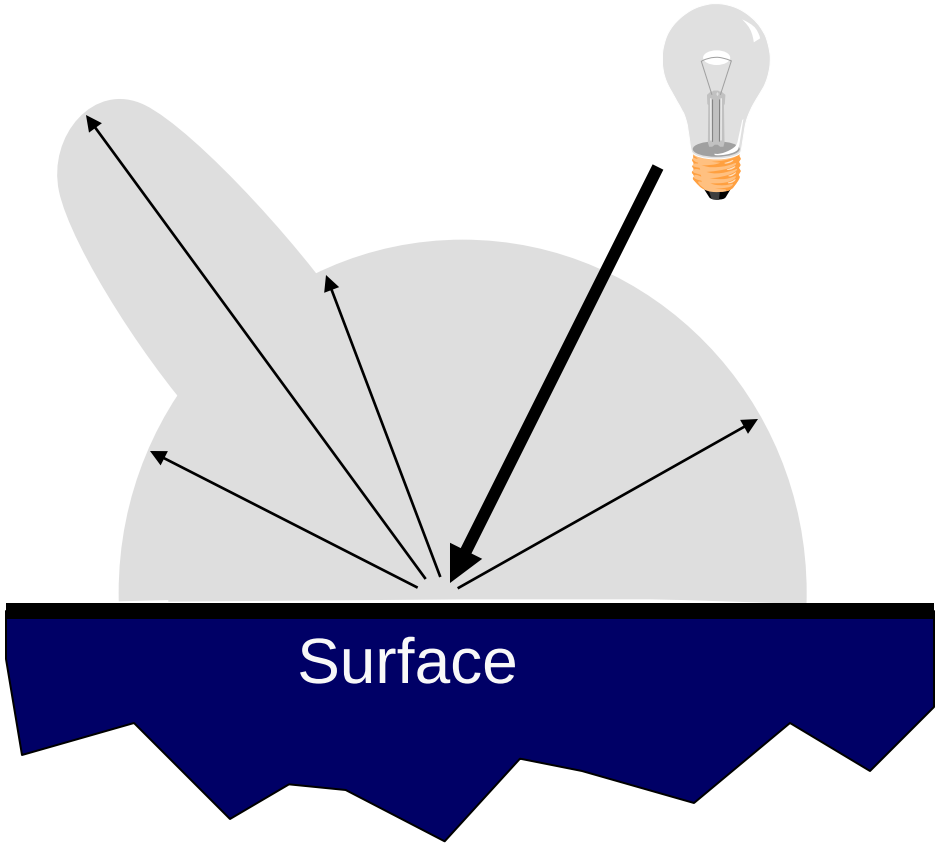

# Illumination

COS 426

# OpenGL Reflectance Model


- Simple analytic model:
  - diffuse reflection +
  - specular reflection +
  - emission +
  - “ambient”

Based on model proposed by Phong



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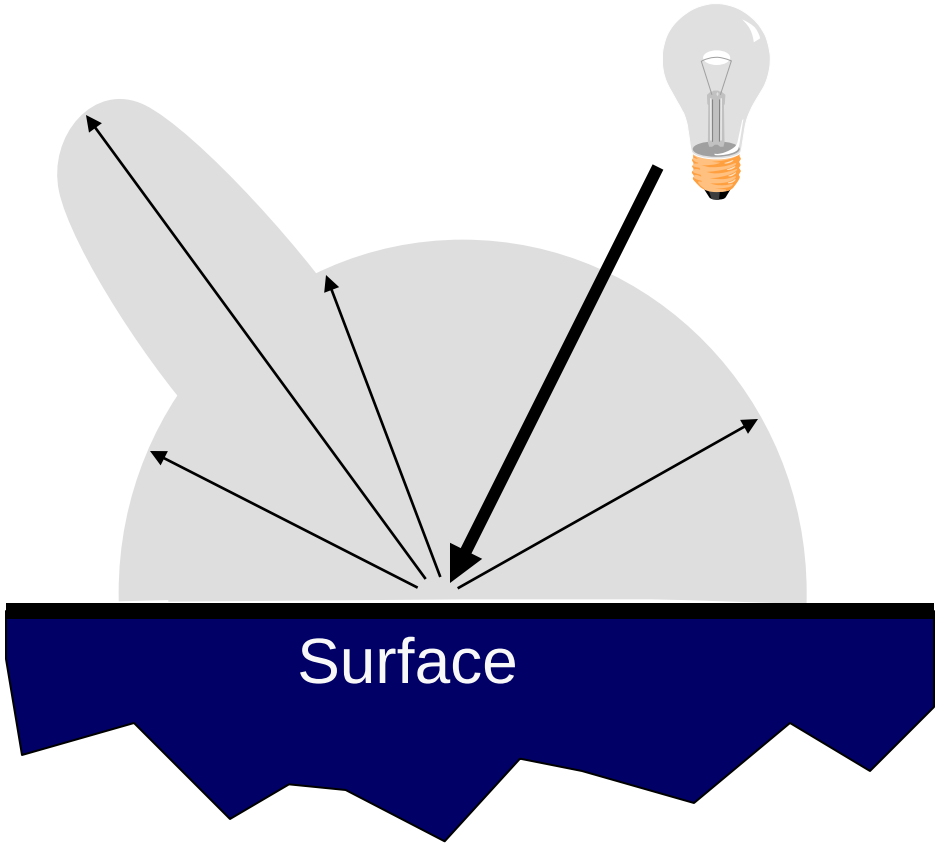
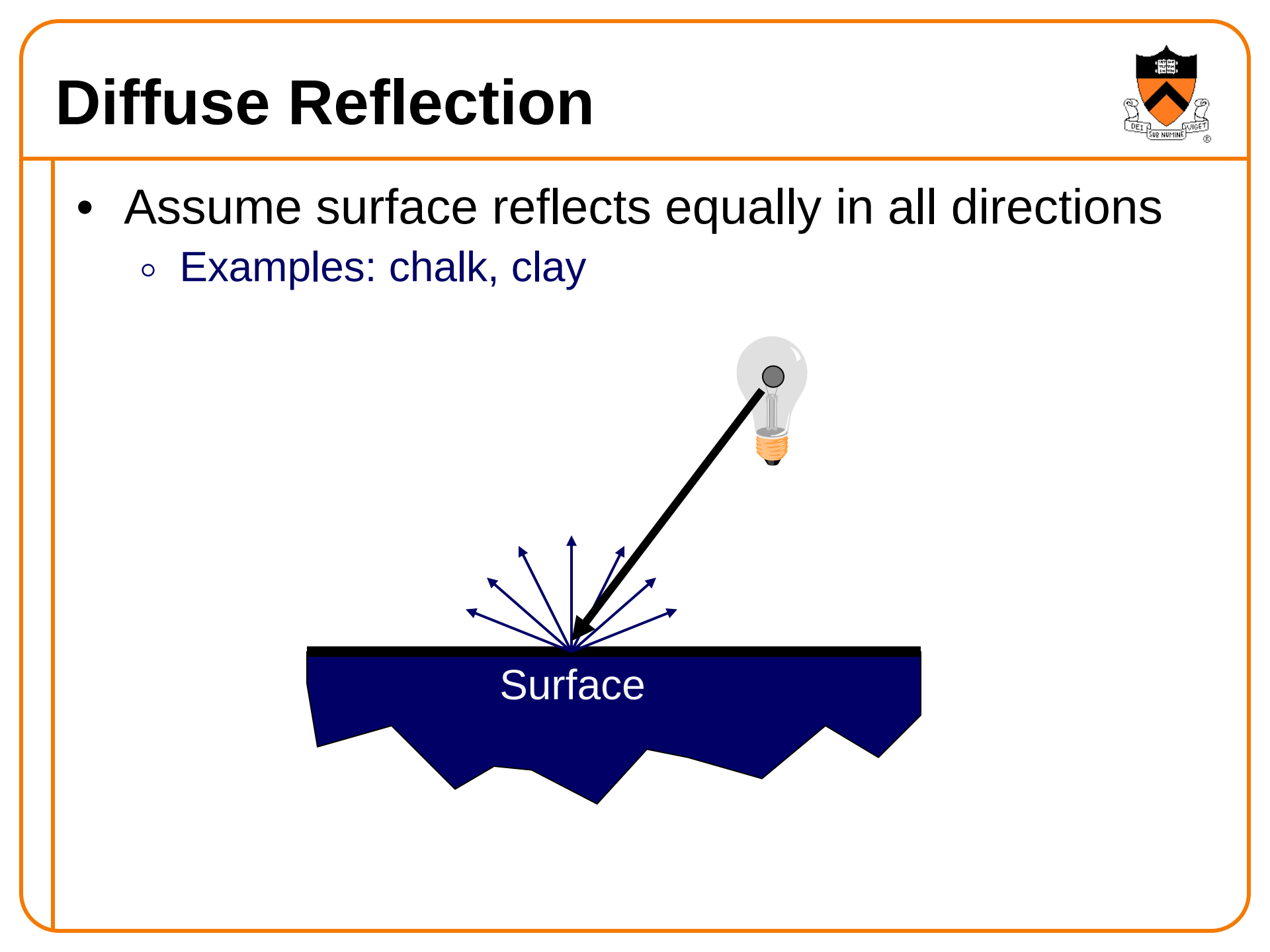


