

# Assignment 1

In this assignment, I have successfully completed all mandatory parts from lab1 to lab4 and also implemented the optional Fresnel Law. The main objective of this project was to implement a class-like structure where each element of the scene and the scene itself could be separated as different objects. The project had two main parts, the first being the implementation of spheres with reflective and refractive properties, and the second being an image of a cat produced from a mesh.

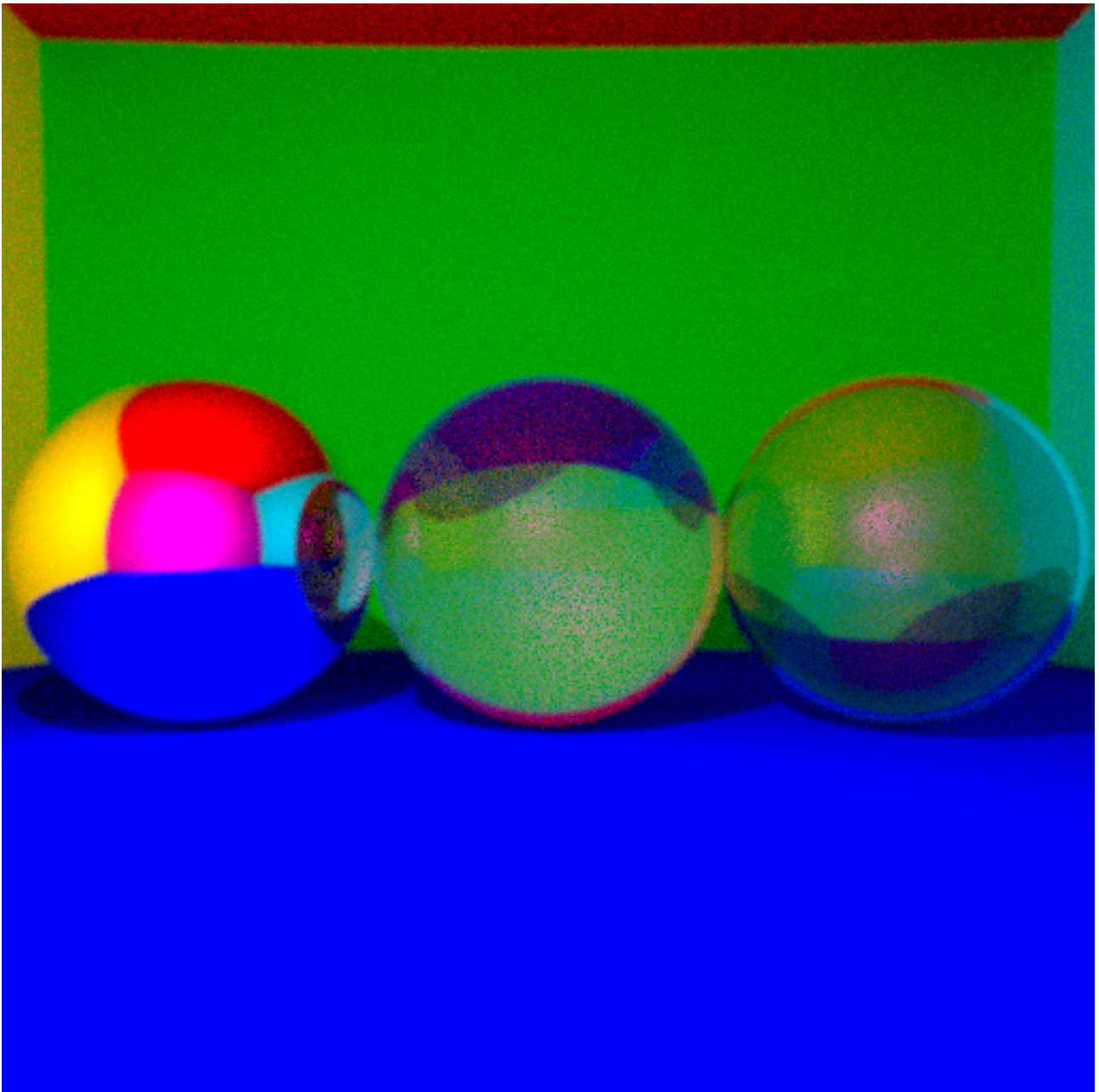
Initially, we created basic classes such as Scene, Ray, and Spheres and implemented diffused and mirror surfaces. We then applied direct lighting and implemented simple shadows. At this point, we could implement the Fresnel Law, which allowed refractive surfaces to have some reflection of light. However, this slowed down the rendering of other objects since it required many rays to be shot for each pixel. Next, we implemented indirect lighting, which made our shadows look more realistic and slightly more transparent. Finally, we finished off with antialiasing to smooth out the picture.

