Assignment 03 Lighting and Shading

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Q1 (a)

```
wrtu = {r * cos(phi[i]) * cos(theta[j]), r * cos(phi[i]) * sin(theta[j]), -r * sin(phi[i])};
wrtv = {-r * sin(phi[i]) * sin(theta[j]), r * sin(phi[i]) * cos(theta[j]), 0};
```

- wrtu: partial derivative of f(x,y,z) of sphere w.r.t. phi
- wrtv: partial derivative of f(x,y,z) of sphere w.r.t. theta

We normalize their cross products to get the coordinates of direction vectors of normal. We make 2 containers for normal too, 1 for the coordinates and the other to store their indices. Then we make buffers for normal.

(b)

```
GLint lpos_world_uniform, eye_normal_uniform; // introduce the light position and eye normal variables
```

```
glUniform3f(lpos_world_uniform, -50.0, 500.0, 30.0); // declare the coordinates of the light source

glUniform3f(eye_normal_uniform, 40.0, -40.0, 40.0); // declare the coordinates of the eye
```

Introduce the coordinates for the light position and eye position. These are further exported to shaders to perform further calculations.

(c)

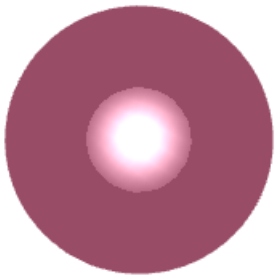
```
//ambient
vec3 Ia = La * ka;       // ambient

//diffuse
vec3 Id = kd*max(dot(n, l)*Ld, 0.0);        // diffuse

//specular
vec3 Is = ks*Ls*max(pow(dot(n,normalize(l+e)),spec_exp),0.0);        // specular
```

Calculating the above in the fshader, by taking values of La,Ld,Ls and ka,kd,ks from lab 5.
Phong exponent(spec_exp) has been taken 32. Back side of the object is not pitch dark:

(d) Result of Phong shading

Q2:

(a) cutoff angle = 30 degrees



Theta is calculated by the dot product of normalized normal and normalized difference of light position and vertex. We compare theta to define regions for our spotlight.

(b)

Cutoff angle out = 30 degrees

Cutoff angle inner = 25 degrees

To make the spotlight smooth on the boundary we take the ratio using the formula given in assignment booklet and multiply it with the sum of ambient and specular shading.

Sources:

- Code of lab 5
- Code of lab 2
- https://learnopengl.com/Lighting/Light-casters#:~:text=A%20spotlight%20in%20OpenGL%20is,the%20radius%20of%20the%20spotlight.
- https://www.youtube.com/watch?v=MAJqiDll0a8
- https://www.youtube.com/watch?v=tmCOMzAA4rc