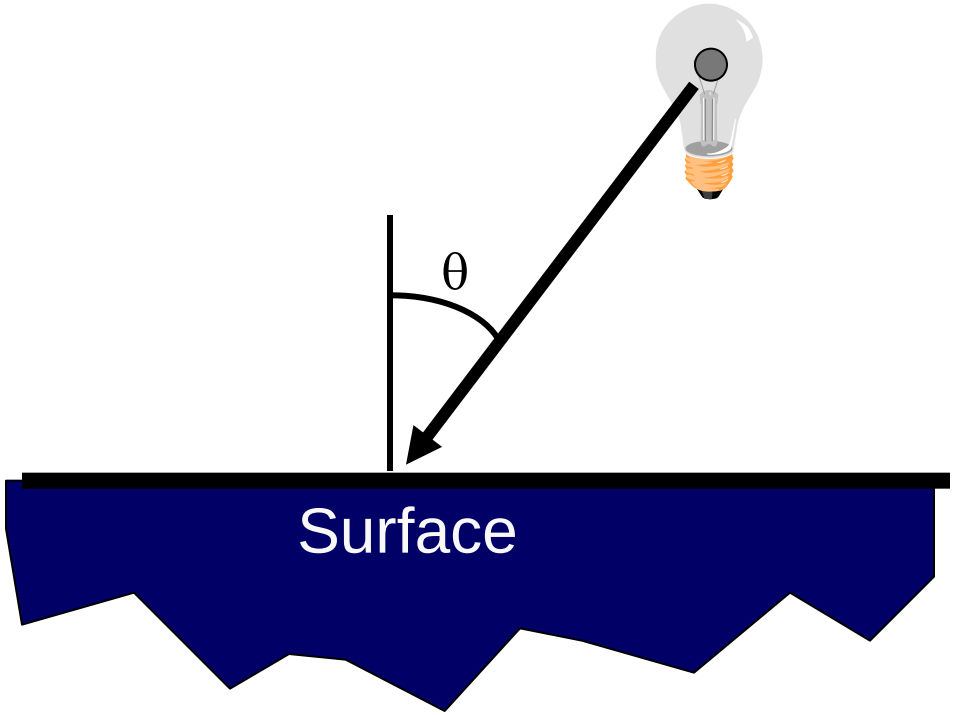
# Diffuse Reflection



- Assume surface reflects equally in all directions
  - Examples: chalk, clay

# Diffuse Reflection

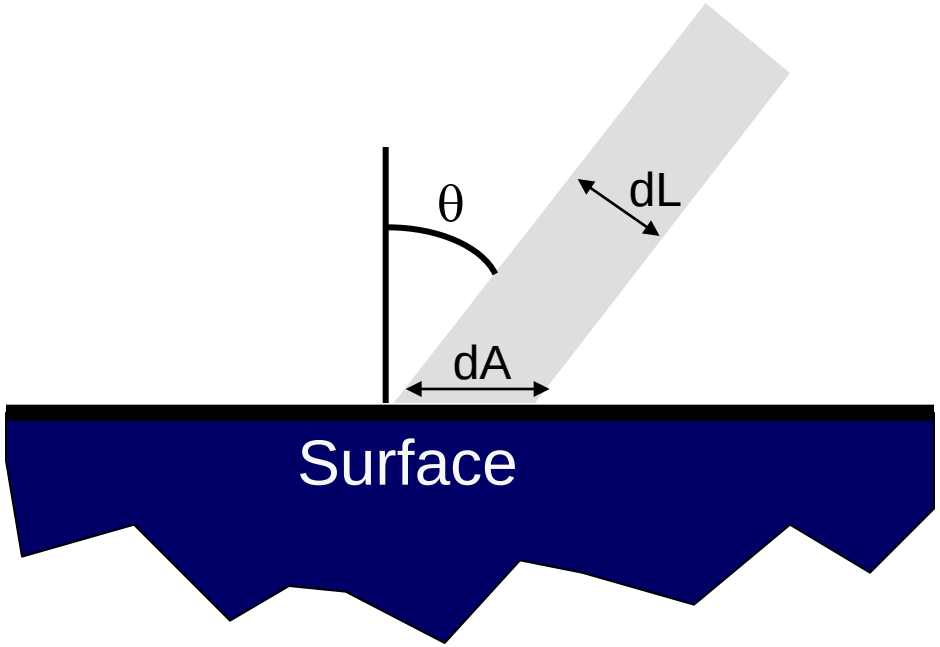
- How much light is reflected?
  - Depends on angle of incident light



