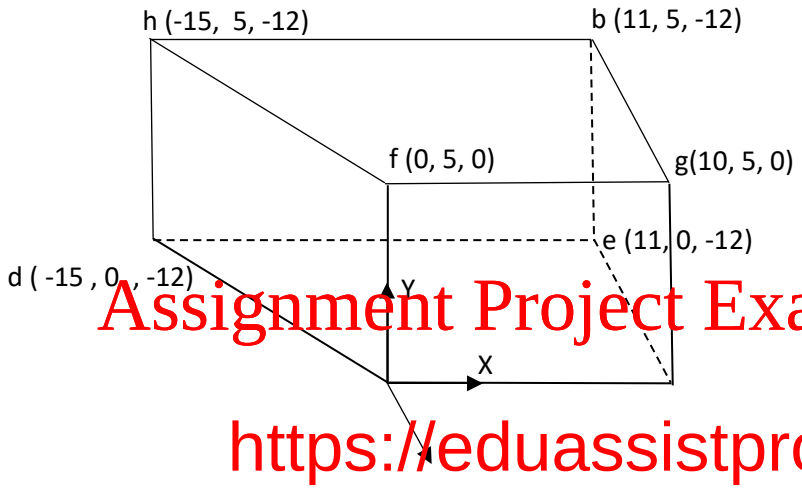
Assignment 1 (Total marks = 100)Qn 1

(30 marks)

a) Use 3 quadrilateral meshes to represent the following simple object. The top face shall be mesh 1. The bottom face shall be mesh 2. The rest of the object shall be mesh 3. For each mesh, draw a 2D array and put the vertex (e.g. a) at the corner to illustrate your idea.

(15 marks)



b) Derive a set of linear inequalities using which we can check whether an arbitrary point (X, Y, Z) is inside the object or not.

[Hint: the equation of most faces can be determined easily. For example, the equation of acgf is simply $Z = 0$.]

(15 marks)

Qn 2 (20 marks)

a) Convert the equation to its parametric form (steps required)

$$\left[\left(\frac{X}{2}\right)^{\frac{2}{5}} + \left(\frac{Y}{2}\right)^{\frac{2}{5}}\right]^{\frac{1}{2}} + \left(\frac{Z}{4}\right)^{\frac{1}{5}} = 1$$

b) What is the name of the shape?

c) Why there is a need to convert the equation to parametric form? (20 marks)

Qn 3 (50 marks)

a) The non-parametric equation of a 3D shape is

$$\left(\frac{X}{2}\right)^{2/s_1} + \left(\frac{Y}{2}\right)^{2/s_1} - Z^2 = -1$$

i) Using the identity $sec^2\alpha - tan^2\alpha = 1$, convert the equation to its parametric form.

ii) Name the 3D shape.

(10 marks)

b) Represent the 3D object below by three quadrilateral meshes: the top face, the bottom face and the rest of the object. [You only need to draw a 2D grid and specify the vertex number e.g. "a" at each corner.] (15 marks)

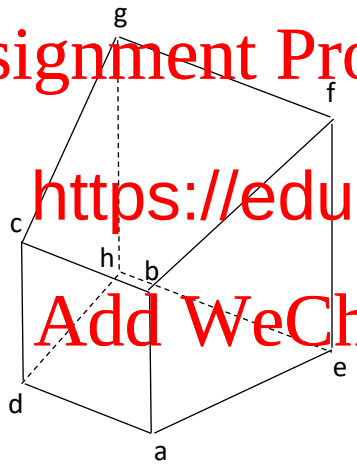


Fig. 1

$a(1,-1,-5)$ $b(1,1,-5)$ $c(-1,1,-5)$ $d(-1,-1,-5)$

$e(10,-10,-50)$ $f(10,10,-50)$ $g(-10,10,-50)$ $h(-10,-10,-50)$

c) Derive the equation of the plane aefb. [The plane equation should give positive left hand side if (X,Y,Z) is on the air side and vice versa.] (15 marks)

d) *[This question requires you to read ahead Lecture 5 and find out how gluPerspective works.]* If Fig. 1 is a clipping volume, write down the corresponding *gluPerspective* command. (10 marks)

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