# Lab 9 Report: Lighting and Shading

Summary

The purpose of this project was to implement Gouraud shading for polygons with ambient and point light sources, resulting in a complete 3D z-buffer rendering system with lighting and shading. Images were produced with this system using the creation of custom 3D models.

Required Images

1. Lighting and Shading Test (test9d.c)

Description: This image was generated using the **lighting_shading** function to calculate the appearance of a surface with ambient and point light sources. The test confirmed the correct implementation of the lighting model by showing the combined effect of ambient and point lighting on a simple geometric shape. The sum of all shading calculations was printed for verification.
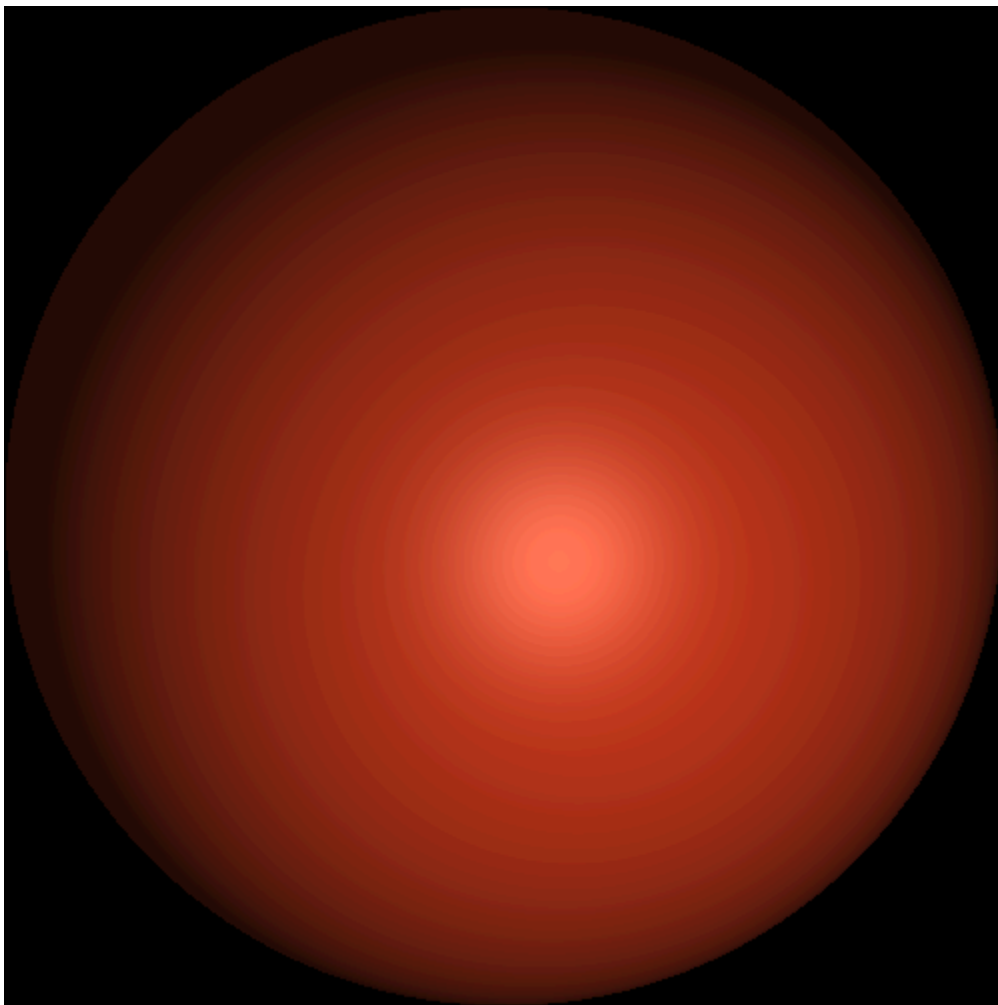
2. *Simple Cube with Gouraud Shading (test9a.c)*

