# Coursework commentary 2018–2019

## CO3355 Advanced graphics and animation

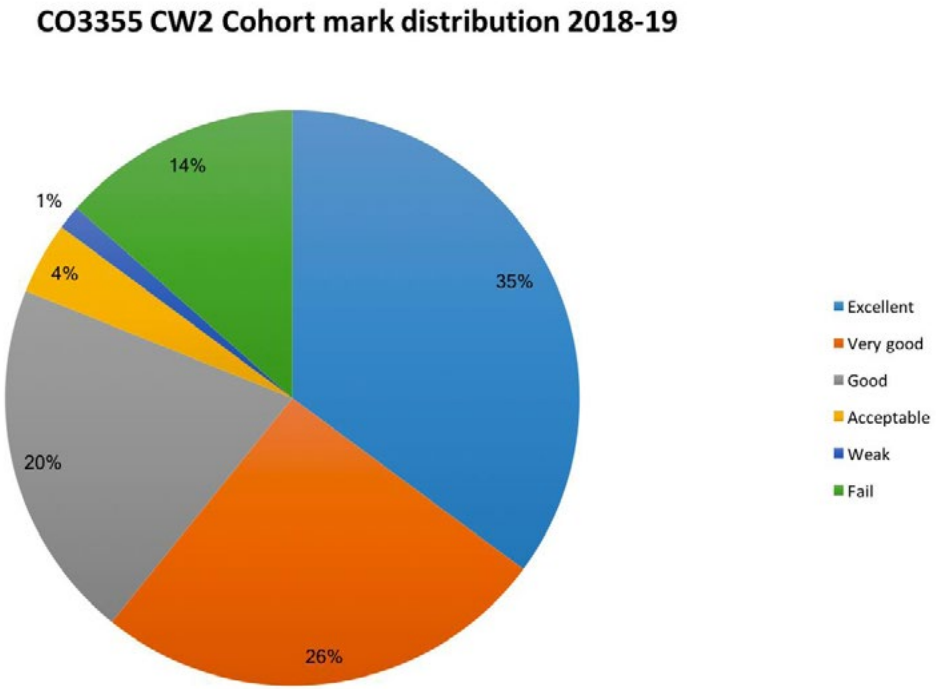
## Coursework assignment 2

### General remarks

There were two parts to this coursework assignment, each comprising four questions. Part A examined lighting techniques and asked students to implement and experiment around the Phong illumination model. In Part B, students worked with texture mapping and visual effects on two dimensional images.

Overall, as depicted in Figure 1, the submissions were of quite a high standard, with more than one third being of excellent quality. These submissions were based on research of online resources, competent coding and experimentation. Moreover, they included a step-by-step explanation of the design and development process, exposing technical obstacles faced and ways that these were tackled. Each step was accompanied by detailed screenshots and critical evaluation of the work.

See 2018–2019 cohort mark distribution for C03355 CW2 below:




On the other hand, there were also students who faced considerable difficulties. These were mainly due to the complex nature of the mathematics involved in 3D graphics, and variations across different OpenGL ES versions, but an additional factor was the somewhat cumbersome nature of GLSL development, especially with respect to code debugging. The latter is an inherent drawback of languages that use the GPU for calculations, as it is very difficult to communicate variables back to the CPU in order to debug the code.

Due to these factors, the coursework assignments for this course can prove quite demanding. However, they can foster creativity and provide students with very effective skills, applied to real world scenarios and widespread technologies. For instance, WebGL, a very popular HTML5/JavaScript API, is based on the same GLSL specification as the one examined in this course. Moreover, the examiners do take these difficulties into account and do not look for great complexity or efficiency of code. Instead they look for well-motivated design decisions that address what has been asked for in the coursework assignment specification, rewarding students for their journey, providing it is well-reasoned and properly documented. To that end, concise reporting is a very important aspect of the coursework assignment evaluation and should be treated with attention.

## Part A

Part A dealt with light shading using Processing and GLSL, provided some basic vertex and fragment shaders and consisted of four questions.

### Question 1

In this question, the requirement was to make *SpecularFocus, SpecularContribution* and *DiffuseContribution* adjustable and to experiment with different values of these parameters, trying the effect on different simple shapes. The parameter names are self-explanatory and they are used to model the reflection properties of the surface.

Most students responded well here, with some including extensive and systematic experimentation using multiple values, and nice description and interpretation of the effects. Some also implemented Graphical User Interfaces to facilitate parameter adjustments. This enabled them to provide multiple screenshots with very little effort and demonstrate the contribution of each parameter. However, there were also submissions that lacked the necessary parameter experimentation.

### Question 2

This question asked students to add an ambient component to their light and confirm that it worked. To this end, a simple modification of the code was required so as to pass the newly created variable to the vertex shader and include it in the calculation of the *light* variable therein.

This was generally answered well.

### Question 3

This question explored how multiple moving light sources can be incorporated. A neat solution would entail the use of a `for` loop in the vertex shader in order to iterate through the light sources. This way, every light component would be calculated for each of the positions, adding them all to calculate the composite light. In order to make the source positions change smoothly over time, one could calculate them using a mathematical function, gradually modifying its input by a small margin at every call of the Processing `draw()` method.

### Question 4

This question required extending the light model so that it used vectors that separate Red, Green and Blue components to effectively implement coloured lighting.

This question was straightforward and, in most cases, did not pose many difficulties to students.

## Part B

This part explored the application of GLSL shaders in an attempt to mimic a visual effect or a painting style on an image and then mapping the outcome as a texture on an object.

### Question 1

In this question, students had to select the effect that they would mimic as well as an appropriate image for the former to be applied. A good answer would describe the effect and explain how it would be implemented, and justify the image selection.

As also mentioned in the question itself, the intention was to apply the effect on a two-dimensional image and then map it as a texture on an object. However, many students chose some 3D toon effect (cel-shading), for which various implementations can be found online. This was not a very appropriate choice as they work on 3D objects and make use of their shape and the incident light. Good answers chose either a painting style (such as expressionism, impressionism or pointillism) or other visual effects, which were mostly based on colour reduction and edge detection and emphasis.

Image selection was also often problematic, as many of the selected images were already cartoonish or smooth, so the effect application was not very apparent.

### Question 2

This question asked students to implement GLSL shaders to perform texture mapping of the original image on a torus-shaped object. This required simple texture mapping as per online tutorials, and was answered well by most students.

### Question 3

In this question, students had to implement their effect and map the outcome on a torus shape. The implementation had to be carried out using GLSL. It was important that the answer contained evidence of the effect application from multiple viewpoints, accompanied by comments on the result as well as on the process itself.

The answers here varied substantially as they were tightly linked with the effect selection. Many provided excellent implementations and very insightful comments, identifying weaknesses and suggesting ways of possible improvement.

### Question 4

This question asked students to extend their code and improvise and experiment with other effects. The options here were not limited to 2D, and any effect could work. As in the previous question, it was very important for students to capture their journey and reflect on it.

The most common extension was the application of the lighting shaders implemented for Part A. But many students went further, experimenting with rendering video as a texture (with some incorporating sound as well), time-based animation effects in fragment shader, or even animation of vertices according to texture.