# Diffuse Reflection

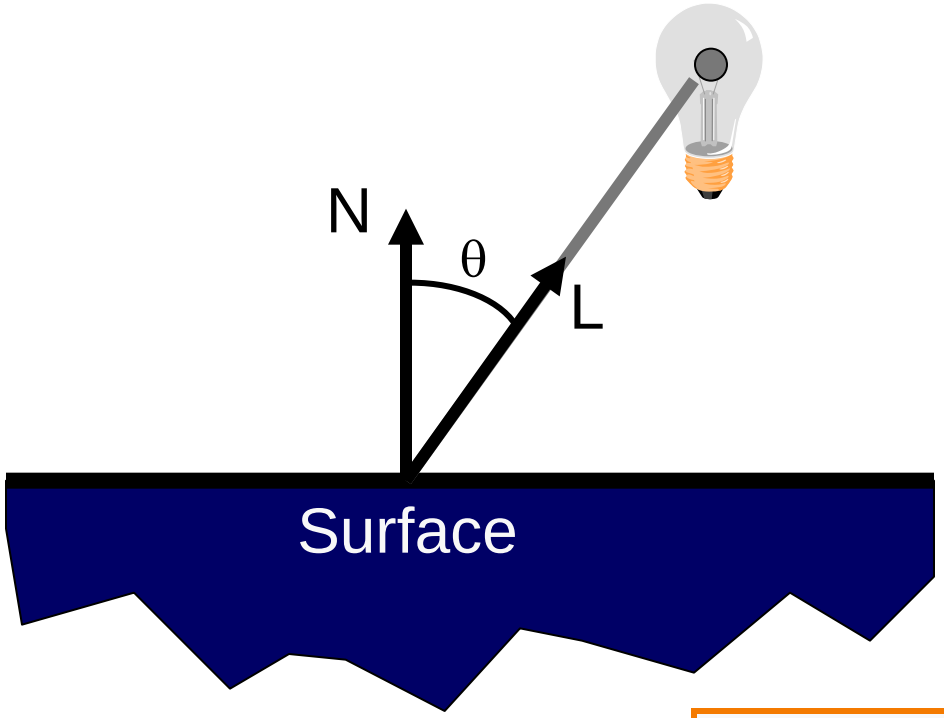
- How much light is reflected?
  - Depends on angle of incident light

$$dL = dA\cos\Theta$$



# Diffuse Reflection

- Lambertian model
  - cosine law (dot product)




$$I_D = K_D(N \bullet L)I_L$$

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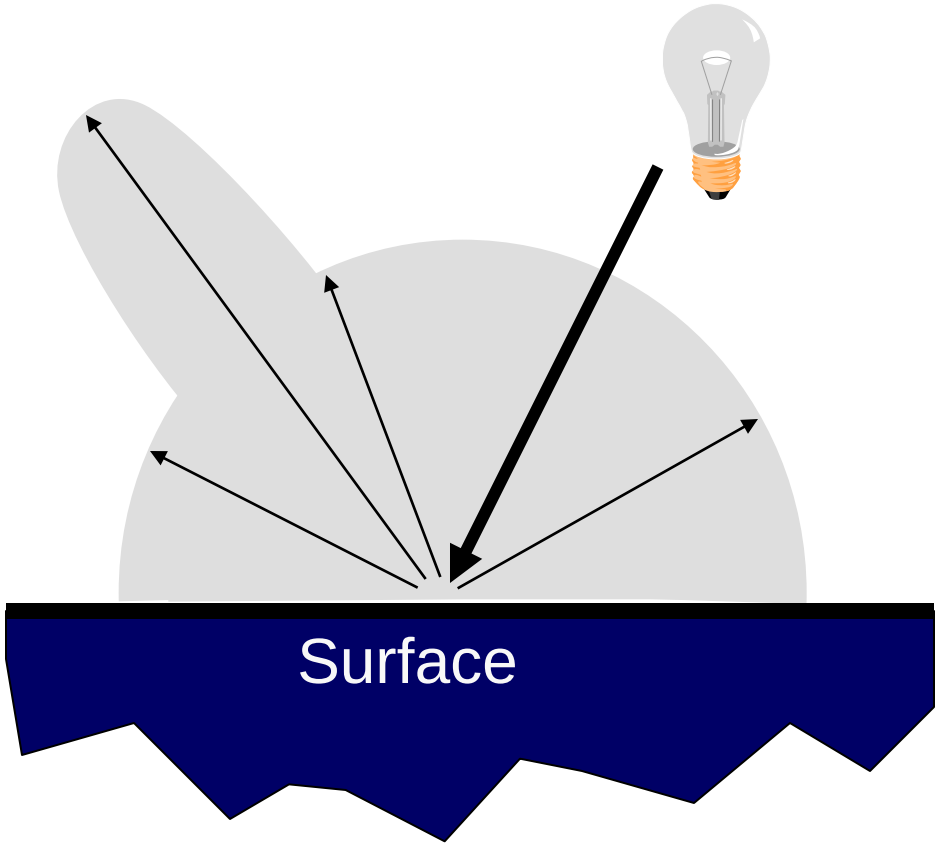
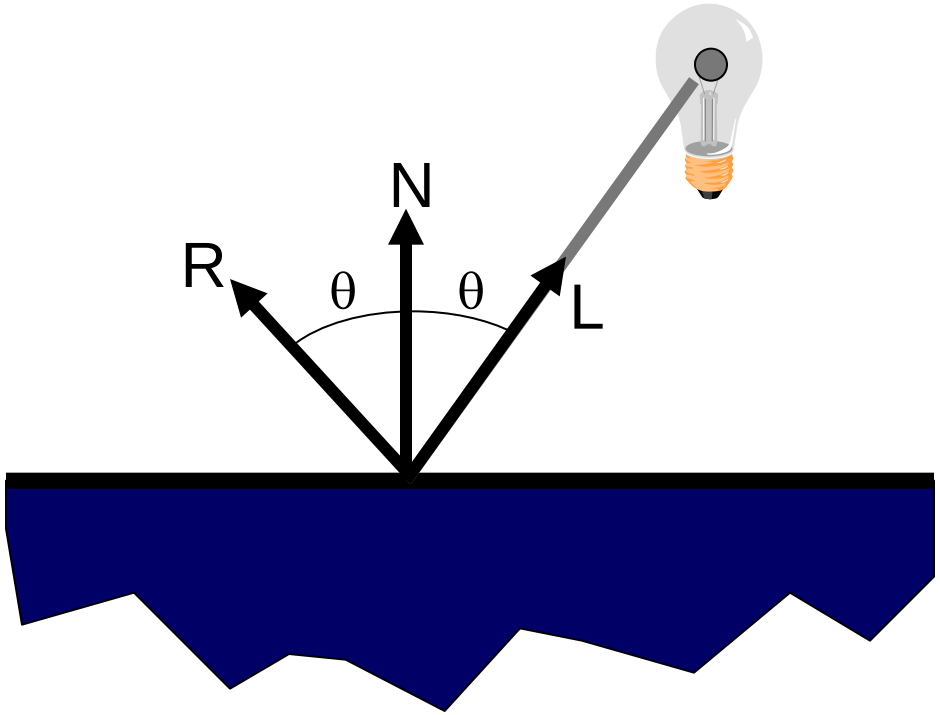


