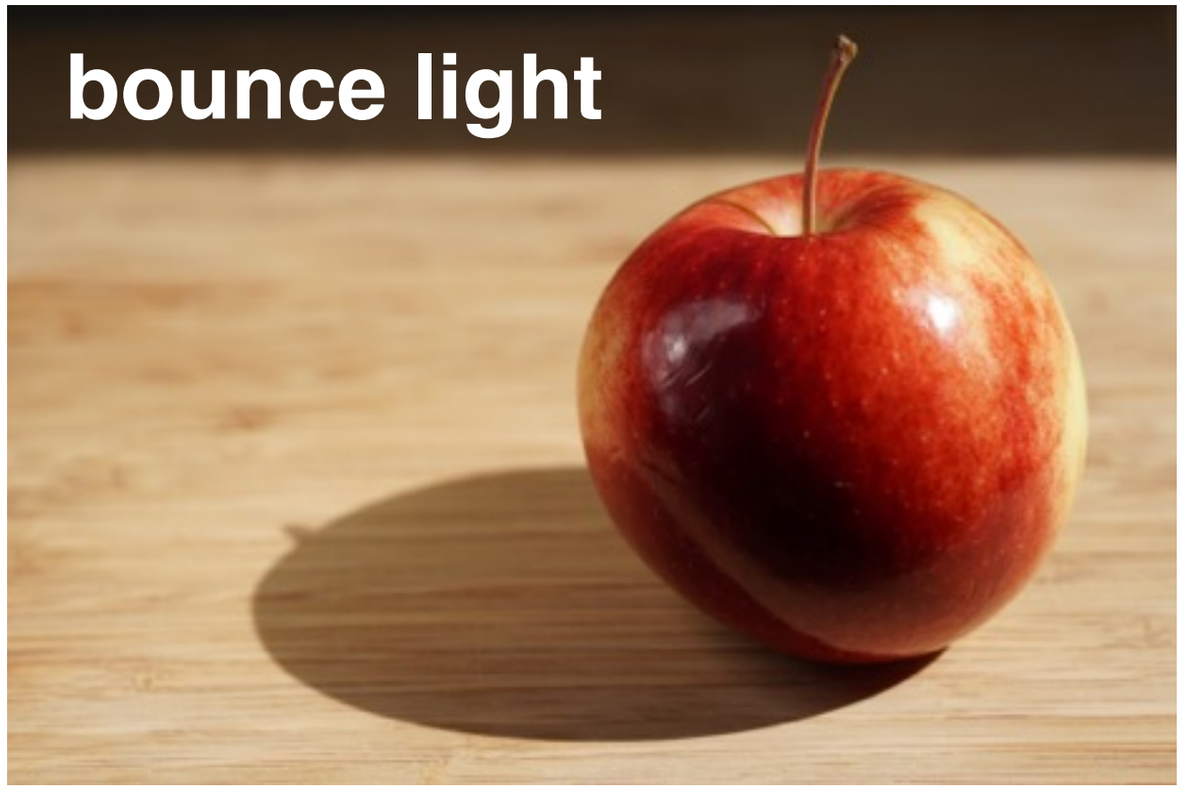
light bounces around the room adding
indirect lighting

Local illumination

surfaces are lit only from the light rays coming
directly from the source in the ceiling
[note that this example does include shadows]

pictures from ‘Fundamentals of Computer Graphics’, Shirley et al.

Global illumination



Local vs global illumination

Global illumination

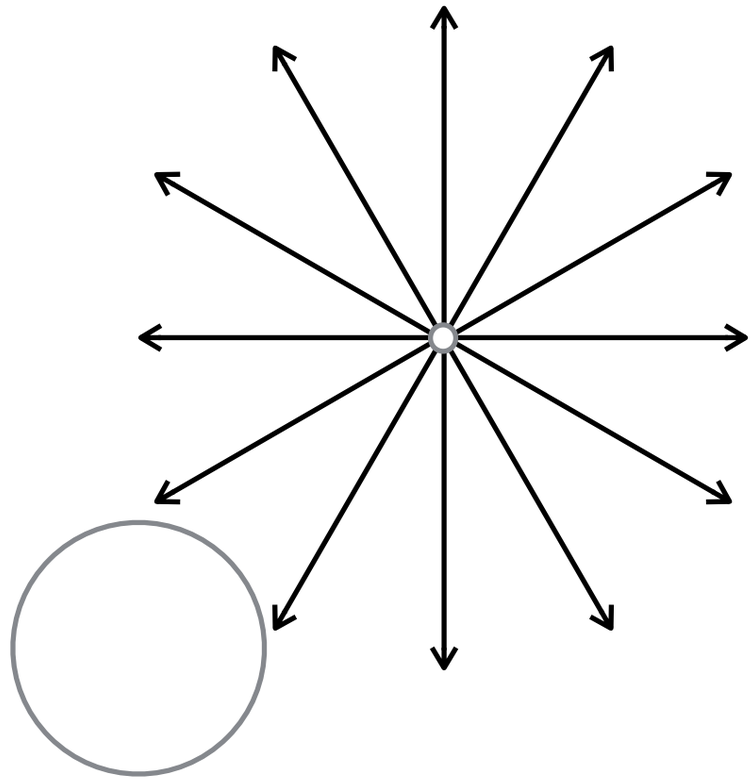
light bounces around the room adding
indirect lighting

