**Project Reflection**

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**Development Choices**

At the beginning of this project, I was very excited to get started and had a clear idea of what I wanted the end product to look like. My 3D scene needed to consist of a moon, tree, fallen wood, and be resting on a piece of land floating in space. Since I was completely new to OpenGL, I kept the design simple enough so to be achievable in the seven weeks. However, my intent, and hope, was that I would gain enough understanding to expand upon my original idea.

I started the process by breaking down each object into their primitive shape(s). The moon, a sphere. The tree, a complex object, having the body of a pyramid, and a cube trunk. The piece of land, a plane. The fallen wood, an elongated cube. I chose these shapes because I figured they would be the “easiest” for a beginner to learn.

The sphere presented to be the greatest challenge. One of my many attempts resulted in an icosahedron which I integrated into my scene as asteroids. Eventually, I was able to get the sphere to work with the caveat that the textures did not apply properly so only the color of the image is displayed. I am still very proud of the finished product since you can tell that the sphere is intended as a moon.

**Navigation**

To interact with the 3D scene the user needs controls so they can do things like zoom in and out, look up, down, left, right, and move around the object. They might also be curious as to how the scene would look as a different projection. I brought this capability to the user by writing functions into the program that enabled the use of input devices. Those input devices are a mouse, scroll wheel, keyboard, and laptop track pad.

On the keyboard, pressing Q allows the user to move up along the y-axis while pressing E moves their view down along the y-axis. The A and D keys move the users view along the x-axis - left and right respectively. The W and S keys move the users view along the z-axis - forward and backward respectively. The default projection setting obtained by pressing P displays the image from a perspective view, 3D, while pressing O sets the image view to orthographic, 2D. The user can toggle between these two projections while moving around the scene.

As the user moves around the scene with their keyboard they can also increase or decrease the speed at which the camera moves. To increase the speed of the camera the user simply moves the scroll wheel up and to slow the camera down they do the opposite and scroll down. The mouse provides further interaction as it enables the user to look up, down, left, and right. This is not to be confused with the WASD keys which move the camera forward, backward, left, and right since the user can be using these keys while looking around with their mouse.

**Custom Functions**

I did my best to modularize my program so that it would be clean and easy to navigate. The #pragma region tags allowed me to segment all of my objects in the URender() function so I knew which one I was working on. The UCreate() and UDestroy() functions for shaders, textures, and the object mesh made it easy to work with multiples of each. The UProcessInput() function allowed me to easily add hot keys to the program - like P and O for projection.

To further elaborate on one of the UCreate functions, the UCreateObjectMesh() is an important function that allowed me to create different shapes without have to write lengthy code into the main program. It contained the shapes’ vertices, normals, and texture coordinates, generated and bound the VAO’s and VBO’s, and generated and enabled the attribute pointers. The VAO, VBO’s, and attribute pointers are functions that I would have liked to encapsulate. It would make creating new shapes more efficient and the Source code would be less cluttered.

**Conclusion**

This course was hands down one of the most difficult courses I’ve taken on my degree path. I faced a lot of roadblocks, frustrations, and spent many hours figuring out how to overcome them. However, I can honestly say this has been one of the most rewarding educational experiences. I am so proud of my final project and my newfound interest in computer graphics.