Algorithm 5: Ray

Comp175: Introduction to Computer Graphics – Spring 2014

Algorithm due: **Monday April 7th** at 11:59pm

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1 Instructions

Complete this assignment only with your team-mate. When a numerical answer is required, provide a reduced fraction (i.e. 1/3) or at least three decimal places (i.e. 0.333). Show all work; write your answers on this sheet. This algorithm hand-out is worth 3% of your final grade for the class.

[2 points] The high-level view of our ray tracer is exactly the same as for intersect, except for a few additions. Below is the high-level pseudocode for **Intersect**. What needs to be changed/added to make this a full-fledged ray-tracer? Just specify what changes need to be made no pseudocode please.

for *point* ∈ *Canvas* **do**
    Cast a ray to find the nearest object
    if ray intersects an object **then**
        for each light **do**
            Cast a ray to the light and evaluate the lighting equation
            Canvas[pt] = *Canvas[pt]* + *color* with only diffuse/ambient components
        end for
    else
        Canvas[pt] = background color
    end if
end for

The casting a ray to the light needs to be recursed with a reflective ray

[2 points] Given a vector $\vec{v}$ and a surface normal $\vec{n}$, find the equation for the vector $\vec{r}$ which is the reflection of $\vec{v}$ about $\vec{n}$ (i.e. in the equal and opposite direction). Write your equation in terms of vector operations. How do you compute the color contributed by the reflected ray? Give a brief description.
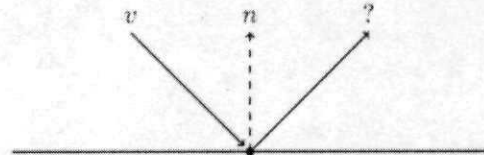
$$\vec{r} = \vec{v} - 2(\vec{v} \cdot \vec{n}) \cdot \vec{n}$$

run the lighting equation again with $\vec{r}$ as the look vector, contribution is that result • reflectivity

[1 point] Is ray tracing a local or global illumination algorithm? Why?

Its global because a reflective ray could go anywhere

[1 point] For what two cases will an object (or portions of an object) not be affected by a light source? There are actually more than two cases, but we expect you to be able to list at least two; you can list more for extra credit.

- If the object is too far away.
- If another object is in between it and the light source.
- If the object is completely black.

[1 point] How do you use the color from the texture map and the **blend** value in the lighting equation?

$$I_\lambda = (K_a O_{a\lambda} + \sum_{i=1}^{n} [f_{atti} I_{m\lambda} * (k_d O_{d\lambda} \vec{N} \cdot \vec{L}_i + k_s O_{s\lambda} (\vec{R}_i \cdot \vec{V})^n] + k_s O_{r\lambda} I_{r\lambda}) * (1-blend) + (blend * color from texture map)$$

[1 point] What is the Phong lighting model used for? What is the purpose of its exponent?

It is used for specular light. It controls the size of the specular highlight.

[2 points] Recall that we can think of texture mapping in two steps. First, mapping from the object to the unit square, and second, mapping from the unit square to the texture map. Let a and b be the x and y values in the unit square that a particular point on an object gets mapped to in the first step. Note that a and b are calculated differently depending on the object. From here, how do you find the coordinates (s, t) to look up in a texture map in terms of a, b, u, v, w and h, where u and v are the number of repetitions in the x and y directions, respectively, w is the texture width, and h is the texture height?

$$s = (a * u * w) \bmod w$$
$$t = (b * v * h) \bmod h$$

2 How to Submit

Hand in a PDF version of your solutions using the following command:

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provide comp175 a5-alg
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