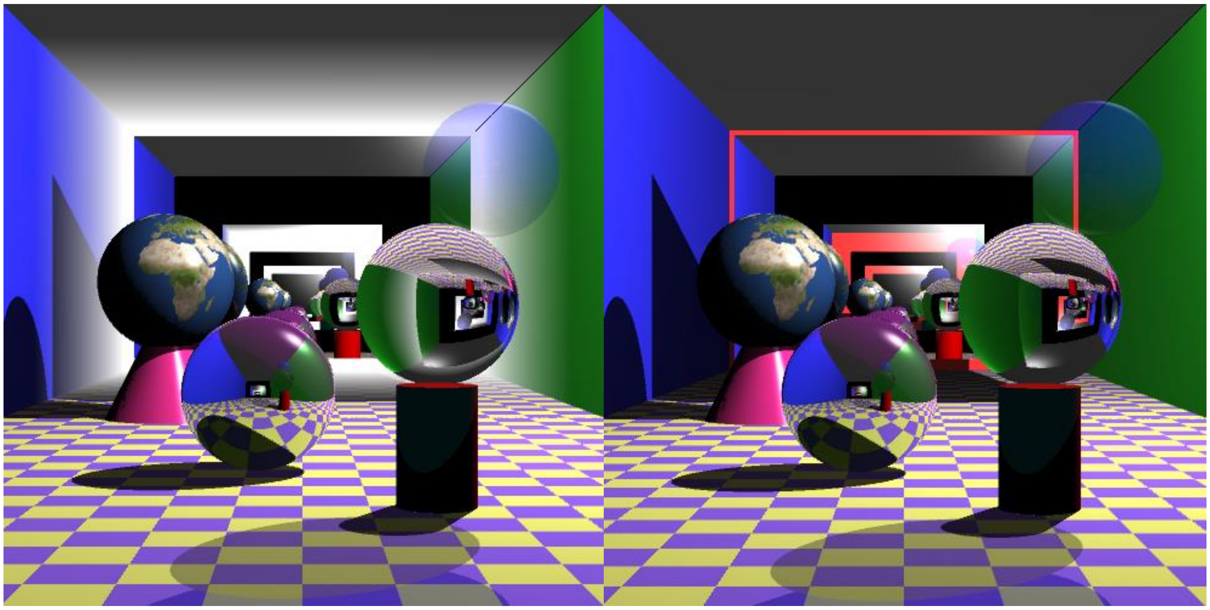
COSC363 Assignment 2 Report



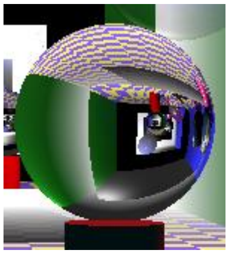
Scene overview

The left image is with fog and the right image is without fog and both images are rendered using basic anti-aliasing. In my scene there are 6 different colored planes. There is one transparent object that is blue and has a lighter blue shadow. Every object in the scene casts its own correct shadow. There is also a reflection generated by two parallel mirrors. The mirrors are just a plane that is very reflective. The floor has a yellow and purple chequered pattern. There is a pink cone with a textured earth sphere on top. There is also a red cylinder with a cap. A refractive sphere is sitting on top of the red cylinder. There is a fog behind the front mirror to give off an infinity edge feel. A basic anti-aliasing is present can be easily switched on and off by a Boolean in the program. With anti-aliasing on it takes around 9seconds to render and around 3seconds without anti-aliasing.

Explanation of scene properties

This is a reference from the lecture notes on how to implement refraction. I used this to help me figure out how to implement refraction in my program.

```
n = obj->normal(ray.hit);
g = glm::refract(d, n, eta);
Ray refrRay(ray.hit, g)
refrRay.closestPt(sceneObjects);
m = obj->normal(refrRay.hit);
h = glm::refract(g,  –m,  1.0f/eta);
```



The two formulas are from the lecture notes, and it helped me implement the cylinder normal function and cylinder intersect function. These were given in the lecture notes.

(un-normalized) $\boldsymbol{n} = (x - x_c,\ 0,\ z - z_c)$

Intersection equation:

$$t^2\left(d_x^2 + d_z^2\right) + 2t\{d_x(x_0 - x_c) + d_z(z_0 - z_c)\}$$
$$+ \left\{(x_0 - x_c)^2 + (z_0 - z_c)^2 - R^2\right\} = 0.$$

The next two formulas were used to help me implement the cone normal function and the cone intersect function. These were given in the lecture notes.

$\tan(\theta) = R/h$ $\quad$ (θ = half cone angle)

$\boldsymbol{n} = (\sin\alpha\cos\theta,\ \sin\theta,\ \cos\alpha\cos\theta)$

where $\alpha = \tan^{-1}\left(\dfrac{x - x_c}{z - z_c}\right)$

$$(x - x_c)^2 + (z - z_c)^2 = \left(\frac{R}{h}\right)^2 (h - y + y_c)^2$$

p_0

Ray equation:

$x = x_0 + d_x t;\quad y = y_0 + d_y t;\quad z = z_0 + d_z t;$

This equation was used to help with the texturing of a sphere, u = s, v = t. The equation is from a Wikipedia link that was mentioned in this course. https://en.wikipedia.org/wiki/UV_mapping

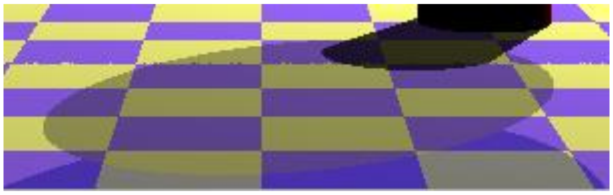
$$u = 0.5 + \frac{\arctan2(d_z, d_x)}{2\pi},$$
$$v = 0.5 + \frac{\arcsin(d_y)}{\pi}.$$

This equation helped me implement the fog feature.

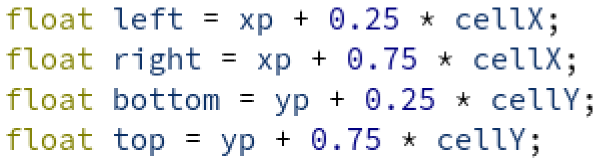
$$\lambda = \frac{(ray.hit.z) - z_1}{z_2 - z_1}$$

color = (1- λ) color + λ white

The shadow from the blue transparent sphere is lighter as well as the shadow from the refractive sphere. Since the transparent sphere is blue the shadow that it casts is slightly blue as well as you can see in the image.

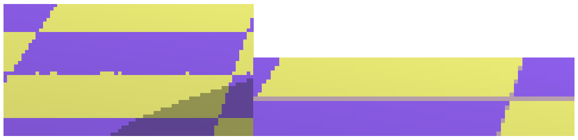


Anti-aliasing was done by dividing the initial cell into 4 pieces and getting the color of the four. Then getting the average color and displaying the average color.



```
float left = xp + 0.25 * cellX;
float right = xp + 0.75 * cellX;
float bottom = yp + 0.25 * cellY;
float top = yp + 0.75 * cellY;
```

Without anti-aliasing and with anti-aliasing



I declare that this assignment submission represents my own work (except for allowed material provided in the course), and that ideas or extracts from other sources are properly acknowledged in the report. I have not allowed anyone to copy my work with the intention of passing it off as their own work.

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