Lecture 19: Global Illumination – Review Questions

- Write down the Rendering Equation. Describe which part of it is not modeled by a ray tracer.
- The contributions of light to an image can be considered as light collected over a huge collection of paths through an environment. When thinking about the possible paths, we need to consider all types of bounces, both specular (predominant in ray tracing) and diffuse. If we use a regular expression for the paths considered in ray tracing, we would have:

  $L(D \mid S)E$ (*direct lighting*)

  $L(D \mid S)S^{*}E$ (*with specular bounces*)

  where L indicates that the path starts at the light
  D refers to a diffuse bounce
  S refers to a specular bounce
  E indicates that the path ends at the eye

  Explain these expressions and show how they result from the ray tracing equation:

$$I = k_a L_a + k_d (l \bullet n) L_d + k_s (r \bullet v)^{\alpha} L_s + k_r I_r + k_t I_t$$

- What light paths are missing in ray tracing? Draw examples of real-world effects, such as color bleeding or caustics, that are not handled by ray tracing. For each, show the corresponding light paths regular expression.
- What is particle tracing? Which light paths can it handle?
- What is path tracing? Which light paths can it handle?
- Path tracing is very similar to ray tracing. What is it that makes it so much more powerful?
- What is the key idea behind photon mapping? The following reference may be useful: http://graphics.ucsd.edu/~henrik/
- Describe how Nayar et al use a light projector to separate direct illumination from global illumination in a scene. See following reference for details: http://www1.cs.columbia.edu/CAVE/projects/separation/separation.php