# Specular Reflection

- Reflection is strongest near mirror angle
  - Examples: mirrors, metals

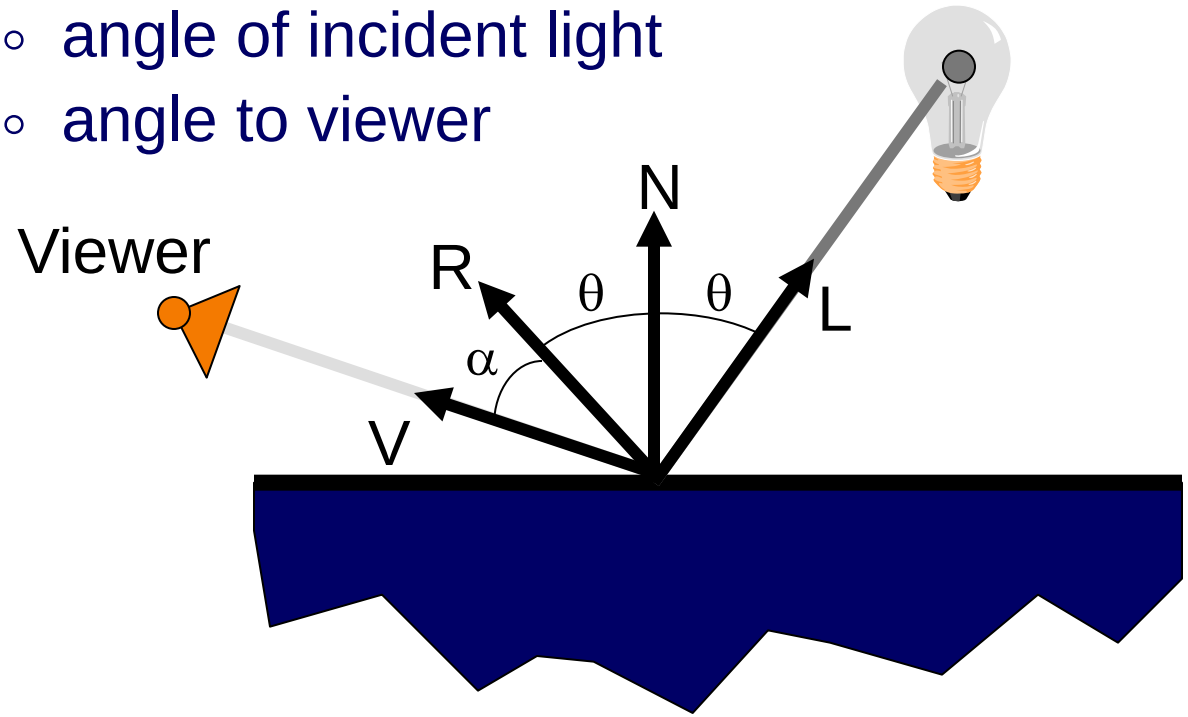


# Specular Reflection

How much light is seen?

Depends on:

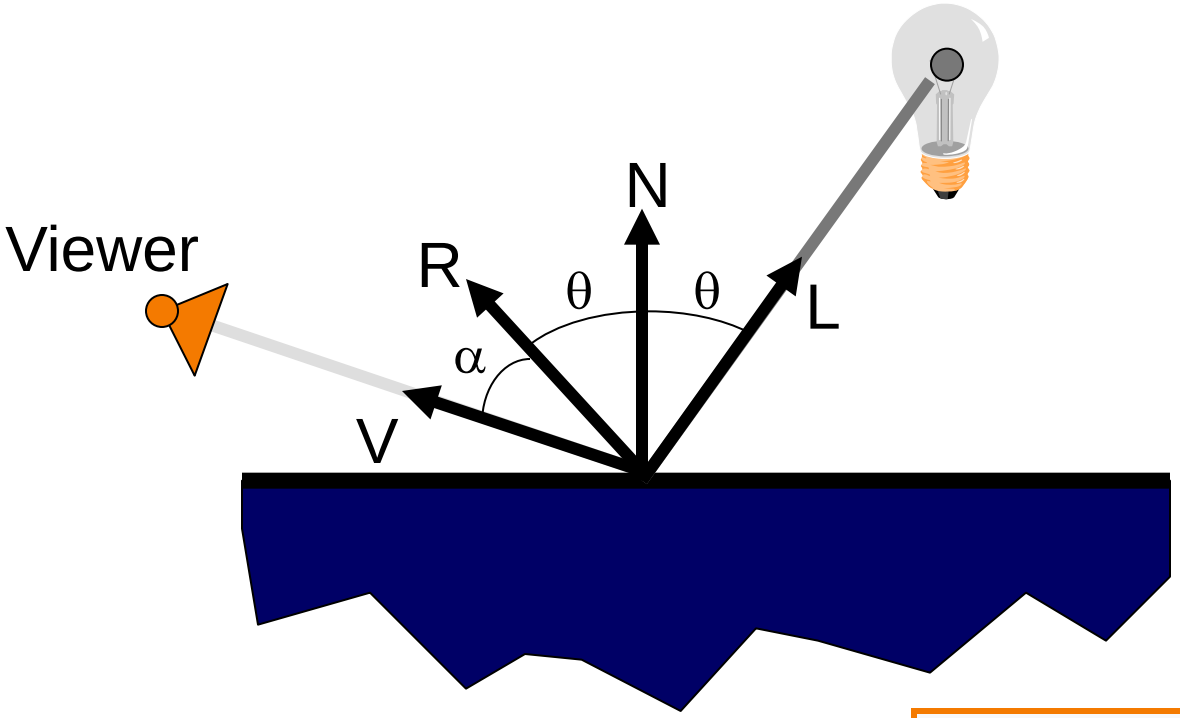
- angle of incident light
- angle to viewer



# Specular Reflection

- Phong Model
  - $\cos(\alpha)^n$

This is a physically-motivated hack!




