Lecture 10: Shading and Textures – Review Questions

- Describe the terms in the rendering equation. Draw a diagram labeling p, p', and p" to illustrate your description.

$$i(p,p') = g(p,p')\left(\varepsilon(p,p') + \int \rho(p,p',p'')i(p',p'')dp''\right)$$

- What features make this equation *global* and not suitable for OpenGL?
- OpenGL makes use of a simplified illumination model -- *the Phong illumination model* (not to be confused with Phong shading!). This model is designed to capture ambient, diffuse, and specular lighting effects. Describe the differences between the ambient, diffuse, and specular lighting models used in OpenGL.
- What information do you need to compute the color at a point due to ambient reflection? Write an expression that performs this color computation.
- What information do you need to compute the color at a point due to diffuse reflection? What expression performs this color computation for a directional light source? for a point light source? for a spotlight?
- What information is needed to determine color due to specular reflection? Write the expression for this color computation for directional and point light sources, including a spotlight.
- Why can't we render a mirror correctly using the specular lighting model?
- Explain Gouraud shading.
- How do we get normals for Gouraud shading? At what points are the normals calculated?
- Explain Phong shading (again, not to be confused with the Phong illumination model!)
- How do we get normals for Phong shading? At what points are these normals calculated?
- How does Phong shading differ from Gouraud shading? Which is more computationally intensive, and why? Give some examples where you would expect to be able to visually identify the differences.
- Describe conceptually how texture can be applied to a triangle in a scene.
- Explain how barycentric coordinates are used to determine the color at each pixel of this textured triangle.
- Why does aliasing occur in texture mapped images?
- Describe bilinear filtering and explain how it helps reduce the aliasing problem.
- Describe mipmaps and explain how they help reduce the aliasing problem.

- What is trilinear filtering, when used in conjunction with mipmaps?
- Texture maps can be used to modify a wide variety of different values that may vary over the surface of an object. List at least five different parameter values that may be controlled using a texture map (i.e., five different ways in which texture maps can be used to control object appearance).
- What is a bump map? a normal map? a displacement map? an environment map?

Bonus:

- How does the Phong illumination model approximate the rendering equation? What types of effects are lost in this approximation?
- Describe the main idea behind anisotropic filtering.