Assignment two - Ray Tracer

Successes:
My box is facing such a way that it has well defined shade, showing its depth. The Ray Tracer generates in a decent amount of time. The reflective ball shows the difference is size and distance between objects while looking at the objects at the front they give the illusion of looking close together.

Failures:
My shadows are dark and do not pick up the colouring of the object and are instead all black due to the lack of ray sample for the shadow generating. My Triangle is positioned in such a way that the whole shape is in shadow. My specular reflection may be considered too bright, and it does cover the textured image too much. My floor plane may also be considered too large for the scene as you can see in the reflective ball, the objects take up minimal space.

Cylinder
My Cylinder implements an intersection via checking that the cylinder is within certain normalized points and returns no intersection (via -1) at any point that a value is outside a valid point. I used the intersection equation below for valid points:

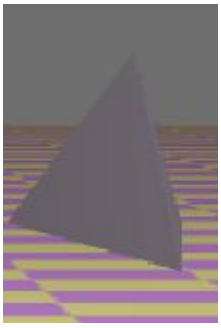
$t^2(dx^2 + dz^2) + 2t\{dx(x0-xc)+dz(z0-zc)\} + \{(x0-xc)^2+(z0-zc)^2 - R^2\} = 0$

Box
My box is a rectangle made up of 6 planes. My z axis stays a consistent -60 in order to make the box in the same area, while my y-axis goes from 0 to 5 to give the box a height of 5, while the x-axis uses four different values to give the planes a box shape.

Floor Texture
To texture my floor plane I used the following equation.

$$s = (ray.xpt.x - a1)/(a2 - a1)$$
$$t = (ray.xpt.z - b1)/(b2 - b1)$$

Tetrahedron

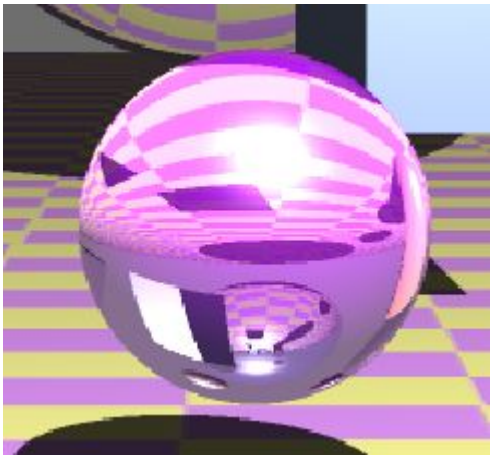


My Tetrahedron was created using an altered version of my plane, which took three points instead of four and was created building from the down facing side. Using a scaling of two between the x values, 4 on the y values and 5 on the z values.

Transparent Object

On the left of the ray tracer, on top of the cylinder, my transparent sphere is visible, it has a transparency coefficient of 0.3, which allows a far lot of light through with 0 allowing all light through and 1 allowing no light through.