$$I_S = K_S (V \bullet R)^n I_L$$

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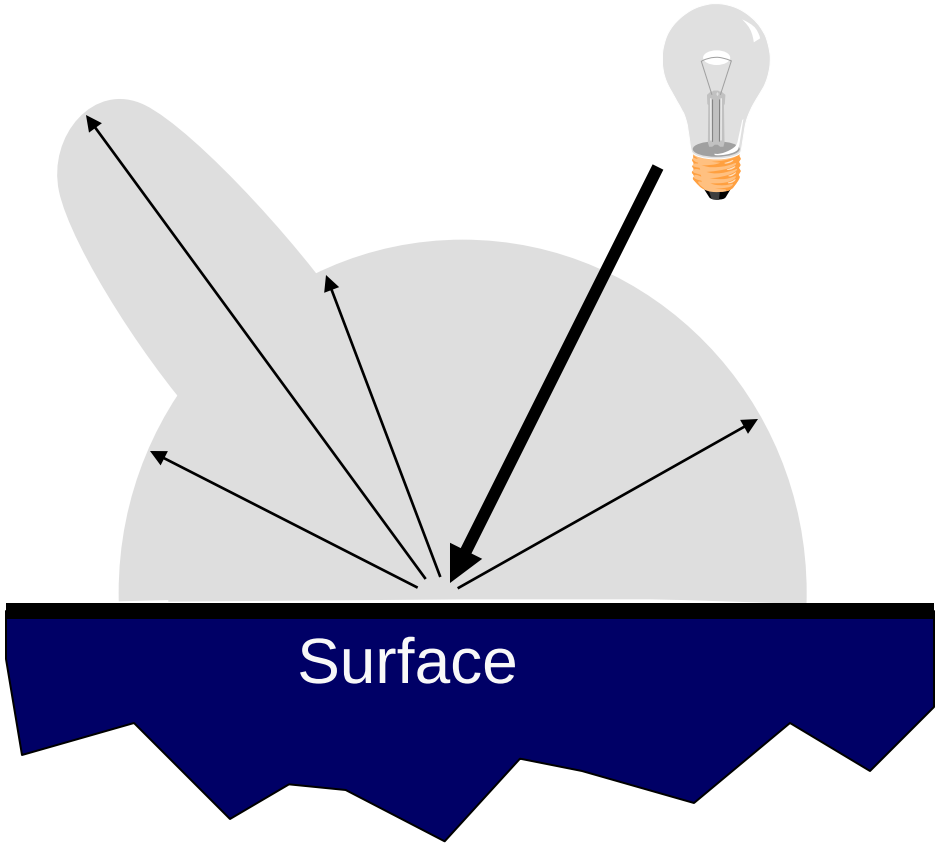
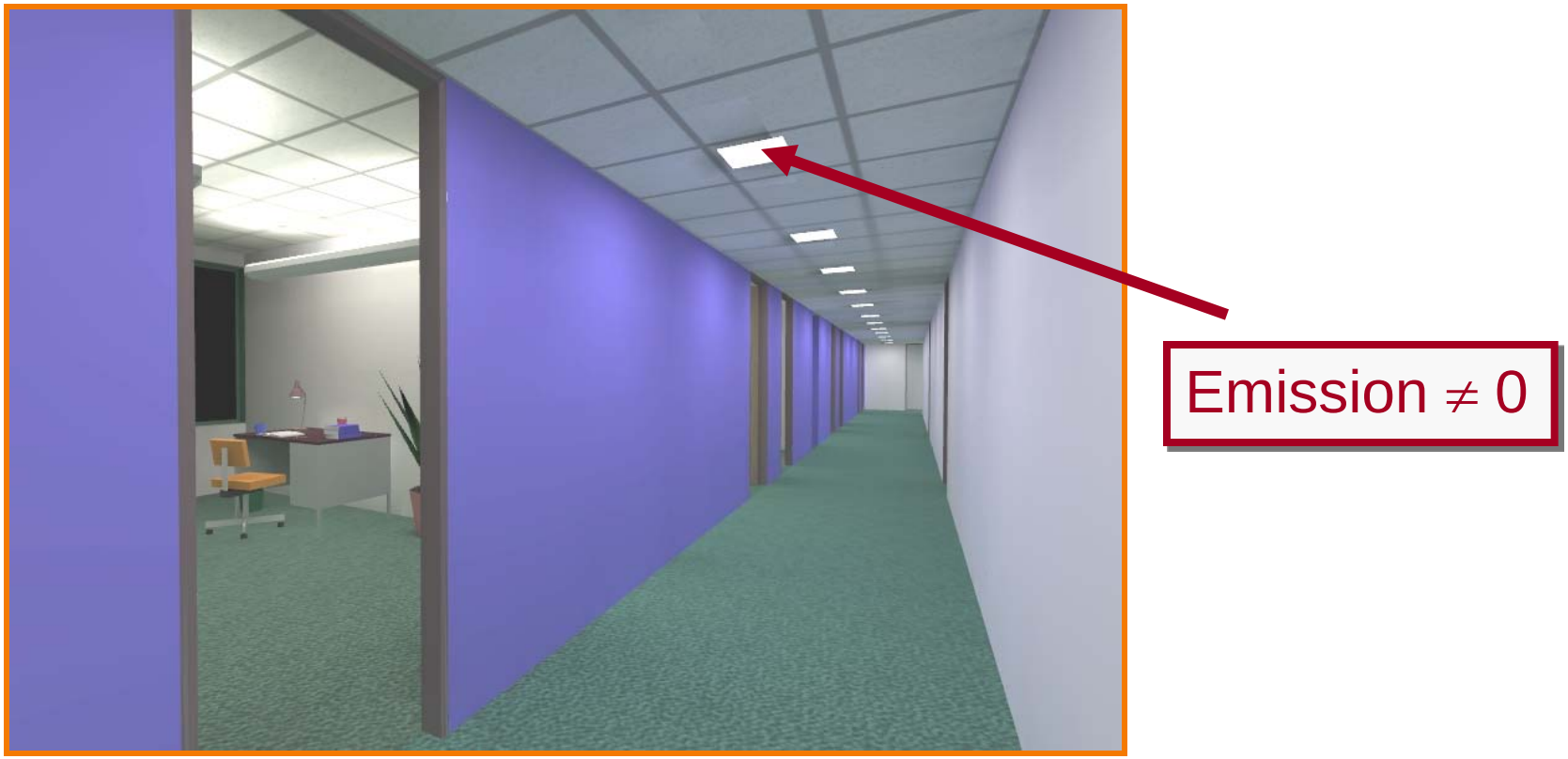


# Emission




- Represents light eminating directly from polygon
  - Note: does not automatically act as light source!
    Does not affect other surfaces in scene!

