COSC363 Assignment 2: Ray Tracing

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Overview:

A ray tracing algorithm has been implemented to create a realistic scene. The scene includes a wide variety of shapes and effects. The scene accurately utiilizes features such as transparency, refraction, shadows, rotation, reflection,textures and specular highlights. These features combined with the use of various shapes create a visually spectacular scene.

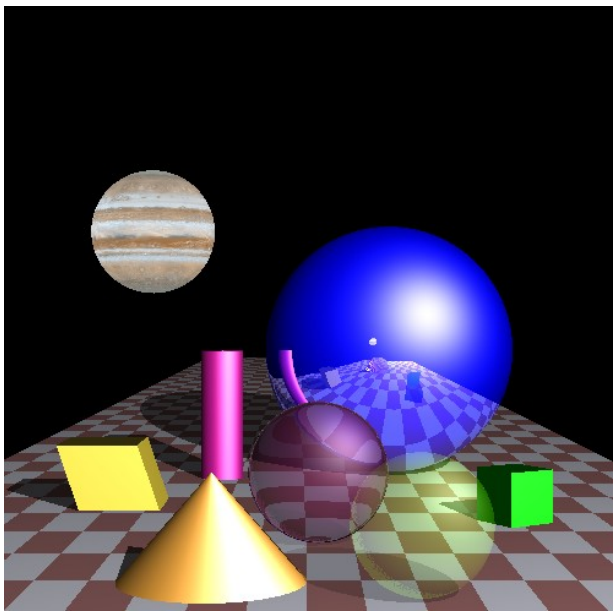

Figure 2: Ray tracing scene with fog turned off

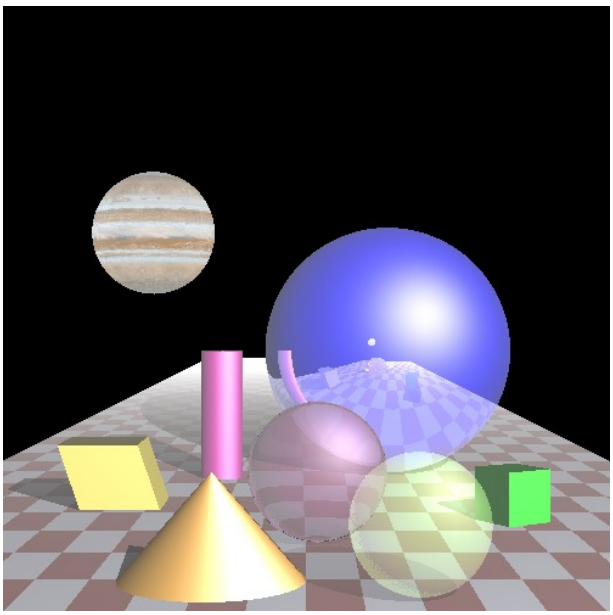

Figure 1: Ray tracing scene with fog turned on.

Standard Features (9 marks):

- Contains one light source aswell as diffuse, and specular reflections generated by the source.
- Contains shadows for every object. Transparent objects create a lighter shadow.
- The scene contains one large blue reflective sphere.
- The scene contains two boxes. One is skewed and one is regular.
- The scene contains a chequerd floor.

Additional Features (7-9 marks):

Primitive Cone (1 mark) :

To be able to display a cone within my assignment, each ray must be able to calculate:

- If it has intersected with the cone
- The normal vector at the point of intersection

These two requirements were constructed as functions. To be able to implement these fucntions, geometric equations were required. The equations for a cone, and cylinder accompained with labelled diagrams (Figure 5) were provided in the lecture notes (Mukundan ,2019). The points of intersection are obtained by substituing the ray equations (Equation 2) into the general point equation (Equation 1). The resulting equation is then solved for t. An issue I had with the original implementation was that a second cone was generated on top of the cone I wanted to display (Figure 3). This issue was resolved by substituing the value of t into the Y ray equation (Equation 2) and ensuring the height was less then the summation of the cone centre plus the height of the cone (Figure 4). A similar method was used to constrain the minimum height of the cone (Figure 4).

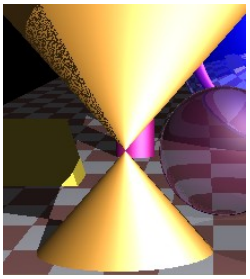

Figure 3: Image of incorrectly implemented cone.

$$(X-Xc)^2-(Z-Zc)^2=\left(\frac{R}{h}\right)^2(h-Y+Yc)^2$$

Equation 1: Every point on cone must

$$X=Xo+d_x*t \quad Y=Yo+d_y*t \quad Z=Zo+d_z*t$$

Equation 2: Ray equations.

satisfy this equation.

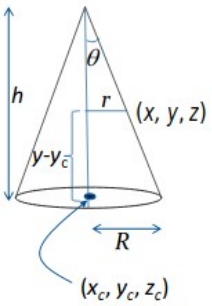

Figure 5: Diagram illustrating the location of each point.

```
if(center.y + height > posn.y + (dir.y * t) && center.y < posn.y + (dir.y * t))
{
    return t;
}
else
{
    return -1;
}
```

Figure 4: Equation implementation to ensure cone in contained with certain values of Y.

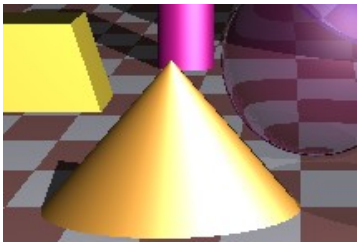

Figure 6: Image Capture of Cone Implementation

Primitive Cylinder (1 mark) :

Transparent Object (1 mark) :

When an object is transparent and additional ray is created that will return the colour

the ray will travel directly through it. The colour display on the grid will a summation

Refraction of Light (1 mark) :

Rotation or Shear Transformation (1-2 mark) :

Non-planar Object Texturing Cone (1 mark) :

Fog Implementation (1-2 mark) :

References :

Dr. R. Mukundan . (2019) . Computer Graphics COSC363 Lec09_RayTracing [PowerPoint Slides]. Retrieved from https://learn.canterbury.ac.nz/mod/resource/view.php?id=803416