Local illumination

surfaces are lit only from the light rays coming
directly from the source in the ceiling
[note that this example does include shadows]

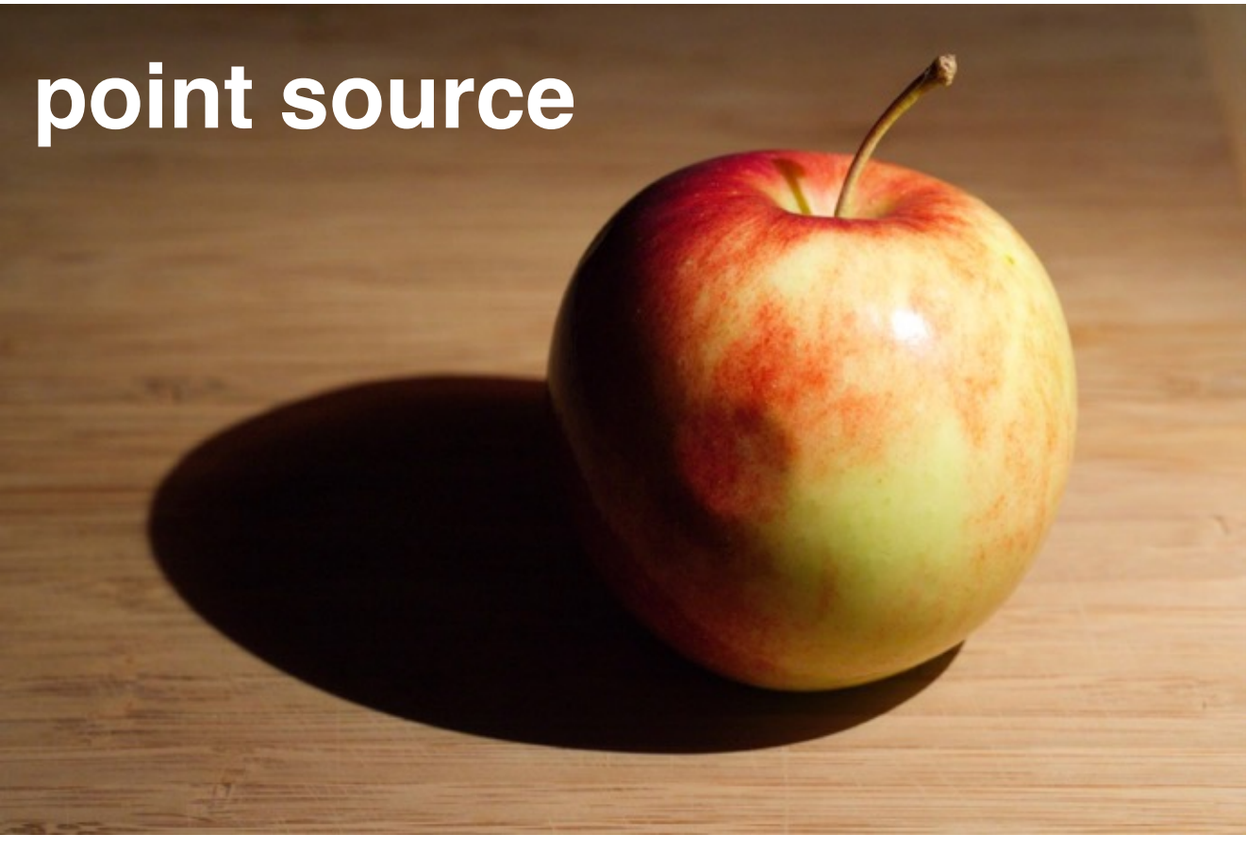
pictures from ‘Fundamentals of Computer Graphics’, Shirley et al.

