CS5984 Advanced Computer Graphics Fall 2011
Homework 4: Ray Casting on GPU

1 Due Date

Homework 4 is due on October 20th, 2011, 11:59pm.

2 Introduction

Ray casting is a simplified algorithm for ray tracing. It only cast incident rays and ignore any reflection and refraction rays. However, it is widely used in many applications to generate high-quality images, such medical data visualization. In this homework, you are requested to write a simple ray casting program using CUDA.

3 Project requirement

Your GPU ray casting application should be able to read a scene file, which including camera information, light source information, and the information of all the objects in the scene. Please use the following scene description file as an example (The scene file is created for POV Ray, which you can test the result in POV Ray.):

```
camera {
   location  <0, 0, -8>
   direction <0, 0, 1.2071>
   look_at   <0, 0, 0>
}

sphere { <1.5, 0.5, 0.0>, 1
   finish {
      ambient 0.2
      diffuse 0.8
      phong 1
   }
   pigment { color red 1 green 0 blue 0 }
}

sphere { <-1.2, 0.5, -3.5>, .5
   finish {
      ambient 0.2
      diffuse 0.8
      phong 1
```

```
    }
    pigment { color red 0 green 0 blue 1 }
}

box { <-3.0, -1.2, -2.0>, <3.0, -1.0, 4.0>
    finish {
        ambient 0.2
        diffuse 0.8
        phong 1
    }
    pigment { color red 1 green 0 blue 1 }

    rotate <-30, 30, 0>
}

box { <0.5, -1.0, -2.0>, <1.5, 0.0, -1.0>
    finish {
        ambient 0.2
        diffuse 0.8
        phong 1
    }
    pigment { color red 0 green 1 blue 0 }
    rotate <0, 30, 0>
}

light_source { <-10, 3, -20> color red 1 green 1 blue 1 }
```
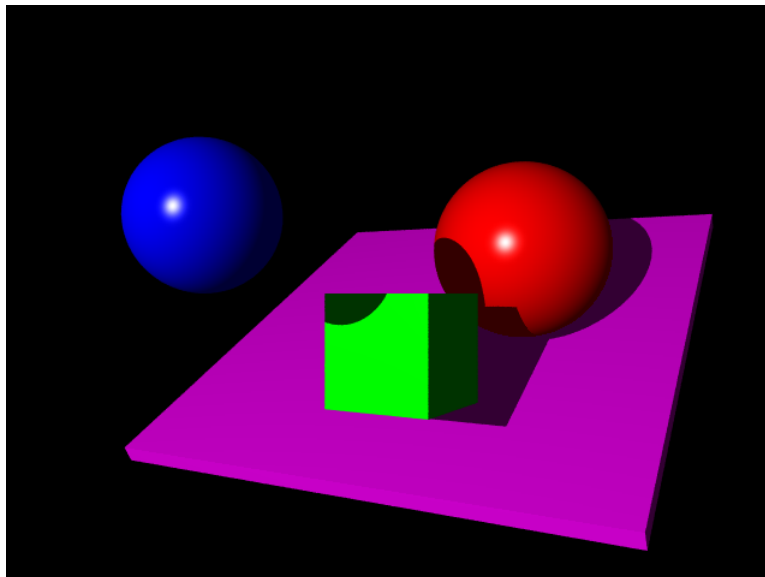

Figure 1: The rendered image of the example scene.

Your ray casting program should have the following features:

- Read from a scene file. You can define your own scene file format.

- Tracing one ray for each pixel of the image plane (through the center of the pixel). The image plane resolution is 640×480.

- Only calculate the shadow ray color, ignore reflection and refraction ray.

- Your scene should have at least two spheres and two boxes. You can have only one light source.

- The local illumination model is Phong Shading model, as we discussed in the class. Please decide on the parameter for the light source and object materials by yourself (including specular, diffuse, and ambient).

4 What to Submit

Put your solution in one or more source files. The main file (which includes function main()) should be named homework4.cpp or homework4.cu. Include all your source files and the makefile (or visual studio project file) in a zip file and upload to class Scholar site in your own Dropbox.

Please also include your scene file and final rendered image in the zip file.

Please do NOT include the compiled EXE file and other intermediate compiled files.

Note: Please use CUDA 4.0 for all the homeworks for this course.