



Cairo University
Faculty of Computers and Information
Final Exam



Department: Information Technology
Course Name: Computer Graphics
Course Code: IT331
Instructor(s): Prof. Reda A.Wahab

Date: 3/6/2018
Duration: 2 hours
Total Marks: 60

TRY ALL QUESTIONS

Question 1 [15 marks]

- [a] Trace the mid-point line drawing algorithm as it draws the line with end points (6, 10) and (12, 18)
- [b] Write the flood fill recursive algorithm? Write a queue based non-recursive version of the algorithm.
- [c] Trace the general polygon filling algorithm by drawing the active linked list with each iteration when filling the polygon with the ordered list of vertices (15, 10), (80,12), (10, 15), (60, 16)

Question 2 [15 marks]

- [a] Describe the basic idea of the Sutherland-Hodgeman algorithm of polygon clipping against a rectangular window.
- [b] Write an efficient algorithm to fill a circle based on the mid-point circle drawing algorithm.

[c] The Barycentric equation of the triangle with vertices P_1, P_2, P_3 is:

$$P(t_1, t_2) = t_1(P_1 - P_3) + t_2(P_2 - P_3) + P_3$$
$$0 \leq t_1, t_2 \leq 1$$
$$t_1 + t_2 \leq 1$$

And the parametric equation of a line connecting the points Q_1, Q_2 is:

$$P(t) = Q_1 + t(Q_2 - Q_1)$$
$$0 \leq t \leq 1$$

- Derive an algorithm to determine whether the line has an intersection with the plane containing the triangle.
- Derive an algorithm to compute the intersection between the line and the triangle assuming they are on the same plane based on the above equations.

Question 3 [15 marks]

- [a] Write the general form of the affine transform in homogeneous space.
- [b] Write the 2D transformation and OpenGL code to rotate some point 30 degrees in the anticlockwise direction about the point (10, 12)
- [c] Write the transformation matrix and OpenGL code needed to rotate some point 60 degrees clockwise about the line connecting the points (0,0,0) and (1,1,1).
- [d] Write the 2D transformation needed to shear an object in the direction (3, 4) with a shear factor of 4.
- [e] Find the affine transformation needed to compute the position of some 2D world point in the coordinate system having basis vectors (0.6, 0.8) and (-0.8, 0.6) and origin (20, 25).

Question 4 [15 marks]

[a] What are the basic camera view and projection parameters of the camera model? Describe the sequence of operations needed to compute the position of the image of a point on the screen given the camera view and projection parameters and the view port parameters.

[b] Derive the Frustum projection matrix of the OpenGL

[c] Given the following camera and viewport parameters:

Camera View Parameters	Center of projection (20, 10, 10) Target point (0,0,0) Viewer's up direction (1, 1, 0)
Frustum Projection Parameters	LEFT=-10 RIGHT=10, Bottom=-10, TOP=10, NEAR=3, FAR=20
Viewport parameters	Left=10 TOP=20 Width=300 HEIGHT=500

Find:

- i. The camera view matrix
- ii. The Frustum projection matrix
- iii. The Viewport mapping matrix
- iv. The image of the triangle with vertices (5, 0, 0), (0,0,5), (5,0,5) on the viewport

Good Luck