Computer Graphics Project --- Ray Tracing

Requirements

- GNU GCC C++ compiler 5.4 (at least support C11)
- CMake 3.5+
- OpenCV (optional)
- GLFW3 - OpenGL (optional)

To compile correctly, at least one of OpenCV and OpenGL is needed, and you can specify the option in the **CMakeLists.txt** file

Instruction

1. Check **CMakeLists.txt**, and set build option, for example if you only have OpenGL library installed, you can set:

    ```
    set(BUILD_WITH_OPENGL 1)
    set(BUILD_WITH_OPENCV 0) # which means you don't have OpenCV library
    ```

2. Then you can run these commands in the source directory to build

    ```
    mkdir build
    cmake ..
    make all -j8
    ```

3. After building, you will find 4 executable files

    ```
    tracer
    tracer_double
    tracer_single
    UnitTest
    ```

4. To visualize the result, you can run each executable like

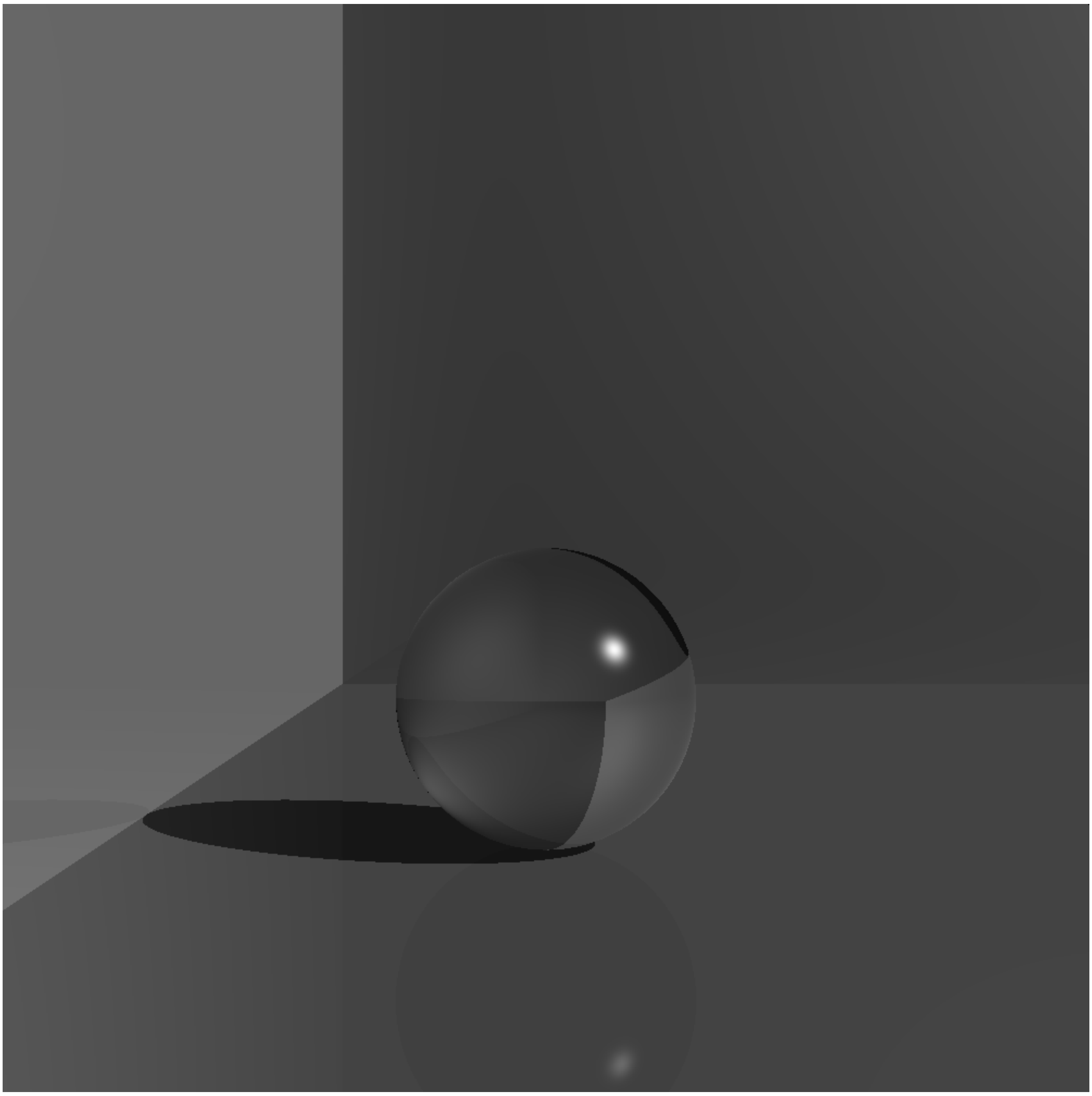
    ```
    # command : [excutable name] [rendering method]
    # for example
    tracer_double opencv;
    UnitTest opengl;
    ```

    but remember, only **OpenCV** Rendering will save a **PNG** image snapshot under its root directory.

