

CSE305 - ASSIGNMENT 1

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In this first assignment, I have implemented a raytracer with the following features:

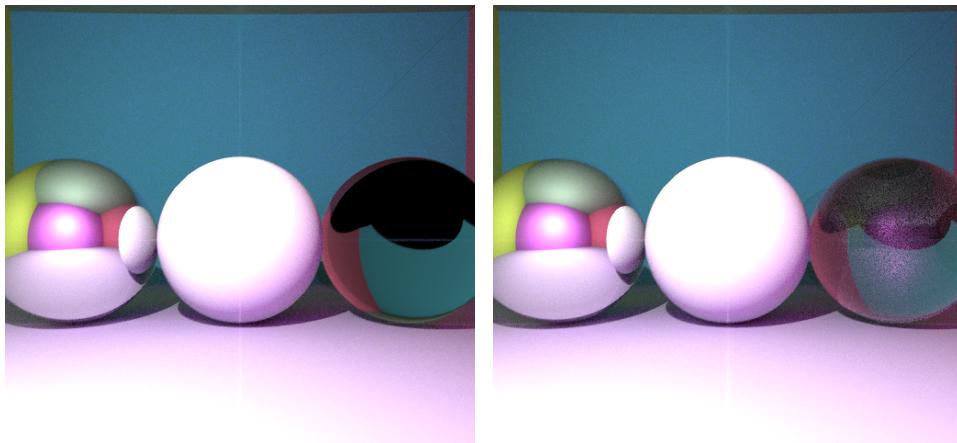
- (1) Surfaces with diffusion, reflection, refraction, and Schlick's approximation of Fresnel's law for better refraction;
- (2) Direct lighting, point light source and shadowing;
- (3) Indirect lighting, spherical light source, and soft shadowing;
- (4) Antialiasing;
- (5) Focus of camera and depth of field;
- (6) Ray-mesh intersection with BVH;
- (7) Phong interpolation.

The assignment was done in 816 lines of code, including 79 lines of code in `main.cpp` and 737 lines of code from 7 files in `./classes`. The project was compiled with C++20, and the following compiler flags

```
-fopenmp -O3 -fcf-protection=none -march=native -mtune=native  
-fno-math-errno
```

The rendering was done one a laptop with Intel Core i7-10710 CPU, 12 cores with 1.6 GHz. No GPU was used for the rendering in this report.

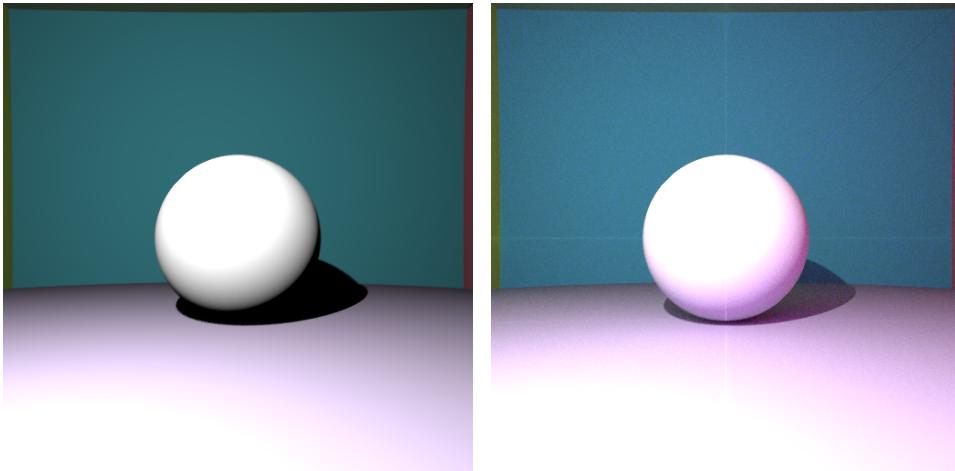
All pictures below were rendered with 64 rays per pixels.



