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# Assignment 4 - Raytracing

1.

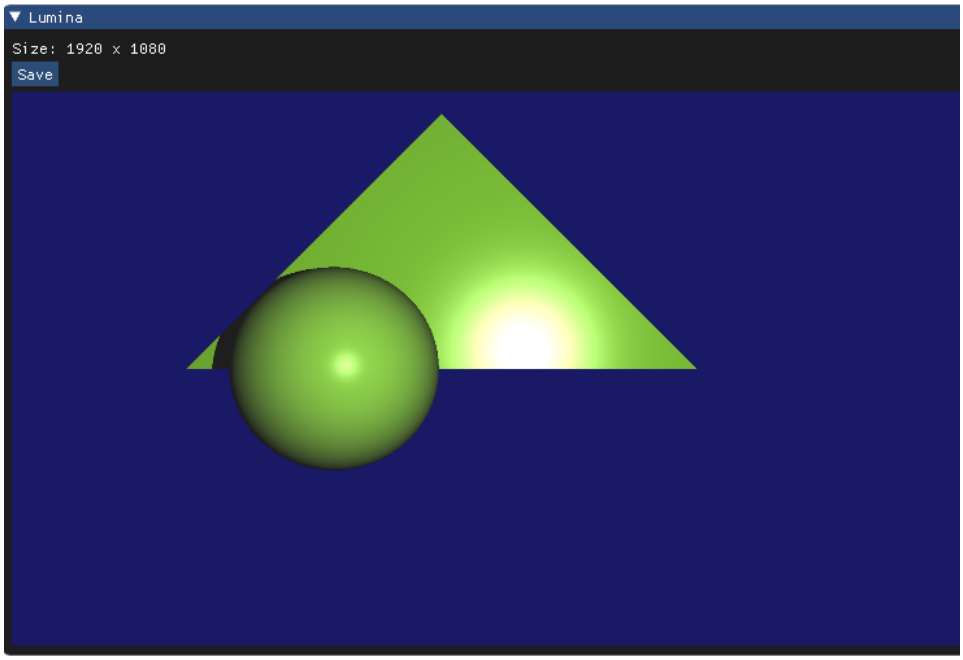
To implement a triangle, I extended the object class, hardcoded the vertex values of the triangle and for finding the ray intersections I used the **Möller–Trumbore ray-triangle intersection algorithm**. This algorithm is easy to implement since precomputation of the plane equation of the plane containing the triangle is not required.

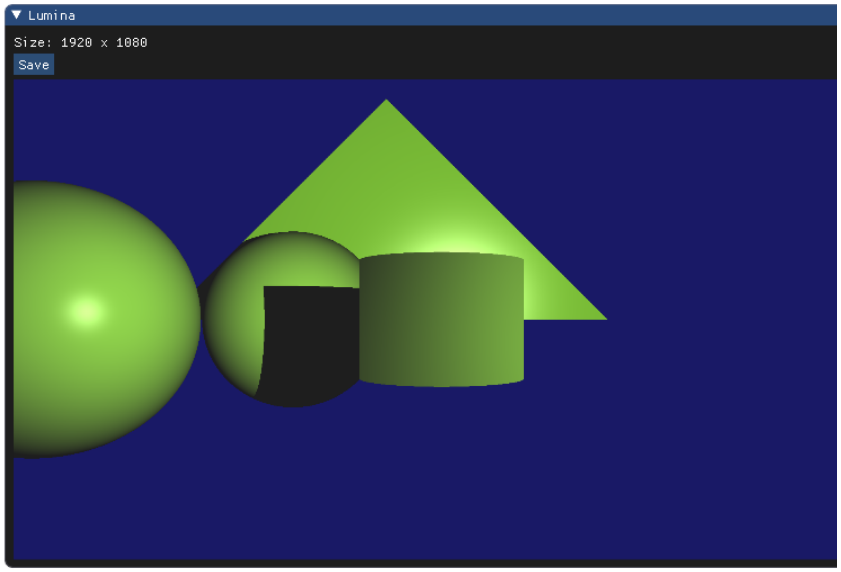
2.

I have implemented the blinn phong shading by adding a shade method in the respective shape.cpp files(rather than using material.cpp). This method required passing the world class as a parameter. Inside the shade method I am calling the array of light sources, and calculating light direction using those values (Vector3D lightdir = rayvec.getPosition() - l->getPosition()).
The I have calculated the ray direction and normal for every shape, and have used the halfway vector method to calculate the diffused and specular shading.

3. I have implemented the shadows in the world.cpp file. Here I check if the ray hits the object then there is iterating over the light source array, then the shadow ay is evaluated. If the ray hits the object then the ka of the material is involved in the final answer otherwise the normal diffused shading is shown.

(1,2,3 combined image)






4.
For the reflected and dielectric part, I have made the changes in world.cpp.
For reflected the formula used is:

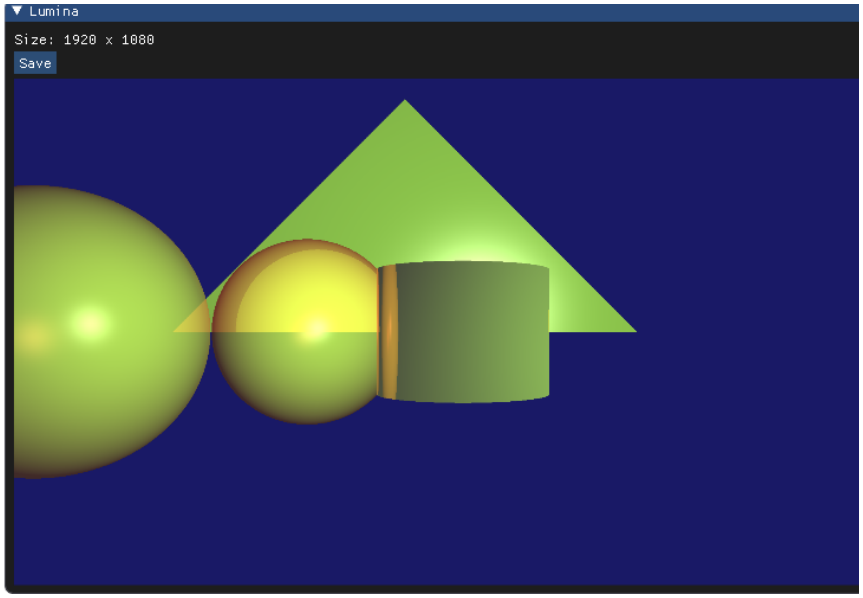
- Mirror reflections can be added by shading reflected rays

$$\mathbf{r} = \mathbf{d} - 2(\mathbf{d} \cdot \mathbf{n})\mathbf{n}$$

For dielectric the formula used is:

- Solving for $\mathbf{t}$:

$$\mathbf{t} = \frac{n(\mathbf{d} - \mathbf{n}(\mathbf{d} \cdot \mathbf{n}))}{n_t} - \mathbf{n}\sqrt{1 - \frac{n^2(1 - (\mathbf{d} \cdot \mathbf{n})^2)}{n_t^2}}$$




Bonus

5.
I have used a similar method as in sphere.cpp to implement a cylinder. There was a minor variation in the normal calculation in order to consider the height of the shape. Along with a cylinder I implemented another sphere to show the reflecting component. (Image of cylinder is include above)