

# L2 SM – Computer Graphics

## Summative Assignment

### Coursework Description and Assessment

You are required to complete all questions. The deadline for submission is the 17th March 2017 (2pm). You should submit your work as a pdf file containing your answers to Question 1, and separately submit all required programming codes for question 2.

#### Essential background reading

- Lecture slides.
- “WebGL Programming Guide,” Kouichi Matsuda and Rodger Lea, Addison Wesley, 2013.

#### Assignment

1. This question relates to the concepts involved in WebGL programming.

a) Describe the difference between **attribute**, **uniform** and **varying** in shader programming. [6 marks]

b) Suppose you want to use a single array in the main() function of a WebGL programme, storing both the (x,y,z)-coordinates and the (r,g,b) colour information for every vertex of a polygon model. Show a programming statement for constructing such an array. Assume the polygon model contains 6 vertices.

Also write down the programming statements for constructing the corresponding vertex buffer objects and assigning the array data to become the position and colour attributes of the vertex shader. [10 marks]

c) Draw the scene graph of the 3D car model as described in question 2. [6 marks]

d) (**Reference: WebGL Prog. Guide Chapter 4, Table 4.1**) Suppose **drawBox(m)** is a function to draw a transformed box according to the transformation matrix **m**. That is, if **m** is a rotation matrix, the function will draw a rotated box.

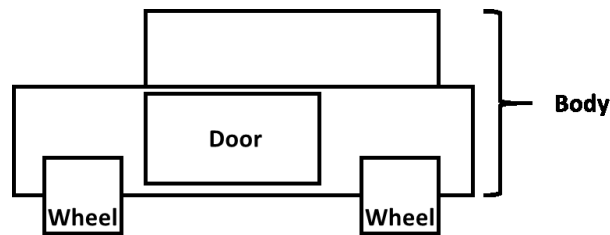
i) Explain the meaning of the following code segment and state the result obtained:

```
m.setRotate(angle, 0.0, 1.0, 0.0);  
m.translate(1.0, 3.0, -5.0);  
drawBox(m);
```

[5 marks]

ii) Explain whether you will get the same result if **m.setRotate()** has been replaced by **m.rotate()**. [3 marks]

2. Using WebGL, implement a program to render a 3D car model and its movement. The car should comprise a body, two doors and four wheels. You can construct each of the car parts by a simple shape, e.g. 3D rectangular box. Figure 1 is an example illustrating the side view of such a 3D car model, which is constructed by 3D rectangular boxes.



**Figure 1**

The wheels of the car should be rotatable, and the car doors should be openable. In addition, your implementation should include a large plain, allowing the car to move on the plain within its boundary. The car movement is controlled by hotkeys.

You should include the following features in the implementation:

- Construct the 3D car model and the plain as described above. [28 marks]
- Provide a proper view of the car and its movements. [12 marks]
- Render each part of the car model with a different color. [6 marks]
- Provide model shading by both directional lighting and point lighting. [12 marks]
- Provide hotkeys to control the car movement. [12 marks]

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