

Exploration in Beautiful Ray Tracing World

Project B report for COMP_SCI 351-2 CG

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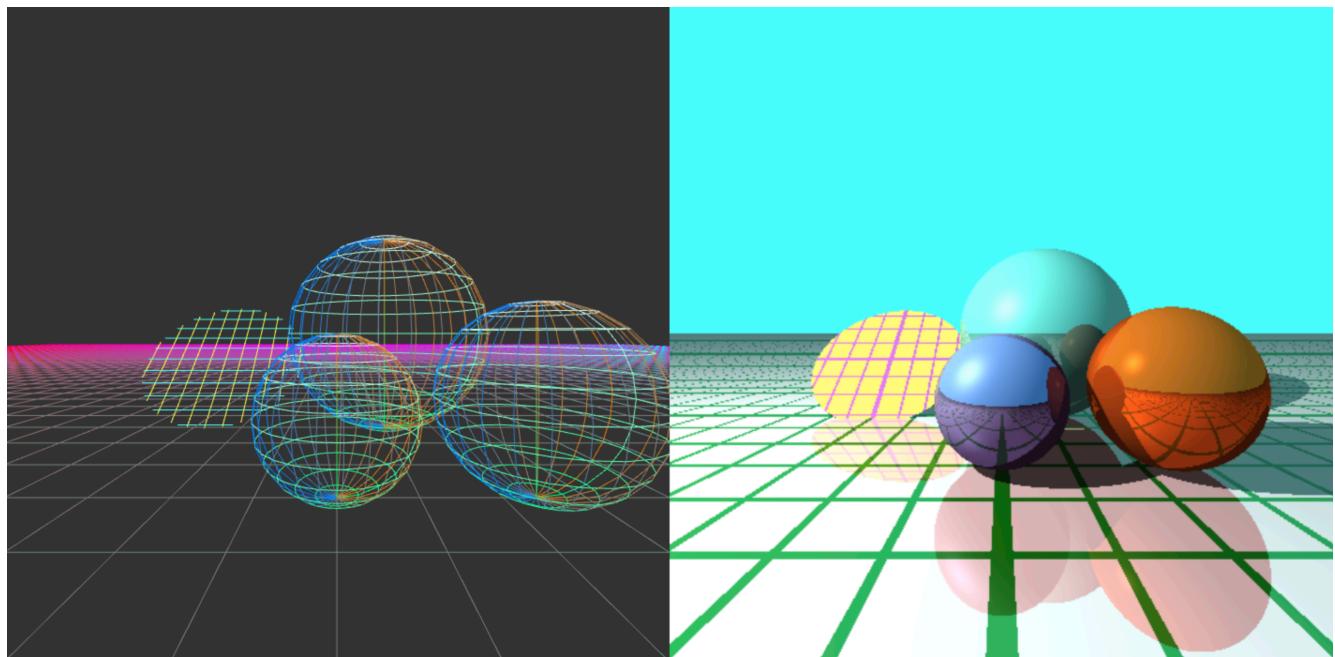


Figure 1. A screenshot of one scene.

Introduction

In Project B, I implemented ray tracing and ray marching to build a beautiful world with different light and material effects on different shapes of objects. [Figure 1](#) shows an example of one scene in the program. On the left side is WebGL preview of the world, while on the right side is the ray traced image from the same view location and angle.

There are four scenes altogether, with two light sources in each scene, and different shape and material of objects, including disk, sphere, box, torus, capsule, CSG curved bowl, and pancake-like squeezed sphere.

The camera is able to move and aim freely in the space, and lamps can be switched on and off. There are also all kinds of features that can be adjusted including anti-aliasing, recursive depth, lamp position, etc.