Description: This image shows a simple cube rendered with Gouraud shading. The colors interpolate smoothly across the faces of the cube, demonstrating the effectiveness of the Gouraud shading algorithm. The shading was calculated at the vertices and interpolated across the surfaces.
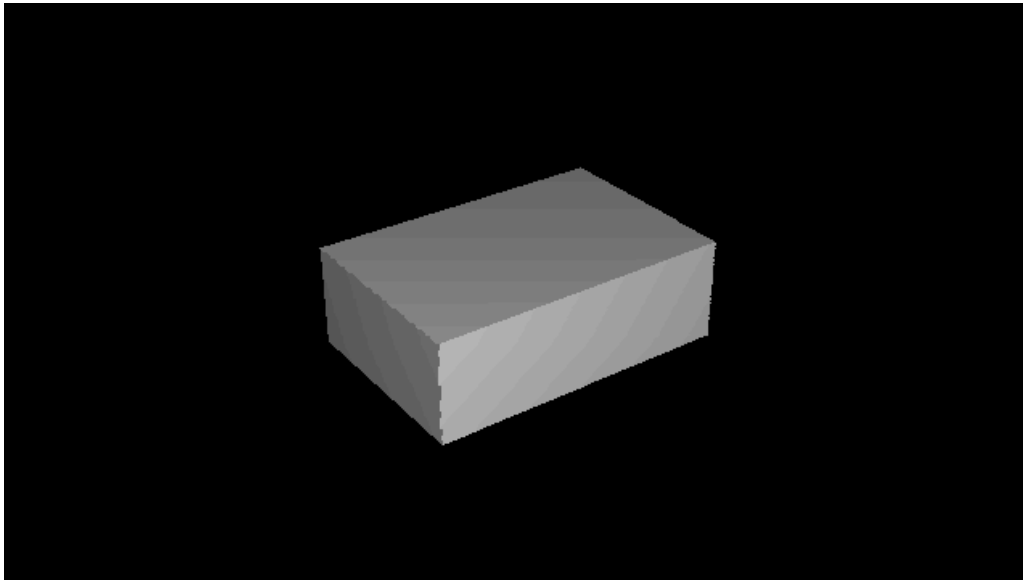

3. *X-Wing Scene with Gouraud Shading (test9b.c)*

Description: This image features the X-wing scene from the previous assignment, now rendered with Gouraud shading. The shading enhances the visual realism of the model by providing smooth color transitions across its surfaces. The implementation was tested to ensure the shading function works correctly in a complex scene.
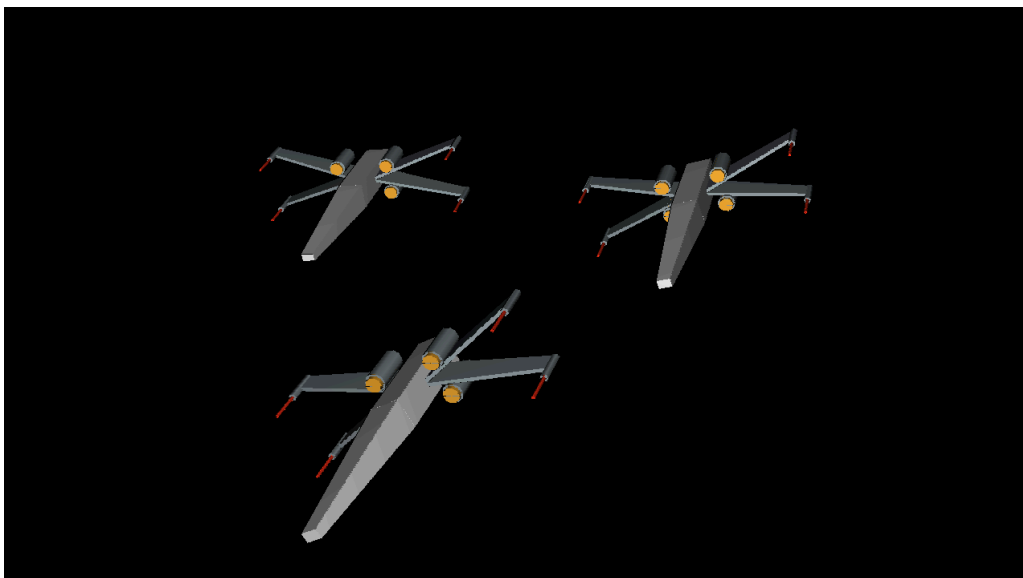
4. *Starfuries Scene (test9c.c)*

Description: Generated using ***test9c.c***, this image demonstrates the system's ability to read ***.ply*** files and render complex models. The scene features multiple Starfury models with correct shading and depth calculations. The shading and z-buffering were verified by rendering the models from various angles.
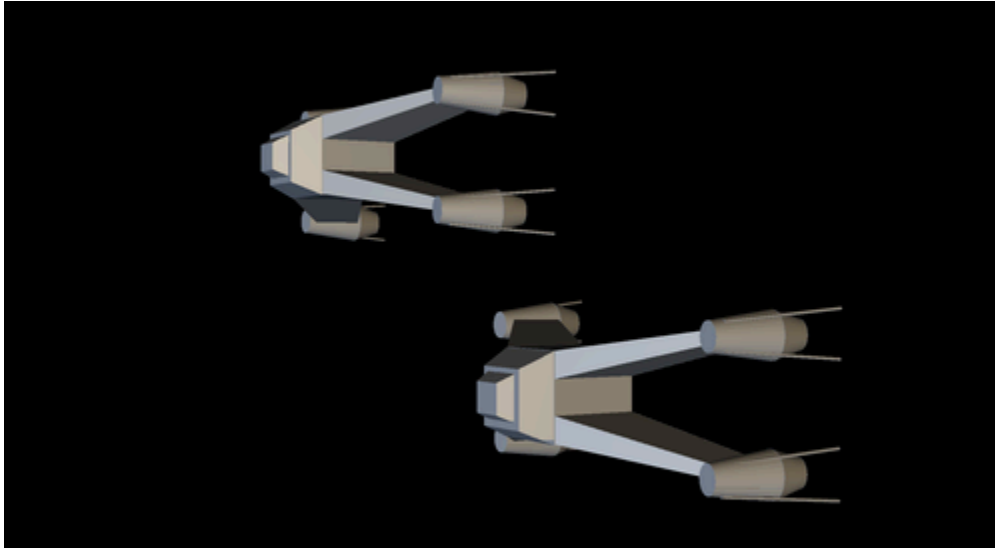

