Computer Graphics

Assignment 2 - Ray Tracing

Due date: Feb 13th 2025 (Thursday) 11:59 PM

1 Objective

In this assignment, you will build a basic ray tracer in Python. The goal is to:

1. Generate rays from a virtual camera to the scene.

2. Compute intersections of the rays with 3D objects (spheres).

3. Use the Blinn-Phong shading model to calculate the color of each pixel in the rendered image.

2 Starter Code Overview

you'll be provided some starting code, including

1. a `Sphere` class with properties:

   - `center` : The 3D coordinates of the sphere's center.

   - `radius` : The radius of the sphere.

   - `color` : The RGB color of the sphere.

   - `ka` : The ambient coefficient.

   - `kd` : The diffuse coefficient.

   - `ks` : The specular coefficient.

- shiniess : The shininess factor for specular highlights.

2. The main function that includes:

   - Two objects of the Sphere class.

   - Definition of the Light Source:

     - position : A 3D point in space (e.g., [5, 5, -10]).

     - intensity : A scalar value representing light brightness.

     - color : The RGB color of the light (e.g., white light: [1,1,1]).

   - The dimensions of the image $n_x \times n_y$ (e.g., 800×800).

   - Definition of the image plane:

     - height : e.g., the bounds of the image plane horizontally are from -1 to 1.

     - width : The corresponding width of the image plane.

   - The camera position, e.g., [0, 0, 0]

   - Distance between the camera and the image plane, e.g., 1.

   - Initial pixel colors of the final output image.

   - Code to display the final output image.

3   Tasks

Complete the render_scene function in the main that loops over all pixels in the image, to:

1. Compute the ray for each pixel.

2. Find the closest sphere intersected by the ray.

3. If a sphere is hit, compute the pixel color using the Blinn-Phong model.

4. If no sphere is hit, set the pixel to the background color (e.g., black or gray).
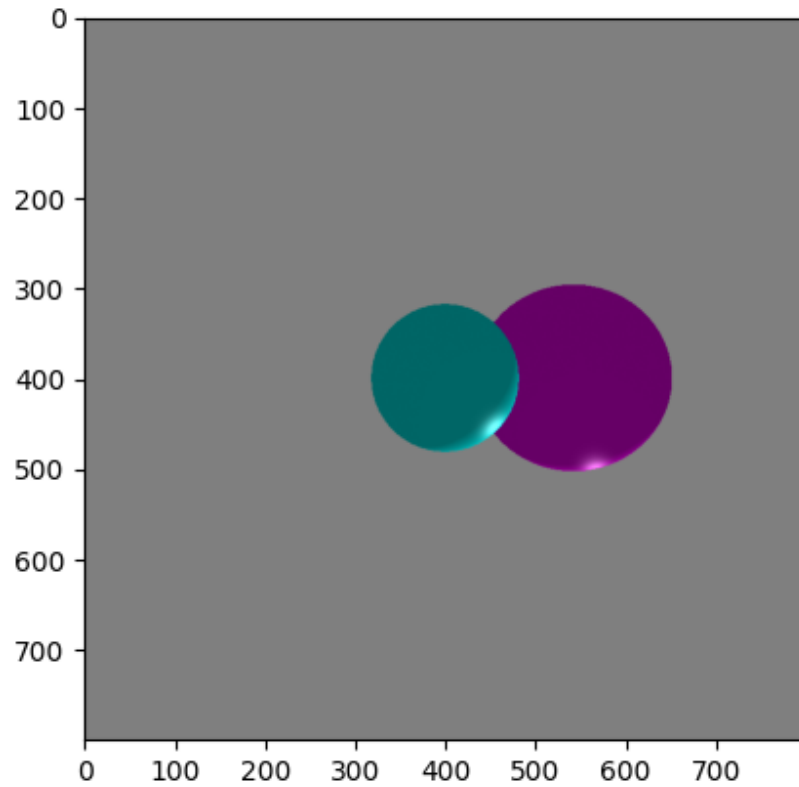
Figure 1: Render Result

4   Results

Your program should output the final image like Figure 1.

Play with the parameters to see how they affect the rendering results.

5   Items to submit

A zip file that contains your Python code and a PDF report showing the output figures from the main function.