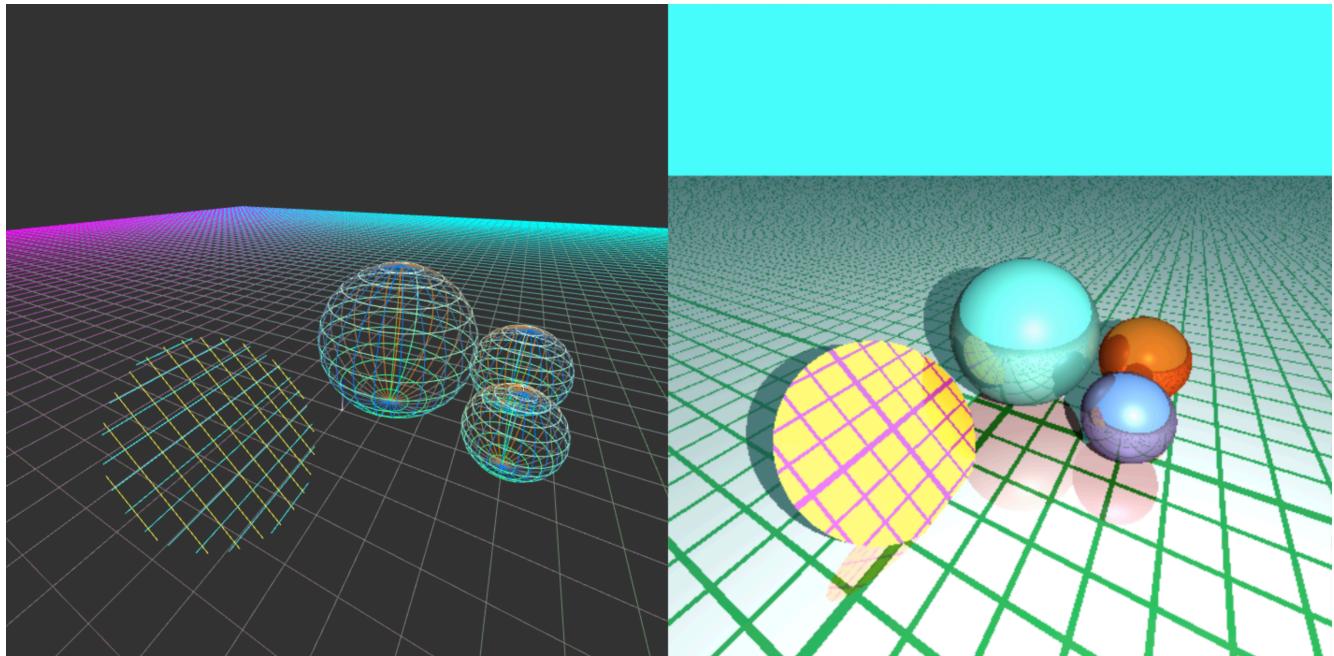


Figure 2. Same scene as Figure 1 but different camera and lamp position.

User Guide

- ❖ **Anti-aliasing:** Press '**Super-Sampling**' button and see the number of 'sample/pixel' on the screen to adjust super-sampling rate, And then press '**T**' to trace. Press '**Jitter**' button to switch on/off jittering. Higher super-sampling rate may take much more time to compute. See [Figure 4](#).
- ❖ **Recursive Depth:** Press '**Change Recurse Depth**' button to adjust recursive depth. See [Figure 6](#).
- ❖ **Change Scene:** Press '**Change Scene**' button to change to another scene. Current scene number is shown on screen. There are 4 scenes for choice. See [Figure 3](#).
- ❖ **Lamp Control:** Press '**switch lamp1**' or '**switch lamp2**' to switch on/off the lamp. Press another time to toggle. Press '**I"K"J"U"O"**' to move lamp1 position, and lamp2 moves with camera. See [Figure 5](#).

❖ Camera Navigation: Press '**W**'**S**' to move camera forward/backwards. Press '**A**'**D**' to strafe left/right. Press '**Q**'**E**' to strafe down/up. Drag mouse to turn camera's aiming direction. Press '**T**' to ray trace after update. See [Figure 2](#).

