

Basic Shading

Phong Reflection Model

For each vertex p compute, a color for the vertex using the following reflection model for each of the Red, Green, and Blue color channels:

$$I = k_d I_d \mathbf{l} \cdot \mathbf{n} + k_s I_s (\mathbf{v} \cdot \mathbf{r})^a + k_a I_a$$

k : reflectance coefficient in $[0, 1]$

\mathbf{l} : unit vector from vertex to light

\mathbf{n} : unit surface normal at the vertex

\mathbf{v} : unit vector in the direction of the viewer

\mathbf{r} : unit vector in the mirror reflectance direction

a : shininess coefficient in $[0, \infty]$

I : Illumination indicates light intensity in $[0, 1]$

subscripts d , s , and a : diffuse, specular, and ambient

1. Shading a Vertex

Suppose we have the following values for a given color channel:

$$\mathbf{n} = \langle 0, 1, 0 \rangle$$

$$\mathbf{v} = \langle 0, 1/\sqrt{2}, 1/\sqrt{2} \rangle$$

$$\mathbf{l} = \langle 0, 1/\sqrt{2}, -1/\sqrt{2} \rangle$$

$$a = 5$$

$$k_d = 1/\sqrt{2}$$

$$I_d = 1$$

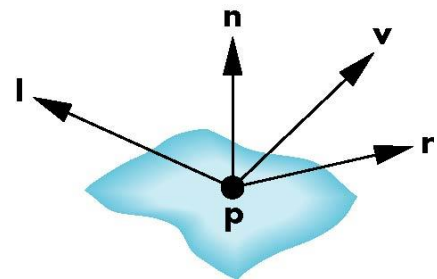
$$k_s = 1/4$$

$$I_s = 1$$

$$k_a = 1/4$$

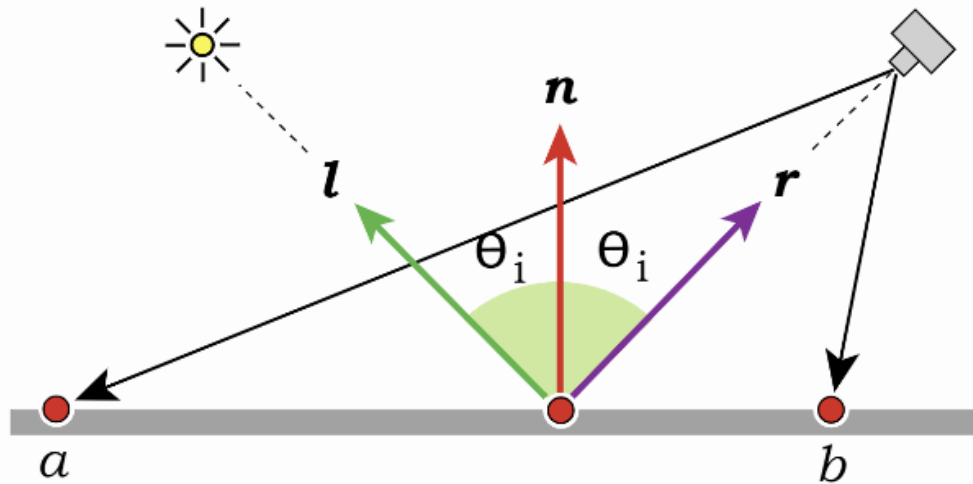
$$I_a = 1/4$$

Compute the vector $\mathbf{r} = 2(\mathbf{l} \cdot \mathbf{n})\mathbf{n} - \mathbf{l}$



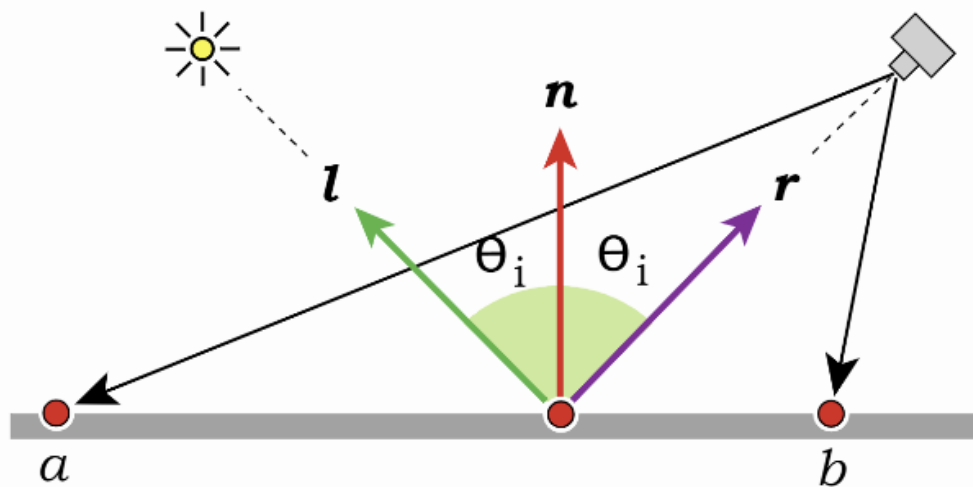
Compute the illumination in the color channel as a rational number.
The radical terms like $1/\sqrt{2}$ should cancel out in this example.

2. Specular Reflection



Using the Phong Model, which of point a and point b exhibits greater specular reflection? Sketch the required vectors at point to support your claim.

3. Diffuse Reflection



Using the Phong Model, which of point a and point b exhibits greater diffuse reflection? Sketch the required vectors at point to support your claim.

4. Barycentric Coordinates

Suppose the triangle below were equilateral and p is the centroid.

What are the barycentric coordinates of p , p_1 , p_2 , and p_3 ?

If p_0 is assigned the color $(1,1,0)$ and p_1 is $(1,1,1)$ and p_3 is $(0,0,1)$, what color would interpolation generate for p ?

