Coursework commentaries 2015–16

CO3355 Advanced graphics and animation

Coursework assignment 1

General remarks

This assignment comprised three major parts. Part A dealt with basic shading methods implemented in GLSL and Processing and included experimentation using a single point light. In part B, students experimented with various parameters in shading (that included multiple lights and objects), measured their effects in performance and incorporated the Phong illumination model. Part C focused on the understanding and implementation of a more advanced illumination model (Cook–Torrance).

Overall, students did well, including some submissions of exceptional quality. Almost all students who attempted at least the first two parts gained a passing mark.

The most common problem was an imbalance between implementation and reporting; while many programming attempts were excellent, these were often not accompanied with reports of similar quality. It is important that each report:

- provides adequate description of the implementation
- exposes the problems faced
- justifies the design decisions made
- provides evidence of the results achieved (such as by using screenshots from multiple viewpoints)
- assesses and interprets them appropriately to demonstrate understanding and intuition.

You should also keep in mind that a very important virtue of a good report is concision; usually, a very few paragraphs of discussion should be sufficient for the above.

Comments on specific questions

Part A

Question 1

This question outlined a Processing function that generates a torus object, and asked students to write a program that renders the results and supports camera navigation using the peasycam library. This was a straightforward task that involved only basic Processing coding. Apart from a small number of submissions that had issues with the correct adjustment of the camera position, it was mostly carried out successfully.

Question 2

Students were required to write appropriate vertex and fragment GLSL shaders in order to implement Gouraud, Phong and flat shading,

respectively, incorporate them in their Processing program and provide the user with the ability to switch between them on the fly. The outcome was to be demonstrated on the torus shape using a single point light that moved following the position of the mouse.

The difference between implementing Gouraud or Phong shading is essentially whether calculations are performed on a per-vertex or per-fragment basis, respectively. In the former case, colours are calculated within the vertex shader and then interpolated across the polygon surface. In the latter, the surface normals are interpolated and then used by the fragment shader to calculate the colour of the fragment. With regard to flat shading, there are a few ways to implement it that include calculating the normal using the camera-space vertex position.

The vast majority managed to implement Gouraud and Phong well. On the other hand, flat shading proved to be more challenging for many. Also, some students had problems in making the point light follow the mouse position.

In terms of interaction, most did well in making the shading method selectable in real time, while some created excellent graphical user interfaces to that end, for which credit was given.

Part B

Question 1

Students were required to incorporate and experiment with different parameters affecting the complexity of the generated scene. More specifically, for each shading method, students were asked to adjust the torus resolution, the number of light sources and the number of torus objects and to measure their effects on the resulting frame rate. Good answers here involved structured and well-documented experimentation, illustrating the effect of modification of each parameter on each of the shading methods and measuring the resulting frame rate.

Some had problems with implementing multiple lights in the scene. Others experimented with a very limited set of values. Many did not measure frame rates. However, there were also a number of excellent implementations with extensive comparison of measurements and intuitive comments on the visual result. Some of the best answers also included summary statistics of the results (means and standard deviation) of a range of experiments repeated with varying conditions.

Question 2

This question asked students to modify their shaders in order to implement the Phong reflection model and to experiment with the contribution of each of its components. An appropriate approach to this involved the inclusion of extra parameters for each of the reflection components, namely specular, diffuse and ambient and combining them using the Phong model in order to calculate the colour.

This question was generally well-answered.

Part C

This required investigation of the Cook–Torrance illumination model. Students were asked to provide an outline of its basic characteristics, implement it in GLSL and experiment with the representation of different materials.

The first part of the answer should be of essay type, explaining the Cook–Torrance model and focusing on how it aids the representation of different materials, ideally including illustrations. Appropriate citation and referencing of sources is essential.

In the second part of the answer, you should implement the model, experiment with a number of materials of your choice, report your findings and discuss.

This was the least popular question and was answered in full by less than 50% of students, with many answers restricted to the essay part of the question. The implementation proved to be quite challenging, involving research and deep understanding of a rather complex lighting model. However, there were a number of excellent implementations, demonstrating in-depth understanding of many key issues.