Cairo University
Faculty of Computers & Information
Information Technology Department

Final Exam
Spring 2012
Time: 2 hours

Computer Graphics (IT322)

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ATTEMPT ALL QUESTIONS

Question 1

[a] Derive the Bresenham's midpoint circle drawing algorithm. Write the algorithm.

[b] Trace the mid-point line drawing algorithm for drawing the line with end points **(8, 9)**, **(12, 17)**. Summarize your traces by supplying the following information:

Initial decision: $d_{initial} =$		
Change in decision when d<0: $d_1 =$		
Change in decision when d>0: $d_2 =$		
Traces		
X	**Y**	**Decision variables**

Question 2

[a] Compare between convex and non-convex shapes. Describe a filling algorithm suitable for filling non-convex polygon filling.

[b] Trace the Cohen-Sutherland algorithm while clipping the line with end points $(80, 0)$ and $(30, 50)$ against a rectangular window with: (XLEFT=10, XRIGHT=40, YBOTOM=20, YTOP=40) if the algorithm tests window edges in the following sequence: LEFT, BOTTOM, TOP, RIGHT

Question 3

[a] Derive an algorithm to draw the 2D cubic Hermite splines. Show how it could be used in drawing cardinal splines.

[b] Write an algorithm to draw a spiral with parametric equations:

$$x = \theta \; cos \; cos \; \theta$$

$$y = \theta \; sin \; sin \; \theta$$

for $\theta \in [0, 20\pi]$

Question 4

Write a homogeneous transformation matrix (or product of matrices) to:

- Rotate an object about the x axis with a rotation angle of 30° clockwise.
- Scale 3D object with respect to a fixed point (3, 2, 8) where the scaling factors in x, y and z directions are $2, 0.5 \; and \; 3$ respectively.
- Transform Figure 1 into Figure 2 as shown below.

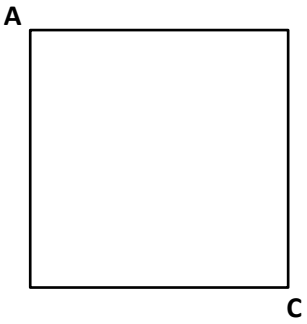

Figure 1

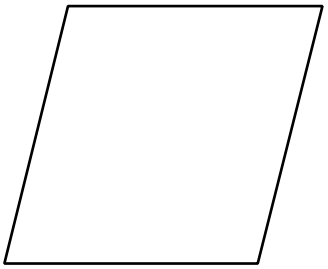

Figure 2

- Map the sphere $(x-10)^2 + (y-20)^2 + (z-15)^2 = 625$ to the ellipsoid:

$$\frac{(x-15)^2}{25} + \frac{(y-40)^2}{49} + \frac{(z-12)^2}{100} = 1$$

- Find the orthogonal projection of an object the plane passing through the points **(1, -3, 0)**, **(2, 4, 1)** and **(0, 1, 0)**

Question 5

[a] Show how to derive the projection matrix that transforms the semi-pyramid clipping volume of the perspective camera into a cube with side length of 2.

[b] Given the following camera view parameters:

COP = (-2, -1, 1) VPN = (2, 1, -1) VUP= (1, 0, 1)

The clipping volume parameters are:

LEFT=-10, RIGHT=10, BOTTOM=-5, TOP=10, NEAR=5, FAR=20:

i. Compute the camera view matrix.
ii. Compute the coordinates of the world point (15, 4, 18) relative to the camera
iii. Determine whether the world point (15, 4, 18) will be clipped out in cases when the used camera is: Parallel camera Perspective camera

Best wishes