(A) Snell's law (9.01 seconds)

(B) Fresnel's law (11.547 seconds)

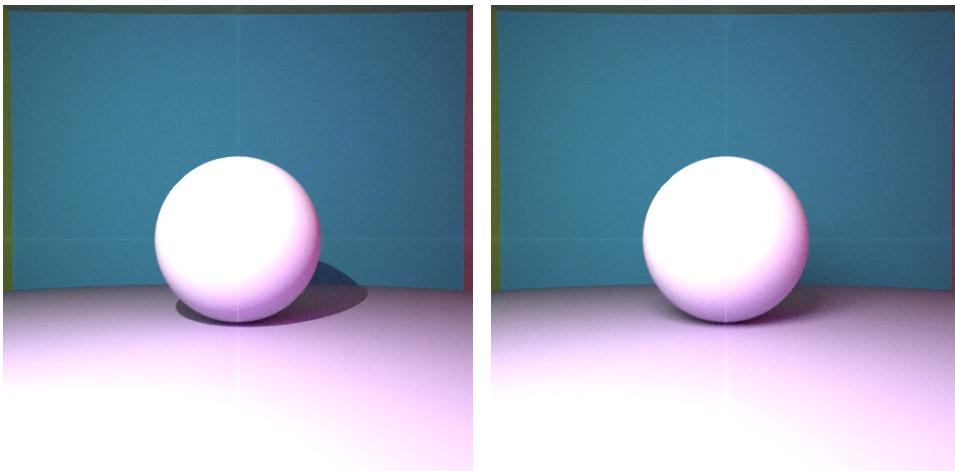
FIGURE 1. Three balls with reflection, diffusion, and refraction.
In this picture, the light source was a point.



(A) Without (1.555 seconds)

(B) With (9.625 seconds)

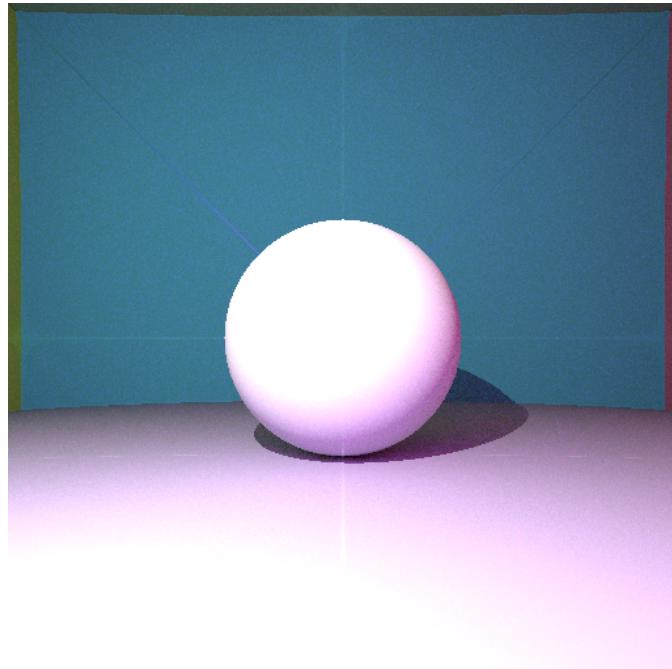
FIGURE 2. A sphere with diffusion, demonstrating indirect lighting. In this picture, the light source was a point.



