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Qn 3.

$$G(x,y) = \left(\frac{x_1+x_2+x_3}{3}, \frac{y_1+y_2+y_3}{3}\right)$$

$$= \left(\frac{-2+1-1}{3}, \frac{3+2+7}{3}\right) = \cancel{(-3}$$

$$= \cancel{\left(-2/3, 4\right)}$$

Centroid $= \boxed{(-2/3, 4)}$

Qn. 4. The transformation matrix for rotation by θ degrees,

$$\Rightarrow R = [(\cos\theta, -\sin\theta), (\sin\theta, \cos\theta)]$$

Qn. 4. θ = rotational angle

a = scale factor along x-axis

b = ~~small~~ scale factor along y-axis

x_c, y_c = coordinates of centroid

Step 1:

Q.4.

translation matrix, rotation matrix, scaling matrix

Composite transformation (M) = $T^{-1} \times R \times S \times T$

$$T = \begin{bmatrix} 1 & 0 & -x_c \\ 0 & 1 & -y_c \\ 0 & 0 & 1 \end{bmatrix}$$

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

$$R = \begin{bmatrix} \cos\theta & -\sin(\theta) & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$T^{-1} = \begin{bmatrix} 1 & 0 & x_c \\ 0 & 1 & y_c \\ 0 & 0 & 1 \end{bmatrix}$$

$$M = \begin{bmatrix} 1 & 0 & x_c \\ 0 & 1 & y_c \\ 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} 1 & 0 & -x_c \\ 0 & 1 & -y_c \\ 0 & 0 & 1 \end{bmatrix}$$

Q.6.

Original Triangle:

① (-2, 3) = 1010

② (1, 2) = 0100

③ (-1, 7) = 1001

Transformed Triangle:

① (-6.5, 1.6) = 1010

② (-0.3, 2.2) = 0100

③ (-8.7, 5.6) = 1001