# OpenGL Reflectance Model


- Simple analytic model:
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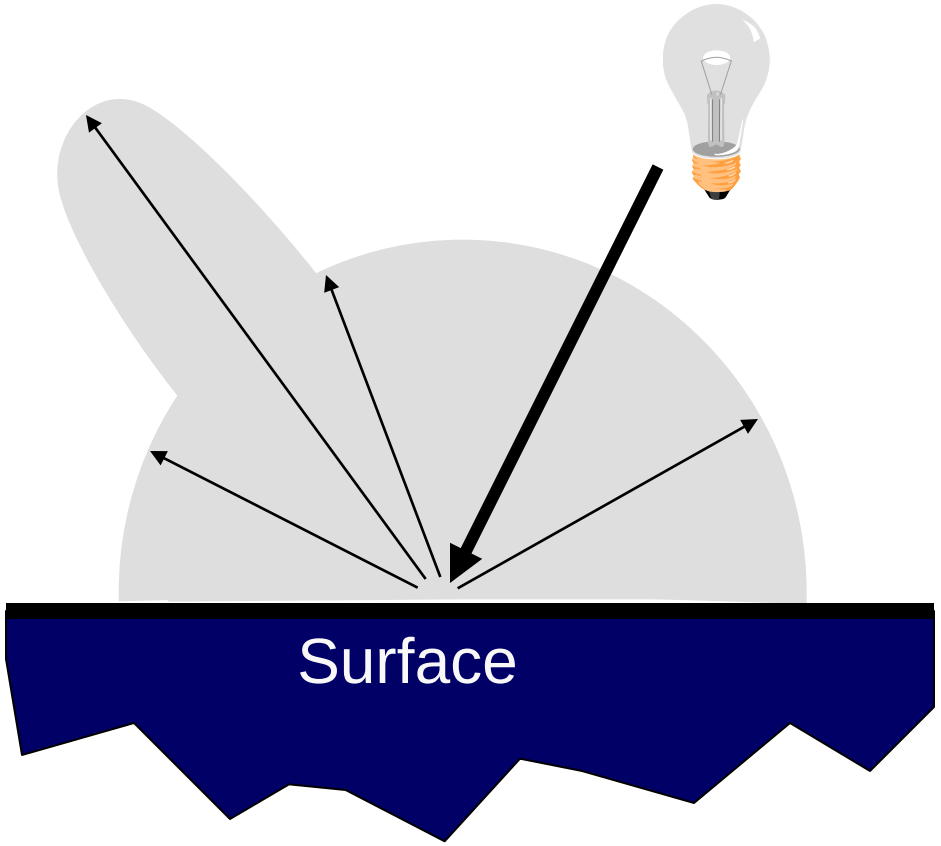
  - specular reflection +
  - emission +
  - “ambient”



# Ambient Term




- Represents reflection of all indirect illumination

This is a total hack (avoids complexity of global illumination)!

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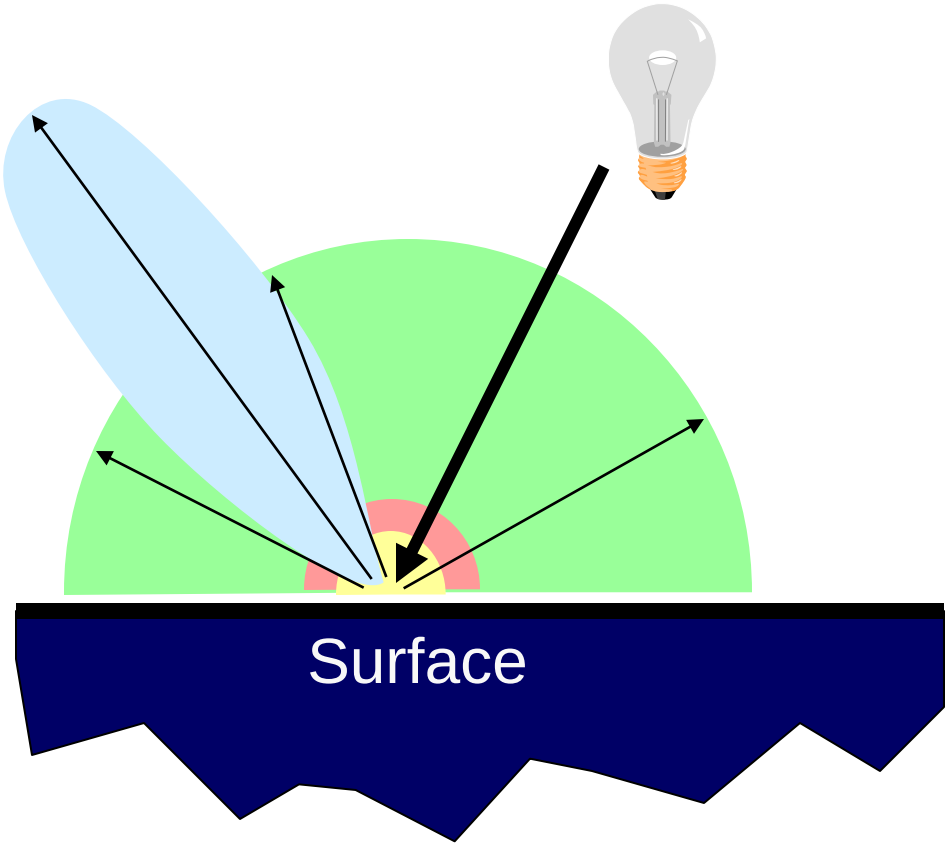
  - emission +
  - “ambient”



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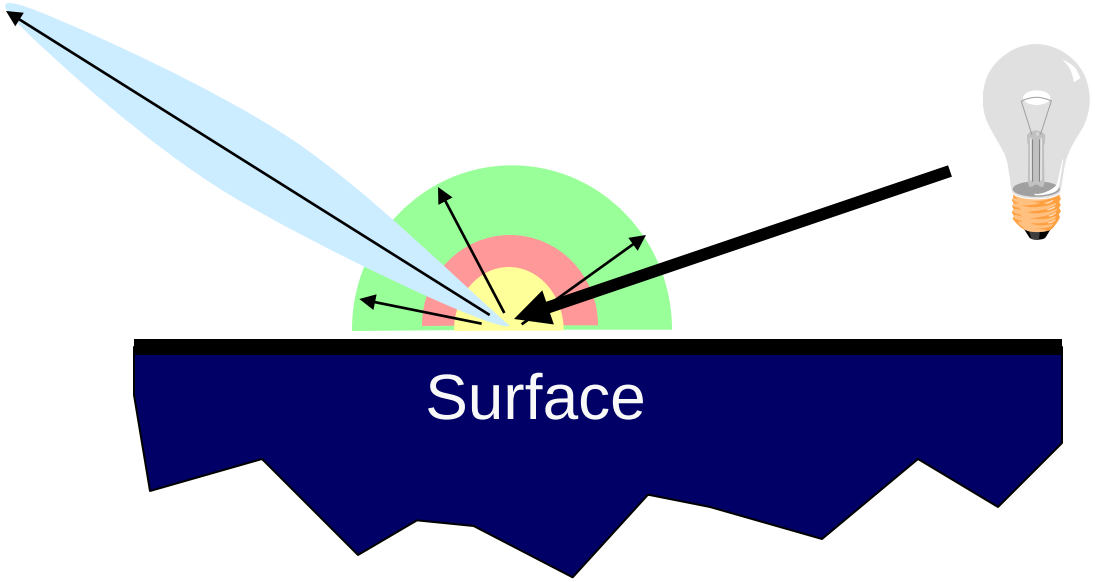
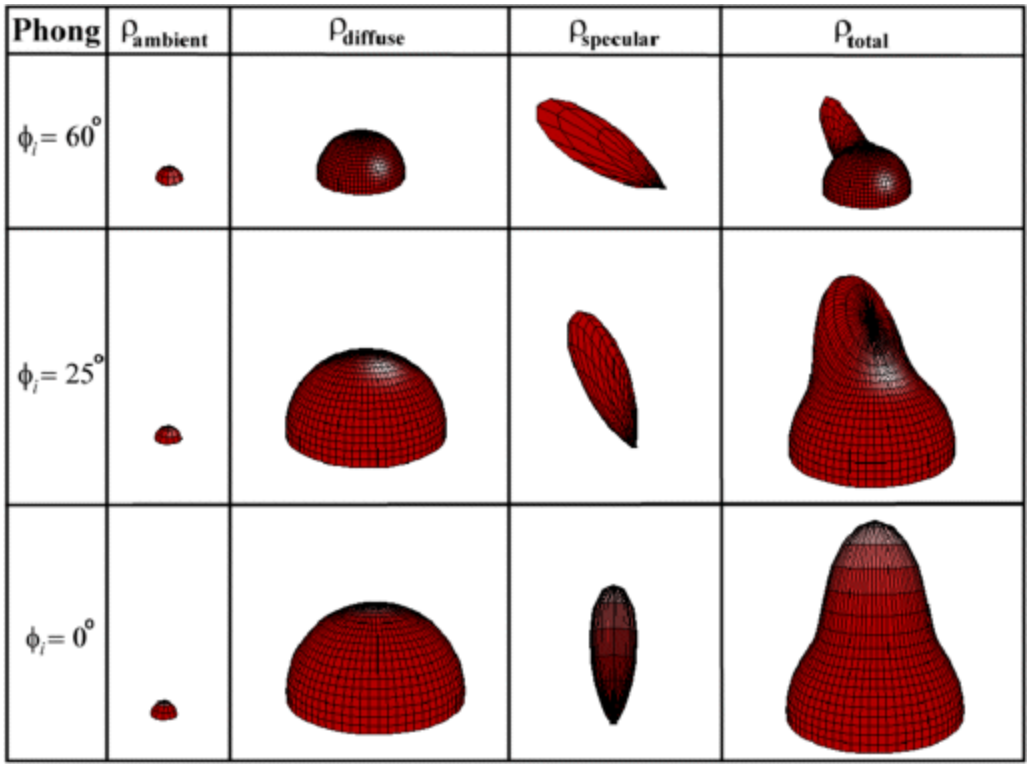