Point light source lighting



Our idealized light is a point source radiating in all directions

Light bulbs have area



That surface makes for softer light

this is the point of shades on lamps

Shadows from lights with area

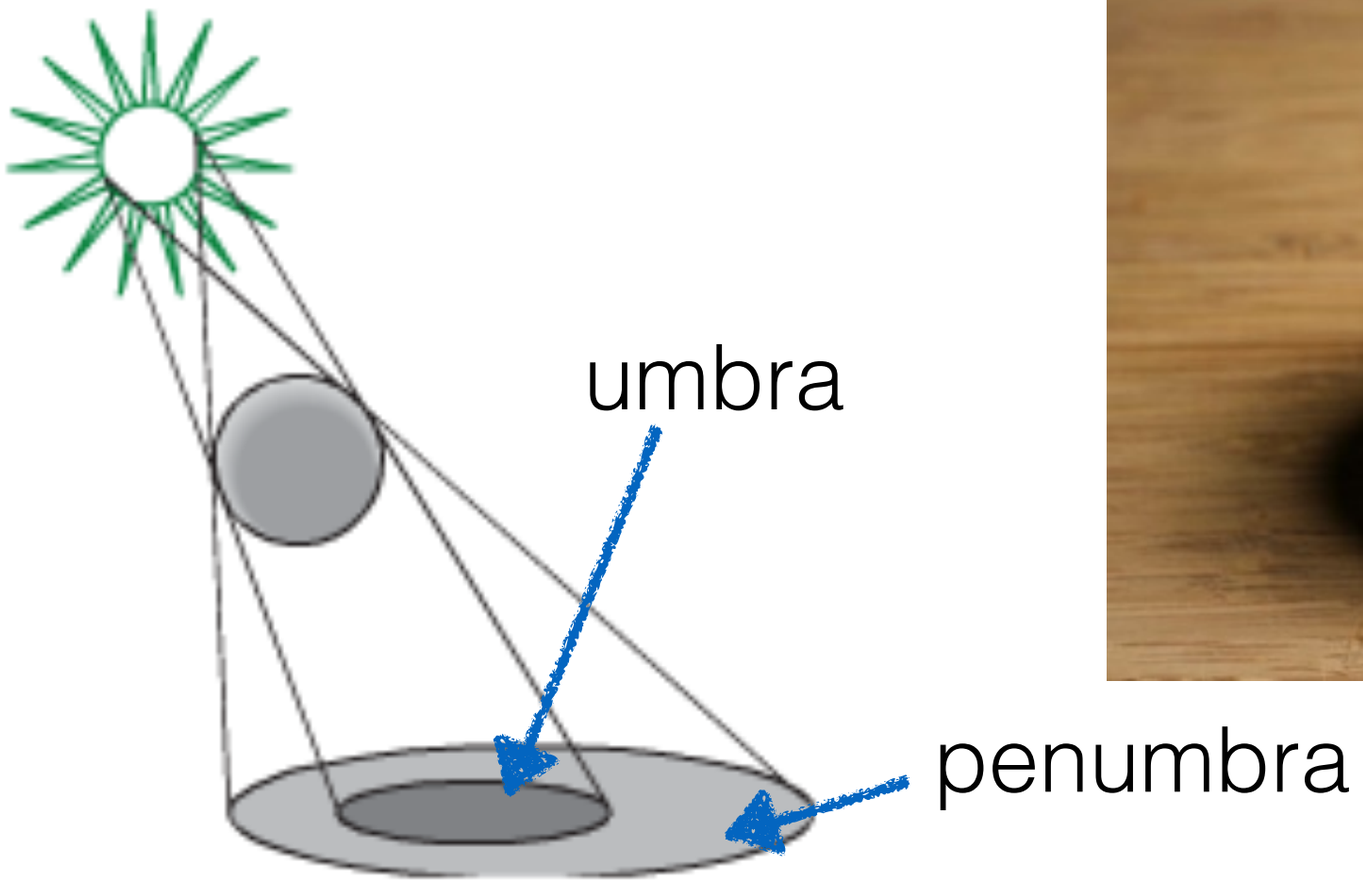
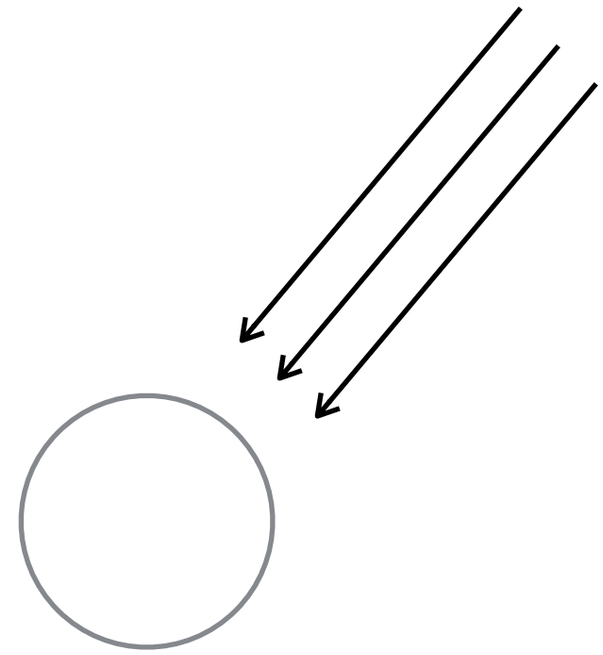


