Midterm Review Questions

Ray-Object Intersection

For each of the questions below, determine if the ray intersects the given object. If it does, compute the value of t at the point of intersection. You may leave your answer in exact form.

1. Consider a triangle T with vertices $x_0 = (-1, 0, 0), x_1 = (0, 1, 0), x_2 = (1, 0, 0)$ and a ray $r(t) = o + t\mathbf{d}$ with $o = (0.5, 0.5, 1)$ and $\mathbf{d} = (0, 0, -1)$. Compute the information outlined above.
2. Consider an axis-aligned box B defined by two points $p_0 = (-1, -1, -1), p_1 = (1, 1, 1)$ and a ray $r(t) = o + t\mathbf{d}$ with $o = (0, 0, 2)$ and $\mathbf{d} = (0, 0, -1)$. Compute the information outlined above.
3. Consider a sphere S with centre $c = (1, 1, 0)$ and radius $r = 1$. Consider a ray $r(t) = o + t\mathbf{d}$ with $o = (-1, 1, 0)$ with $\mathbf{d} = (1, 0, 0)$. Compute the information outlined above.

Multisampling

1. Generate 4 samples using n-rook sampling.
2. Generate 9 samples using Jittered sampling.

Viewing Systems

1. Given a pinhole camera with $e = (-1, 1, 1)$, $l = (0, -1, 0)$ and $\mathbf{up} = (0, 1, 0)$, compute the orthonormal basis for this camera. You may leave your answer in exact form.
2. Given $d = 4$ and a viewing plane with dimensions 100×100, compute the ray $r(t) = o + t\mathbf{d}$ that passes through the pixel at $(60, 6)$ with sample point $p = (0.5, 0.5f)$.

Rendering Theory

1. Given $k_d = 0.5$ and $c_d = (0.5, 1.0, 0.5)$, evaluate $f_r(p, \omega_i, \omega_o)$ for the Lambertian BRDF.

Transforms

1. Suppose you are given a matrix T that contains a mixture of rotations, scaling, and translations in 3D space. Compute two matrices S and L where S contains the scaling and rotation components of T and L contains the translation components of T.