

Material Properties

Lecture 19

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Outline

- 1 The Lighting Model
- 2 Material Properties
- 3 The Lighting Calculations

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The Lighting Model

- We discussed the lighting model, with its three kinds of light.
 - Ambient – From all directions, reflected in all directions
 - Diffuse – From one direction, reflected in all directions
 - Specular – From one direction, reflected in one narrow range of directions

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Material Properties

- We may give objects corresponding **reflective** properties.
 - **Material ambient** – Reflectivity of ambient light
 - **Material diffuse** – Reflectivity of diffuse light
 - **Material specular** – Reflectivity of specular light
 - **Material shininess** – How shiny the specular reflection is.

Material Ambient and Diffuse

- Typically, material ambient and material diffuse reflect the innate color of the material.
- Thus, they are usually given the same value as the vertex attribute `vColor` (which we will no longer use).
- That is what our model has implicitly done.

Material Ambient and Diffuse

```
vec3 mat_amb(1.0f, 0.5f, 0.0f);  
GLuint mat_amb_loc = glGetUniformLocation(program, "mat_amb");  
glUniform3fv(mat_amb_loc, 1, mat_amb);  
  
vec3 mat_diff(1.0f, 0.5f, 0.0f);  
GLuint mat_diff_loc = glGetUniformLocation(program, "mat_diff");  
glUniform3fv(mat_diff_loc, 1, mat_diff);
```

- We define material ambient and material diffuse and pass them as uniform variables to the shaders.

Material Specular and Shiny

Material Ambient and Diffuse

```
vec3 mat_spec(1.0f, 1.0f, 1.0f);  
GLuint spec_loc = glGetUniformLocation(program, "specular");  
glUniform3fv(spec_loc, 1, specular);
```

```
GLfloat shiny = 20.0f;  
GLuint shiny_loc = glGetUniformLocation(program, "shiny");  
glUniform1f(shiny_loc, 1, shiny);
```

- Because the calculations use only one value for *shiny*, it makes more sense that it be a material property than a light property.
- It can be assigned different values for different objects.

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The Lighting Calculations

- In the shader, we perform calculations similar to before.

$$\mathbf{R} = -\mathbf{L} + 2(\mathbf{L} \cdot \mathbf{N})\mathbf{N}$$

$$r_a = m_a * l_a$$

$$r_d = m_d * l_d * \max(\mathbf{L} \cdot \mathbf{N}, 0)$$

$$r_s = m_s * l_s * \max(\mathbf{R} \cdot \mathbf{V}, 0)^{\text{shiny}}$$

$$\text{color} = r_a + r_d + r_s$$