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, 0, 0, 1);*

Qn 2

a) $M_{2\leftarrow 3} = T(0,10,0)R_z(30^o) = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 10 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} cos30^o & -sin30 & 0 & 0 \\ sin30 & cos30^o & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$

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

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

$= \begin{pmatrix} 0.5cos30^o & -0.5sin30^o & 0 & -2 \\ 0.5sin30^o & 0.5cos30^o & 0 & 10 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$

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

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

d) refer to the underlined added code

Qn 3

a)

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

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

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

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

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

b)

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

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

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

$$Z_{vp} = -5$$

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

c)

i)

Use method 2, P1 is the coordinate system.

The transformation is

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

(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
        draw_part2 ( );
}
```


iii)

The underlined code