Azmari Sultana

Id 22201949

Section : 14

CSE 423

Assignment 1

Ans no 1

(a)

Mid point line drawing algorithm :

$(5, -15)$ to $(0, -5)$

$dx = 0 - 5 = -5$

$dy = -5 + 15 = 10$

$|dy| > |dx|$

$dx < 0$

$dy > 0$

$\therefore$ zone 2

In case of zone 0,

$(5, -15) \rightarrow (-15, -5)$

$(0, -5) \rightarrow (-5, 0)$

$dx = -5 + 15 = 10$

$dy = 0 + 5 = 5$

$d_{init} = 2dy - dx = 2 \times 5 - 10 = 0$

$\Delta NE = 2dy - 2dx = 5 \times 2 - 10 \times 2 = 10 - 20 = -10$

$\Delta E = 2dy = 2 \times 5 = 10$

x	y	d	NE/E	d updated	pixel (zone 0)	pixel (zone 2)
-15	-5	0	E	10	(-15, -5)	(5, -15)
-14	-5	10	NE	0	(-14, -5)	(5, -14)
-13	-4	0	E	10	(-13, -4)	(4, -13)
-12	-4	10	NE	0	(-12, -4)	(4, -12)
-11	-3	0	E	10	(-11, -3)	(3, -11)
-10	-3	10	NE	0	(-10, -3)	(3, -10)
-9	-2	0	E	10	(-9, -2)	(2, -9)
-8	-2	10	NE	0	(-8, -2)	(2, -8)
-7	-1	0	E	10	(-7, -1)	(1, -7)
-6	-1	10	NE	0	(-6, -1)	(1, -6)
-5	0	0	E	10	(-5, 0)	(0, -5)

b) DDA line drawing algorithm:

$$m = \frac{-5+15}{0-5} = -2$$

$$\therefore \frac{1}{m} = -0.5$$

y	x	x (round)	pixel
-15	5	5	(5, -15)
-14	4.5	5	(5, -14)
-13	4	4	(4, -13)
-12	3.5	4	(4, -12)
-11	3	3	(3, -11)
-10	2.5	3	(3, -10)
-9	2	2	(2, -9)
-8	1.5	2	(2, -8)
-7	1	1	(1, -7)
-6	0.5	1	(1, -6)
-5	0	0	(0, -5)

Am no 2

(a)

Total pixels = 3840 X 2160

= 8294400 pixels per frame

(b)

Time to generate one frame = $\frac{1}{60}$

= 16.67 ms

(c)

Pixel per frame = 50000 X 16.67

= 833500

GPU only process 833500 pixels per frame. But 1 frame contain 8294400 pixels. So the GPU cannot render 1 entire frame in the required time for 60 fps.

Ans no 3

$x_{min} = -50$, $x_{max} = 60$

$y_{min} = -10$, $y_{max} = 100$

Outcode for $(-50, -70)$ = 0100

Outcode for $(40, 100)$ = 0000

Outcode 1 AND outcode2 = 0000

So partially inside.

Outcode 1 has bottom bit.

Applying bottom intersection:

$y = y_{min} = -10$

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

$= -50 + \frac{9}{17}(-10 + 70)$

$= -18.24$

$(x, y) = (-18.24, -10)$

Outcode 1 = 0000 [recalculated]

So, (x_1, y_1) has been clipped to $(0, 0)$

So completely inside.

The AND operation in Cohen - Sutherland is a process to identify line segments that are entirely outside the clipping window. After AND operation, if the outcodes of both endpoints of a line segment is nonzero, it represents the line locates completely outside the clipping window. In that case, we don't need to calculate anything for that line. So, this operation helps us to avoid unnecessary calculations.

Example:

Q1 outcode : 0101

Q2 outcode : 0001

0101 AND 0001 = 0001

Since the result is nonzero, this represents the line is completely outside the clipping window. So, we can avoid the line.