# OpenGL Reflectance Model

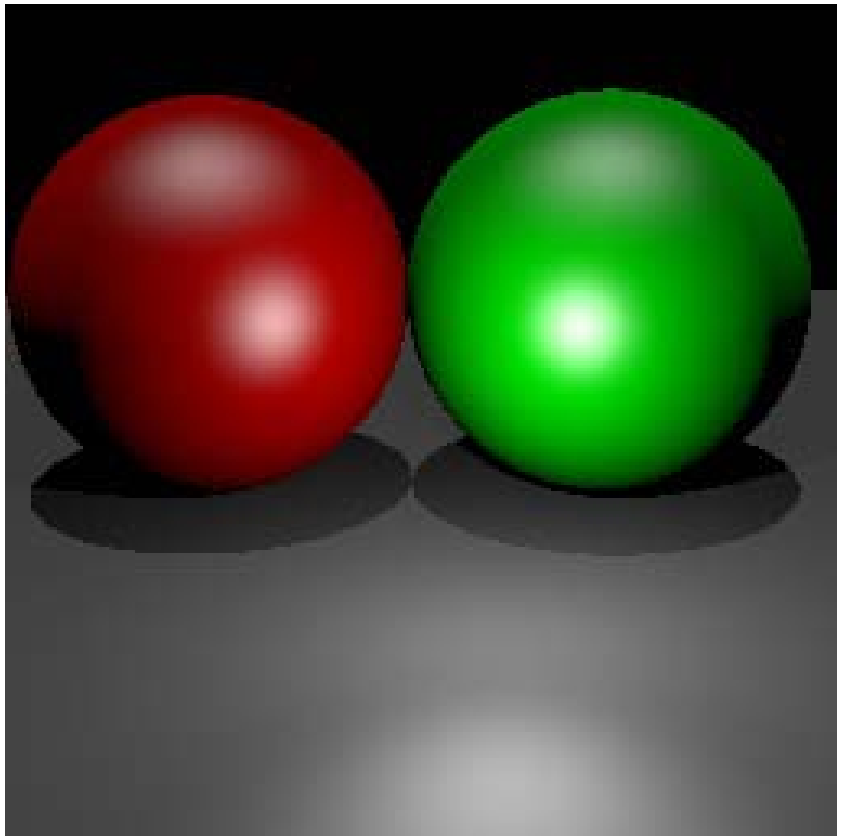
- Sum diffuse, specular, emission, and ambient



