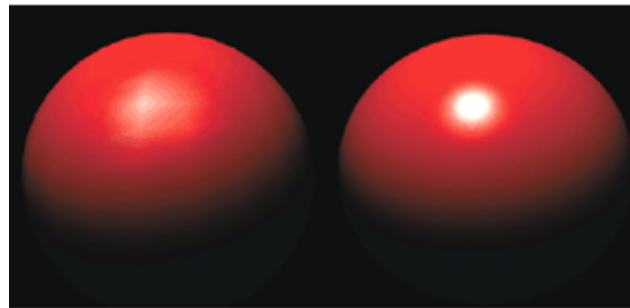# 3D Shading

Due date: May 23, 2021, Sunday, 11:59pm

In this assignment, you improve the 3D shooting game implemented in assignment #3 by adding multiple light sources and fragment shading. After this assignment, you will have a deeper understanding on the interaction between various light sources and 3D objects.
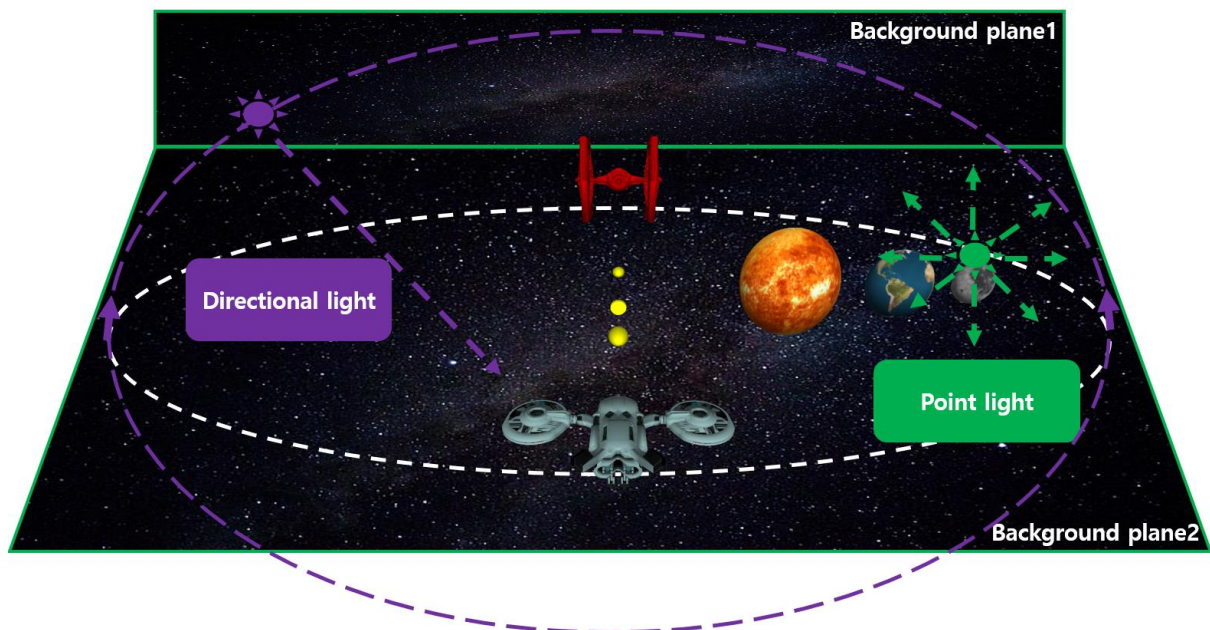

**Figure 1. Gouraud shading (left) and Phong shading (right)**

Figure 2. Types and rough positions of the lights.
(You don't have to render the positions of the light sources)

Requirements

- **Lighting**
  - There are two kinds of light sources: point light and directional light.
  - Point light
    - The point light has a fixed position relative to the satellite in planetary system. i.e. when satellite moves, point light moves accordingly. (the planetary system consisting of 1 star, 1 planet, and 1 satellite)
    - The influence of the light decreases with distance.
  - Directional light
    - The directional light should move in a half circular motion around the approximate center of the scene. In other words, as shown in fig. 3, the directional light repeats the following process: It moves from the initial point to the end point and then back to the initial point.
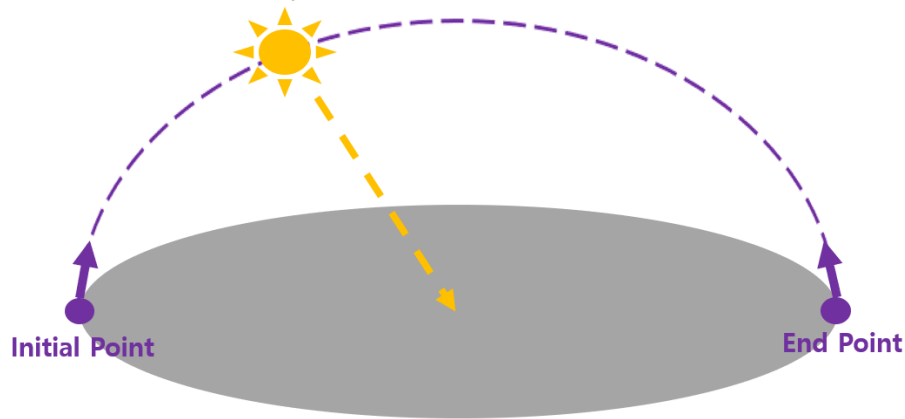
Figure 3. Movement of directional light

    - The directional light applies to all objects in the scene.
    - The cycle of the directional light should be short enough to observe the effect of the light movement (about 10 seconds per cycle)

- **Shading**
  - The following two shading modes with hidden surface removal should be supported. (Refer to fig. 1)
    - Gouraud shading (with hidden surface removal)
    - Phong shading (with hidden surface removal)
  - All objects should be implemented with multiple light sources based on Gouraud or Phong shading.
  - It should be able to select Gouraud or Phong shading with keyboard input 's'.
  - You should draw both diffuse and specular reflections (with possible ambient light)

- **Texture mapping**

- You should implement diffuse texture mapping on the character, background and the planetary system. (You can use whatever texture you want)
    - You should implement diffuse map on/off toggle with keyboard input 't'.
- In the case of Phong shading, you should apply normal mapping to the planetary system. (You can use whatever normal map you want)
    - You should implement normal map on/off toggle with keyboard input 'n'.

- **Misc.**
    - Create a background using 2 planes. (1 in the front, 1 in the bottom) (Refer to fig. 2)
    - Features which are not specified in this document are the same as in the assignment #3-2.
    - You are free to implement any details that are not specified and record them in the report.

- **Extra points**
    - If you implement other functions that are not mentioned in this document, you may obtain extra points. (Up to 10% of the full marks)
        - The directional light applies to all objects in the scene.