Assignment 1
Modelling and Transformation

G53GRA Computer Graphics — February 10, 2019

This assignment is compulsory and worth 10% of your final mark for this module. It is due for submission by **11am Friday 22nd February 2019**. Late submissions will receive a penalty of 5% of the assignment grade per working day.

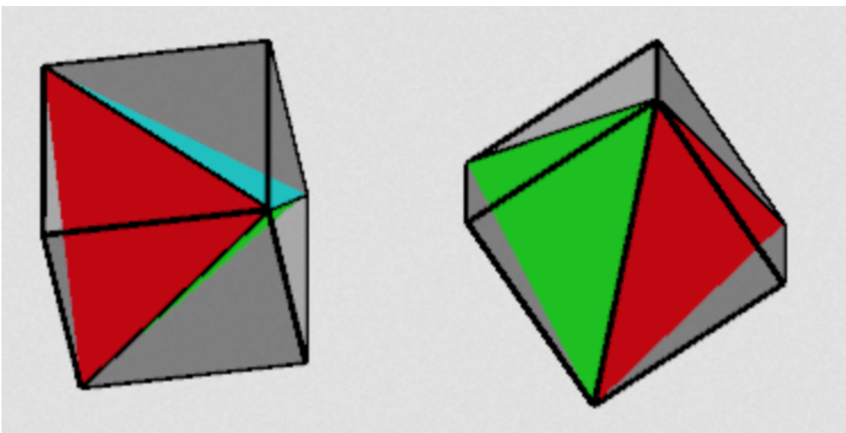
A maximum of three files should be submitted on Moodle: *.zip file*(s), each containing your code (complete application, including executable) and *.pdf or Word file* containing brief explanation of your implementations and/or your answers to the questions. Please include screenshots of your program output in your .pdf or Word file.

Choose two questions (5% each) from the following three:

1 Modelling

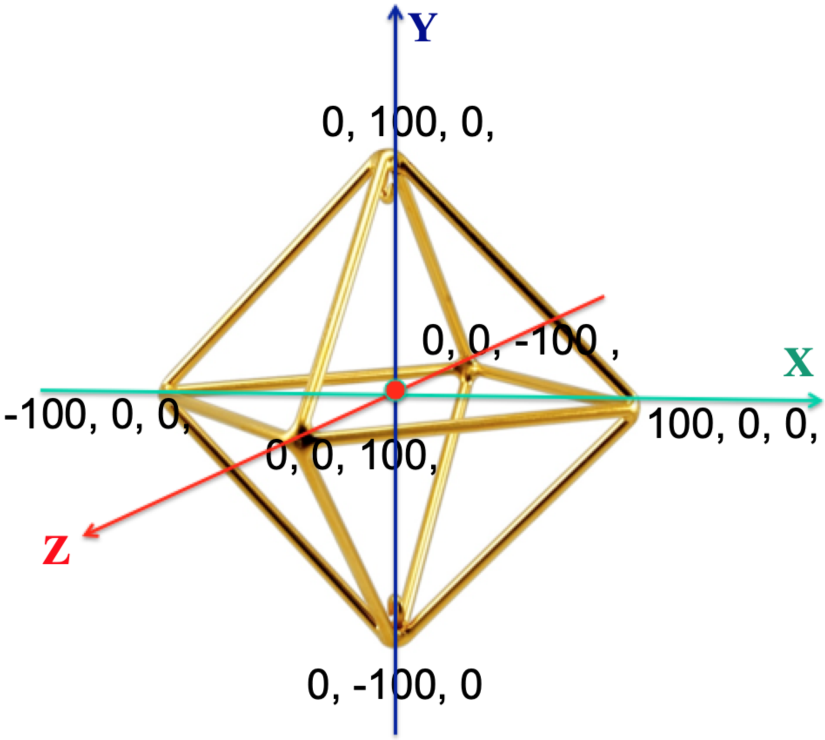
Use OpenGL commands and freeglut to create both a cube and a regular tetrahedron using *only* `GL_TRIANGLES` and explicitly defined vertices. Do ***not*** use predefined shapes, such as `glutWireCube()`. The cube must be drawn using triangles, rather than quads, and the tetrahedron must be regular, i.e. its four sides are equilateral triangles, or all edges are of equal length. You can easily visualise your shape as a wireframe by using a `GL_LINE_LOOP`.

The diagram below demonstrates how to draw a regular tetrahedron using the vertices of a cube. You can also draw the tetrahedron outside the cube if you wish.



2 Surface Subdivision

Implement surface subdivision that turns an Octahedron to a Sphere. The diagram below shows the coordinates of the 8 corners of the Octahedron.



3 Transformation

Transform the line segment $\overline{\mathbf{ab}}$ ($\mathbf{a}$ and $\mathbf{b}$ are the end points of the line segment) by the following sequence: rotate the segment around the y-axis by $90°$, then translate the rotated segment by vector $\mathbf{t} = (2, 1, 3)$. You should calculate the composite transformation matrix $\mathbf{M}$, and the new end points $\mathbf{a}'$ and $\mathbf{b}'$ after transforming $\mathbf{a}$ and $\mathbf{b}$ by $\mathbf{M}$ respectively. ***You must show your complete working.***

$$\mathbf{a} = (0, -1, 0) \qquad \mathbf{b} = (1, 0, 1)$$

Note that the rotation matrix for y (with homogeneous coordinate) is:

$$R_y(\theta) = \begin{bmatrix} \cos\theta & 0 & \sin\theta & 0 \\ 0 & 1 & 0 & 0 \\ -\sin\theta & 0 & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$