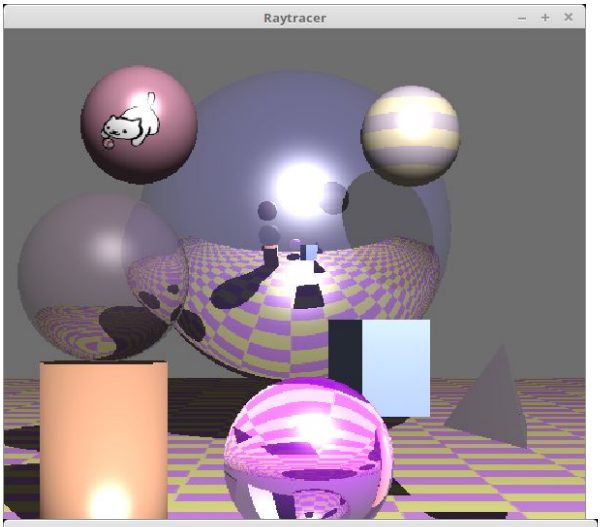
Refractions



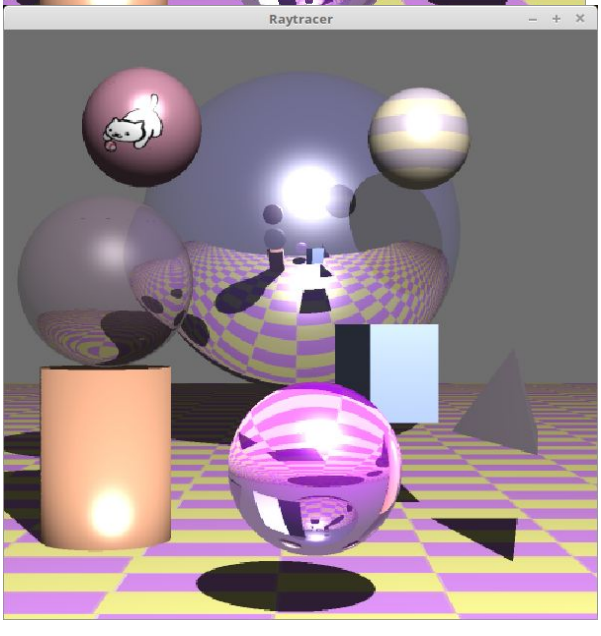
This refracted sphere is set at the middle of the scene and is the front object in order to be able to see the most possible objects. The top of the sphere shows the refraction from the ground while the top shows the other objects as well as the reflection of the floor from the sphere behind. The refraction eta is set to what would mimic water.

Anti-aliasing

Anti-aliasing was completed using super sampling by creating four rays for each cell quad. These four ray's colours were added together then divided by four (The sample amount)



This image has no anti-aliasing; this is most obvious in the spheres as you can easily see the jagged edges.



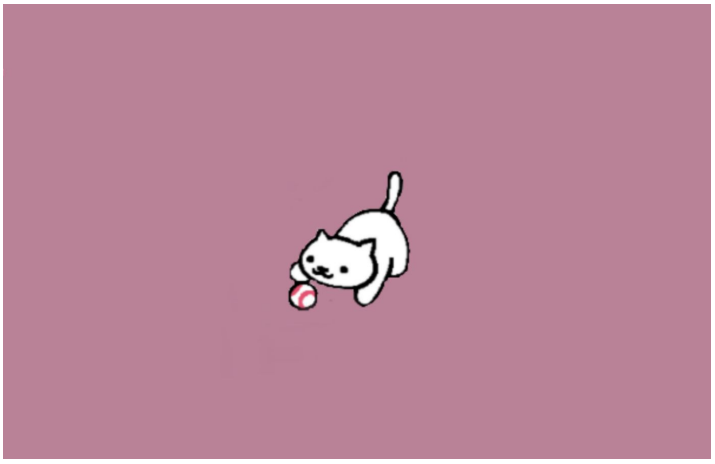
The image has anti-aliasing is on. The jagged edges on the sphere are smoother and crisper.

Texture with Image

The sphere was textured using the image below using the following equation:

$$\varphi = atan(x - xc,\ z - zc) + Pi\ /Pi * 2$$

$$\Delta = atan(y - yc, (x - xc)^2 + (z - zc)^2)$$



Texture with Procedural Pattern

Created by making a sphere a solid colour and changing the colour of any ray on the y axis that was divisible by two.

```
if(ray.xindex == 4 && step < MAX_STEPS)
{
    if ((int)ray.xpt.y%2)
    {
        col = sphere_colour;
    }
}
```

Texture References

Cat:

Note: texture has been modified in photoshop

http://40.media.tumblr.com/8c152489ce27e50d631d69eee0c4af38/tumblr_o0rf04xf2j1u33k4zo7_400.png

Tile:

Created myself in photoshop

Resources and References

- http://bentonian.com/teaching/AdvGraph1314/3.%20Ray%20tracing%20-%20color%20and%20texture.pdf
- https://www.gamedev.net/topic/632060-ray-tracing-texture-map-a-sphere/
- http://luthuli.cs.uiuc.edu/~daf/courses/ComputerGraphics/Week8/Shading.pdf
- https://docs.blender.org/manual/es/dev/render/blender_render/materials/properties/transparency.html
- R. Mukundan