

Answers to EE5808 Assignment 2

Qn 1

a) Parallel projection: all the projection rays are parallel

Perspective projection: all the projection rays pass through the projection reference point (or point of projection)

b) α is the angle the projection rays make with the view plane/projection plane

Cavalier projection: $\alpha = \tan^{-1}1$

Cabinet projection: $\alpha = \tan^{-1}2$

c) $Z = 2$.

The equation is expressed in camera coordinates (or viewer coordinates)

d) $gluLookAt(100, 100, 100, 0, 100, 0, 6, 0, 1)$;

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Qn 2

a) $M_{2 \leftarrow 3} = T(0, 10, 0)R_z(30^\circ) = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 10 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \cos 30^\circ & -\sin 30^\circ & 0 & 0 \\ \sin 30^\circ & \cos 30^\circ & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$

$= \begin{pmatrix} \sqrt{3}/2 & -0.5 & 0 & 0 \\ 0.5 & \sqrt{3}/2 & 0 & 10 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$

b) $M_{1 \leftarrow 2} = T(-2, 10, 0)R_z(30^\circ)S(0.5, 0.5, 1.0)$

$$= \begin{pmatrix} 0.5\cos 30^\circ & -0.5\sin 30^\circ & 0 & -2 \\ 0.5\sin 30^\circ & 0.5\cos 30^\circ & 0 & 10 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$= \begin{pmatrix} \sqrt{3}/4 & -0.25 & 0 & -2 \\ 0.25 & \sqrt{3}/4 & 0 & 10 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

c)

glTranslatef (10, 0, 0);

Part (); // Part 1

glTranslatef (-2, 10, 0); // $M_{1 \leftarrow 2}$
glRotatef (30, 0, 0, 1);
glScalef (0.5, 0.5, 1.0);

Part (); // Part 2

glTranslatef(0,10,0);
glRotatef (30, 0, 0, 1); // $M_{2 \leftarrow 3}$

glRotatef (45, 0, 1, 0);

Part (); // Part 3

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d) refer to the underlined added code

Qn 3

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a)

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$VRP = (0, 100, -100)$
 $VPN = (0, 100, -100)$
 $VUP = (0, 1, 0);$

$$Z_{VC} = (0, \frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}})$$

$$VUP \times VPN = \begin{vmatrix} i & j & k \\ 0 & 1 & 0 \\ 0 & 100 & -100 \end{vmatrix} = (-100, 0, 0) \quad X_{VC} = (-1, 0, 0)$$

$$Y_{VC} = Z_{VC} \times X_{VC} = \begin{vmatrix} i & j & k \\ 0 & 1/\sqrt{2} & -1/\sqrt{2} \\ -1 & 0 & 0 \end{vmatrix} = (0, \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}})$$

$$M_{VC \leftarrow WC} = \begin{pmatrix} X_{VC} & -VRP \cdot X_{VC} \\ Y_{VC} & -VRP \cdot Y_{VC} \\ Z_{VC} & -VRP \cdot Z_{VC} \\ 0 & 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} -1 & 0 & 0 & 0 \\ 0 & 1/\sqrt{2} & 1/\sqrt{2} & 0 \\ 0 & 1/\sqrt{2} & -1/\sqrt{2} & -200/\sqrt{2} \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

b)

$$1 = \frac{V_{pz}}{\sqrt{V_{px}^2 + V_{py}^2}}$$

$$(V_{px}, V_{py}) = (1, 1)$$

$$V_{pz} = \sqrt{2}$$

$$Z_{vp} = -5$$

$$M_{parallel} = \begin{pmatrix} 1 & 0 & \frac{V_{px}}{V_{pz}} & \frac{Z_{vp} \cdot V_{px}}{V_{pz}} \\ 0 & 1 & \frac{V_{py}}{V_{pz}} & \frac{Z_{vp} \cdot V_{py}}{V_{pz}} \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} 1 & 0 & -1/\sqrt{2} & -5/\sqrt{2} \\ 0 & 1 & -1/\sqrt{2} & -5/\sqrt{2} \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

c)

i)

Use method 2, P1 is the coordinate system.

The transformation is

$$T(60, 0, -100)R_y(30^\circ) = \begin{pmatrix} \sqrt{3}/2 & 0 & 0.5 & 60 \\ 0 & 1 & 0 & 0 \\ -0.5 & 0 & \sqrt{3}/2 & -100 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

(3 marks) (2 marks)

ii)

```

void draw_part2 (void)
{
    glPushMatrix ( );

    glTranslatef (60, 0, -100);
    glRotatef (30, 0, 1, 0);

    glRotatef (15, 1, 0, 0);
    Part_2 ( );

    glPopMatrix ( );
}

```

```

void object (void)
{
    glTranslatef (10, 10, 10);

    Part_1 ( );
    draw_part2 ( );

    glScalef (-1, 1, 1);
    draw_part2 ( );
}

```

iii)

The underlined code

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<https://powcoder.com>

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