The second part of the project involved implementing Ray Mesh Intersection. Without optimization, this took a long time to compile. Therefore, we implemented a bounding box and a BVH algorithm to reduce computational time.

In the following pages, I will present some of the results we obtained.

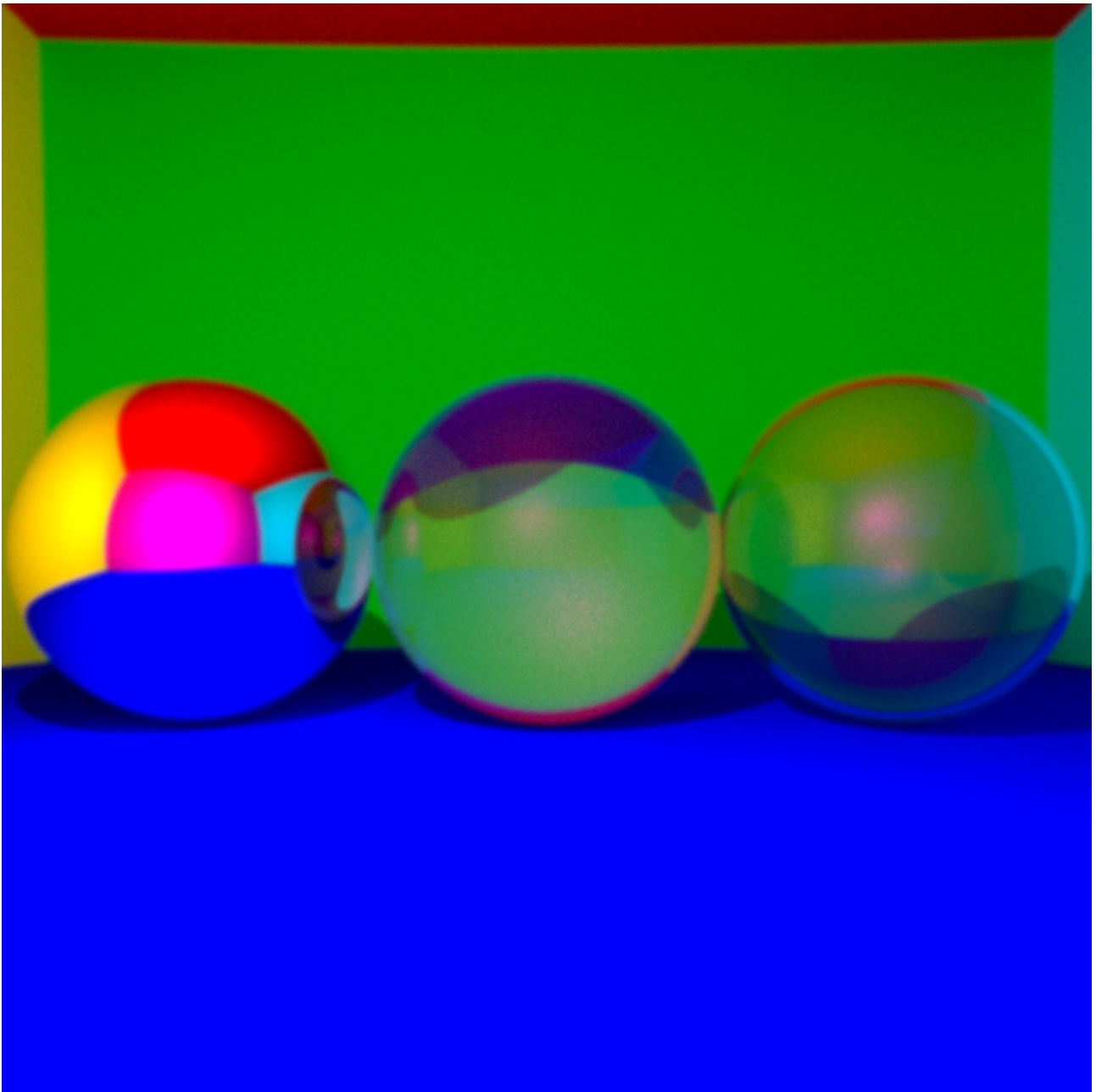
## Image 1

- **50 seconds** to render
- **64 Rays per pixel**
- with Fresnel Law
- max ray depth 5
- Light position (-10, 20, 40)
- Light intensity  $2e10$
- with indirect lighting
- with antialiasing



