

# CS4247 Graphics Rendering Techniques (2018/2019 Semester 2)

## Assignment 1

Release Date: 28 January 2019, Monday

**Submission Deadline: 22 February 2019, Friday, 11:59 PM**

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## LEARNING OBJECTIVES

**Writing OpenGL program to simulate planar reflection using texture-mapping and a multi-pass rendering technique.** After completing the programming assignment, you should have learned how to

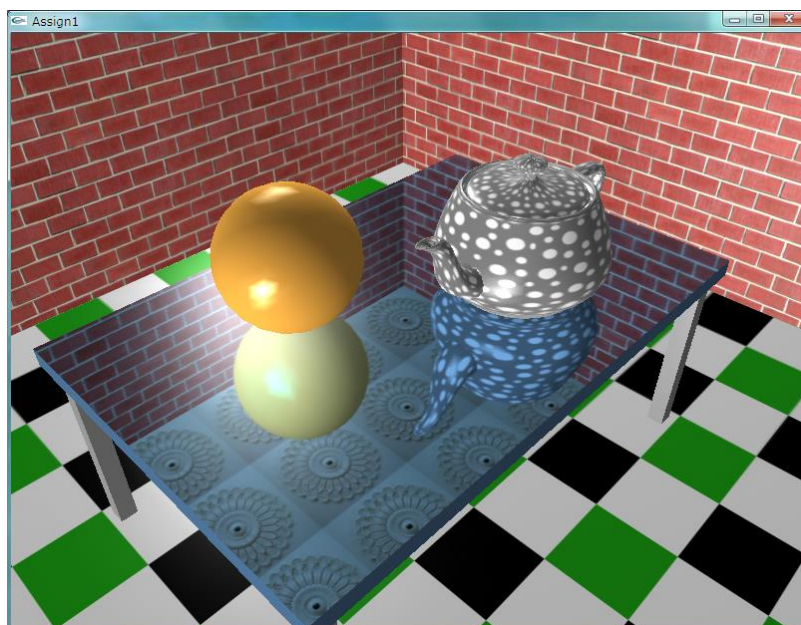
- set up texture mapping in OpenGL,
- model and draw texture-mapped objects,
- set up off-center view frustum,
- read back image in framebuffer for texture mapping, and
- simulate planar reflection using a multi-pass rendering technique.

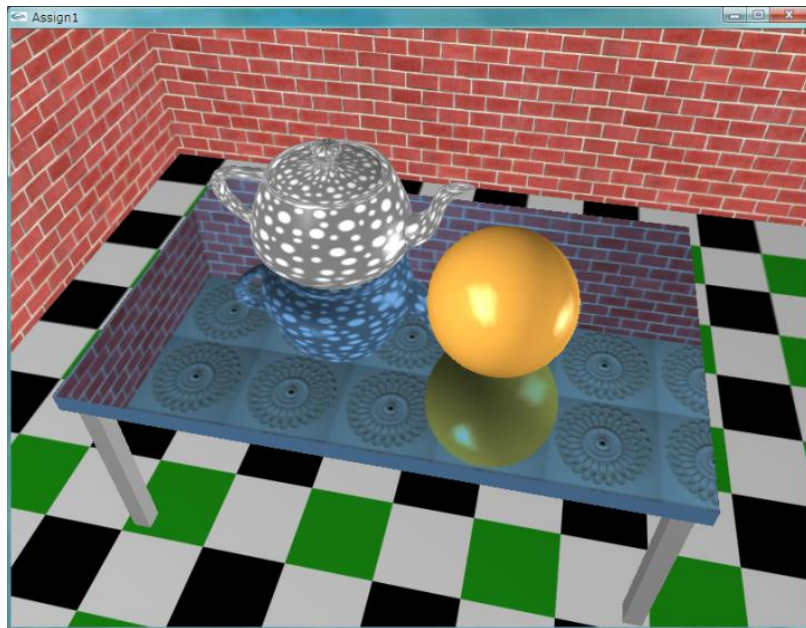
## TASKS

You are to complete an **unfinished OpenGL program**, so that it can simulate **planar reflection**, using a multi-pass rendering technique and the texture-mapping capabilities provided by OpenGL. You have to complete the program according to the following requirements.

Please download the ZIP file **cs4247\_assign1\_2019\_todo.zip** from the **Assignments** folder in the IVLE Workbin. A Visual Studio 2008 solution **assign1.sln** is provided for you to build your program.

You can try the **completed Win32 executable** program **assign1\_done.exe** found in the same ZIP file. Please read the instructions shown in the console window to learn how to operate the program. The followings show some example rendered images from the completed program:





## Task #1

You have to complete **assign1.cpp** to produce the planar reflection that you see in the above example images. You are not required and must not change any other source files.

