

# COSC363: Computer Graphics Assignment 1

(Max. Marks = 20; Due date: 5 April 2019)

## Alien Invasion!



### 1. The Scene

The aliens have landed on our planet! To protect themselves from humans, the aliens decided to occupy an abandoned fortress. They have also reactivated the cannon in front of the castle gate to deter anybody from approaching the castle. Their spaceship is nicely hidden behind the fort walls. The aliens always remain inside the spaceship so that they can take off at any time. They use robots to patrol the area and to carry out various tasks.

### 2. Task Description

In this assignment, you will develop an OpenGL program to display your version of the above scene. The minimum requirements are outlined below.

- 2.1 A model of a fortress/castle. This need not be a highly complex model. It could be constructed using a set of GLUT objects.
- 2.2 A model of a cannon placed outside the fortress gate. The cannon should fire a projectile when the 'c' key is pressed. You could use the model given in Lab02, or design your own model.
- 2.3 A few robots (at least two) deployed by the aliens. Each robot is a simple animated object with 'robot-like' features (eg. Hemi-spherical head with eyes, antenna, lights, wheels or legs for movement). The robots should perform some action such as continuously moving along a path around the fortress, pushing an object etc.
- 2.4 A model of a spaceship placed inside the fortress. The spaceship should display some animation (eg. rotating parts, flashing lights). Pressing the 's' key should initiate a lift-off of the spaceship.

- 2.5 You should be able to move camera through the scene using the standard set of directional keys: Up arrow: move camera forward in the current direction, Down arrow: move camera backward in the current direction, keeping the look direction same, Left arrow: Turn left by 5 degs, Right arrow: Turn right by 5 degs. The initial camera position must be somewhere outside the fortress gate.
- 2.6 At least three different textures must be used in the scene. It is not necessary to texture-map all surfaces. Please do not use very large images (>10MB) as textures.

### 3. Graphics Models

The object models in the scene may be constructed using any of the following methods:

- By transforming and combining a set of GLUT/GLU objects such as spheres, cubes, cylinders etc to form a composite model.
- By defining a set of vertices and connecting them together to form polygonal surfaces.
- By using surface generation methods such as sweep surfaces, surfaces of revolution etc.

You are not required to design or use highly complex mesh models for this assignment. Designing objects using modeling packages such as Max, Blender, Lightwave, etc., will not give you any extra points.

### 4. Extra Features and Marks

The assignment will be marked out of 20, with 18 marks allocated for the program and 2 marks for a report (see below). With just the basic features given in 2-1-2.6 above, the program would earn at most 10 marks out of 18. To get more than that, you need to implement additional features. Some possible features, and the approximate marks they would each gain if implemented correctly (up to a maximum of 18 marks) are as follows.

- Planar shadows cast by at least one object (1 mark)
- A spot light on a moving/rotating object (2 marks). The movement of the light should be clearly visible.
- An additional animated system inside the fortress (1-3 marks depending on complexity)
- Two camera modes: The first camera mode gives a general (default) view of the scene as described in 2.5 above. The second camera mode, when selected, has to show the view from a point on the spaceship. Use the HOME key to toggle

between the two modes. As the spaceship lifts off, the second camera mode should display the view of the castle beneath it (2 marks)

- Physics models (eg. gravity, trajectory of the projectile). Give relevant equations in your report. (1-2 marks depending on the complexity of the model)
- A custom-built sweep surface, including extrusions, surfaces of revolution etc (1-2 marks). This will require evidence in the report of how the surface was generated.
- A surface shape generated using a mathematical formula (eg. paraboloids) (1-2 marks)
- Collision detection (1-2 marks)
- Particle systems (2-4 marks)

The marks associated with each feature should be taken to be indicative of the time and/or effort required to implement that feature. The above list should not be taken as a list of the only features that can be implemented.

### 5. Report (Max. marks: 2, Max. number of pages: 4)

The report should include the following sections:

- Your name and student number.
- A brief description of your scene (1 paragraph)
- At least two screenshots showing important aspects of the scene or animation.
- A description of each extra feature implemented, including relevant equations.
- You may also discuss any special challenges faced and how you solved those problems.
- A full list of control functions (keyboard, mouse, special keys) defined for interacting with the scene.
- All resources and references used in your work must be cited in the report.

You may include more than 4 pages in the report, only if absolutely necessary.

### 6. Program and Scene Development:

- Please do not use highly complex 3D mesh models.
- Please do not use source codes of programs from online repositories, tutorials, and books. You may use images and libraries for loading them (eg JPEG loader) if there are no copyright restrictions. Please check this carefully and acknowledge the source in your report.

- Develop your program in C/C++ language using only OpenGL 2 API. Please do not use OpenGL 4 code (vertex/fragment shaders etc), or other libraries, extensions (eg. ARB, EXT etc) that are not part of the standard OpenGL API
- You may use parts of lab code and resources (models, images, image loading functions). However, animations developed in the lab should not be directly included in your assignment without significant changes.

## 7. Assignment Submission

Submit electronically (using *Learn*), the source code and all supplementary files (models, images etc) needed to run the program. Please also submit your report in either MS Word or PDF format. The files should all be packaged together and submitted as a single .zip file.

**This is not a group project. Your assignment submission must represent your own individual work. In particular, students are not permitted to share program source code in any way.**

## 8. Miscellaneous

1. Check regularly on the *Learn* system forums for spec updates and clarifications.
2. You may submit up to one week late for a 15% penalty.
3. Standard departmental regulations regarding dishonest practices apply.