Result

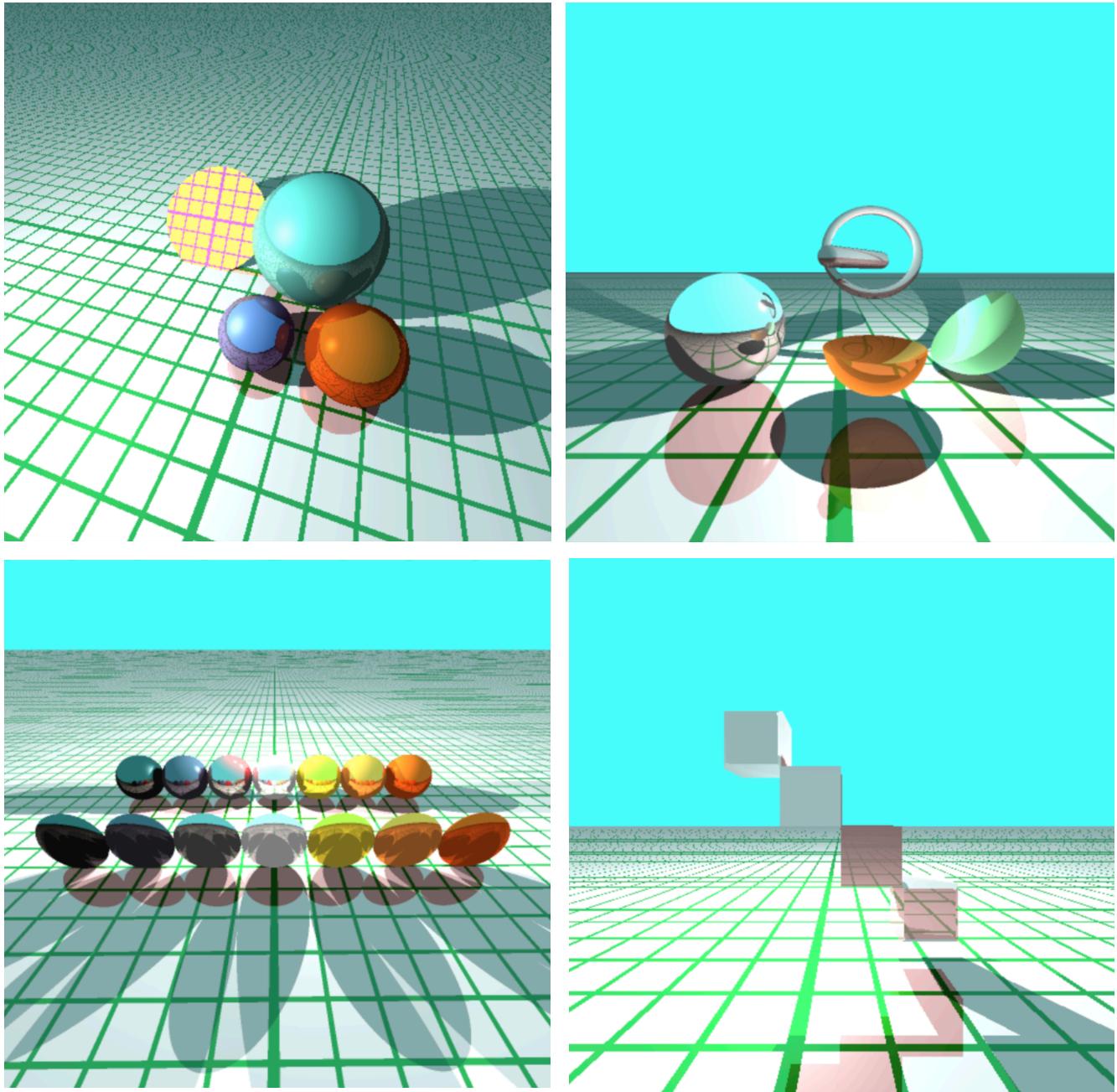


Figure 3. (upper-left) scene 1 from above, with 3 balls and 1 disk. (upper-right) scene 2 from left side with 1 torus, 1 capsule, 1 ball and two CSG curved bowls (using difference operator).

(lower-left) scene 3 from front with 7 balls and 7 lens of different materials. (lower-right) scene 4 from front with 4 boxes.