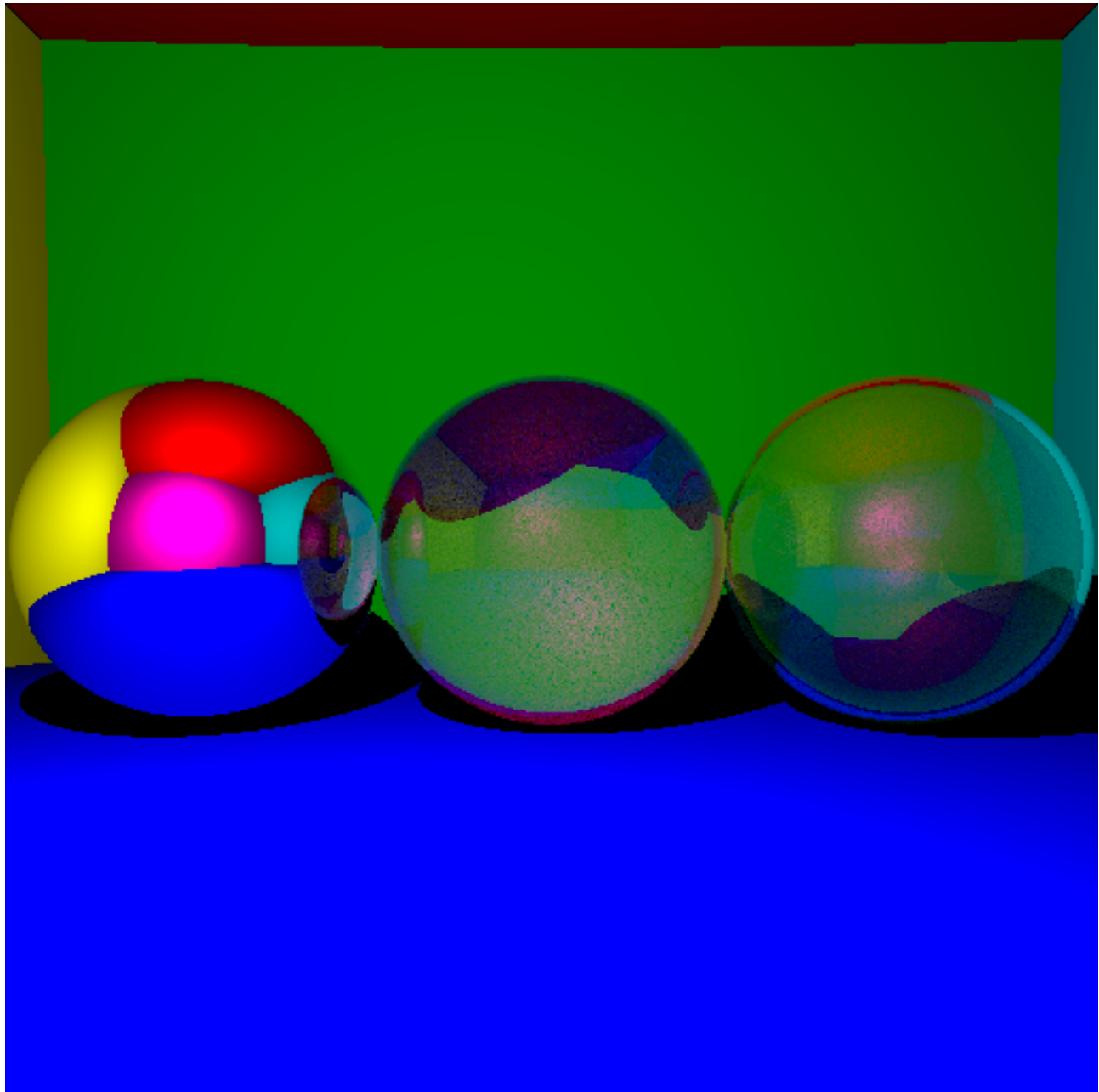
## Image 2

- **14 minutes 58 seconds** to render
- **1000 Rays per pixel**
- with Fresnel Law
- max ray depth 5
- Light position (-10, 20, 40)
- Light intensity  $2e10$
- with indirect lighting
- with antialiasing



