**3D COMPUTER GRAPHICS AND ANIMATION**

**PROGRAMMING ASSIGNMENT 16**

**Gouraud Shading**

**Difficulty: 4/5**

Create an application that simulates the shading of a sphere. The sphere originally is centered at (0, 0, 0) and has a radius of 1.

By default, an orthographic (parallel) projection at z=0 plane is used for the view; when the program runs, a circle should be seen. There is a light source, by default at (-10, 10, 10).

The program must be able to:

* Translate the sphere on the x, y, and z axes.
* Perform back face culling on the sphere.
* Illuminate the sphere using Flat, Gouraud, and Phong shading. Include ambient, diffuse, and specular lighting.
* Allow the user to change the diffuse, ambient, and specular coeficient of the sphere.
* Allow the user to change the specular reflection exponent of the sphere.
* Move the light source to another location.
* Add another light source.
* Incorporate distance into the illumination.
* Bonus points for user friendliness. Negative points for extreme user unfriendliness.

What to submit:

* An executable file.
* The source code (and other libraries/files if necessary).
* A report.

The report should contain the following:

1. Introduction.

* Explain what the program is about.
* Explain in what language the program is implemented.

1. Basic theory.

* Explain the Phong Illumination Model.
  + Explain ambient, diffuse, and specular light.
* Explain shading.
  + Explain Flat, Gouraud, and Phong shading. Explain how each method is done.
  + Write down the pseudocode for each method of shading.
  + Explain the advantages and disadvantages of each method of shading.
* Use your own words to write down this section (Basic Theory). Do not just mindlessly “copy & paste” from some source on the web (or worse yet, from the PPT files). Failing to comply with this rule will result in a severe penalty.

1. Implementation

* Explain the main interface of the program and the components on the interface.
* Explain every feature in the program and how to use them.

1. Design

* Explain the main data structures (if any) used in the program.
* Explain the main/global variables used in the program.
* Explain the transformation matrices used in the program.
* Explain how the bonus features are implemented.

1. Evaluation

* Evaluation of each case for rotation on the axes. Include screenshots for each case. Explain whether each case is successful.
* Evaluation of the main features. Try the following cases.
  + Moving the sphere along each axis. Include screenshots of the change of shading on the sphere.
  + Moving the light source along each axis. Include screenshots of the change of shading on the sphere.
  + Showing how specular lighting does not work properly with Gouraud shading. Try moving the light source or the sphere to view the changes in specular lighting. Include screenshots.
  + Changing the values of the ambient, diffuse, and specular coeficients. Include screenshots of the change of shading on the sphere.
  + Changing the values of specular reflection exponent. Include screenshots of the change of shading on the sphere.
* Also perform a test case for all the bonus features you implemented
* Include screenshots of each test case.

1. Work log.

* Record the date and time of every moment you work on this assignment and job description of each member at each session. The work log should be a table with the following columns:
  + Date
  + Activity / progress
  + Personnel involved
* Write a summary of the implementation of each requirement given in the first page. For each requirement, explain whether that requirement is fully implemented, partially implemented, or not implemented at all. Give explanations if necessary.

1. Conclusion and remarks.

* Explain whether the program works as expected.
* If some parts of the program do not work as expected, explain why.
* What are your comments about this assignment?

You must report your progress every week. The following features must be implemented during your progress report:

Week 1:

* The sphere can be moved along each axis.
* Back face culling is used to show only the front faces of each pyramid.
* The sphere is illuminated using flat shading (all surfaces must have the same base color).
  + Ambient, diffuse, and specular lights are used for illumination.
  + The light source is set at the default location.

Week 2:

* The sphere illuminated using Gouraud shading.

Week 3:

* The sphere illuminated using Phong shading.

Submit the assignment no later than midnight, 27 December 2019, to [x60880@yahoo.com](mailto:x60880@yahoo.com).