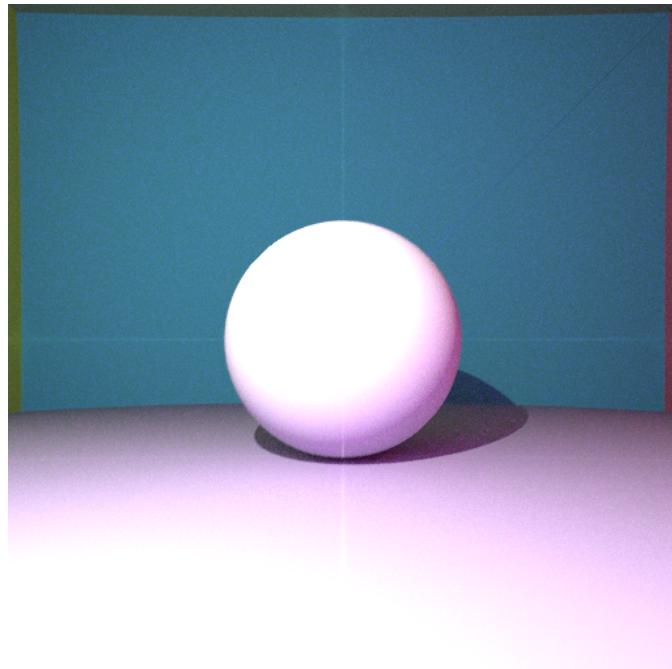
(A) Point (9.625 seconds)

(B) Spherical ($r = 10$) (9.035 seconds)

FIGURE 3. A sphere with diffusion. Two different light sources were used; indirect lighting was used.

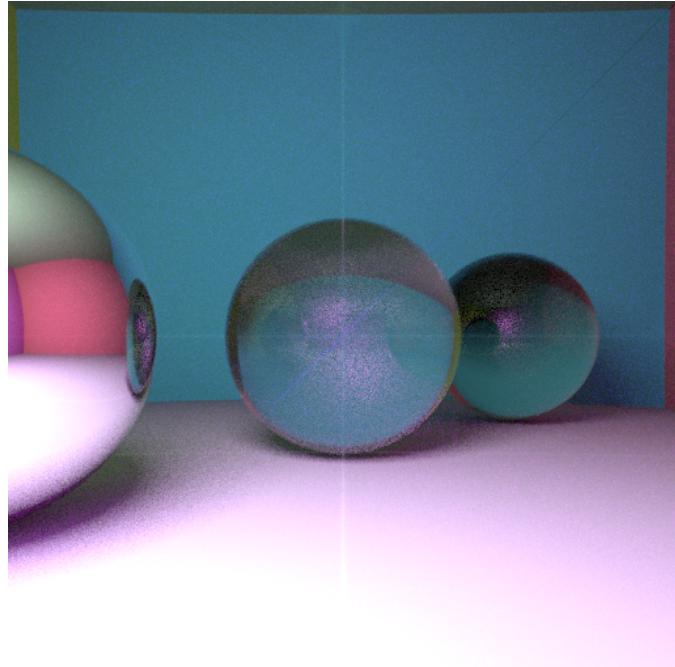


(a) Without (16.013 seconds)

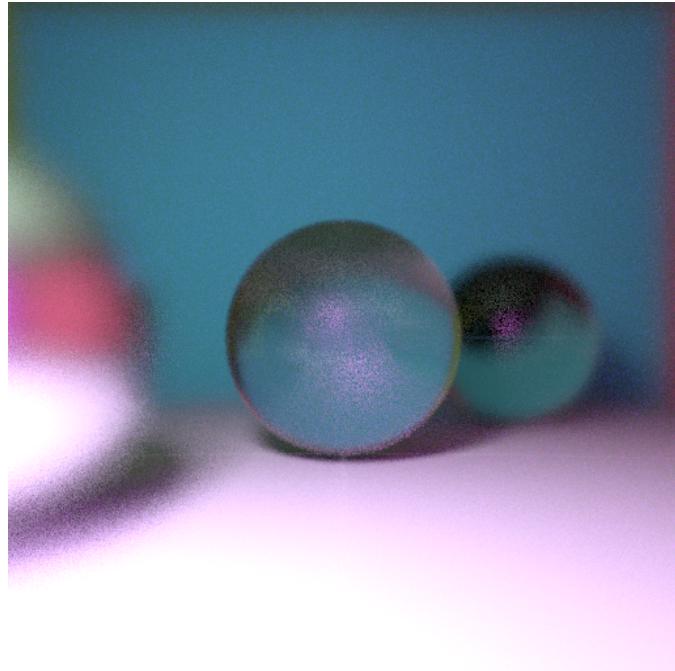


(b) With (17.264 seconds)