fig 6.8, Interactive Computer Graphics, 7e, Angel and Shreiner

More area == softer shadows

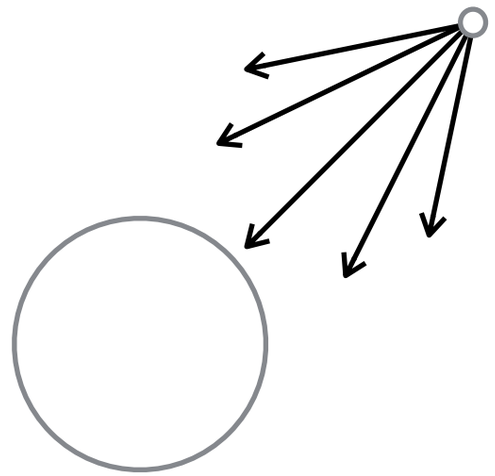
Directional lighting



Distant light sources can be modeled has having parallel rays

NYC Municipal Archives

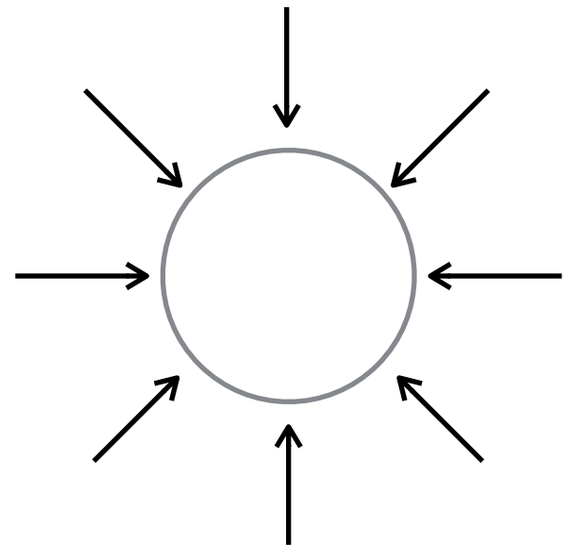
Spot lights



Point light sources with angular restriction

*typically, spots are modeled has having **falloff** towards the edges*

