

Shader Lighting and Textures

CSCI 4239/5239

**Advanced Computer Graphics
Spring 2013**

Shader Lighting

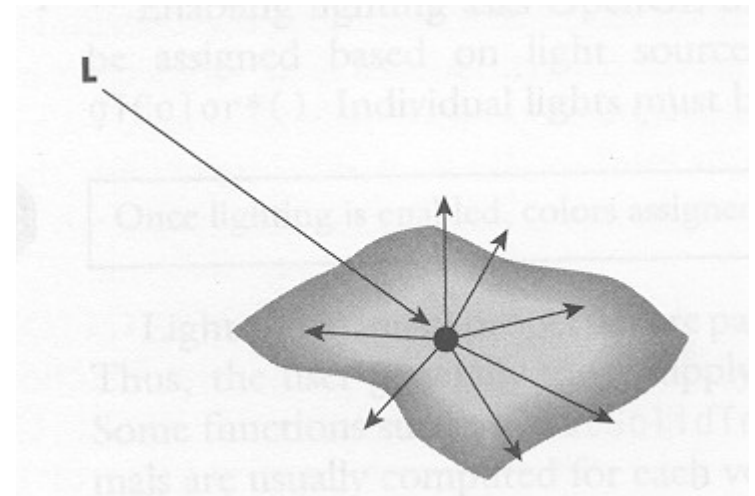
- Ultimate flexibility
 - Lighting method
 - Phong reflection
 - Blinn-Phong reflection
 - Lighting
 - Per vertex with Gouraud shading
 - Per pixel lighting
 - Special effects
 - High Dynamic Range lighting
- Ultimate responsibility
 - Nothing happens automatically

OpenGL Lighting Components

- $C = M_E + M_A(C_A + C_G) + (N \cdot L)M_D C_D + (N \cdot H)^S M_S C_S$
- C_x are light components
- M_x are material components
- Components
 - Emission
 - Ambient (also Global Ambient)
 - Diffuse
 - Specular
- Calculated for each light, vertex, RGBA
- Assumes values in the range 0-1

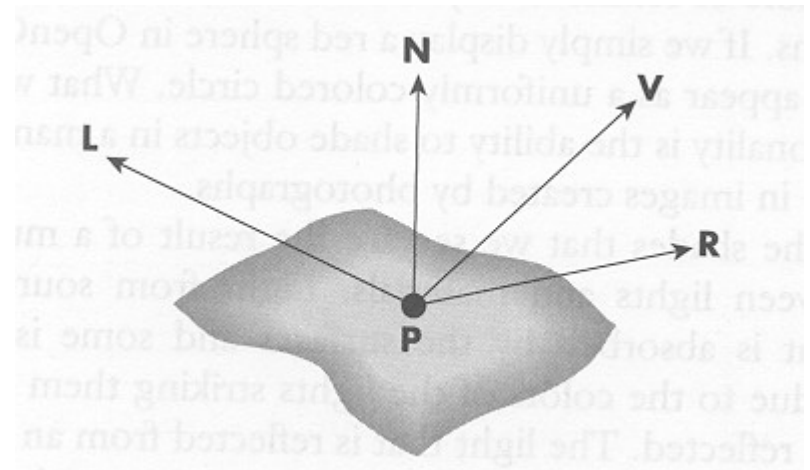
Diffuse Reflections

- Diffuse light scatters in all directions
 - Lambertian reflection
- Intensity depends on cosine of the angle of incidence
- Intensity $(N \cdot L)MC_D$



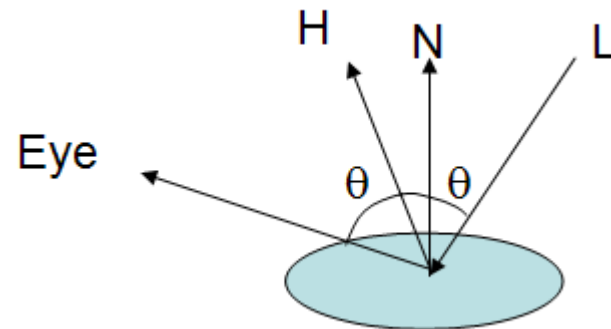
Phong Reflection Model

- L light source
- N normal vector for surface
- R reflected light
 - $R = 2(L \cdot N)N - L$
- V viewer (eye)
- Intensity $(V \cdot R)^S MC$
 - S shininess
 - M material reflection coefficient
 - C color of light source
- Calculated independently for R,G,B



Blinn-Phong Reflection Model

- Also called modified Phong or Fast Phong
- Simpler and faster
- Half angle $H = L + V$ (renormalize)
- Intensity $(N \cdot H)^s MC$



Per Vertex Lighting

- Calculate lighting at vertex
- Linearly interpolate across polygon
 - This is often called Gouraud shading
 - Real Gouraud shading averages normals at vertexes and then interpolates
- Effort proportional to number of vertexes
- May miss important effects for large polygons

Per pixel lighting

- Calculate lighting at pixel
- Calculate ambient and emission by vertex
 - Set L,P,V,H for use in frag shader
- Calculate diffuse and specular by pixel
- Effort proportional to number of pixels

Shader Textures

- Pointer to texture
 - `sampler2D name;`
 - Points to current texture from `glBindTexture()`
- Extract pixel at `vec2` texture coordinate *pos*
 - `texture2D(name,pos);`
- Different sampler/function for 1D,2D,LOD,...
- Returns `vec4` (RGBA)

Assignment 4: Performance

- Explore the performance of different ways to do things in shaders
 - int vs. float
 - built-in functions vs. expressions
 - functions vs. inline
 - OS, hardware, etc dependencies
- Use lighting, textures, procedural textures, etc. to measure performance
 - FramesPerSecond() in CSCIx239
- Make sure VSYNC is disabled