CG test - 4

(2) The drawback of using DDA are:

⇒ uses floating point approximation, hence inaccurate.

⇒ Can lead to graph looking like a ladder in a larger span.

Given $(x, y) = (17, 2)$ $(x_2, y_2) = (10, 5)$

$$\text{slope} = \frac{\Delta y}{\Delta x} = \frac{3}{7}$$

$$|m| < 1$$

if $p_k < 0$ then

$x_{k+1} = x_k - 1$

$y_{k+1} = y_k - 1$

$p_k = p_k + 2\Delta y$

$p_k \geq 0$ then,

$x_{k+1} = x_k - 1$

$y_{k+1} = y_k + 1$

$p_k = p_k + 2\Delta y - 2\Delta x$

Here

$\Delta x = 7$, $2\Delta x = 14$, $\Delta y = 3$, $2\Delta y = 6$

Initial decision parameter $(p_{k+1}) = 2\Delta y - \Delta x = 6 - 7 = -1$

for starting point $(17, 2)$

k	p_k	x_{k+1}	y_{k+1}	x_{k+1}, y_{k+1}
0	-1	16	2	(16, 2)
1	5	15	3	(15, 3)
2	-3	14	3	(14, 3)
3	3	13	4	(13, 4)
4	-8	12	4	(12, 4)
5	-2	11	4	(11, 4)
6	4	10	5	(10, 5)

\# Scaling transformation is a linear transformation, that scales the size of the object.

To prove: Two successive scaling are multiplicative:

let, points be scaled by S_x, S_y

let P be scaled by the scaling factors Sx_2, Sy_2 to point,

then combined transformation can be observed as.

$$T = S(Sx_2, Sy_2)(Sx_1, Sy_1)$$

$$= \begin{bmatrix} Sx_2 & 0 & 0 \\ 0 & Sy_2 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} Sx_1 & 0 & 0 \\ 0 & Sx_1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} Sx_1 Sx_2 & 0 & 0 \\ 0 & Sy_1 Sy_2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

∴ This proves two scaling are multiplicative.

Given

A(0,0,0) B(1,1,0) C(1,2,2) D(0,2,0)

For rotating +90°

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} \cos 90 & 0 & \sin 90 & 0 \\ 0 & 1 & 0 & 0 \\ -\sin 90 & 0 & \cos 90 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 4 \\ 4 \\ 2 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 0 & 2 & 0 \\ 0 & 1 & 2 & 2 \\ 0 & -1 & -1 & 0 \\ 1 & 1 & 1 & 1 \end{bmatrix} //$$

∴ coordinates after rotating 90° is

(0, 0, 0, ~~2~~) (0, 1, -1) (2, 2, -1) (0, 2, 0)

Now to reflecting on y-z plane.
↳ x chages ; yz unchaged

$$R_{y \cdot yz} = \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

Coordinatesafter reflecting about y-z plane is
$A''(0,0,0)$ $B''(0,1,-1)$ $C''(2,2,-1)$ $D''(0,2,0)$

(5) window: A ~~a~~ area selected for display from real world is called a window.
viewport: It is a area on display device to which window is displayed.

windows to view port transformation is the trasformation of the area from window to viewport. It is used to display ~~on~~ a window on a viewpoint device.
↳ Steps to trasform window to viewport are:
(i) Scaling the clipping window to size of viewport using fixed point position of (xw_{min}, yw_{min})
(ii) Traslate (T) (xw_{min}, yw_{min}) to (xu_{min}, yu_{max})

$$S = \begin{bmatrix} S_x & 0 & xw_{min}(1-S_x) \\ 0 & S_y & yw_{min}(1-S_y) \\ 0 & 0 & 1 \end{bmatrix}$$

$$T = \begin{bmatrix} 1 & 0 & xu_{min}-xw_{min} \\ 0 & 1 & yu_{min}-yw_{min} \\ 0 & 0 & 1 \end{bmatrix}$$

window to viewport transformation matrix:

$$T_{wv} = \begin{bmatrix} S_x & 0 & t_x \\ 0 & S_y & t_y \\ 0 & 0 & 1 \end{bmatrix}$$

Date / /
Page No.

$$S_x = \frac{xv_{max} - xv_{min}}{xw_{max} - xw_{min}}$$

$$S_y = \frac{yv_{max} - yv_{min}}{yw_{max} - yw_{min}}$$

$$t_x = \frac{xw_{max} \cdot xv_{min} - xw_{min} \cdot xv_{max}}{xw_{max} - xw_{min}}$$

$$t_y = \frac{yw_{max} \cdot yv_{min} - yw_{min} \cdot yv_{max}}{yw_{max} - yw_{min}}$$

Cohen-Sutherland divides the coordinate system to 9 regions.
All 9 regions have their associated region codes.

(a) Every lines endpoint is assigned a 4 digit binary code.
(b) If the region code of both endpoint in 0000, the line is completely inside the clip window.

→ if logical AND of region code is not '0000' the line lies completely outside.

In both cases, line clipping is not necessary, if:

(i) B_1 is high, $x = xw_{min}$
$y = y_1 + xw_{max}$

(ii) B_2 is high, $x = xw_{max}$
$y = y_1 + m(x - x_1)$

(iii) If B_3 is high, $y = yw_{min}$
$x = x_1 + \frac{1}{m}(y - y_1)$

(iv) B_4 is high, $y = yw_{max}$
$x = x_1 + \frac{1}{m}(y - y_1)$

Region code

B_4	B_3	B_2	B_1

$x_{wmax} = 50$, $x_{wmin} = 10$

$y_{wmax} = 50$ $y_{wmin} = 10$

line endpoint = $P(20,5)$ $Q(40,30)$

$R(20,20)$ $S(50,60)$

For $(20,5)$, $(40,30)$

Region code $(20,5)$

$B_1 : 20<10 : 0$

$B_2 : 20>50 : 0$

$B_3 : 5<10 : 1$

$B_4 : 5>50 : 0$

Region code $\rightarrow$ 0 1 0 0

Region code for $Q(40,30)$

$B_1 : x < x_{wmin} : 40<10 : 0$

$B_2 : x > x_{wmax} : 40>50 : 0$

$B_3 : y < y_{wmin} : 30<10 : 0$

$B_4 : y > y_{wmax} : 30>50 : 0$

Region code $\rightarrow$ 0 0 0 0

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5}{1}$$

Performing logical AND for region codes

$$\begin{array}{r} (0100)^2 \\ A = (0000)^2 \\ \hline 0000)^2 \end{array}$$

Intersection point for $P(20,5)$

B_3 using: $y = y_{wmin} \Rightarrow y = 10$

$$x = x_1 + \frac{1}{m}(y - y_1)$$

$$x = 20 + \frac{1}{3}(10-5)$$