Assignment 3

Qn 1

Using the camera setting below:

glLookAt (100, 0, 100, 20, 0, 20, 0, 1, 0);

Modify the above code and write the *glutIdleFunc (animate)* function to accelerate from the original position at $t = 0$ sec to (200, 0, 100) at $t = 2$ sec. Include a term which can control the rate of acceleration.

Qn 2

a) Write OpenGL code which sets up the following lighting:

   A distant light at with lighting direction (0, 1, 0)
   The R, G, B components all have the same intensity.
   The ambient, diffuse and specular component all have intensity 0.5.

b) Write OpenGL code for the material characteristics of a sphere

   The R, G, B components all have equal parameters.
   Ambient reflection coefficient $k_a = 0.1$
   Diffuse reflection coefficient $k_d = 0.3$
   Specular reflection coefficient $k_s = 0.9$
   Specular reflection exponent $n_s = 2$

c) Derive the R intensity at a point on an object positioned at (0, 0, 0) with outward surface normal vector $\left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, 0\right)$. The camera in Qn 1 is used.

d) What kind of shading method will you recommend for this object? Why?

Qn 3

The triangle below is part of a quadrilateral mesh. It is scanned from left to right, top to bottom:
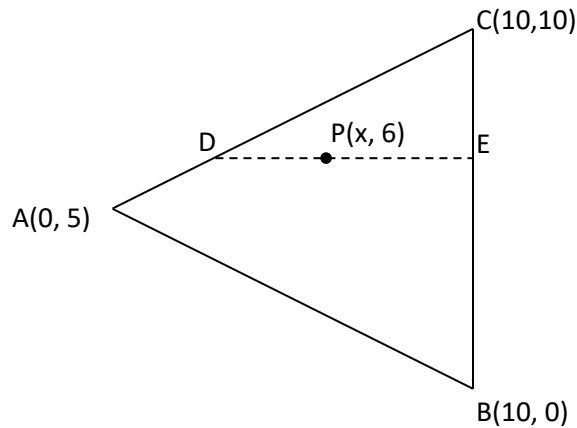
a) Let Gouraud shading be used. If the intensities at vertex A and C are $I_A = 0.5$ and $I_C = 1.0$ respectively, what is the intensity at D?

b) Let Phong shading be used. If the unit normal at D and E are

$$N_D = (0,0,1) \qquad N_E = (0,1,0)$$

Derive the incremental form for the normal of a point $P(x)$ which lies on the line segment $\overline{DE}$.

Qn 4 (This question requires knowledge of Lecture 8)

a) The point in Qn 2 c) is not hidden. How do you know that? What technique is involved?

b) An object is composed of a 100×100 quadrilateral mesh. On average, each quadrilateral in the mesh projects to 500 pixels. There are 30 objects in the scene. The graphics monitor has resolution 2560×1440. Estimate the number of elementary operations needed by

   i)   Z buffer
   ii) Ray casting for which the objects are all spheres
   iii) Ray casting for which the objects are all complex. For this question, assume that it is easy to test whether a pixel ray intersects a triangle.