COL781, Computer Graphics

Assignment 1

Final Report

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1 Introduction

In this assignment, we have implemented recursive ray tracing with the following features:

1. A scene with various objects (as defined in the report) and multiple light sources
2. Local illumination model (Phong) with diffuse, specular and ambient components
3. Global illumination with reflection, refraction and shadows
4. Anti-aliasing using supersampling

2 Class Vec3d

We have defined a class that represents a vector as in 3-dimensions. An object of this class has three attributes, the three direction components of this vector.
Point3d (coordinates of a point in 3d) and color3d (R,G,B values of a color) are aliases of this class.

3 Camera

We set up the camera with the following parameters: coordinates of camera (origin), direction of viewing (view_dir), upward direction from camera (upward_dir) for fixing the camera to a particular angle. It has also parameters to fix the viewing screen, namely screenwidth, screenheight and screendepth.

4 Light Sources

We have created a scene with multiple light sources. Every light source has the following attributes: the coordinates of the source and the color of light.

5 Materials

The material class defines the properties of the material of the object. An object of this class has the following parameters: one attenuation factor value for reflection and refraction each, values of constants k_a, k_d and k_s used in the equation of Phong's Illumination Model, specular reflection coefficient and refractive index for the material.

6 Objects

We have worked with the objects of the following types:

1. Sphere
2. Cuboid
3. Ellipsoid
4. Quadric
5. Cylinder
6. Circle
7. Cone
8. Triangle
9. Polygon

The following subsections define the above mentioned objects:

6.1 Sphere

Sphere takes the following parameters: coordinates of origin of sphere, radius of sphere and the material.

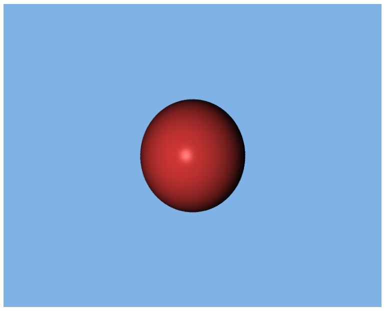

Figure 1: Sphere

6.2 Cuboid

Cuboid takes the following parameters: coordinates of one corner of cuboid and then of three adjacent corners(in left handed coordinate system fashion) and the material.

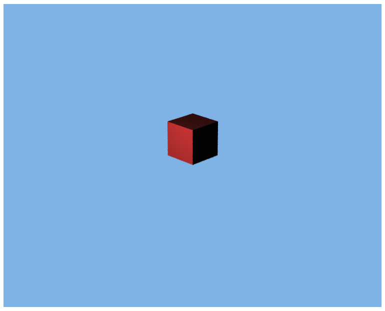

Figure 2: Cuboid

6.3 Ellipsoid

Ellipsoid takes the following parameters: coordinates of center of ellipsoid and three values a,b and c: the lengths of axes of ellipsoid parallel to x,y and z axes respectively.

6.4 Quadric

Quadric takes the following parameters: the value of coefficients(A to J, as per the standard defintion) and the material.

The following are types of quadrics defined explicitly(assuming xz plane to be the base/ground of the scene):

6.4.1 Cylinder

Cylinder takes the following parameters: x and z coordinates of the center of base, height of the cylinder, radius of the base , a boolean to decide if the cylinder is hollow or not and the material.

6.4.2 Circle

Circle takes the following parameter: coordinates of center, radius and material. Here y coordinate of circle is the height of circle from xz plane. Circle is defined for the purpose of making a filled cylinder.

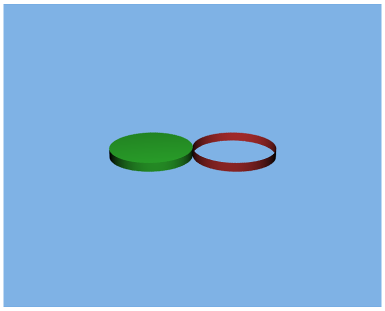

Figure 3: Hollow and Filled Cylinders

6.4.3 Cone

Cone takes the following parameters: x and z coordinates of the center of base, height of the cylinder, radius of the base and the material.

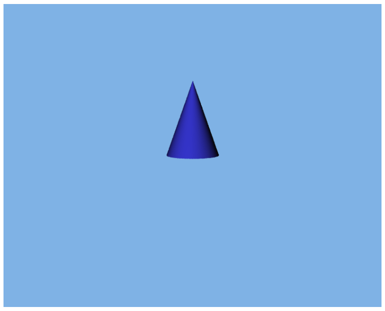

Figure 4: Cone

6.5 Triangle

Traingle takes the following parameters: the coordinates of the three vertices and the material.

