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Homework 4: Shaders

The assignment given was to develop the Phong reflection model both with Gouraud shading and Phong shading.

The Phong reflection model is produced by three lighting types: ambient, diffused, and specular. The ambient light does not actually rely on the existence of light sources, it is simply a basic level of color to allow the user to see areas of the frame that are not directly lit by light sources. The diffused lighting applies a general brightness factor to areas within a range of the light source calculated from the light's direction as well as the normal. Note that this lighting does not depend on the view port's position. The final element of the Phong reflection model, specular highlighting, is the "glare" effect that one might see when looking at a reflection of a light. It is another layer of brightness over the other two but is only applied when within a certain narrow range dependent on the view port's position. Therefore, the view port's position, the surface's normal, and the light's direction must all be accounted for when calculating these specular highlights.

The algorithms used for interpolating the normals were the following two different ways: Gouraud and Phong. Gouraud interpolation calculates the normals by using the vertexes, while Phong shading interpolates the normals pixel by pixel across the polygon's surface. Phong shading results in a cleaner and smoother result at the cost of a much higher computational expense.

The algorithm used for the specular highlight shading was Blinn—Phong shading which is a slightly altered version of Phong shading based on the idea that the dot product of the normal and the "halfway vector" (the vector halfway between the view port and the light source) is roughly equal to the dot product of the reflection direction and the direction of the viewer. Using this as well as increasing the intensity, the exponent on the dot product, a result very similar to standard Phong shading can be produced with more efficiency. This factor applied to the color of the pixel as well as the specular coefficient to control the result gives a sharp glare focused on the viewer. For diffused light, the standard Lambertian reflectance algorithm was used. The dot product of the surface's normal and the light direction give a general diffusion factor based on the angle of the light; this is then multiplied by the diffusion coefficient to determine its overall strength. Applying this to the color produces a softly lit surface based on the light color. The ambient light was a simple multiplication of the *surface's* color to the ambient coefficient. Because the calculation does not involve light sources at all, the color of the light is irrelevant; only the original color of the surface will come through if only applying ambient light.

The resulting images produced follow expectations. The colors of the lights can easily be seen on the sides of the object depending on the light source's position. On the tilted object, the specular highlighting can be seen near the top where the color turns white from reflection.

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