# OpenGL Reflectance Model

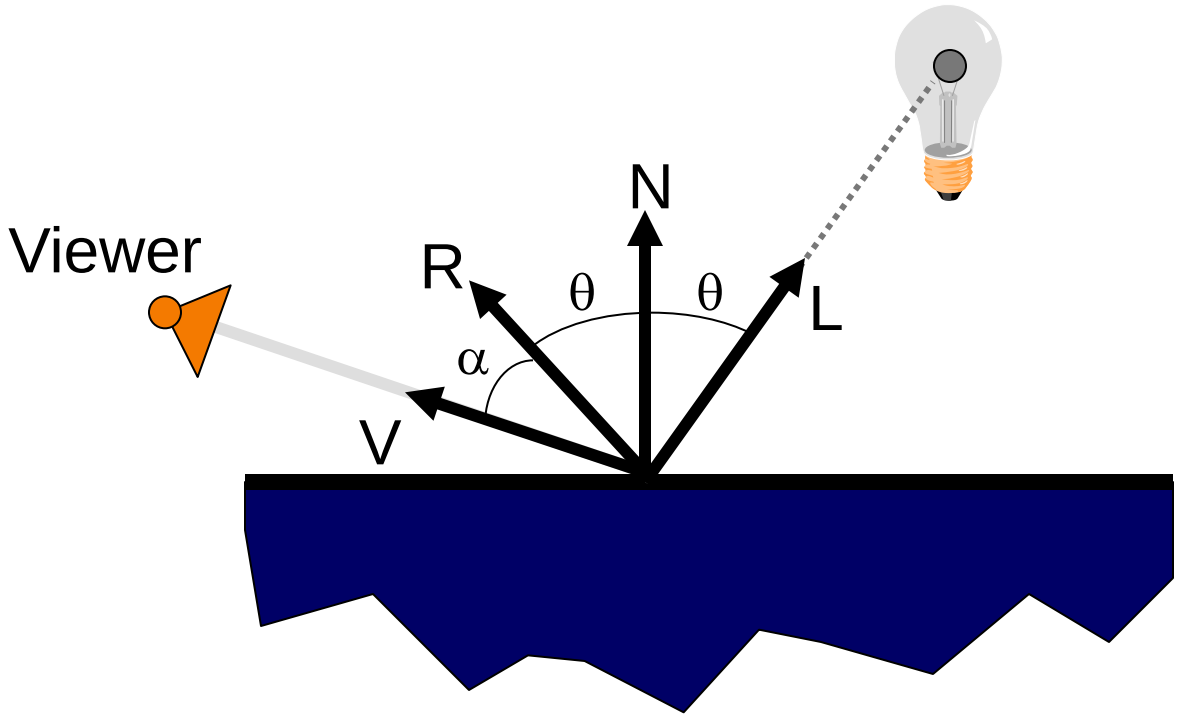


- OK for plastic surfaces, …



# Direct Illumination Calculation

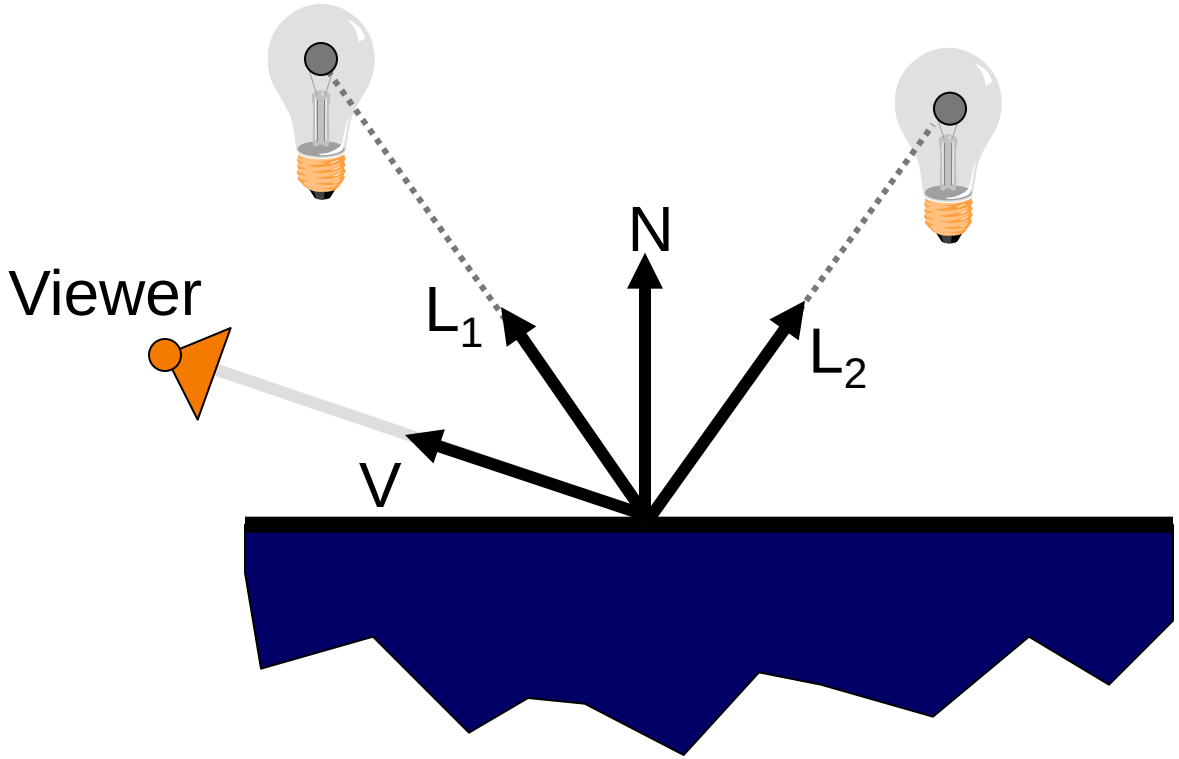
- Single light source:




$$I = I_E + K_A I_{AL} + K_D (N \bullet L) I_L + K_S (V \bullet R)^n I_L$$

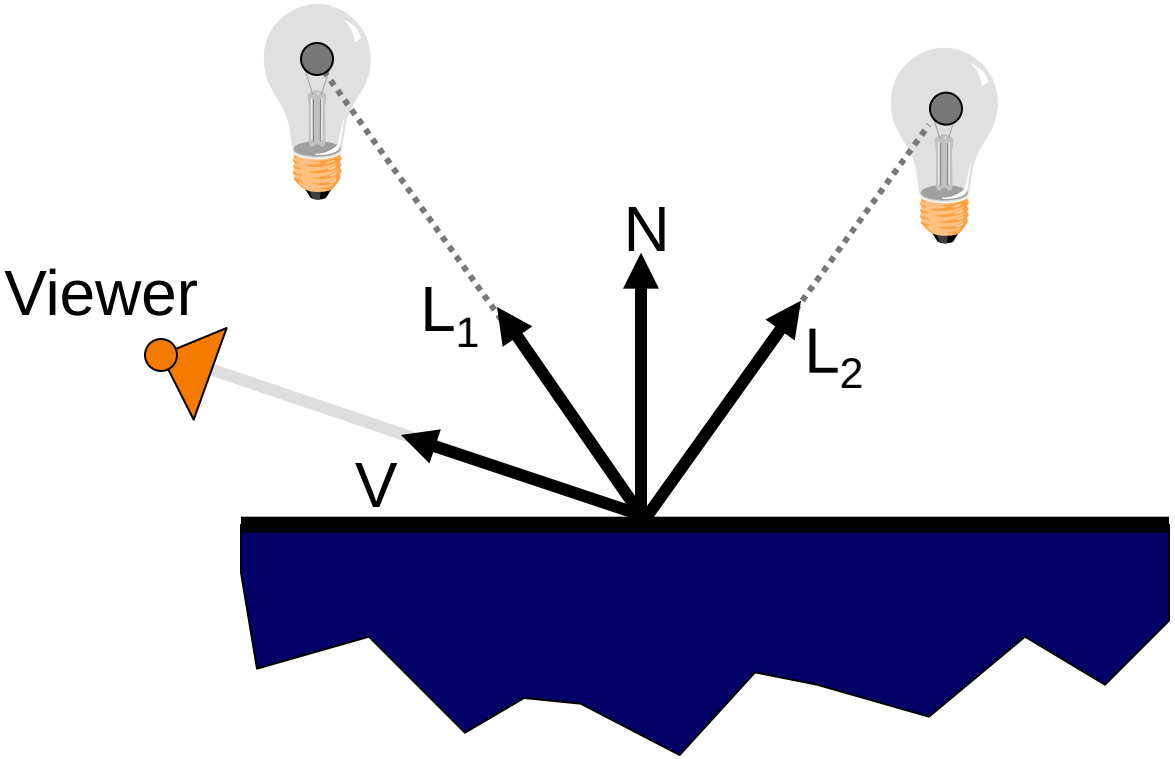
# Direct Illumination Calculation

- Multiple light sources:




$$I = I_E + K_A I_{AL} + \sum_i (K_D (N \bullet L_i) I_i + K_S (V \bullet R_i)^n I_i)$$

# Direct Illumination Calculation




- Multiple light sources:

Note: this is shorthand for $(I_r, I_g, I_b)$

$$I = I_E + K_A I_{AL} + \sum_i (K_D (N \bullet L_i) I_i + K_S (V \bullet R_i)^n I_i)$$