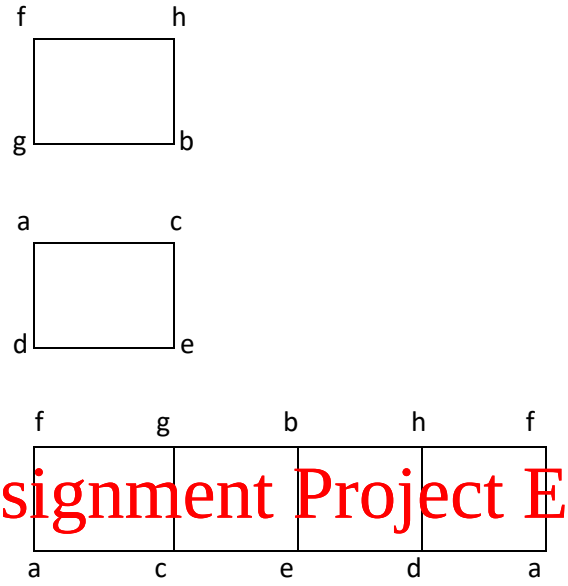
Answers to Assignment 1 Qn 1

a)



b)

$$(A,B,C) = \overrightarrow{af} \times \overrightarrow{ad} = \begin{vmatrix} i & j & k \\ 0 & 5 & 0 \\ -15 & 0 & -12 \end{vmatrix} = (-60,0,75)$$

The equation of the face □ afhd is

$-60X + 75Z = 0$

$$(A,B,C) = \overrightarrow{ce} \times \overrightarrow{cg} = \begin{vmatrix} i & j & k \\ 1 & 0 & -12 \\ 0 & 5 & 0 \end{vmatrix} = (60,0,5)$$

To solve for $60X + 5Z + D = 0$, we put (10,0,0) into the equation, $D = -600$

The equation of the face □ cgbe is

$60X + 5Z - 600 = 0$

The system of linear inequalities are

$-60X + 75Z < 0$

$60X + 5Z - 600 < 0$

$-12 < Z < 0$

$0 < Y < 5$

Qn 2

a) $Z = 4sin^{10}\,\alpha$
$X = 2cos^{10}\,\alpha\,cos^{5}\beta$
$Y = 2\cos^{10}\,\alpha\,sin^{5}\beta$

b) Super-ellipsoid

c) makes the sampling more uniform and avoid square/cubic root, which would cause part of the shape to become missing (either reason acceptable)

Qn 3

a) i)

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

$Z = \sec(\alpha)$

$$\left(\frac{X}{2}\right)^{2/s_1} + \left(\frac{Y}{2}\right)^{2/s_1} = tan^2\alpha$$

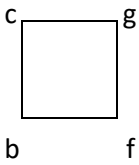
$$\frac{1}{\tan(\alpha)}\left(\frac{X}{2}\right)^{1/s_1} = cos\beta \Rightarrow X = 2(tan^{s_1}\alpha)(cos^{s_1}\beta)$$

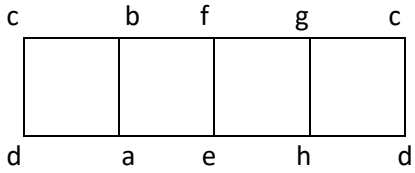
Similarly, $Y = 2(tan^{s_1}\alpha)(sin^{s_1}\beta)$

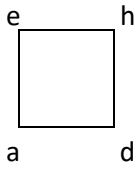
a) ii)

Super-hyperboloid (Two-sheeted Super-hyperboloid)

b)







c)

$$(A, B, C) = \overrightarrow{ae} \times \overrightarrow{ab} = (9, -9, -45) \times (0,2,0) = \begin{vmatrix} i & j & k \\ 9 & -9 & -45 \\ 0 & 2 & 0 \end{vmatrix} = (90,0,18)$$

$5X + Z + D = 0$

Put in a(1, -1, -5) gives $D = 0$. The plane passes through the origin. The plane equation is

$5X + Z = 0$

d)

By symmetry, PRP = (0, 0, 0)

$$tan\left(\frac{\theta}{2}\right) = \frac{1}{5} \Longrightarrow \theta = 22.61986495$$

The command is

gluPerspective (22.61986495, 1, 5, 50)