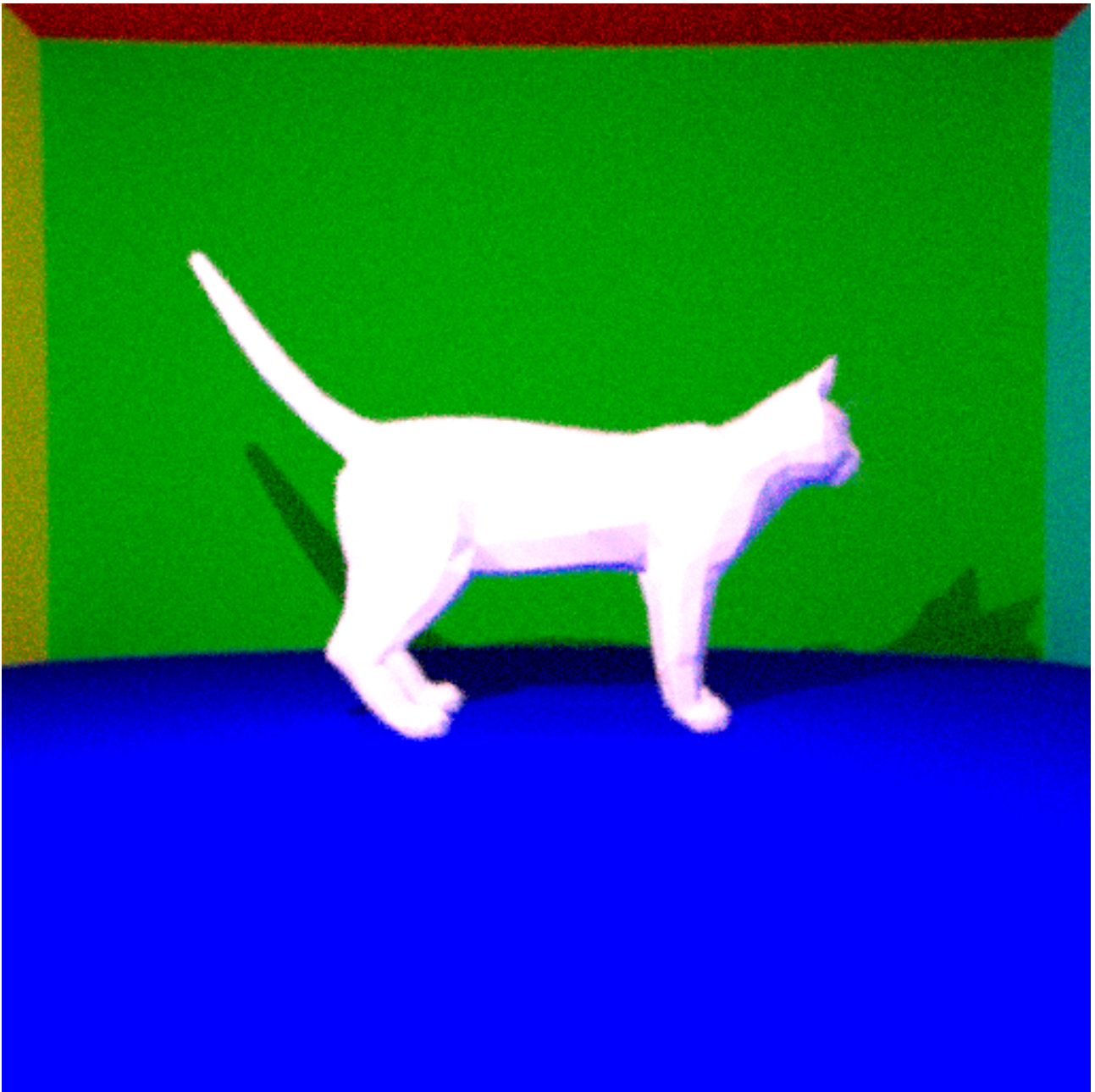
### Image 3

- **7 minutes** to render
- **1000 Rays per pixel**
- with Fresnel Law
- max ray depth 5
- Light position (-10, 20, 40)
- Light intensity  $2e10$
- **without** indirect lighting
- **without** antialiasing



## Image 4

- **47 seconds** to render
- **32 Rays per pixel**
- with Fresnel Law
- max ray depth 5
- Light position (-10, 20, 40)
- Light intensity  $2e10$
- Albedo of cat: Vector(1.0,1.0,1.0)
- with indirect lighting
- with antialiasing
- with **BVH**





## Image “Ghost Cat”

Mistake done when updating variable N in intersection in Triangle Mesh lead to this beautiful cat that became a ghost before coming to life.