Extensions / Portfolio

1. *Mochi Skewers (test9e.c)*

Description: This creative image features a 3D model of a mochi skewer placed in a scene with at three variants, a point light source, and an ambient light source. Gouraud shading was used to render the models, creating a visually appealing scene with smooth color transitions. The models were positioned to demonstrate the lighting effects from different angles.
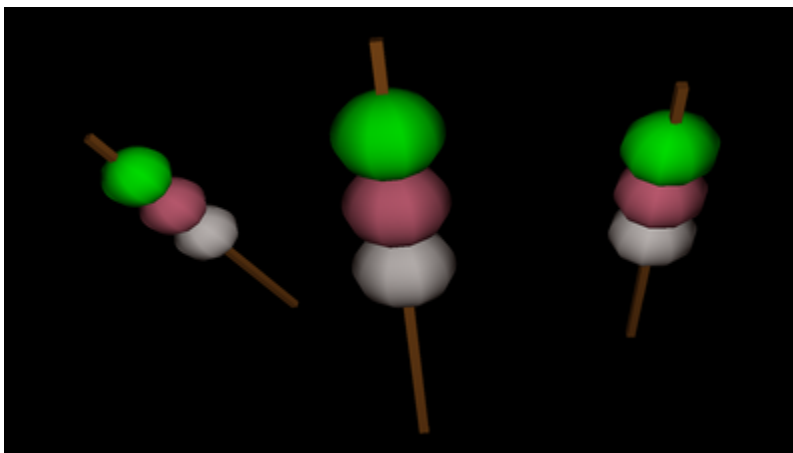
2. *Carpet from Bezier Surfaces with Gouraud Shading (test9bez.c)*

<u>Description</u>: This image showcases the results of updating my Bezier surface functions to support Gouraud shading. The carpet is rendered with smooth transitions of light and color, achieved by correctly calculating and interpolating the surface normals. This enhancement allows the Bezier surface to reflect light more realistically, highlighting the curves and contours of the model.
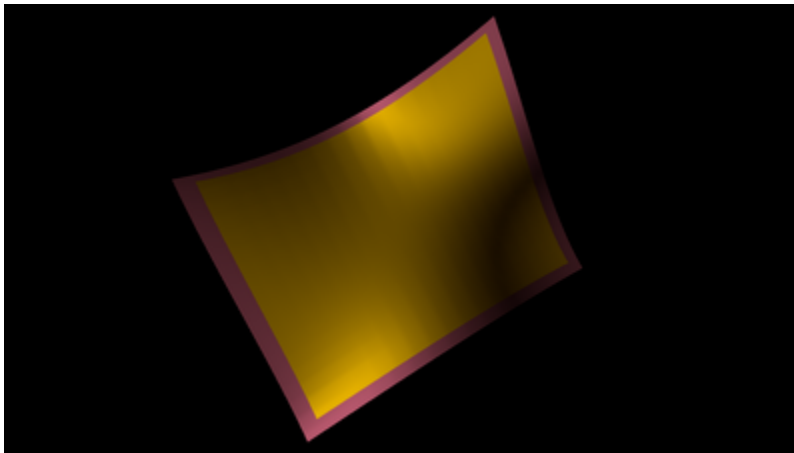
<u>Reflection</u>

This project provided a comprehensive understanding of lighting and shading techniques in 3D rendering. Implementing Gouraud shading deepened my knowledge of how light interacts with surfaces and the importance of shading algorithms in achieving realistic graphics. The extensions further expanded my shading implementation for bezier surfaces, which are crucial for modern computer graphics.

<u>Acknowledgements</u>

I would like to recognize the following for helping me complete this assignment:

- **Instructor and Course Material:** Professor Maxwell's lecture notes and videos provided me with guidance and reference materials for implementing the algorithms. My chat with him during office hours helped me mitigate issues with harsh shadows in my images.

- **Classmates:** Raphael Russo

- **Online Resources:** Various online tutorials and articles from sites like W3schools on scanline and barycentric algorithms contributed to my understanding of the concepts.