FIGURE 4. A sphere with diffusion, demonstrating antialiasing. In this picture, the light source was a sphere $r = 5$. *No depth of field was used.*

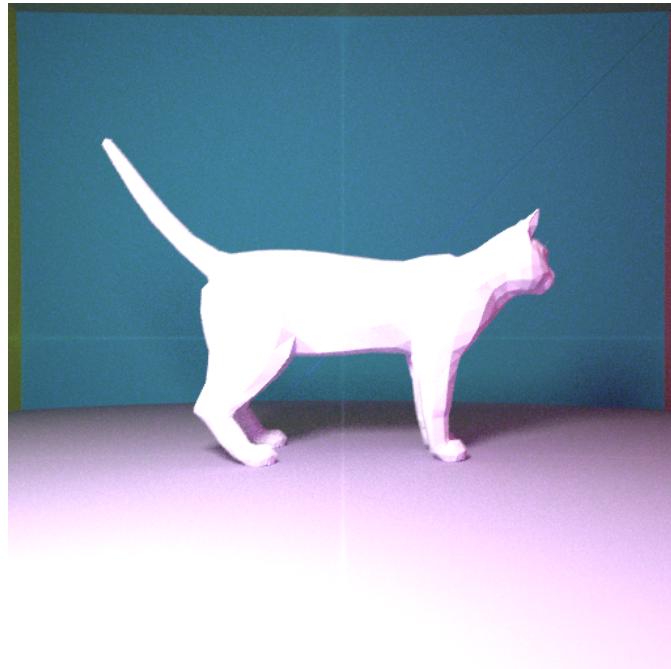


(A) Without depth of field (10.925 seconds)

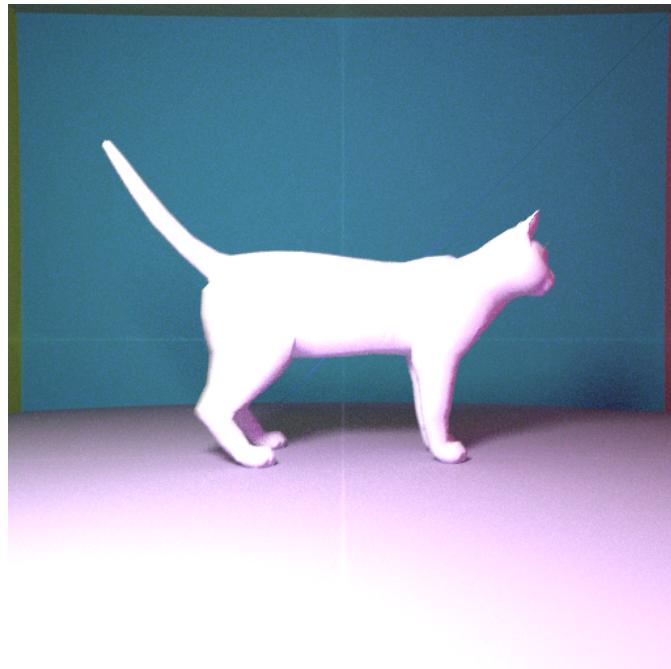


(B) With depth of field (12.254 seconds)

FIGURE 5. Three balls with reflection, diffusion, and refraction, demonstrating depth of field. In this picture, the light source was a sphere $r = 5$. Refraction was done with Fresnel's law.



(a) Without Phong interpolation (15.153 seconds)



(b) With Phong interpolation (14.241 seconds)

FIGURE 6. A cat, rendered with BVH and Phong interpolation. In this picture, the light source was a sphere $r = 5$. No depth of field was used to improve visibility.