



ANSWER AS MUCH AS YOU CAN.

Question 1

[a] Write the sequence of transformations needed to rotate an object about its center (a, b).

[b] In a 2D graphics system if a composite transformation is constructed as:

- Rotation: $R(30^\circ)$
- Translation: $T(2, -3)$

Determine:

- i. The matrix of the composite transformation
- ii. The position of the point (7,2) after being transformed by the composite transformation
- iii. The parameters of the following equivalent sequence of transformations:
 - Translation: $T_1(a, b)$
 - Rotation: $R_1(\theta)$

Question 2

[a] Write the non-recursive version of the flood-fill algorithm

[b] Derive the mid-point drawing algorithm of the ellipse given by the equation:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

Question 3

[a] If a 2D triangle is clipped to a rectangular window, what is the maximum number of vertices of the resulting polygon? Sketch an example.

[b] Given a parallel projection camera with the following viewing volume parameters: near=2, top=1, right=1, far=6, bottom=-1, left=-1. Determine if the line $p_1(0,4,-2)p_2(1,1,-6)$ requires clipping by the clipping volume and compute the vertices of the clipped line.

(The given points are represented in the camera coordinate system)

Question 4

[a] What is the difference between parallel and perspective projections? Describe an application in which each type of projection is preferable

[b] Determine the projection of a point (15, 12, 10) on the view plane of a perspective camera with parameters:

COP=(1,2,-1)

VPN=(1,1,1)

VUP=(1, 1, 0)

Distance to view plane (D) is 5

Question 5

[a] Derive the transformation matrix used to map a rectangle with parameters: left=2, top=5, width=10, height=15 to a square centered at (8, 2) with side length of one.

[b] Write an algorithm to get the intersection between a line $P_1 - P_2$ and a plane passing through the points: P_3, P_4 and P_5 . You may use the basic 3D transformations in your algorithm

Best wishes

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