The 3D scene contains a table with a flat rectangular semi-reflective table-top. The scene is also populated with other objects, at least some resting on the table-top. The table-top must reflect the scene. Here are some additional requirements:

- The reflection on the table-top is created by texture mapping a reflection image onto the table-top rectangle. The reflection image is generated by drawing the scene seen from an **imaginary viewpoint**, which looks through the table-top from under the table. This rendered image is then copied from the color buffer to a texture object, to be used for texture mapping the table-top rectangle.
- The reflection on the table-top should not be 100% (it is not a perfect mirror), and the underlying diffuse color and lighting on the table-top must still be visible. (Hint: use the correct texture function/environment.)
- **Mipmapping** must be used for all texture mapping, including for the reflection texture mapping. For the texture object that contains the texture image copied from the color buffer, you have to set the texture object using `glTexParameteri(GL_TEXTURE_2D, GL_GENERATE_MIPMAP, GL_TRUE)`.
- You are not allowed to use the **stencil buffer** for this assignment.
- Write your code immediately below the locations marked “**TASK #1: WRITE YOUR CODE BELOW**”. There are three of such locations.

## **Task #2**

In addition to the given teapot and sphere, you have to **add one new texture-mapped object** into the scene. The new object should be positioned above the table-top, and can float in the air.

For this task, you are allowed to modify only **assign1.cpp**. You should use your own new image(s) to texture-map your new object. As before, **mipmapping** must be used for all texture mapping.

Besides your completed **assign1.cpp**, you also need to submit the new texture image(s).

## **GRADING**

The maximum marks for this programming assignment is **100**, and it constitutes **10%** of your total marks for CS4247. The marks are allocated as follows:

- **Task #1 — 80 marks,**
- **Task #2 — 20 marks.**

Note that marks will be deducted for bad coding style. If your program cannot be compiled and linked, you get 0 (zero) mark.

**Good coding style.** Comment your code adequately, use meaningful names for functions and variables, and indent your code properly. You must fill in your **name**, **matriculation number**, and **NUS email address** in the **header comment**.

## **SUBMISSION**

For this assignment, you need to **submit only**

- Your completed **assign1.cpp** that contains code for both Task #1 and Task #2;
- File(s) of your **new texture image(s)** for Task #2. They must be put in the **images** folder.

You must put them in a ZIP file and name your ZIP file **<matric\_no.>\_assign1.zip**. For example, **A0123456X\_assign1.zip**. All letters in your matric. number must be capitalized.

Submit your ZIP file to the **Assignment 1 Submission** folder in the IVLE Workbin. Before the submission deadline, you may upload your ZIP file as many times as you want to the correct folder. **We will take only your latest submission.** Once you have uploaded a new version to the folder, you **must delete the old versions**. Note that when your file is uploaded to the Workbin folder, the filename may be automatically appended with a number. This is fine, and there is no need to worry about it.

## **DEADLINE**

Late submissions will NOT be accepted. The submission folder in the IVLE Workbin will automatically close at the deadline.

(See **Bonus Assignment** on next page.)

## **BONUS ASSIGNMENT (OPTIONAL)**

This bonus assignment is completely optional. You can still get full marks for the module without doing it.

The maximum marks for this bonus assignment is **100**, and it adds up to **3 additional points to your total CA marks (maximum of 60 marks)** of CS4247. If, as a result of the bonus points, your total CA marks exceed 60, then it will be capped at 60.

### **Requirements**

For this bonus assignment, you are required to add **real-time shadow rendering** to the scene produced in Task #1 and Task #2. Here are the additional requirements:

- You can only add and modify code in **assign1.cpp**. You must rename your file to **assign1\_bonus.cpp** for submission.
- You can only add shadows using the **shadow mapping method**.
- There are two point light sources defined in the scene. You should add shadows only from the light source that is above the table-top (Light 0).
- The shadowed region must not be totally black. (Hint: look up the OpenGL texture parameter `GL_TEXTURE_COMPARE_FAIL_VALUE_ARB`.)
- Shadows should be combined with the existing texture mapping on the objects. (Hint: look up OpenGL multitexturing.)
- You must not use shaders.

### **Submission & Deadline**

You need to submit

- File(s) of your **new texture image(s)** for Task #2. They must be put in the **images** folder;
- Your **assign1\_bonus.cpp** for the bonus assignment.

You must put them in a ZIP file and name your ZIP file **<matric\_no.>\_bonus1.zip**. For example, **A0123456X\_bonus1.zip**. All letters in your matric. number must be capitalized. As usual, submit your ZIP file to the **Assignment 1 Submission** folder in the IVLE Workbin.

Note that your Task #1 and Task #2 (for the non-bonus part) should be separately submitted in the ZIP file **<matric\_no.>\_assign1.zip**.

This bonus assignment has the **same submission deadline** as Task #1 and Task #2.

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