SET08116 Computer Graphics
Lighting Tutorial 1 Worksheet

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This tutorial worksheet will allow you to practice how lighting is calculated for a vertex. In this worksheet we will build up an example of lighting a quad. Your goal is to calculate the colours of the individual vertexes based on the information given.

Remember that our lighting calculations are as follows:

$$
\begin{aligned}
AMBIENT &= \mathcal{DA} \\
DIFFUSE &= (\mathcal{DC}) \max(\mathbf{N} \cdot \mathbf{L}, 0.0) \\
SPECULAR &= (\mathcal{SD}) \max(\mathbf{N} \cdot \mathbf{H}, 0.0)^m \\
TOTAL &= AMBIENT + DIFFUSE + SPECULAR
\end{aligned}
$$

where

$$
\begin{aligned}
\mathbf{H} &= \frac{\mathbf{L} + \mathbf{E}}{\|\mathbf{L} + \mathbf{E}\|} \\
\mathbf{E} &= \frac{e - p}{\|e - p\|}
\end{aligned}
$$

The other values we will introduce as we go along.

1 Scene Data

Our quad in the scene has the following initial data defined.

Vertex 1 -

Position - $(-10, 10, -10)$

Normal - $(-0.577, 0.577, 0.577)$

Vertex 2 -

Position - $(10, 10, 0)$

Normal - $(0.577, 0.577, 0.577)$

Vertex 3 -

Position - $(10, -5, 0)$

Normal - $(0, 0, 1)$

Vertex 4 -

Position - $(-5, -5, -5)$

Normal - $(0.577, -0.577, 0.577)$

The diffuse material colour of the quad ($\mathcal{D}$) is Cyan $(0, 1, 1)$.

2 Ambient Light

The first step you have to undertake is calculate the ambient colour for each of the vertexes. To do this you will need the ambient light value which is $(0.5, 0.5, 0.25)$. Use the $AMBIENT$ equation to calculate the four vertex colours now.

3 Diffuse Light

For the diffuse colour you require the light colour which is full red and its direction ($\mathbf{L}$) - $(0, 0.707, 0.707)$. Use these values and the $DIFFUSE$ equation to calculate the diffuse colour of the four vertexes.

4 Specular Light

For specular colour we add the specular material colour ($\mathcal{S}$) which is white. We also need the eye position (e) which is $(50, 10, 30)$. Finally we need the shininess of the material (m) which is 0.5. Use these values and the $SPECULAR$ equation to calculate the specular colour of the four vertexes.

5 Final Colour

The final colour of the four vertexes are the three previous colours combined. Calculate the final colour of the four vertexes by combining these colours together now.

6 Practice

Define other geometric shapes and the necessary parameters and work out the colours. Start with values you would know the answer for (e.g. a quad directly in front of the viewer and the light shining on it from different directions). Practice lighting calculations as they are important for your general understanding of how lighting works.