Algorithm 5: Ray

CSI 4341: Introduction to Computer Graphics – Fall 2018

Algorithm due: **Thursday, November 8th** at 11:59pm
Project due: **Thursday, November 15th** at 11:59pm

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1 Instructions

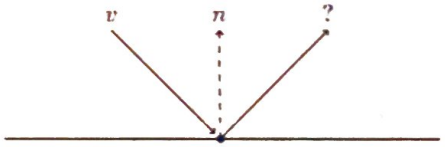
When a numerical answer is required, provide a reduced fraction (i.e. 1/3) or at least three decimal places (i.e. 0.333). Show all work; write your answers on this sheet. This algorithm handout is worth 3% of your final grade for the class.

[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
```

rays must be cast to each light from intersect to find shadows, and must be cast to other objects for reflections. Also, transparency must be added.

[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.



$\vec{r} = \vec{V} - 2(\vec{V} \cdot \vec{n})\vec{n}$

We find the color based on the intersection of the $\vec{r}$ with the nearest object, then multiply by a reflectivity coefficient

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

It is a global illumination algorithm, as it incorporates shadows/other objects.

[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, n, m, w and h, where n and m are the number of repetitions in the x and y directions, respectively, w is the texture width, and h is the texture height?

$s = a\left(\frac{nw}{u}\right)$

$t = b\left(\frac{mh}{v}\right)$

note: I gives coords for one repetition. iterate over all reps in for loop to get full map.

[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 path to the light source is blocked by another object, or if it is blocked by the object itself.

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

The textures rgb values are multiplied by the blend value to determine how much the texture should be used to color the object.

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

The phong lighting model is used to find ambient, diffuse, and specular values for an object's color, and its exponent is used to determine the specular surface property.

2 How to Submit

Hand in a copy of your solutions through Canvas.