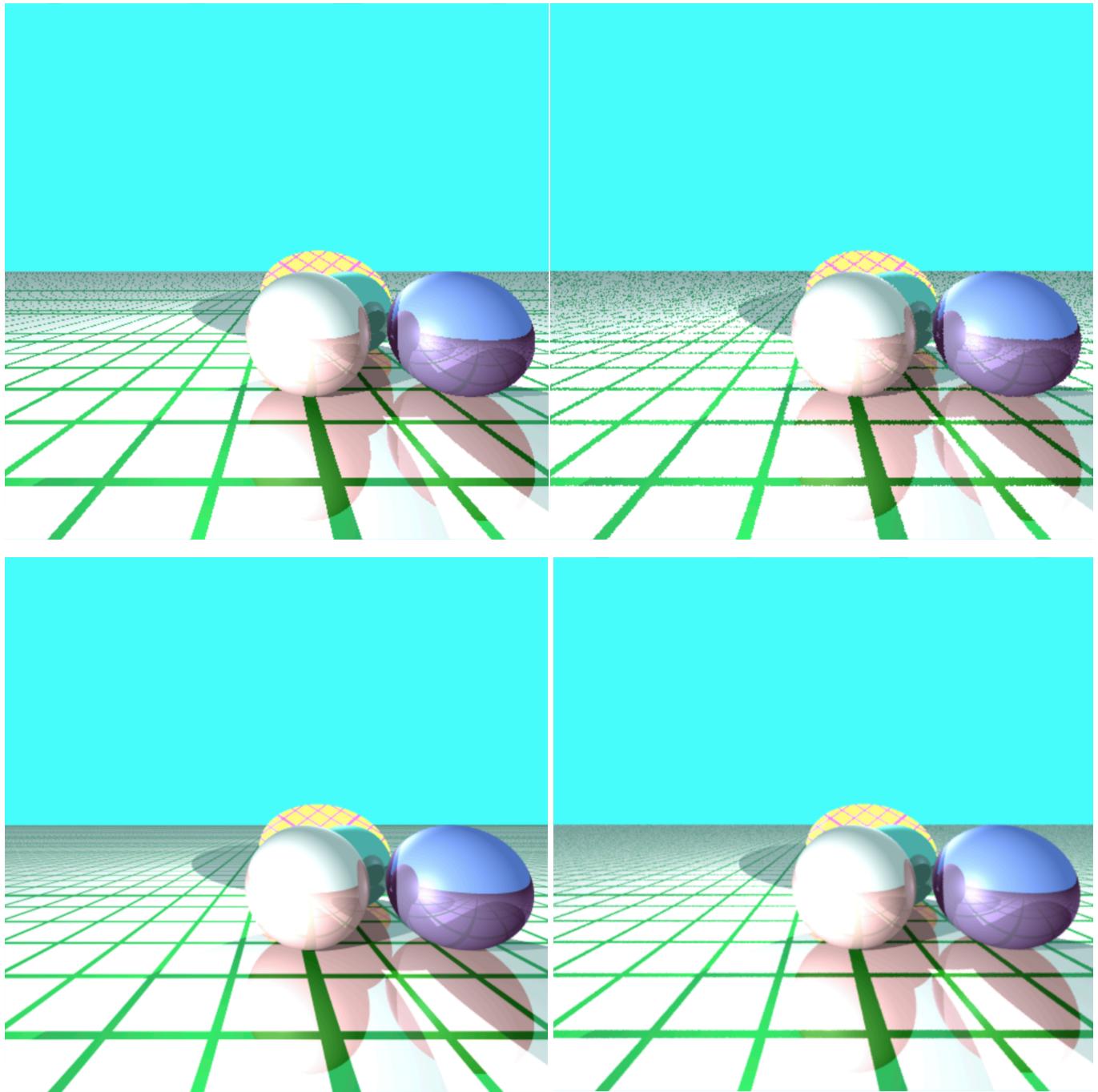


Figure 4. (Upper-left) 1 sample/pixel, no jitter. (Upper-right) 1 sample/pixel, jittered. (Lower-left) 4 sample/pixel, no jitter. (Lower-right) 4 sample/pixel, jittered.

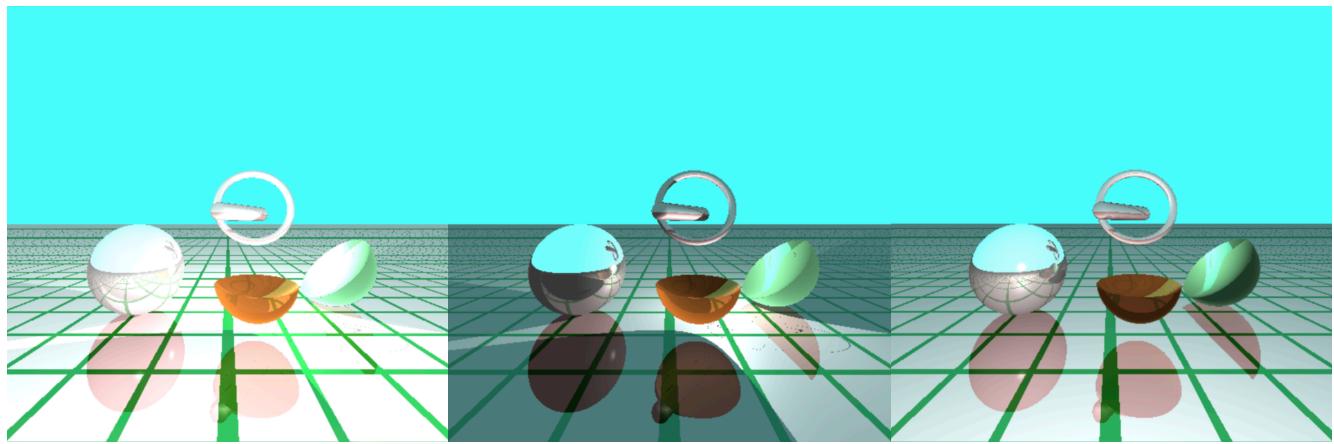


Figure 5. (left) Scene 2 with two lamps on. (middle) only lamp1 on. (right) only lamp2 on.

