Homework 4: Shaders
Due Date: Friday, October 26th

1. Explain the difference between a vertex and fragment shader.
   o A vertex shader allows you to overwrite the functionality of OpenGL’s vertex
     positioning functionality, allowing you to edit transformations, normal calculations,
     light calculations, texture mapping, etc.
   o A fragment shader allows you to overwrite the functionality of OpenGL’s fragment
     coloring functionality, allowing you to specify your own color for a given fragment
     (or pixel).

2. Given a normal vector \( N <1, 3, 7> \) and a light source vector \( L <0, 2, 5> \). Compute the
   reflection vector and the half vector. Don’t forget to normalize.
   Reflection vector: \( R = 2*(\text{dot}(n,l))*n - l \)
   \(<0.13, 0.39, 0.91>\)
   Cannot compute the half vector, you don’t have the eye position.

3. Describe what I might do if I wanted to make my object bumpy, but not change the
   actual object. (You don’t need to say anything about implementation, just theory)
   Apply a non-uniform shading to the surface of the object (any form of texturing,
   custom shaders, etc.)
   (The problem was worded poorly; it should have read, “Make my object look bumpy,
   without changing the geometry”. This could be done by applying a normal map, or in
   the case of bumps have some sin, cos transformations on the normals, because they
   are periodic and “bumpy” you can transform the normals based upon a combination
   of those functions.)

4. This is a texture map with \( u, v \) coordinates listed:

![Texture Map](image-url)
a. Draw the approximate mapping on each quad if they were textured using the above image.

Solution is as follows:

![Quad mappings](image)

b. Describe the difference between bump mapping and texture mapping.

- Bump mapping is affecting the normals which changes what parts of the object are illuminated based upon the lighting conditions.
- Texture mapping affects the colors of the object by placing a section of an image onto a section on the object but has nothing to do with the normals or how the object is lit.