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CSE 423: Computer Graphics
Quiz - 3

Duration: 25 minutes [**No Extra page**] Full Marks: 20

Name:	ID:	Section: 02

CO1	1.	In a CMY color model given C=0.4 , M=0.8, Y=0.6. Find out the Hue, Saturation and Lightness in HSL model	10
CO1	2.	In a perspective projection The center of projection is at (15,-30.25,0) and the Projection Plane is at (0,0,-320). Find the projected output point for input point (35,10,-400).	10
CO1	3.		

1.

$C = 0.4$
$M = 0.8$
$Y = 0.6$

$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = 1 - \begin{bmatrix} C \\ M \\ Y \end{bmatrix}$

$R = 0.6$
$G = 0.2$
$B = 0.4$

$Max = 0.6$
$Min = 0.2$

$l = 0.6 - 0.2 = 0.4$

$L = \frac{Max + min}{2} = \frac{0.6 + 0.2}{2} = 0.4$

$S = \frac{l}{1 - |2L - 1|} = \frac{0.4}{1 - |0.8 - 1|}$

$\Rightarrow \frac{0.4}{1 - 0.2} = \frac{0.4}{0.8} = 0.5$

Hue max R

So $H = \frac{G - B}{l} \times 60$

$= \frac{0.2 - 0.4}{0.4} \times 60^\circ$

$= -0.5 \times 60$

$= -30^\circ$

$\Rightarrow -30^\circ + 360^\circ$ [$\because$ as less than 0° so $+360^\circ$]

$\Rightarrow 330^\circ$ Ans.

(2)

COP at = (15, -30.25, 0)

PP at = (0, 0, -320)

d_x = COP x - PP. x = 15

d_y = -30.25

d_z = 0 - (-320) = 320

So,

$$MP = \begin{bmatrix} 1 & 0 & \frac{-d_x}{d_z} & \frac{d_x}{d_z} \cdot pp.z \\ 0 & 1 & \frac{-d_y}{d_z} & \frac{d_y}{d_z} \cdot pp.z \\ 0 & 0 & -\frac{pp.z}{d_z} & pp.z \cdot \left(1 + \frac{pp.z}{d_z}\right) \\ 0 & 0 & \frac{-1}{d_z} & 1 + \frac{pp.z}{d_z} \end{bmatrix} \times \begin{bmatrix} 35 \\ 10 \\ -900 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 & \frac{-15}{320} & \frac{15}{320} \times -320 \\ 0 & 1 & \frac{30.25}{320} & 30.25 \\ 0 & 0 & \frac{320}{320} & 0 \\ 0 & 0 & -\frac{1}{320} & 0 \end{bmatrix} \times \begin{bmatrix} 35 \\ 10 \\ -900 \\ 1 \end{bmatrix}$$

Subtract by 1.25

$$= \begin{bmatrix} 38.75 \\ 2.9375 \\ -900 \\ 1.25 \end{bmatrix} = \begin{bmatrix} 35 \\ 1.25 \\ -320 \\ 1 \end{bmatrix}$$

Ans.

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CSE 423: Computer Graphics
Quiz - 2

Duration: 20 minutes [No Extra page] **Full Marks: 20**

Name:		Section: 01

CO1	1.	What is the benefit of a homogeneous coordinate system over a cartesian coordinate System? Give an example.	05
CO1	2.	Find out the reflection of point (5,6) with respect to line $\sqrt{3}x-3y+3=0$	15
CO1	3.		

(1)

Cartesian

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

$$= \begin{bmatrix} x+tx \\ y+ty \\ 1 \end{bmatrix}$$

Homogenous

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

$$= \begin{bmatrix} x+tx \\ y+ty \\ 1 \end{bmatrix}$$

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benefits

(i) In cartesian system, we had to add an additional (tx, ty) which is solved in homogenous system.

(ii) Homogeneous system is more efficient than cartesian sys

Reflection of point $\underbrace{(5,6)}_{\text{input}}$ with respect to line $\sqrt{3}x - 3y + 3 = 0$

$\Rightarrow \quad \sqrt{3}x - 3y + 3 = 0$ $\qquad y = mx + c$

$\sqrt{3}x + 3 = 3y$

$y = \frac{\sqrt{3}}{3}x + \frac{3}{3}$

$y = \frac{1}{\sqrt{3}}x + 1$

$y = mx + c \longrightarrow \therefore m = \frac{1}{\sqrt{3}}$, $c = 1$

Anticlockwise $+\theta$

$m = \tan\theta$

$\frac{1}{\sqrt{3}} = \tan\theta \Rightarrow \theta = \tan^{-1}\left(\frac{1}{\sqrt{3}}\right) = 30°$

Reflection along x axis

$T_{(0,1)} * R(+\theta) * Ref(x) * R(-\theta) * T_{(0,-1)}$

$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = \underbrace{\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}}_{T(0,1)} * \underbrace{\begin{bmatrix} \cos 30° & -\sin 30° & 0 \\ \sin 30° & \cos 30° & 0 \\ 0 & 0 & 1 \end{bmatrix}}_{R(+\theta)} * \underbrace{\begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}}_{Ref(x)} * \underbrace{\begin{bmatrix} \cos(-30°) & -\sin(-30°) & 0 \\ \sin(-30°) & \cos(-30°) & 0 \\ 0 & 0 & 1 \end{bmatrix}}_{R(-\theta)} *$$

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & -1 \\ 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 5 \\ 6 \\ 1 \end{bmatrix}$$

$T(0,-1)$

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$$= \begin{bmatrix} \cos 30 & -\sin 30 & 0 \\ \sin 30 & -\cos 30 & 1 \\ 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} \sin 30 & \cos 30 & -\cos 30 \\ \cos 30 & -\sin 30 & 1.5 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 6.83 \\ 2.83 \\ 1 \end{bmatrix} \approx (6.83, 2.83)$$ Ans