

# COSC 4370

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October 19<sup>th</sup>, 2021

## 1 Problem

The assignment requires the reproduction of an image using OpenGL lighting and shading skills. The image consists of an orange cube in a black background reflecting light from an arbitrary light source in the same space. The cube is facing from the left profile, showing two of its faces with one of its faces reflecting the light source.

## 2 Method

The functions used or modified to create the image were provided by the homework file as well as the Learn OpenGL website.

In main.cpp, the functions used were `glm::perspective()`, `glm::radians()`, and `camera.getViewMatrix()`.

In the header file Camera.h, the functions used were `glm::mat4 getViewMatrix()` and `glm::lookAt()`.

For the phong.frag fragment shader file, the functions used were provided by both the OpenGL program as well as the cmath library: `lightingShader.setvec3()`, `normalize()`, `reflect()`, `max()`, `pow()`, `dot()`, and `vec4()`. These functions were used to manipulate the ambient, diffuse and specular lighting of the image by assigning values to any function, including nested functions, and combining them as one result. The color was also achieved using these same functions.

For the phong.vs view space file, the functions used were `mat3()`, `vec3()`, `vec4()`, and `transpose()` in order to achieve the Phong shading in view space.

## 3 Implementation

The main.cpp source code and Camera.h header files were first modified in order to achieve a black screen when the program was run. This was done by manipulating the parameters in both the `glm::perspective()` function in main.cpp and the `glm::lookAt()` function in Camera.h. The next step involved modifying the code in both the phong.frag and phong.vs files in order to display the red square on a black screen when the program was run. The LearnOpenGL Basic Lighting tutorial was very helpful in accomplishing these initial steps. The next step involved manipulating values in order to recreate the given image as best as possible.

The color variable located on the last line of the void main() block in the phong.frag file was changed from a nested `vec4(vec3())` function to only a `vec4()` function in order to achieve the orange cube image. The spec variable was also changed to be raised from the power of 32 to the

power of 256 for the dot product between the view direction and reflect direction. This allowed the light source to be more reflective off the surface of the cube.

In the main.cpp file, the light position was changed from the values in `lightPos(1.2, 1.0f, 1.0f)` to the new values in `lightPos(16.0, 2.5f, 1.2f)` in order to move the light source further on all three axes (x, y, z) and allow the light source to be reflected off the cube's surface as illustrated in the image to be replicated.

## 4 Result

Using the 'W', 'A', 'S', 'D' keys, the cube image was shifted and zoomed in to achieve the images shown below.



