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CSE 423: Computer Graphics Quiz - 2

Duration: 20 minutes [No Extra page]

Full Marks: 20

Name.	ID.	Section: 02
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CO1	1.	What is the benefit of a homogeneous coordinate system over a cartesian coordinate System? Give an example.	05
CO1	2.	Rotate point (5,6) at an angle 60 degree clockwise with respect to point (4,3) and then scale it 4 times in x axis and 5 times in y axis with respect to origin. Find out the output point. You have to show each step properly.	15
CO1	3.		

Answer to the Question No: 01

Solution: In a cartesian coordinate system, we have to add an extra matrix to get the final result. This is costly. That is why, to eliminate that extra costly step, we should use Homogeneous Coordinate system. Here, we don't need to do any extra step.

Example: For translation,

$$x' = x + tx$$

$$y' = y + ty$$

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} *$$

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} * \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} tx \\ ty \end{bmatrix}$$

Cart Cartesian System.
Here, we have to do an addition extra which is costly.

$$\begin{bmatrix} 1 & 0 & tx \\ 0 & 1 & ty \\ 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

Homogeneous System.
Here, no extra calculation is needed. Just add a dummy variable. This is faster and better.

Answer to the Question No: 02

Solution: given point ~~(5, 3)~~ (5, 6)

respective point (4, 3)

angle 60° (clockwise)

Scale: 4 times in X & 5 times in Y.

Output (before scaling) = $T(4, 3) * R(60^\circ) * T(-4, -3) * \text{input}$

$$= \begin{bmatrix} 1 & 0 & 4 \\ 0 & 1 & 3 \\ 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} \cos(-60) & -\sin(-60) & 0 \\ \sin(-60) & \cos(-60) & 0 \\ 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 1 & 0 & -4 \\ 0 & 1 & -3 \\ 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 5 \\ 6 \\ 1 \end{bmatrix}$$
$$= \begin{bmatrix} 7.098 \\ 3.6339 \\ 1 \end{bmatrix} \approx \boxed{(7.098, 3.6339)}$$

Output (after scaling) = $\text{Scale}(4, 5) * \text{input}$

$$= \begin{bmatrix} 4 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 7.098 \\ 3.6339 \\ 1 \end{bmatrix}$$
$$= \begin{bmatrix} 28.392 \\ 18.169 \\ 1 \end{bmatrix} \approx \boxed{(28.392, 18.169)}$$

Ans

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