Cairo University
Faculty of Computers and Information
Information Technology Department
Course: Computer Graphics (IT322)
Spring 2015

ATTEMPT ALL QUESTIONS

Question 1 (15 points)

a) Derive the parametric circle drawing algorithm in its most efficient form.
b) Describe the parametric cubic Bezier curves. Show how their parameters are computed from the control points.
c) Trace the mid-point line drawing algorithm for drawing the line with end points **(12, 9)**, **(2, 15)**. 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 (15 points)

a) What is clipping in 2D? Write an algorithm to clip a line against a rectangular window.
b) Write the convex polygon raster scan filling algorithm? Show why it cannot be used to draw non-convex polygons? What are the modifications needed to overcome the problems of convex polygons.
c) Trace the general polygon filling algorithm while filling the polygon: (30, 10) – (15, 15) – (30, 20) - (10, 10) by supplying the following information:

Y	Active List	Filling Line Coordinates
10		
11		
12		
13		
14		
15		

Question 3 (15 points)

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

a) Translate an object a distance of 10 steps in the direction (3, 0, 4).
b) Rotate an object about the y axis with a rotation angle of 30° in the anti clock wise direction.
c) Transform the rectangle in Figure 1 to the rectangle in Figure 2 as shown below.

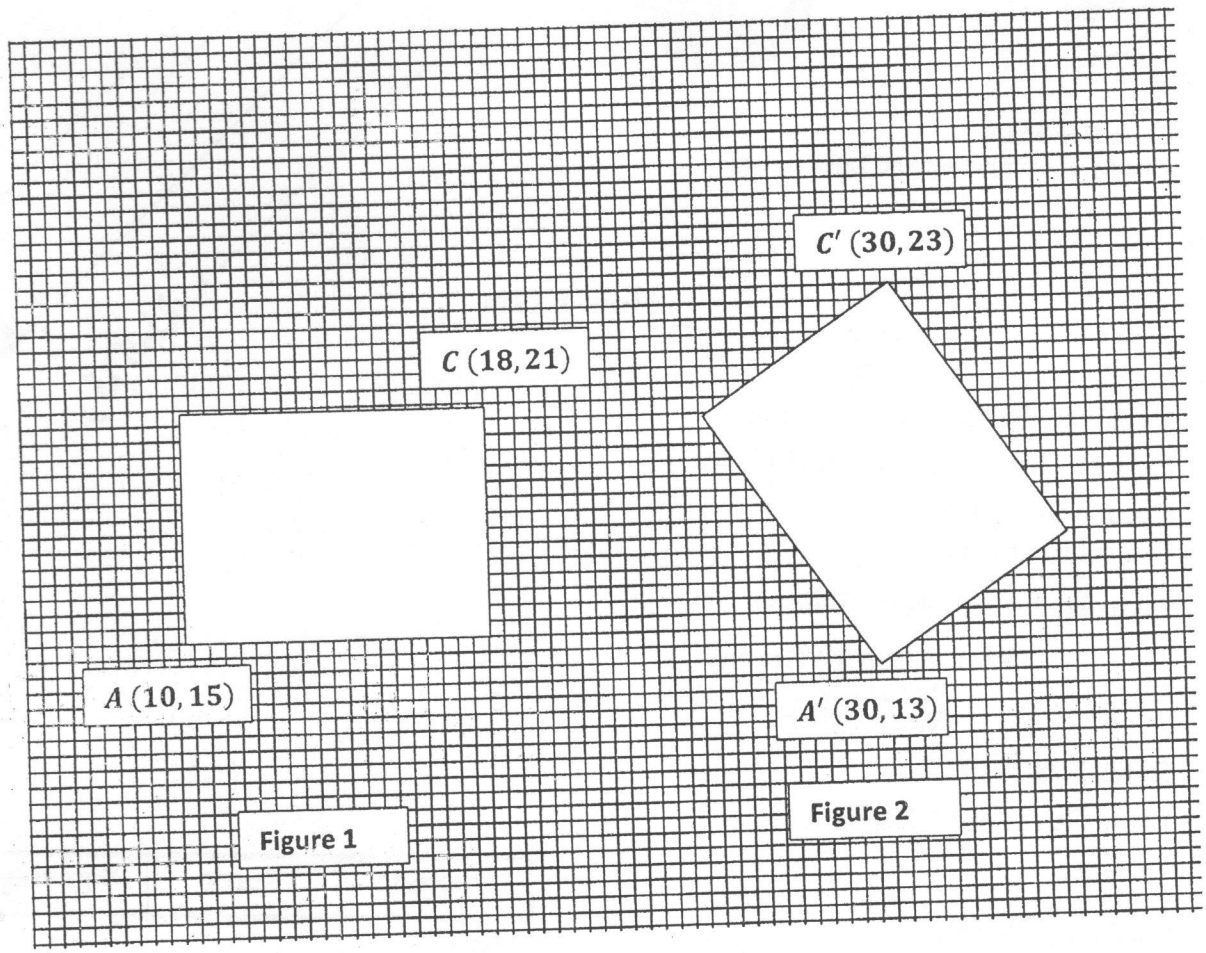

Figure 1

Figure 2

d) Scale a 3D object around the fixed point (5, 7, 2) uniformly with a scaling factor of 0.5.
e) Shear a 2D object in the direction (5, 12) with a shearing factor 3.
f) Compute the representation of a given world point in a coordinate system located at (4, 2, 10) with principle axes (0.6, 0.8, 0), (-0.8, 0.6, 0), (0, 0, 1). All the given vectors are measured in the world coordinate system.

(15 points)

Question 4

a) Show how the OpenGl Frustum matrix is computed. Write an algorithm that computes the frustum matrix derived from the six clipping point parameters: (left, right, bottom, top, near, far).
b) Given the following camera view parameters: COP= (-1, -1, -1), TP= (0, 0, 0), VUP= (1, 0, 1). The clipping volume parameters are: (left=-10, right=10, bottom=-20, top=20, near=10, far=30). The viewport parameters are (left=5, right=5, width=200, height= 300)
   i. Compute the camera view matrix.
   ii. Compute the frustum matrix.
   iii. Compute the viewport matrix
   iv. Compute the coordinates of the world points: (15, 15, 15), (15, 15, 20) and (20, 20, 25) in the viewport.

Best wishes