SCHOOL of ELECTRICAL ENGINEERING & COMPUTER SCIENCE
FACULTY of ENGINEERING & BUILT ENVIRONMENT
The UNIVERSITY of NEWCASTLE

Comp3320/6370 Computer Graphics

Semester 2, 2018

Lab Week 5

Version 1

1 Summary and Goals

This week's lab covers the transformation and perspective mathematics required for rendering 3D objects, rather than just the 2D objects we have worked with so far. Use the Week 2 solution as a starting point, as it has the required libraries included.

Students are encouraged to ask questions about math exercises from the lectures and resources section. Particularly today, it is important to understand how to use **homogeneous transforms** as they will form the basis for rendering objects in your projects, and the **math is assessable** (it is in the lectures)!

2 Glossary

Here are some key terms we will discuss today:

- **Homogeneous Matrix** - A 4x4 matrix which defines an linear transform plus a translation in 3D space. The advantage of homogeneous matrices is that translation and other transforms can all be performed with a single matrix multiplication.
- **Model Matrix** (Maps : Model Space $\rightarrow$ World Space) - A homogeneous matrix which defines the pose of a mesh or object relative to the world.
- **View Matrix** (Maps : World Space $\rightarrow$ Camera Space) - A homogeneous matrix which defines the pose of the camera or view.
- **Projection Matrix** (Maps : Camera Space $\rightarrow$ Clip Space) - A 4x4 Matrix which defines the linear (but not homogeneous) transform to clip space.
- **Depth Buffer / z-Buffer** - A buffer which stores a z-depth value for each pixel on screen. It represents the distance to the closest object drawn so far and is used to compute the correct occlusion for 3D objects (see z-buffer algorithm in lecture slides).

3 During the Lab: Transforms

Our primary topic for today is including the 3D transform step in OpenGL.

1. First, understand the definitions of the Model, View and Projection matrices above
2. Then complete the tutorial at `http://open.gl/transformations` starting from the "Using transformations for 3D" heading
3. Continue on to the Depth buffer tutorial at `http://open.gl/depthstencils`. (Optional: Stencil tutorial - this will be very useful if you plan to implement reflections in your major project.)

4 After the Lab: Mathematics Excercises

It is recommended students complete the *Exercises II* sheet and the excersises from the *Transforms II* lecture slides to get a good understanding of the math we are using in this lab. Working for these examples can be covered during the labs on request.