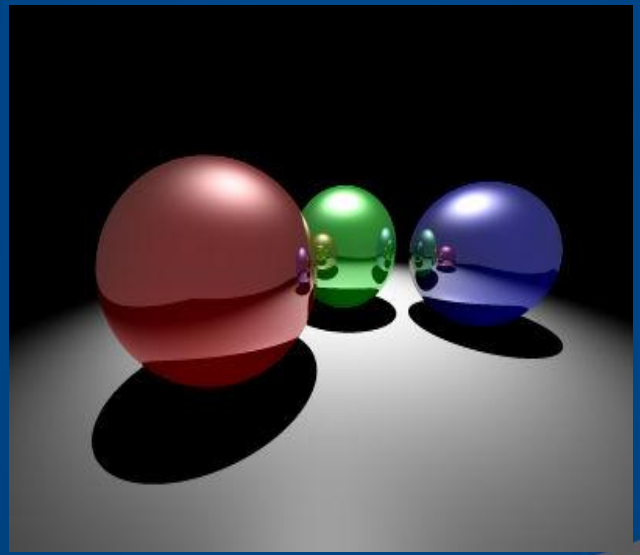
Lighting - Specular

Ooooh shiny!



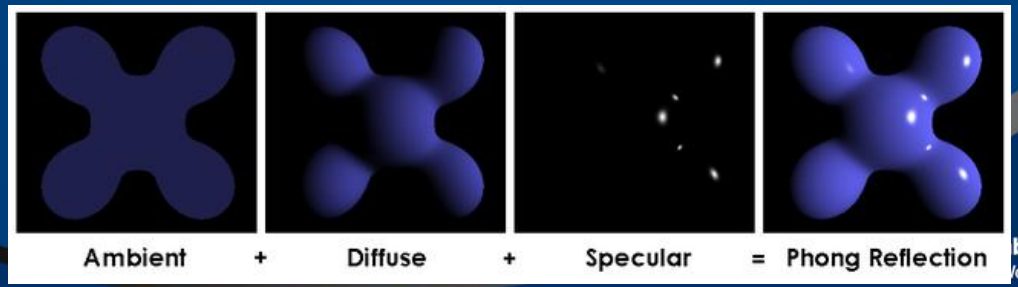
Recap

- Last session we looked at the Phong Lighting model
  - We covered the Ambient and Diffuse portions of the equation

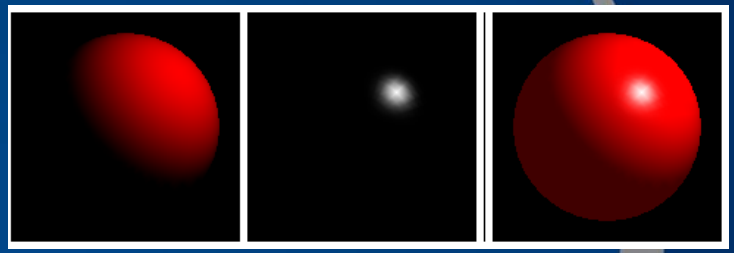
$$I_p = k_a i_a + \sum_{m \in lights} (k_d (L_m \cdot N) i_d + k_s (R_m \cdot V)^a i_s)$$

Ambient Diffuse Specular

- This session we will take a quick look at the final part of the equation
  - Specular

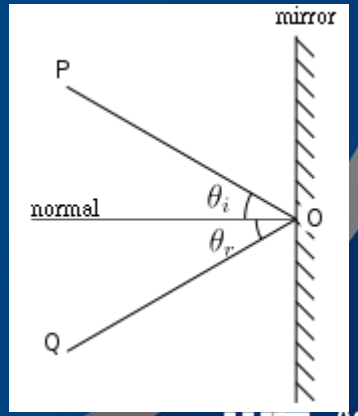


Specular Highlights



- Specular highlights are the bright spots of light that appear on shiny objects when the light reflects just right into your eye
  - Think of all those times as a kid you tried to reflect light into your teacher's eyes!

- This light is confined by the law of reflection, in that the reflected light ray makes the same angle with the surface as the incoming light ray
  - If the reflected ray enters the viewer's sight then the specular highlight is added to the final calculated colour at that point



Specular Lighting

- Specular lighting is calculated for each light just as diffuse was

$$I_p = k_a i_a + \sum_{m \in lights} (k_d (L_m \cdot N) i_d + k_s (R_m \cdot V)^a i_s)$$

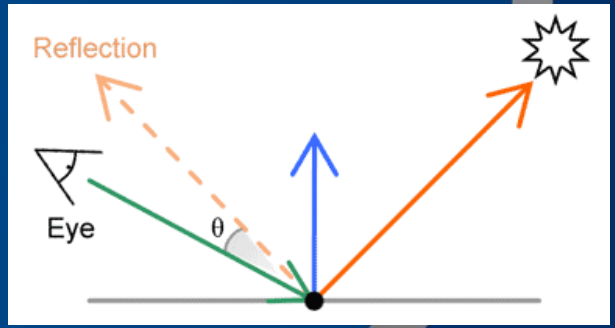
Diffuse Specular

- However it has a few extra bits in the equation
  - ***Rm*** is the light vector reflected about the surface normal
  - ***V*** is a vector from the surface to the viewer / camera
  - The dot product is also raised to a power ***a***
  - $\boldsymbol{k_s}$ and $\boldsymbol{i_s}$ just refer to the surface material's specular colour and the light's specular colour

Specular Lighting

- To calculate the reflected light vector we simply reflect it around the surface normal

- We then perform a dot product between the light's reflected vector and a vector from the surface to the viewer
  - This value is called the specular term
  - The specular term is clamped between 0 and 1 much like the diffuse term was



Specular Lighting

- We also raise the specular term to a specular power
  - This helps control the intensity of the reflection

Complete Phong Equation

- The specular term is then multiplied with the specular colour
  - Defined as the light's specular colour multiplied with the surface's specular colour
- Finally the calculated specular colour is added along with all other light's specular to the final pixel colour
- Specular lighting helps define shiny surfaces and can mimic glass, plastic, skin, water, etc
  - Also helps highlight shape and texture of a surface

Summary

- Specular highlights add a sense of shine and surface roughness to objects

- The Phong Lighting incorporates a specular term for each light
  - Based on an angle between the view vector and a reflected light vector

http://en.wikipedia.org/wiki/Specular_highlight
http://en.wikipedia.org/wiki/Specular_reflection