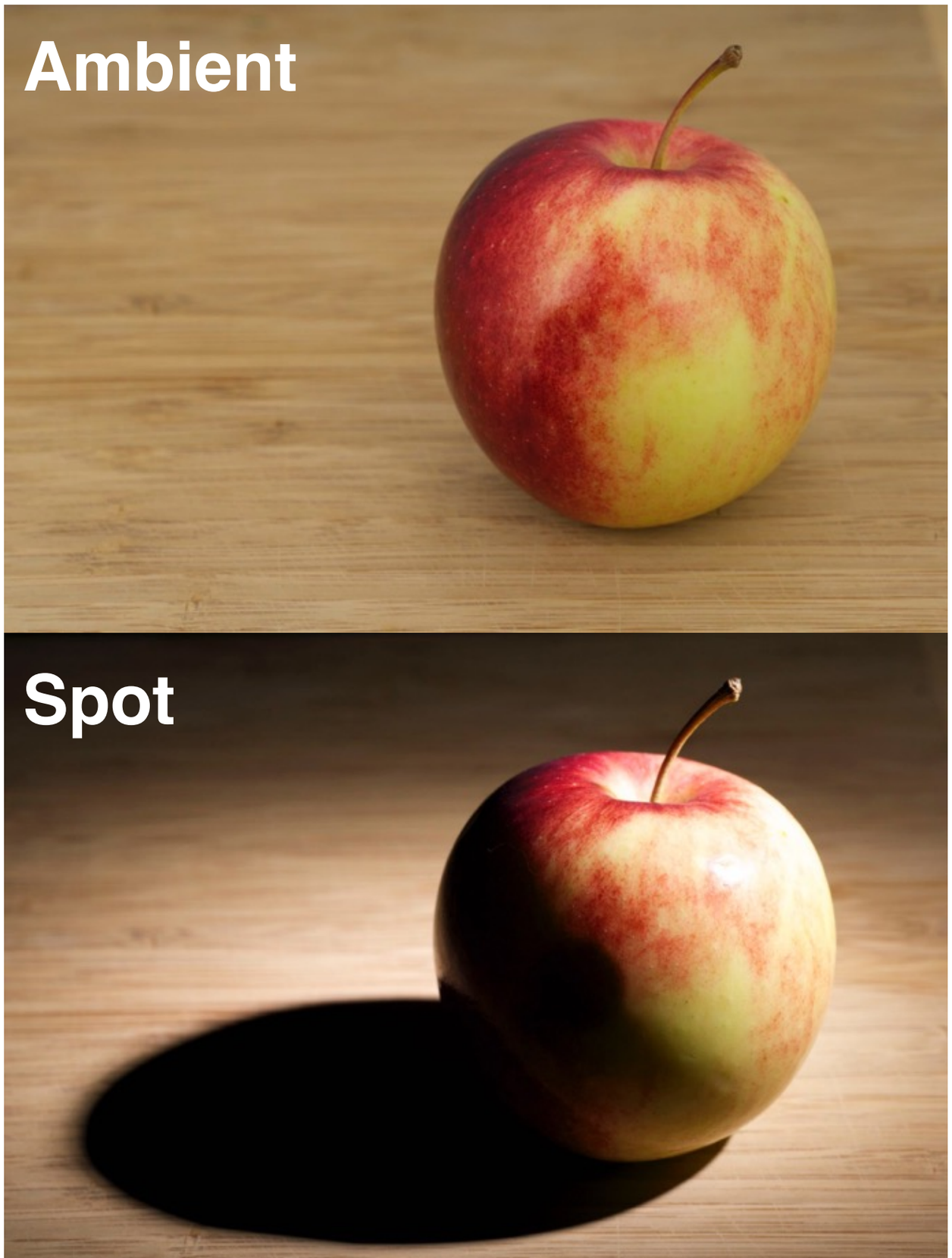
Ambient light

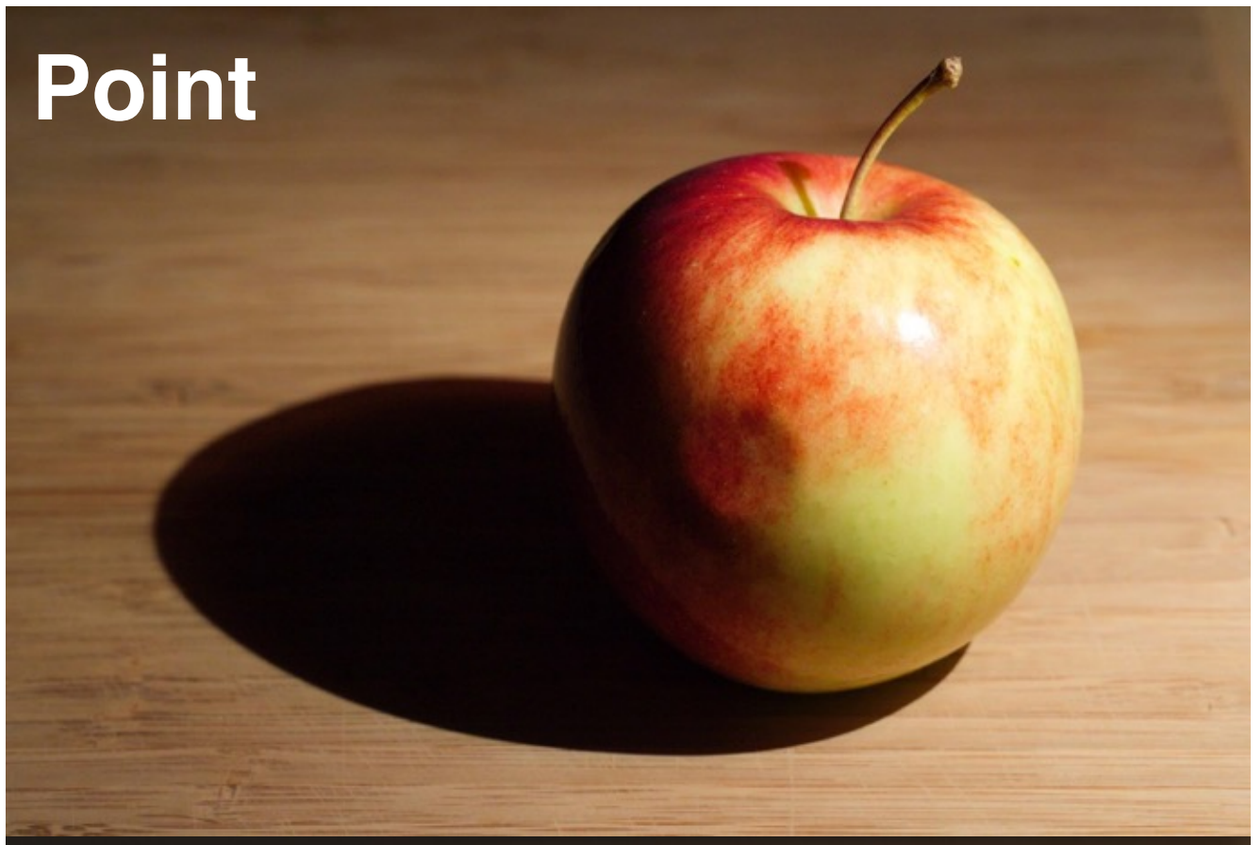


Light evenly coming from all directions

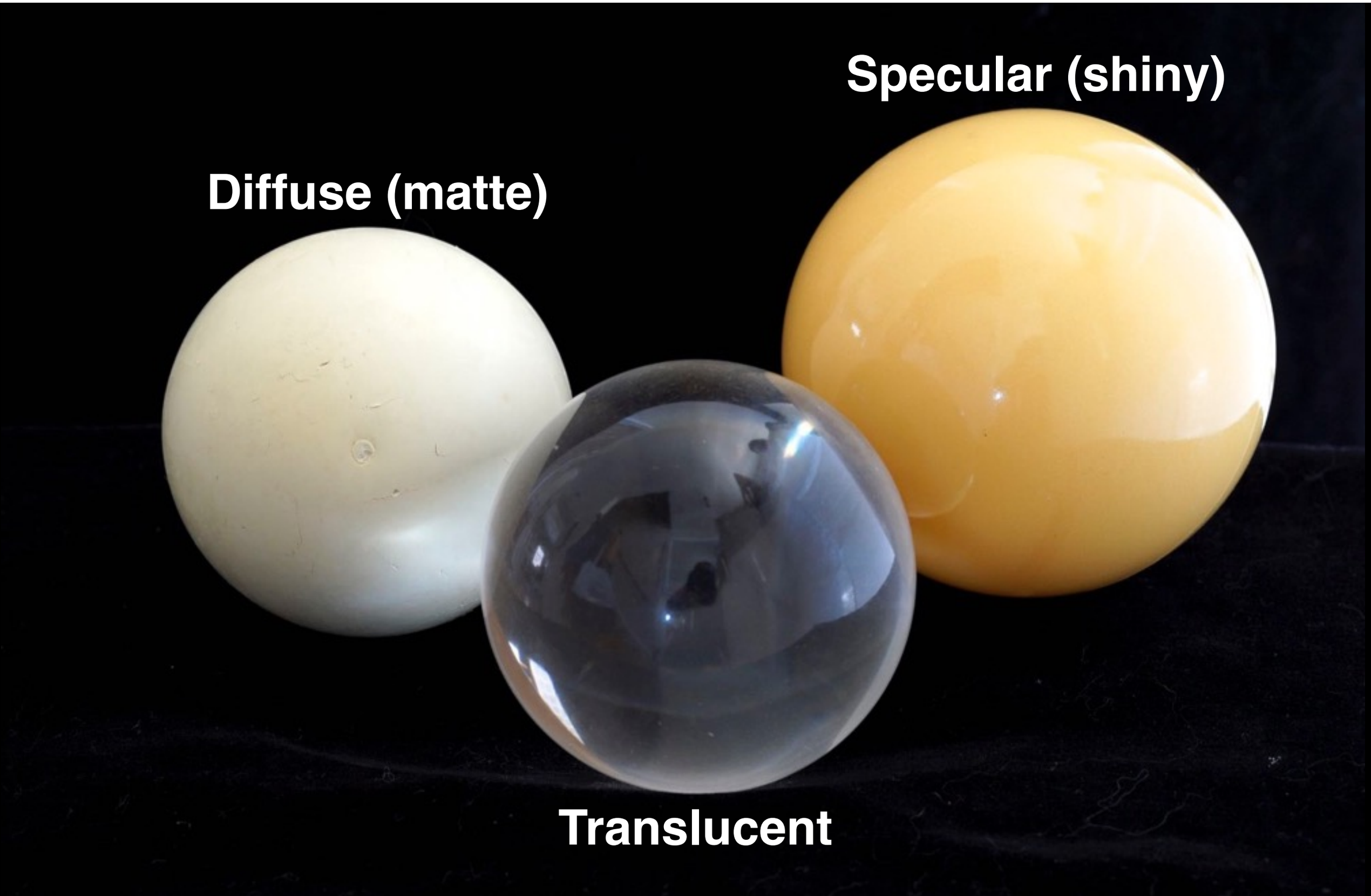
Hack that models a well designed room full of light

