

EXERCISE 1

To do this exercise we add in the phong model a shadow term.

To get this shadow term we need to compute the closest hits given a point and the light direction. If we hit an object that means that the object that we hit is between the light and the point. This means that the shadow term will be 0, if there is no hit the shadow term will be 1.

EXERCISE 2

To do this exercise we check if the material of the object reflects. If this happens we need to create a reflection ray, using the `glm::reflect`. With this new ray we can compute the colors of the hit between the new ray and the closest hit.

The important thing in this exercise is that we will use the recursivity to get all the colors, that's why we need to set a variable that stops the recursivity otherwise we will create an infinite loop.

One problem that we had with this exercise was that we didn't change the diffuse so the sphere had some purple parts.

EXERCISE 3

In order to solve this exercise, we have had to do something similar to the previous exercise.

We had to calculate the direction of the refracted ray.

Once we had the direction, we created the refracted ray which intersects with the nearest object in the already calculated direction.

We have recursively called the function to calculate the next refracted rays, until they are all calculated.

But, an important point for these rays is that, the first time a ray intersects an object, it refracts, and then refracts again on its way out (or may refract several times within the object itself). But mainly the ray will refract twice (unless we are right at the to edge, where it will only refract once).

Therefore, when the ray is refracted more than once, we have to take into account the normals.

When we first intersect the object, the normal is the object's own normal, but when we intersect the second time, we are inside the object itself, so the normal in this case will be the inverse of the normal we know about the object. So we will have to take this into account in order to rotate the normal of the object when necessary.

We will also have to correct the diffuse parameter of the material, which if is a very high value we will not be able to see the refracted objects through the sphere.

FINAL RESULT:

