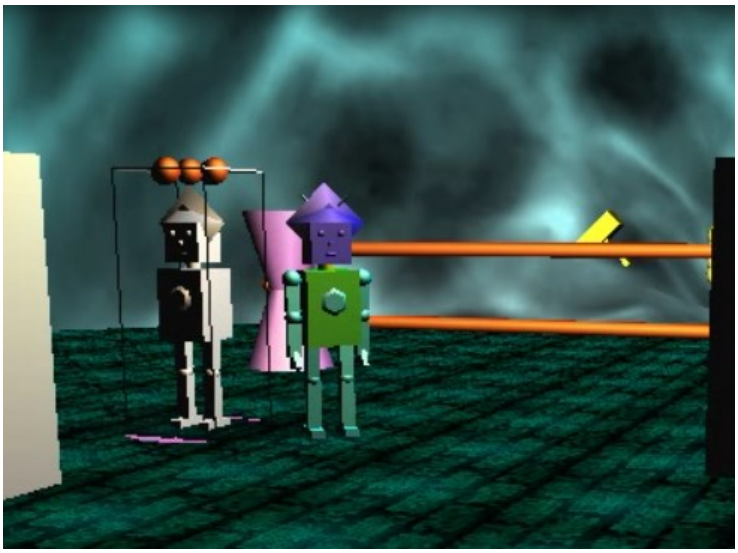
COSC363: Computer Graphics
Assignment 1
(Max. Marks = 20; Due date: 7 April 2017)

A Robot's World



1. Task Description

In this assignment, you will develop an OpenGL-2 program to display a three-dimensional model of a robot's work space including a few animations. The assignment task can be broadly divided into four sections:

Minimum requirements (**9 marks**): The scene should contain a set of minimum features as outlined in Section 2.

Extra features (**5 marks)**: You can implement a wide range of extra features and gain up to a maximum of 5 marks. A few examples of such features are given in Section 3.

Rendering quality (**4 marks):** Up to 4 marks are allocated for the overall rendering quality of the scene, including animations.

Report (**2 marks)**: You should also prepare a brief report containing a few screenshots and details of the extra features that you have implemented (see Section 4).

2. Minimum Requirements

2.1 The scene should contain the model of at least one mobile robot. The robot model may be constructed using a set of graphics primitives or by using any of the standard techniques for the construction of a mesh model. You are not required to develop highly complex or articulated models for this task.

2.2 The robot needs to perform an action. Design a simple task (animation) for this purpose, such as moving an object from one point to another, or performing an acrobatic somersault!

2.3 In addition to the robot(s), the scene should contain at least three other composite objects, each of which may be constructed using polygonal meshes, or by combining two or more solid primitives (cubes, dodecahedron, teapot, cone etc.). At least two of the composite objects must have some form of continuous animation.

2.5 There must be at least two light sources in the scene, and at least two objects must have specular reflections.

2.6 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 above key functions are specified only for marking convenience. You may assign a different set of keys for camera movement if necessary.

2.7 At least three different textures must be used in the scene. It is not necessary to texture-map all surfaces.

An object model may be constructed by transforming and combining a set of GLUT/GLU objects such as spheres, cubes, cylinders etc to form a composite model. 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. Downloading pre-built mesh models from the Internet and using them in the program will also not give any extra marks.

3. Extra Features and Marks

A list of possible features, and the approximate marks they would each gain if implemented correctly (subject to a maximum of 5 marks) is as follows.

- Planar shadows cast by at least one object (1 mark)
- A spot light on a moving/rotating object (1 mark). The movement of the light should be clearly visible. One of the two light sources in the scene can be used as a spotlight.
- Two camera modes (2 marks): The first camera mode gives a general (default) view of the scene as described in 2.6 above. The second camera mode, when selected, should show the view from a moving robot (first-person view).

- Physics models (eg. gravity). Give relevant equations in your report. (1-3 marks depending on the complexity of the model)
- A custom-built model designed using vertex coordinates and polygon definitions. This will require evidence in the report of how the shape was designed. Include images of any sketches, diagrams that you have created. (1-2 marks)
- 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. Include images of any sketches, diagrams used.
- A surface shape generated using a mathematical formula (eg. paraboloids) (1-2 marks)
- Collision detection (2-3 marks)
- Skybox (1 mark)
- 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 9 marks for the minimum requirements in Section 2 are relatively easy to get when compared to the marks gained for a number of the extension features in the list above. The list given above should not be taken as the complete set of features that can be implemented.

4. Report (Max. marks: 2, Max. number of pages: 3)

The report should include the following sections:

- Your name and student number (Important!)
- A brief description of your scene (One paragraph)
- At least two screenshots showing important aspects of the scene or animation.
- A description of each extra feature implemented, including relevant equations.
- A description of models generated by you, including any diagrams, sketches etc used in their design.
- 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 (Important!).
- All resources and references used in your work must be cited/acknowledged in the report.

You may include more than 3 pages in the report, only if absolutely necessary.

5. Program Development

- Please do not use source codes of demo programs found on the Internet, books and other OpenGL resources. You may use images and libraries (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-2 API

- You may use parts of lab code and resources (models, images, image loading functions). Models and animations developed in the lab will give you marks only if significant changes or enhancements have been made to them.

6. 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.

Please note that we will not download any files from cloud storage locations such as Google Drive, Dropbox Etc. All assignment files must be submitted via Learn only.

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.

7. 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.