Lighting types

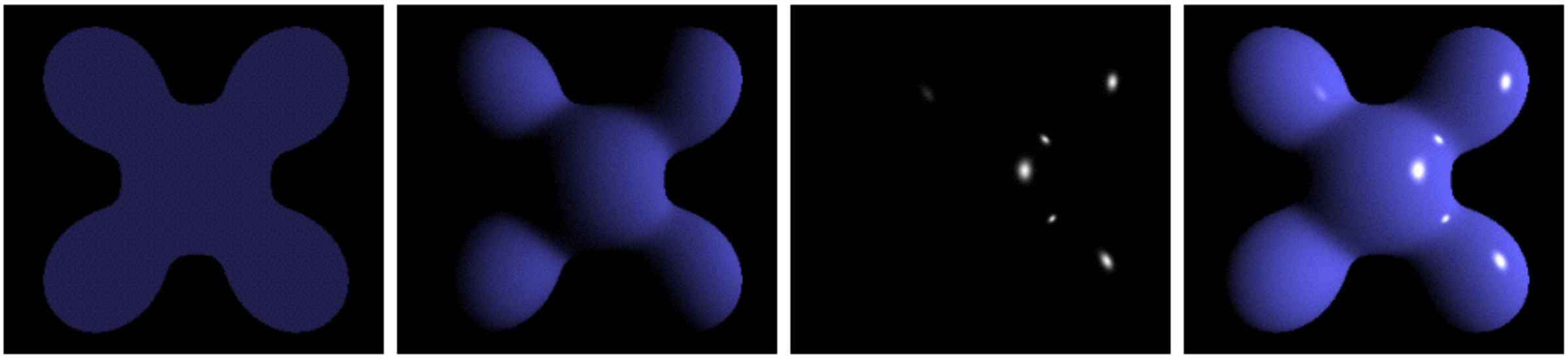




Material types



Phong lighting model



Luminance

$$I = \begin{pmatrix} I_r \\ I_g \\ I_b \end{pmatrix}$$

$$I = I_a + I_d + I_s$$

Phong lighting model

Luminance

$$I = \begin{pmatrix} I_r \\ I_g \\ I_b \end{pmatrix}$$

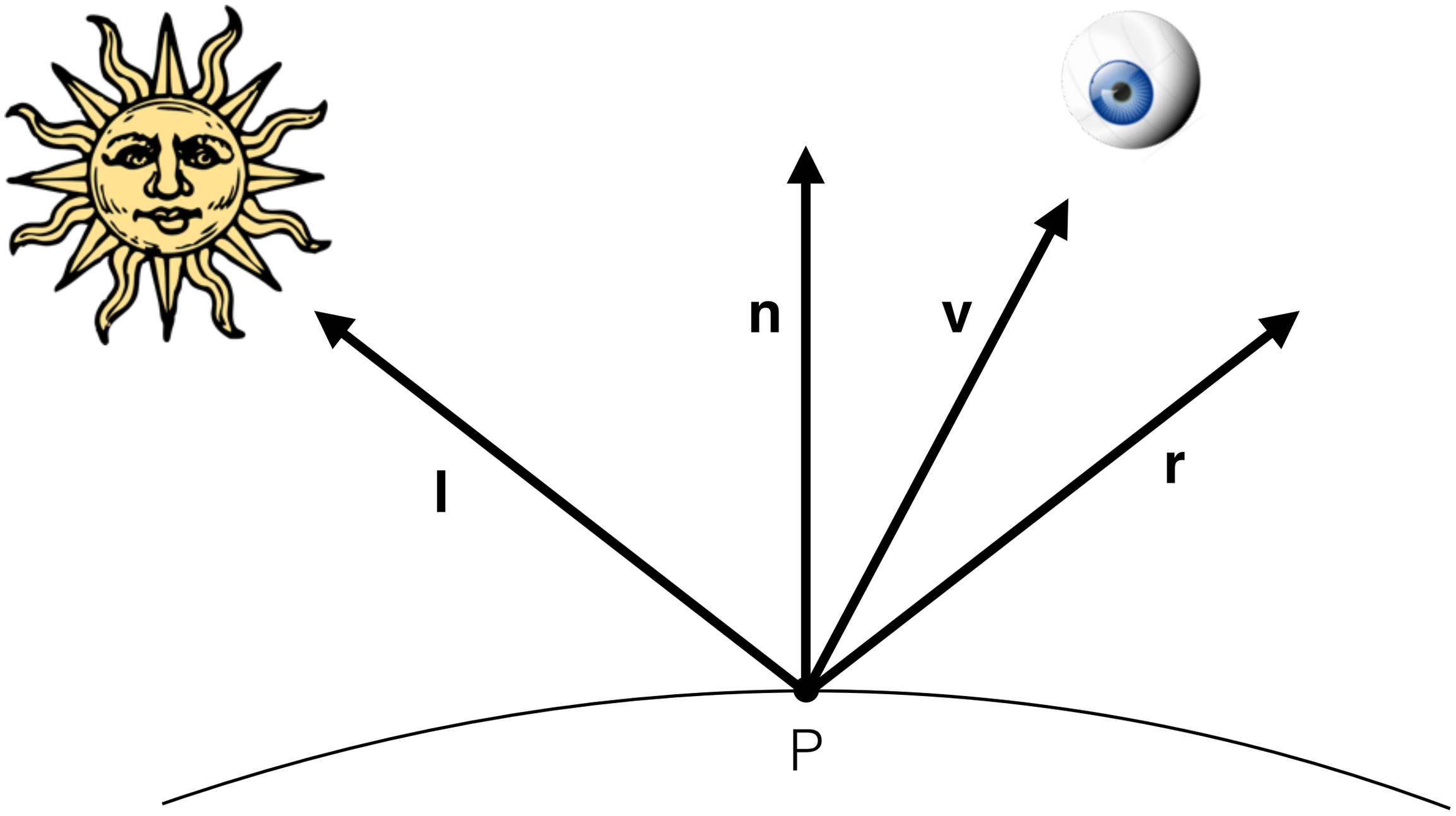
$$L_i = \begin{bmatrix} L_{ira} & L_{iga} & L_{iba} \\ L_{ird} & L_{igd} & L_{ibd} \\ L_{irs} & L_{igs} & L_{ibs} \end{bmatrix}$$

each light is broken into ambient, diffuse and specular components, with each of those broken into the three channels

$$\text{material} = \begin{bmatrix} k_{ra} & k_{ga} & k_{ba} \\ k_{rd} & k_{gd} & k_{bd} \\ k_{rs} & k_{gs} & k_{bs} \end{bmatrix}$$

each surface has material properties or **reflection coefficients** (0 <= k <=1), which tells us how much of the light reflects off of the surface

Principle vectors of the Phong illumination model

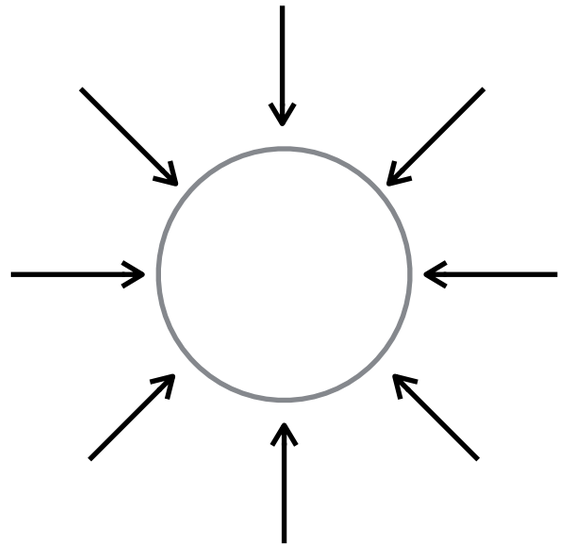


all vectors should be normalized

Ambient lighting

Use the material ambient reflection coefficient to determine the luminance of the light bouncing off of the surface

