

## Homework 4: Shaders

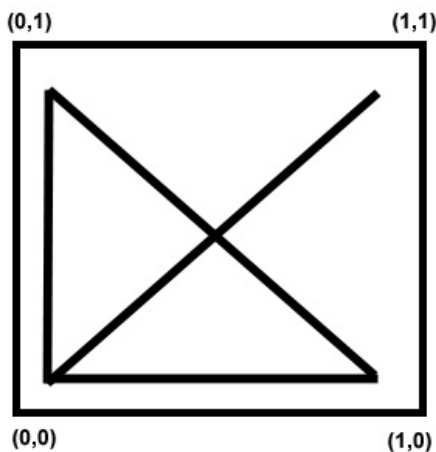
Due Date: Friday, October 26<sup>th</sup>

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1. Explain the difference between a vertex and fragment shader.
  - 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.
  - 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  $N \langle 1, 3, 7 \rangle$  and a light source vector  $L \langle 0, 2, 5 \rangle$ . Compute the reflection vector and the half vector. Don't forget to normalize.

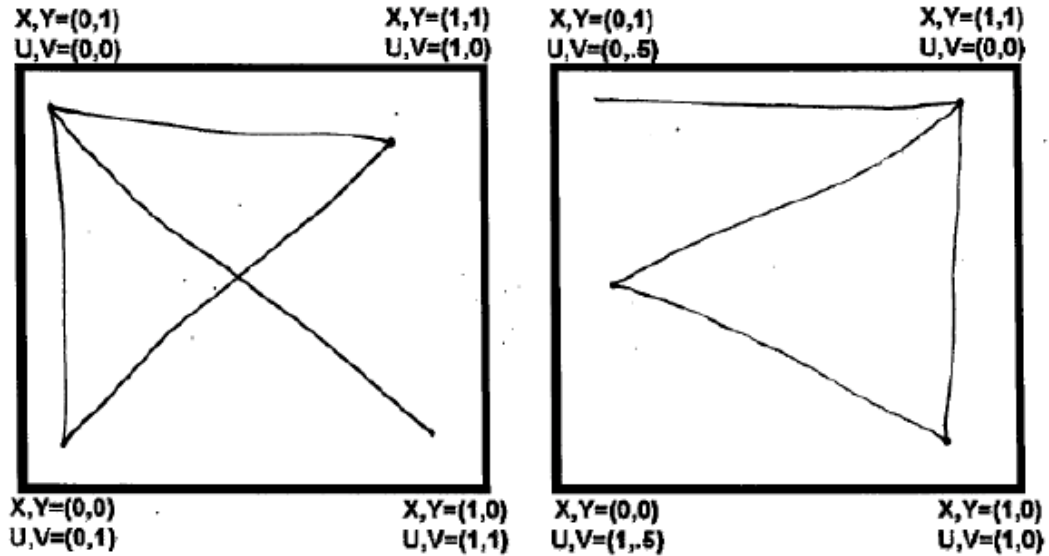
Reflection vector:  $R = 2 * (\text{dot}(n,l)) * n - l$   
 $\langle 0.13, 0.39, 0.91 \rangle$   
Cannot compute the half vector, you don't have the eye position.
3. Describe what I might do if I wanted to make my object bumpy, but not change the actual object. (You don't need to say anything about implementation, 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:



- a. Draw the approximate mapping on each quad if they were textured using the above image.

Solution is as follows:



- 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.