Cs184 Project 3-2 Write up

# Part 1

In this part of the project, I implemented BSDFs which yield realistic renders of both mirror (reflective) surfaces and glass like (refractive) surfaces. In the series of photos below, two spheres (one mirror and one glass) are rendered in the 3D virtual space. The images were produced with 64 samples per pixel and 4 samples per light. The images use varying max ray depths as it gives an insight into both how the ray tracing engine works and how the reflective and refractive surfaces are generated realistically.

Max Ray Depth: 0 - the only light that can be seen is that which comes directly from the light source.

Max Ray Depth: 1 – At this ray depth, the diffuse BSDFs that are in a direct line with the light source are illuminated. The mirror BSDF is reflecting the light coming from the light source. The glass surface is reflecting the light source, but the reflection is uneven/ spotty due to the coin flip component of the sample\_f function for glass. This means that some of the light reflected off the surface while some refracted into it.

Max Ray Depth: 2 – At this ray depth, the shadows below the balls have gained some color and so has the roof of the room. The mirrored ball is now reflecting what was in the scene when max ray depth is 1 (glass ball completely black, roof back, shadows black). The glass ball is also reflecting the scene from when max ray depth is one, but this reflection is weak and spotty for the same reasons discussed in Max Ray Depth 1. At this point none of the light that has entered this sphere has exited.

Max Ray Depth: 3 – At this point the image is looking pretty photo realistic apart from the dark reflection of the glass ball in the mirrored one. This is because the mirrored ball is reflecting the scene from when Max Ray Depth is 2 in which the glass ball is very dark. The light has finally been able to exit the glass ball and hit the sensor so now the glass ball actually looks like glass. It still maintains its reflections from the lower ray depths and projects this interesting shadow on the ground where the light is focusing in the middle.

Max Ray Depth: 4 – At this point the photo has all the correct features with the bright bottom of the sphere and the focused middle part of the glass shadow reflecting to an even smaller point of focus on the blue wall. This is possible due to the extra bounce. The reflection of the glass ball is mostly correct.

Max Ray Depth: 5 – This photo has a few points which are brighter than the previous due to the extra light bounces/exposure.

Max Ray Depth: 100 – At this high depth, the parts of the image are brighter than the previous ones. However, there are no extra noticeable extra features when comparing to a max ray of 5 or 4.

# Part 4

In this part I implemented a thin lens camera model which is able to simulate the focusing of a camera. This differs from the originally used pinhole model which simulates a camera lens radius of zero, meaning that the whole image is in focus. The thin lens model randomly samples the ray over the camera lens then runs a ray from that spot on the lens, through the point of focus that a ray generated by the pinhole model would yield. The ray intersection/ ray bouncing works exactly the same once the initial ray is generated. This means that the image is more focused at the focal length, but circle of uncertainty at points not at the focal distance is produced by randomly sampling the camera lens.