6.6 Polygon

Polygon takes the following parameters: number of vertices, a vector list containing vertices in order and the material.

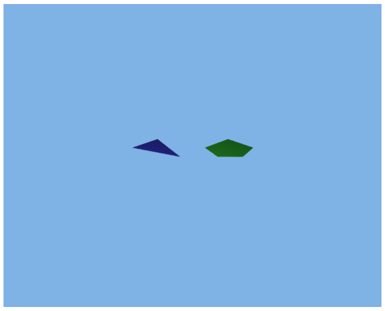

Figure 5: Triangle and Polygon

7 Input File

Input can be taken using a text file. Every object of the scene is given in following format:

```
object_name{
    parameter 1
    parameter 2
    ...
}
```

1. Coordinates should be given in a single line with space and no comma
2. Every parameter should be on a new line
3. File should end with keyword ”end”

8 Complete Example Scene

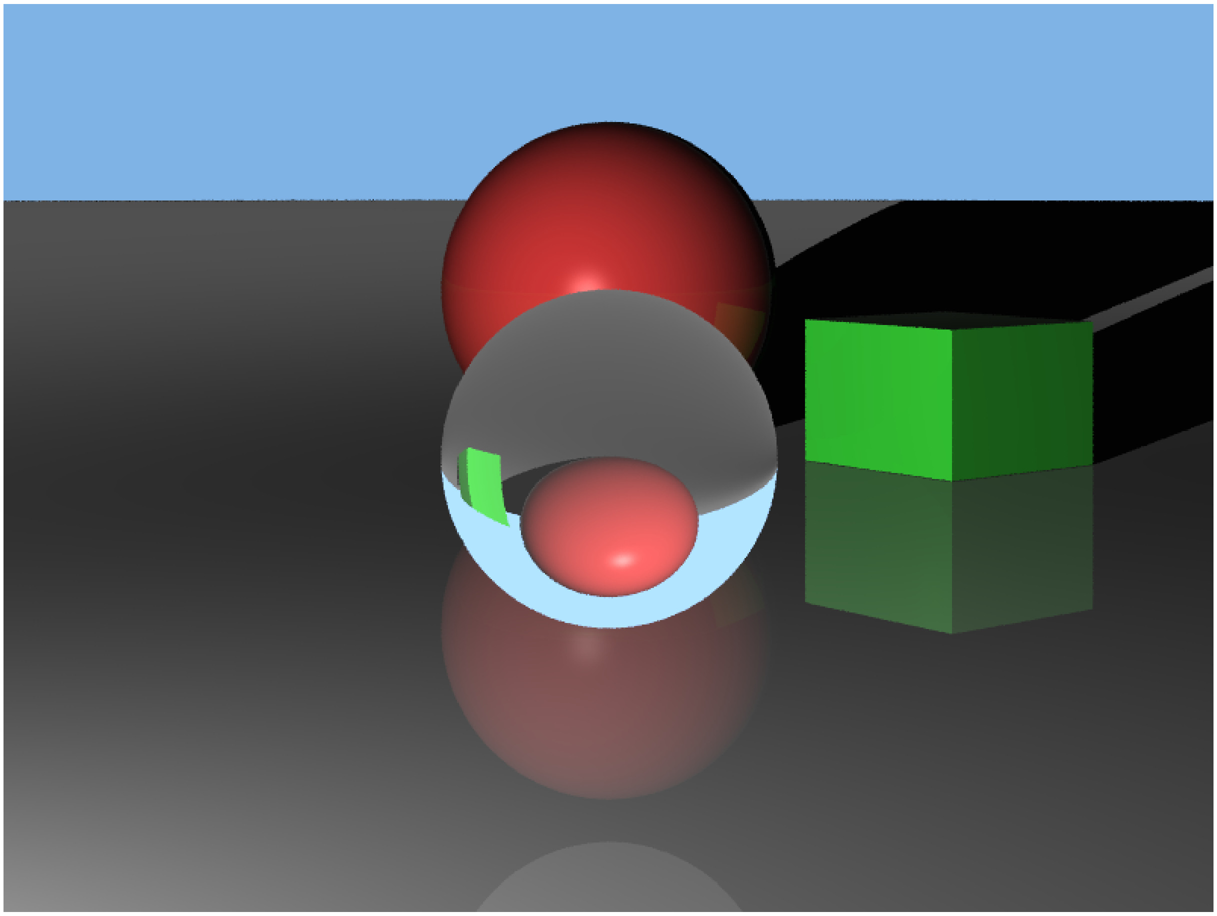

Figure 6: Example Scene with Reflection and Refraction