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Q2) b)

Centroid of triangle $\Rightarrow x_c = (x_1 + x_2 + x_3)/3$

$y_c = (y_1 + y_2 + y_3)/3$

$\therefore \quad x_c = (-2 + 1 + -1)/3 = \cancel{0/3} \ \underline{-2/3}$

$y_c = (3 + 2 + 7)/3 = 12/3 = \underline{4.0}$

Q4)

$$T = \begin{bmatrix} 1 & 0 & x_c \\ 0 & 1 & y_c \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \cos(\theta) & -\sin(\theta) & 0 \\ \sin(\theta) & \cos(\theta) & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & -x_c \\ 0 & 1 & -y_c \\ 0 & 0 & 1 \end{bmatrix}$$

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

$\cancel{= a.\cos\theta \quad b.\cos\theta}$

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

$$= \begin{bmatrix} a.\cos\theta & -a.\sin\theta & (-x_c.a.\cos\theta + (-y_c.-a.\sin\theta) + x_c \\ b.\sin\theta & b.\cos\theta & (-x_c.b\sin\theta + (-y_c.b.\cos\theta) + y_c \\ 0 & 0 & 1 \end{bmatrix}$$

Q6) triangle ⇒ point A = (-2, 3) ; point B = (1, 2); point C = (-1, 7)

tranform_triangle ⇒ point A = (-4.60, 5.23); point B = (-5.17, 1.47); point C = (7.77, 5.32)

t_A = 0000 ; t_B = 0000 ; t_C = 0100

tt_A = 0001 ; tt_B = 0001 ; tt_C = 0010

Q9) Let's have a 3D point (1, 0, 0)

- Applying a 180° rotation around z-axis (not homogenous)

$$R_z = \begin{bmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \qquad R_z \cdot point = \begin{bmatrix} -1 \\ 0 \\ 0 \end{bmatrix}$$

- Reflecting point in the YZ plane

$$Ref_{YZ} = \begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \qquad Ref_{YZ} \cdot point = \begin{bmatrix} -1 \\ 0 \\ 0 \end{bmatrix}$$

∴ Reflection followed by rotation is the same as doing nothing which is the matrix

$$I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

As $R_z . Ref_{YZ} \cdot point == I . point$