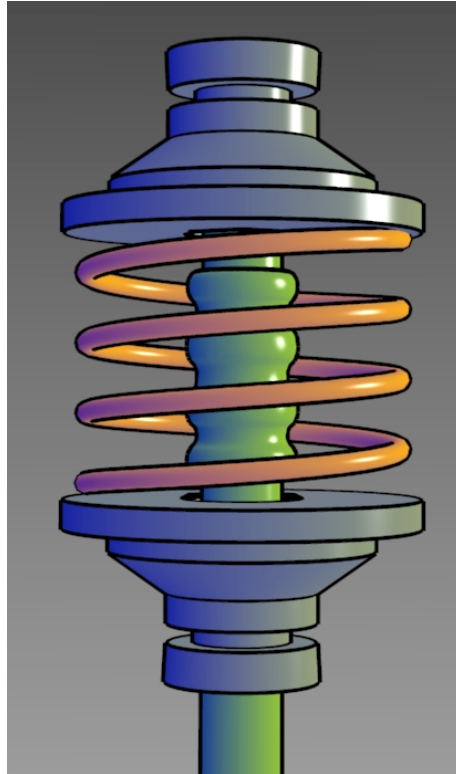# CS3 Assignment 1: Shaders

Due: Friday, January 7th, 2022

For this assignment, you will write a shader to implement a technique called Gooch shading. This shading style is named after Amy Gooch, who originally presented it at the SIGGRAPH conference in 1998. [Click here](#) to see the original paper - You're not required to read it, but you may find it interesting!

The idea behind Gooch shading is to render shaded parts of an object in cool colours (like blue), and highlighted areas in warm colours (like yellow). This technique is meant to make it easier to see details in parts of an object that are in shadow. As a result this shader is often used for technical models.

There are three steps required to implement Gooch shading. The first step is to add specular shading, which is given to you in the BlinnPhongFragment snippet on the shader website. The second step is to add a black outline to the object. Review the Zoom recording from November 17th for the steps required to implement this.

The third step is to add cool shadows and warm highlights. There is a specific formula given in the original paper for performing this step. You should be implementing this formula directly in your fragment shader!

Gooch Shading Formula

First, we need to calculate the shadow colour and the highlight colour for our current fragment. To do this, we use the following formula to give us two 3D vectors:

$$k_{cool} = k_{blue} + (0.2 * k_d)$$
$$k_{warm} = k_{yellow} + (0.6 * k_d)$$

In the above formulas, k_{blue} and k_{yellow} are vectors that represent the colours blue and yellow, respectively. k_d represents the object's colour for the current fragment. Often research papers use the letter *k* for variables that represent a colour (I'm not sure why, but I welcome any theories). Since the above formulas are adding two 3D vectors together, the resulting values k_{cool} and k_{warm} are also 3D vectors.

Once we have the colours that represent areas of shadow and highlight for the current fragment, we will combine them based on how much the current fragment is in shadow. For that, we use this formula:

$$k_{final} = (\frac{1 + \hat{l} \cdot \hat{n}}{2})k_{warm} + (1 - \frac{1 + \hat{l} \cdot \hat{n}}{2})k_{cool}$$

$\hat{l} \cdot \hat{n}$ represents the dot product between the light direction and the normal of the fragment. (For this assignment, your shader should have exactly one light source!). k_{final} represents the final colour of your fragment, so this is what you should assign to `gl_FragColor`.

Submitting Your Assignment

Implement this assignment on the [shader editor website](#) we used in class. When you're ready to submit, click the "Download" button at the top of the page. This should open a new tab that shows you text from all three of your shaders. Please save this code as a .txt file (you can do this by copy and pasting it into a program like Notepad) and submit that to the Schoology submission page.