

National University of Sciences & Technology
School of Electrical Engineering and Computer Science
Department of Computing
CS361 - Computer Graphics

Assignment # 1: Lighting & Shading	
CLO 4 - Design and implement 2D and 3D graphical solutions for real-world problems.	
Maximum Marks: 10	Instructor: Dr. Sidra Sultana
Date:18-02-2025	Deadline: 28-02-2025

Objective:

The purpose of this assignment is to help students understand the principles of lighting in computer graphics, focusing on lighting vectors, Gouraud shading, and Phong shading. Students will apply mathematical concepts and implement shading techniques in code.

Instructions:

1. Answer all questions.
2. Show all necessary calculations where required.
3. Implement coding questions in **Python (using OpenGL) or C++** and submit a working script with screenshots of output.
4. Submit your assignment as a PDF report along with the code files.

Question 1: Understanding Lighting Vectors (5 Marks)

Given a light source positioned at $L(3,4,5)$ and a surface point at $P(1,1,1)$, compute the **light direction vector**.

Question 2: Gouraud Shading (5 Marks)

Consider a triangle with three vertices $A(1,1,1)$, $B(2,2,2)$, $C(3,1,0)$. Assume the normal at each vertex is:

- $N_A = (0,0,1)$
- $N_B = (0,1,0)$
- $N_C = (1,0,0)$

Using Gouraud shading, describe the process of interpolating color values across the surface.

Question 3: Phong Shading (5 Marks)

Given a normal at a point $N(0,0,1)$, a light vector $L(0.5,0.5,0.5)$, and a view vector $V(0,0,-1)$, calculate the **reflection vector** R using: $R = 2(N \cdot L)N - L$

Question 4: Coding Implementation (5 Marks)

Write a **C++ program** that demonstrates **Phong shading** for a simple 3D sphere. Your program should:

- Implement the Phong reflection model.
- Use a light source positioned at (10,10,10)(10,10,10).
- Allow rotation of the sphere to observe shading effects.

Submission: Attach your code file and screenshots of output.

Bonus Question (Optional - 2 Marks)

Discuss the impact of using **real-time ray tracing** instead of traditional Gouraud or Phong shading in modern game engines like Unreal Engine 5.