

CPSC 453: Shading

(Chapter 6.1-6.5, 6.7-6.10)

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Combining all Light Contributions

- output = diffuse + specular + ambient



- $I_d = K_d(l \cdot n)L_d + K_s(r \cdot v)^\alpha L_s + K_a L_a$

Incorporating a Distance Term

- Physically correct light decays proportional to $1/d^2$
- This looks incorrect. Shadows are too sharp.
- In practice we use a term of the following:

$$I = \frac{1}{a+bd+cd^2}(K_d L_d (l \cdot n) + K_s L_s (r \cdot v)^{\alpha}) + K_a I_a$$

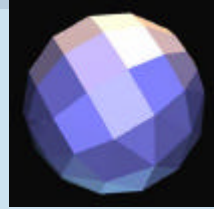
- a, b, c are user defined to “look right”

Adding Color

- We compute an individual I term for each color: I_r, I_g, I_b
- Example
 - ambient = (0.33, 0.22, 0.03)
 - diffuse = (0.78, 0.57, 0.11)
 - specular = (0.99, 0.91, 0.81)
 - shininess 27.8
 - right light = (1.0, 0.0, 0.0)
 - left light = (1.0, 1.0, 1.0)



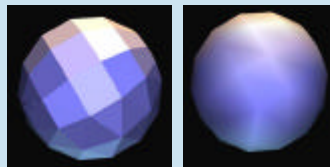
Flat Shading



- Individual faces are visualized
- The same color is used at all points on the face
- The same normal for each vertex
- Good for a distant viewer
- OpenGL: `glShadeModel(GL_FLAT)`

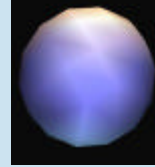
Flat Shading

- Efficient
- Mach band phenomena
- Not suitable for smooth objects



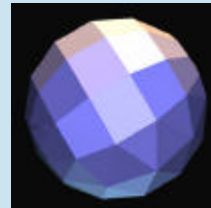
Smooth Shading

- Visualize the underlying surface
- Each vertex has its own normal
- Each point on a face has its own color
- Two interpolation techniques:
 - Phong
 - Gouraud
- OpenGL: `glShadeModel(GL_SMOOTH)`

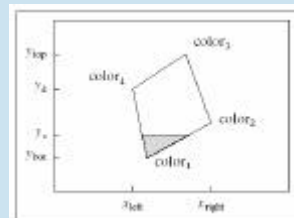


Polygon Fill Routine

```
For each face in the mesh
  for (y=ybot; y<=ytop; y++){
    find xleft and xright
    for (x=xleft; x<= xright; x++){
      * find the color c at (x,y)
      put c into the pixel at (x,y)
    }
  }
}
```

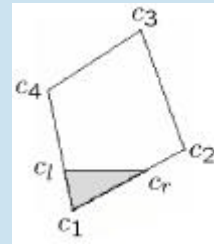


- Flat shading:
 - move * to outside of loops
 - Efficient
 - But often looks bad



Smooth Shading (Gouraud)

- Gouraud shading: interpolate colors between vertices
- Two axes of linear interpolation (bilinear)
- $c_l = (1-\beta)c_1 + \beta c_4$
- $c_r = (1-\gamma)c_1 + \gamma c_2$
- $c = (1-\alpha)c_l + \alpha c_r$
- α, β, γ ?
- More expensive than flat shading



• interpolate the no