Result

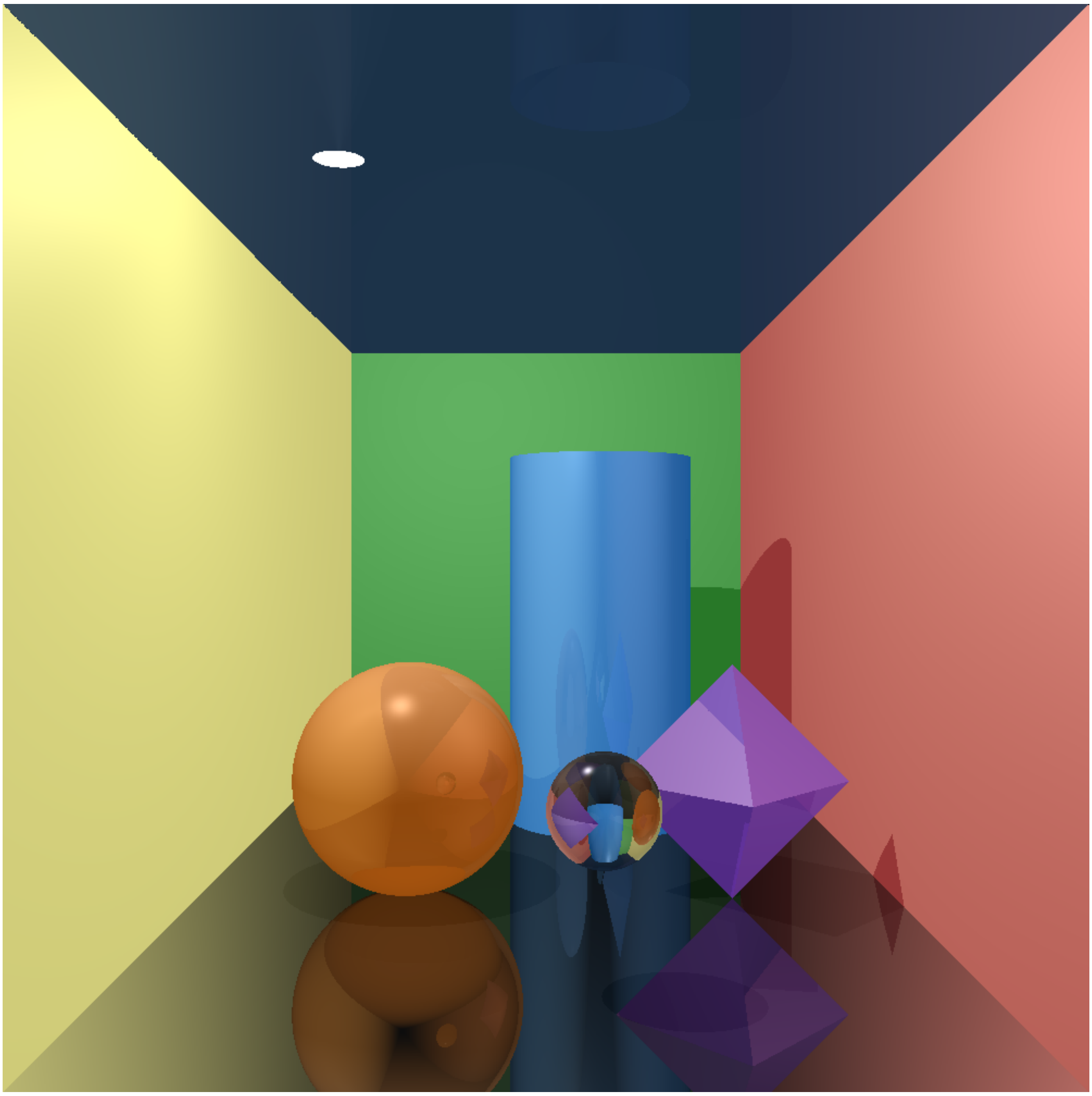
Each executable will generate a scene, and they are shown here

`UnitTest`

> This is a simple scene, which include 3 planes, 1 sphere and 1point light source. The rays are recursively traced **2** times. All objects' material use Phong reflection model. The differences are:
>
> 1. The ***shininess*** term is different. It is obvious that the sphere is more shiny.
> 2. The planes and the sphere have different mirror property (reflection).
> 3. The sphere has glass property (transparency).
>
> 

