

## HW3 Guideline

### Task: Implement Phong & Gouraud shading.

#### Phong shading

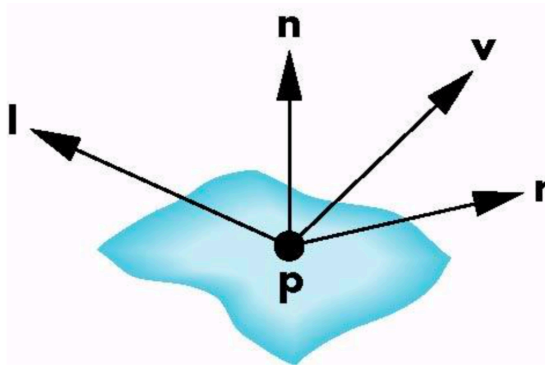
##### Main.cpp

1. Compute normal vector  
Compute the Earth vertices' normal coordinates and pass them to vertex shader by using **glVertexAttribPointer**.
2. Set up light position
  1. You can use **gluSphere** to represent your point light source.  
Remember to add color to your light source for visualization and translate it to the specific light position.(We will provide color & pos in spec.)
  2. Pass light position to vertex shader by using **glUniform3fv**.
3. Get ModelView matrix before doing translate.
  1. Using **glGetFloatv** to get current ModelView matrix.
  2. Pass ModelView matrix to vertex shader by using **glUniformMatrix4fv**.

##### Vertex shader

1. Compute normal matrix
  1. You have to implement normal matrix by yourself.  
**Hint: You can't directly use ModelView matrix to transform normal vector to view space. You can find out some formula online.**
  2. Compute new normal vector  
**Hint: Using normal matrix & normal vector**
  3. Pass new normal vector to fragment shader.
2. Compute ModelView position and pass it to fragment shader.
3. Compute ModelView light position and pass it to fragment shader.

## Fragment shader



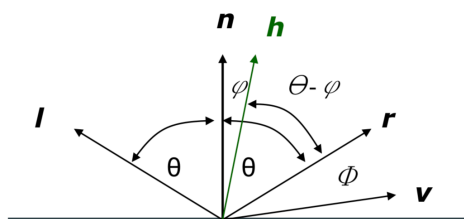
$$I = I_{ambient} + I_{diffuse} + I_{specular}$$

$$= k_a I_a + k_d I_d (l \cdot n) + k_s I_s (v \cdot r)^\alpha$$

## Using the Halfway Angle

- ▶ Replace  $(v \cdot r)^a$  by  $(n \cdot h)^b$
- ▶ b is chosen to match shininess
- ▶ Note that halway angle is half of angle between r and v if vectors are coplanar

Halfway vector :  $h = (l + v) / |l + v|$



$$\theta + \varphi = \theta - \varphi + \phi$$

$$2\varphi = \phi$$

1. Initialize parameters by yourself:  $k_a$ ,  $k_d$ ,  $k_s$ ,  $\alpha$ ,  $\beta$ . ( $0 \leq k_d, k_s \leq 1$ )
2. Compute four vectors:
  1. To source l
  2. To viewer v
  3. Normal n
  4. Perfect reflector r or you can use h(mentioned above)
3. Compute Ambient, Diffuse, Specular by using these parameters.
4. Output final fragment color.

## **Gouraud shading**

**Hint: You should change the order of shader to implement.**