[Computer graphics.]

Mid 2018-19:

① Find the 3D transformation for mirror reflection with respect to xy plane.

Ans: In 3D transformation, a Mirror reflection Across the yz plane means that we negate the x- ~~ox~~ coordinate while keeping y and z- coordinate unchanges.

Transformation Explanation:

For Any point $P(x,y,z)$ in homogeneous coordinates $P(x,y,z,1)$ Applying the Matrix gives:

$$P' = \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} -x \\ y \\ z \\ 1 \end{bmatrix}$$

so, the transformed point is $P'(-x,y,z)$ which is the reflection of $P(x,y,z)$ Across the yz plane.

{DDA Algorithm}

(2) Consider endpoints P1(0,0) and P2(4,6). the line calculate the end points that made up P1 P2 using DDA Algorithm.

Ans:

Step 1: Compute dx and dy

$dx = x_2 - x_1 = 4 - 0 = 4$

$dy = y_2 - y_1 = 6 - 0 = 6.$

Step 2: Determine the number of steps.

$steps = max(|dx|, |dy|) = max(4, 6) = 6.$

Step 3 Compute $x_{increment}$ and $y_{increment}$.

$$x_{increment} = \frac{dx}{steps} = \frac{4}{6} = 0.67$$

$$y_{increment} = \frac{dy}{steps} = \frac{6}{6} = 1.$$

Step 4: Generate Middle Points.

start at $P_1(0,0)$ and iteratively add increments.

Step	x	y	Rounded (x,y)
0	0	0	(0,0)
1	0.67	1	(1,1)
2	1.34	2	(1,2)
3	2.01	3	(2,3)
4	2.68	4	(3,4)
5	3.35	5	(3,5)
	4.02	6	(4,6)

Final output:

The points forming the line using DDA Algorithm Are.

(0,0), (1,1), (1,2), (2,3), (3,4) (3,5), (4,6).

(4) Find the normalization transformation that maps a widow whose lower left corner is at (1,1) and upper right corner is at (3,5) onto a viewport that has lower left corner at (0,0) and upper right corner (1/2, 1/2)

Ans:

Normalization transformation is used to map window (world coordinates) to a viewpoint (device coordinates) using the transformation formula:

$$x' = x_v + \left(\frac{x - x_w}{w_r - w_l}\right)(v_r - v_l)$$

$$y' = y_v + \left(\frac{y - y_w}{w_t - w_b}\right)(v_t - v_b)$$

where,

(w_l, w_b) = Lower left corner of the window = (1,1)

(w_r, w_t) = Upper right corner of the window = (3,5)

(v_l, v_b) = Lower left corner of the viewport

(v_r, v_t) = Upper right corner of the viewport

Step1: Compute Scaling Factors.

The scaling factors for x and y coordinates are.

$$S_x = \frac{V_r - V_l}{W_r - W_l} = \frac{\frac{1}{2} - 0}{3 - 1} = \frac{1/2}{2} = 1/4$$

$$S_y = \frac{V_t - V_b}{W_t - W_b} = \frac{\frac{1}{2} - 0}{5 - 1} = \frac{1}{8}.$$

Step2: Compute Translation Factors.

The translation factors for x and y coordinates are

$$T_x = V_l - S_x \cdot W_l = 0 - \frac{1}{4} \times 1 = -1/4.$$

$$T_y = V_b - S_y \cdot W_b = 0 - 1/8 \times 1 = -1/8.$$

Step3: Construct the Normalization Transformation Matrix.

The 2D transformation matrix for scaling and translation is

$$T = \begin{bmatrix} S_x & 0 & T_x \\ 0 & S_y & T_y \\ 0 & 0 & 1 \end{bmatrix}$$

$$T = \begin{bmatrix} 1/4 & 0 & -1/4 \\ 0 & 1/8 & -1/8 \\ 0 & 0 & 1 \end{bmatrix}$$

Final Normalization Transformation Equation.