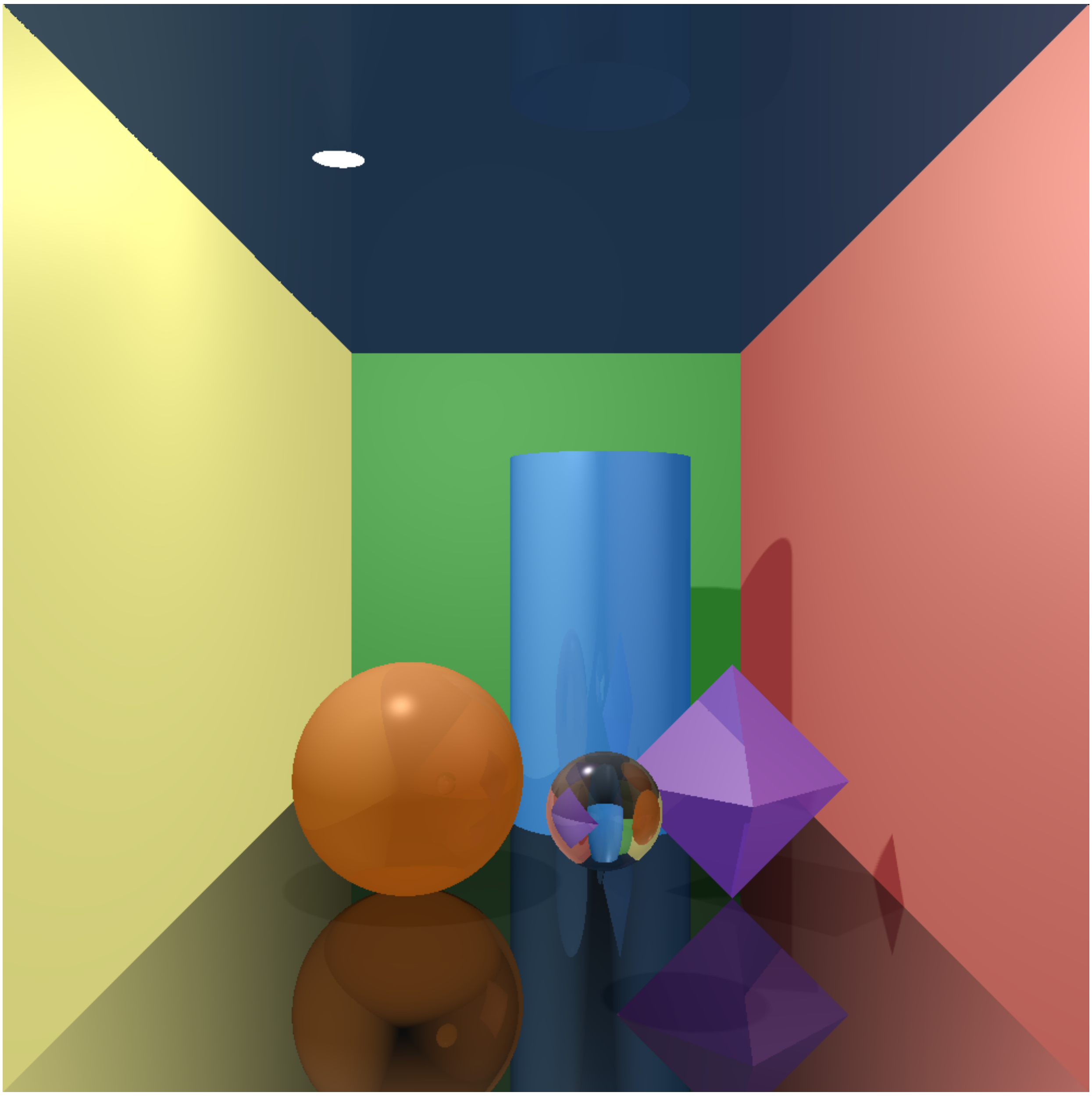
`tracer`

> This scene contains 2 sphere, 1 cylinder, 1 octahedron and 5 planes, with 1 point light source. The rays are recursively traced **3** times.
>
> 1. only the front sphere is transparent.
> 2. All objects except the left, back and right planes have mirror property.

> 3. Due to different ***ambient*** light terms and reflect behaviors (***specular*** and ***diffuse*** term), the colors of the objects are different.
> 4. ***shininess*** terms are different
>
> But with one point light source, the shadow is *sharp*.
>
> 

`tracer_single`

> Compare to `tracer` , `tracer_single` has a different light source. In face, **9 point light sources** are used to simulate **1 circle light source**. and we can find that the shadow become *soft*.

> 

`tracer_double`

> I add another **circle light source** (In fact, there are total 12 point light source) in the scene. Maybe it's too bright?