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AUGMENTED & VIRTUAL REALITY ASSIGNMENT : TRANSFORMATION

Q1) Apply the following transformation for a triangle with co-ordinates :

(2, 2) (4, 2) (3, 3)

(a) Translate the triangle with (5, 5) as the translation factor.

$$[x' \ y'] = [x \ y] + [t_x \ t_y]$$

A $[x' \ y'] = [2 \ 2] + [5 \ 5] = [7 \ 7]$

B $[x' \ y'] = [4 \ 2] + [5 \ 5] = [9 \ 7]$

C $[x' \ y'] = [3 \ 3] + [5 \ 5] = [8 \ 8]$

(7, 7) (9, 7) (8, 8)

~~(b) Apply rotation by 45°~~

~~$$[x' \ y'] = [x \ y] \begin{bmatrix} \cos\theta & +\sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$$~~

~~A $[x' \ y'] = [2 \ 2] \begin{bmatrix} 1/\sqrt{2} & 1/\sqrt{2} \\ -1/\sqrt{2} & 1/\sqrt{2} \end{bmatrix}$~~

~~$= \frac{1}{\sqrt{2}} [2 \ 2] \begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix} = \frac{1}{\sqrt{2}} [2-2 \ \ 2+2] = \frac{1}{\sqrt{2}} [0 \ 4]$~~

~~$= [0 \ 2\sqrt{2}]$~~

~~B $[x' \ y'] = [4 \ 2] \cdot 1/\sqrt{2} \begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix} = \frac{1}{\sqrt{2}} [2 \ 6]$~~

~~$= [\sqrt{2} \ 3\sqrt{2}]$~~

C $[x' \; y'] = [3 \;\; 3] \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix} \frac{1}{\sqrt{2}} \begin{bmatrix} 0 & 6 \\ 6 & 3\sqrt{2} \end{bmatrix}$

$(0, 2\sqrt{2})$	$(\sqrt{2}, 3\sqrt{2})$	$(0, 3\sqrt{2})$

(c) Scale the affected (rotated) with scaling factor (2, 2)

$$[x' \; y'] = [x \; y] \begin{bmatrix} 0 & s_y \\ s_x & 0 \end{bmatrix}$$

(b) Apply rotation by 45° on (2, 2)

$$[x'-h \;\; y'-k] = [x-h \;\; y-k] \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$$

A $[x'-2 \;\; y'-2] = [2-2 \;\; 2-2] \begin{bmatrix} 1/\sqrt{2} & 1/\sqrt{2} \\ -1/\sqrt{2} & 1/\sqrt{2} \end{bmatrix}$

$[x'-2 \;\; y'-2] = [0 \;\; 0] \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix} = [0 \;\; 0]$

$[x' \;\; y'] = [2 \;\; 2]$ (2, 2)

B $[x'-2 \;\; y'-2] = [4-2 \;\; 7-2] \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix}$

$[x'-2 \;\; y'-2] = \frac{1}{\sqrt{2}} [2 \;\; 5] \begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix} = \frac{1}{\sqrt{2}} [-3 \;\; 12]$

$[x'-2 \;\; y'-2] = [\sqrt{2} \;\; 6\sqrt{2}]$

$[x' \;\; y'] = [2+\sqrt{2} \;\; 2+6\sqrt{2}]$

$(2+\sqrt{2}, \; 6\sqrt{2}+2)$

c $[x'-2 \quad y'-2] = [8-2 \quad 8-2] \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix}$

$= [6 \quad 6] \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix} = \frac{1}{\sqrt{2}} [0 \quad 12] = [0 \quad 6\sqrt{2}]$

$[x' \quad y'] = [2 \quad 2+6\sqrt{2}]$

$(2, \quad 6\sqrt{2}+2)$

$(2,2) \quad (2+\sqrt{2}, \quad 2+6\sqrt{2}) \quad (2, \quad 2+6\sqrt{2})$

(c) scale the object (rotated) with scaling factor (2, 2)

$[(4,4) \quad (4+8\sqrt{2}, \quad 4+12\sqrt{2}) \quad (4, \quad 4+12\sqrt{2})$

(2) consider a line A(3,2) and B(8,10) obtain the co-ordinates of transformed line by using (4,1) as translation factor

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(12, 2) and (32, 10)

(3) consider the object with co-ordinates
A(2, 4) B(3, 1) C(5, 3)
transform it by first reflecting it about the x-axes and then rotating it by 60°.

reflecting x about axes

A(2, -4)
B(3, -1)
C(5, -3)

$\begin{bmatrix} x_1 & y_1 \\ x_2 & y_2 \\ x_3 & y_3 \end{bmatrix} = \frac{1}{2} \begin{bmatrix} 2 & -4 \\ 3 & -1 \\ 5 & -3 \end{bmatrix} \begin{bmatrix} 1 & \sqrt{3} \\ -\sqrt{3} & 1 \end{bmatrix} = \frac{1}{2} \begin{bmatrix} 2+4\sqrt{3} & 2\sqrt{3}-4 \\ 3+\sqrt{3} & 3\sqrt{3}-1 \\ 5+3\sqrt{3} & 5\sqrt{3}-3 \end{bmatrix}$

④ Consider an object ABC with coordinates A(1,1) B(10,1) and C(5,5).
Rotate the object by 90° in counter clockwise direction and give the coordinates of the transformed object.

Rotating by 90°

$$[x' \ y'] = [x \ y]\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} = [-y \ x]$$

(1,1) → (-1,1)
(10,1) → (-1,10)
(5,5) → (-5,5)

⑤ Consider a △ABC whose coordinates are A(4,1) B(5,2) C(4,3)

ⓐ Reflect given △ about the x axis
$(x, y) \longrightarrow (x, -y)$

(4,-1) (5,-2) (4,-3)

ⓑ Reflect given △ about the y axis
$(x, y) \rightarrow (-x, y)$

(-4,1) (-5,2) (-4,3)