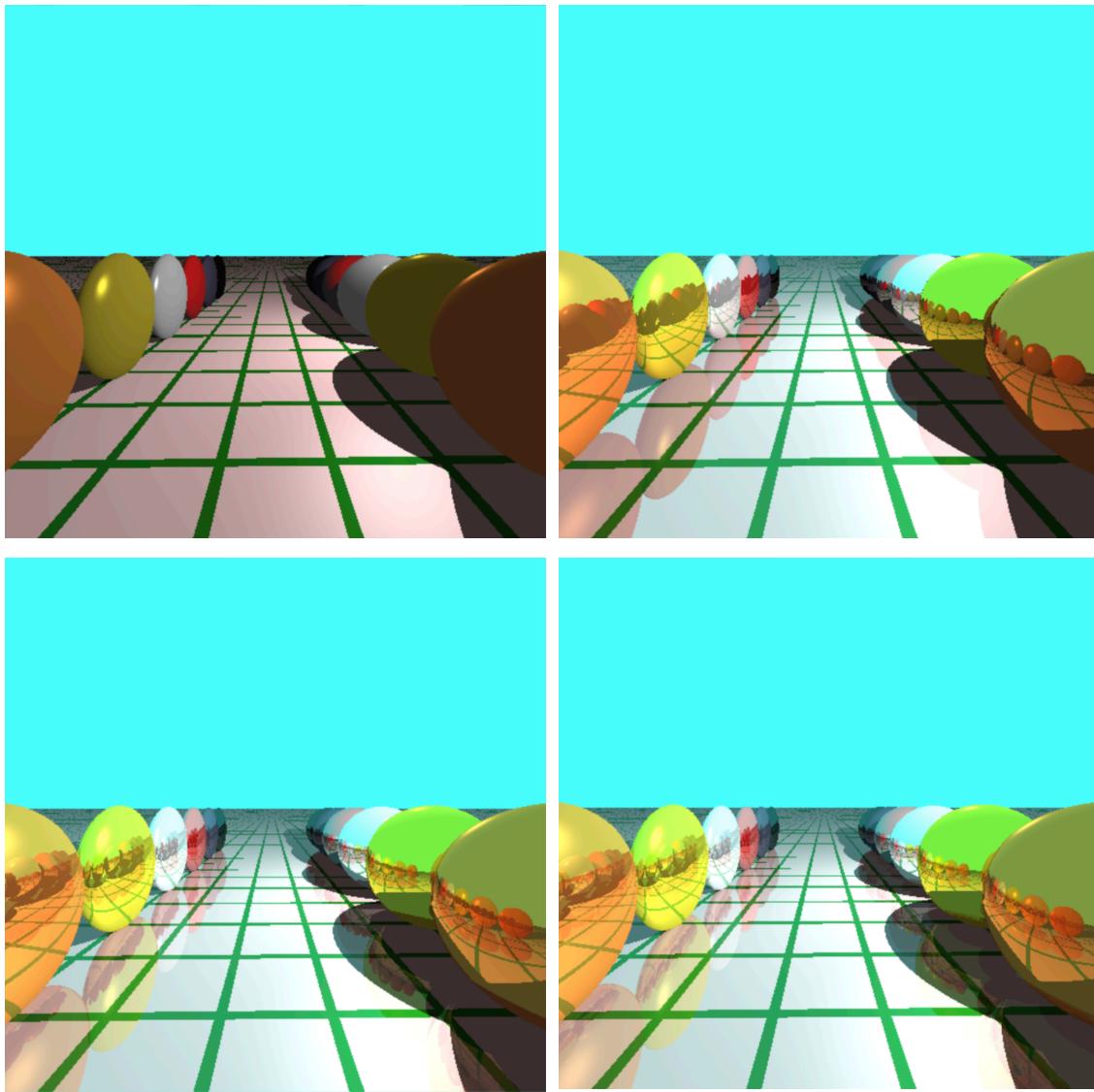


Figure 6. Different recursive steps (0-3) in scene 3.