For Any point (x,y) in world coordinates the corresponding viewport coordinates (x',y') are given by.

$$x' = \frac{1}{4}x - \frac{1}{4}$$

$$y' = \frac{1}{8}y - \frac{1}{8}.$$

This Transforms maps the window $(1,1)$ to $(3,5)$ onto viewport $(0,0)$ to $(1/2, 1/2)$.

5. III What is an image's Aspect Ratio? is a Simultaneous Shearing the same As a shearing in one direction followed by a shearing in another direction? why?

Ans: Aspect ratio: of An image is the ratio of its width to its height, typically expressed As:

$$\text{Aspect Ratio} = \frac{\text{width}}{\text{Height}}.$$

For example:

→ 1920 × 1080 (Full HD) → Aspect ratio = $\frac{1920}{1080}$ = 16 : 9.

→ 1280 × 720 (HD) → Aspect ratio = 16 : 9.

→ 1024 × 768 → Aspect ration = 4 : 3.

Aspect ratio is important in graphics, video rendering and UI design to ensure proper scaling and avoid distortion.

Is simultaneous shearing the same As shearing in one Direction Followed by Another ?

Ans: No, they Are not same.

~~Shearing distorts an object~~

→ Sequential shearing (x first, then y) introduces intermediate transformations, Affecting the final result

→ Simultaneous shearing Applies both at once. leading to different outcomes compared to sequential shearing.

Question 3: (Marks 5)

Rotate object about the line passing through (1, 3. 2) anul (2. 4, 3) by the angle of 49
Question 4: Marks 10)

Question 6: [Marks 4
Scan conversion is essentially a systematic approach so mapping objects that are denned in continous space to their discrete approximation. The various forms of distortion that result from this operation are collectively referred to as the aliusing effects of scan conversion Describe about Anti-aliasing effect.

Ans:

Question 6: Anti-Aliasing Effect

Aliasing occurs when a continuous object is represented in a discrete pixel grid, causing distortion such as jagged edges (staircase effect) in diagonal or curved lines.

Anti-aliasing is a technique used to reduce these distortions by smoothing the edges of objects. It works by adjusting pixel intensity to create a gradient transition between edges and the background.

- **Common Anti-Aliasing Techniques:**

1. **Supersampling (SSAA)** – Renders at a higher resolution and then downsamples.
2. **Multisampling (MSAA)** – Samples multiple points in a pixel and averages the color.
3. **Fast Approximate (FXAA)** – Applies a post-processing blur to smooth edges.
4. **Weighted Area Sampling** – Assigns intensity values to pixels based on their coverage.

Question 7: (Marks 6)
Magnify the triangle with vertices A(0, 0), B(1, 1) and C15.23 10 owice w wie kamping C(5,2) fixed.
Ans:

To magnify a triangle **twice** while keeping **C(5,2) fixed**, follow these steps:

1. **Translation to Origin:** Move **C(5,2) to (0,0)**

$$T_{(-5,-2)} = \begin{bmatrix} 1 & 0 & -5 \\ 0 & 1 & -2 \\ 0 & 0 & 1 \end{bmatrix}$$

   New coordinates after translation:

   - A'(0 - 5, 0 - 2) → (-5, -2)
   - B'(1 - 5, 1 - 2) → (-4, -1)
   - C'(5 - 5, 2 - 2) → (0, 0)

2. **Scaling by 2 (about origin):**

$$S = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

   New coordinates after scaling:

- A'(0 - 5, 0 - 2) → (-5, -2)
- B'(1 - 5, 1 - 2) → (-4, -1)
- C'(5 - 5, 2 - 2) → (0, 0)

2. **Scaling by 2 (about origin):**

$$S = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

New coordinates after scaling:

- A''(-5 × 2, -2 × 2) → (-10, -4)
- B''(-4 × 2, -1 × 2) → (-8, -2)
- C''(0 × 2, 0 × 2) → (0, 0)

3. **Translate back to (5,2):**

$$T_{(5,2)} = \begin{bmatrix} 1 & 0 & 5 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix}$$

Final coordinates after translation:

A(-5, -2), B(-3, 0), C(5, 2)