$$I_a = k_a L_a$$



L_a could be the contribution of a particular light, or a global value

Diffuse lighting

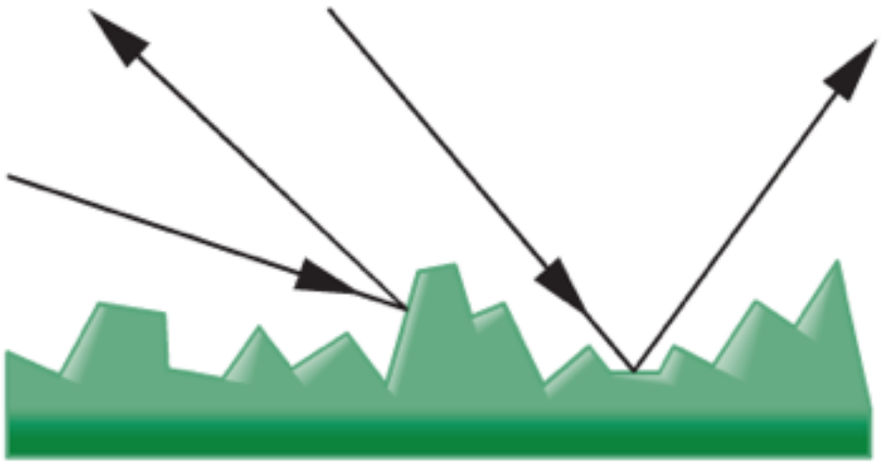


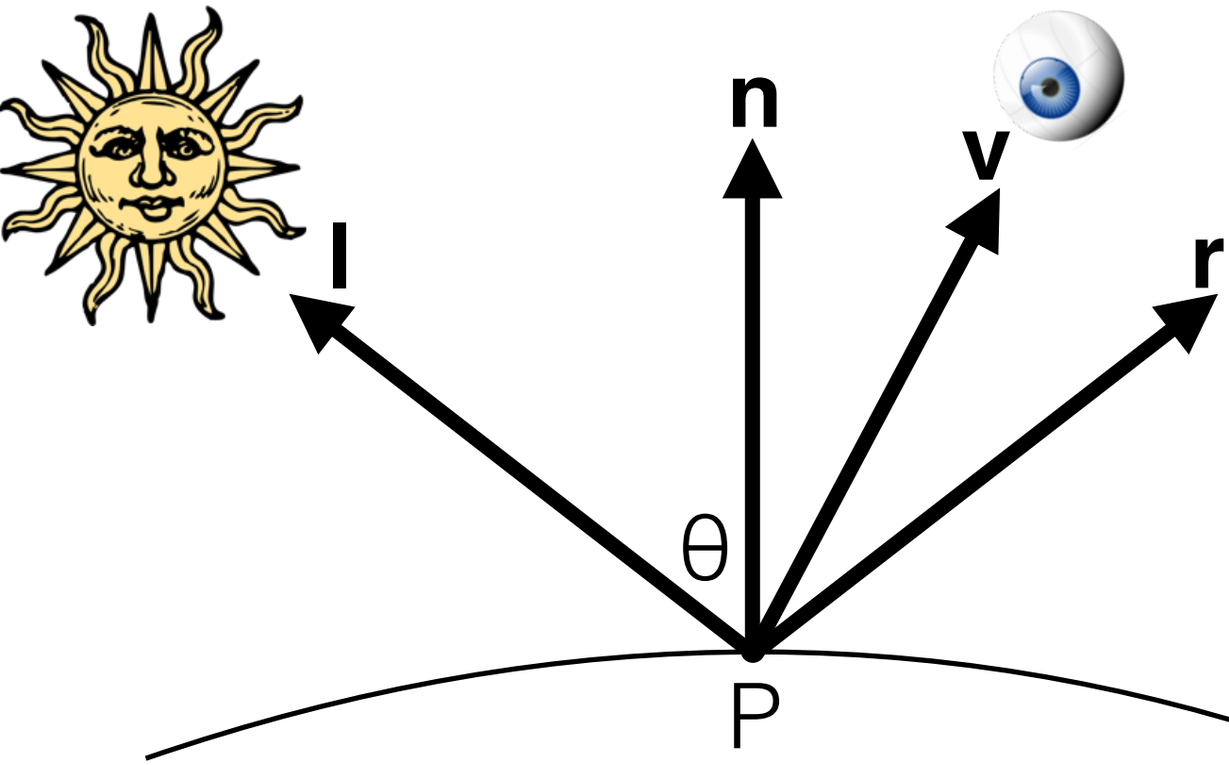
fig 6.14, Interactive Computer Graphics, 7e, Angel and Shreiner

Lambert's Law

the amount of reflected light is proportional to the cos(θ)

L_d — diffuse component of the light

k_d — diffuse reflection coefficient



~~$I_d = k_d(\hat{l} \cdot \hat{n})L_d$~~

$$I_d = k_d \max(0, (\hat{l} \cdot \hat{n})L_d)$$

$$I_d = \frac{k_d}{(a + bd + cd^2)} \max(0, (\hat{l} \cdot \hat{n})L_d)$$