MID-POINT LINE ALGORITHM (Contd*)

LECTURE 4

Equation of a line:

Ø Implicit form { $y = mx + c$ .... (i) , where $m = dy/dx$

↓

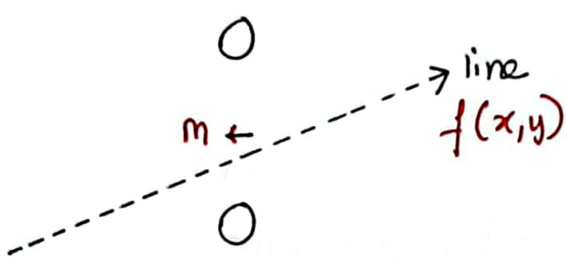
$\Rightarrow y = \frac{dy}{dx} \cdot x + c$ .... (multiply both sides with dx)

$\Rightarrow dx \cdot y = dy \cdot x + dx \cdot c$ ...... (take dx.y to the right hand side)

$\Rightarrow dy \cdot x - dx \cdot y + dx \cdot c = 0$ .... (replace,
✓ $dy = A$
✓ $-dx = B$
✓ $dx \cdot c = C$)

Ø Explicit form { $\boxed{A.x + B.y + C = 0}$ ....(ii)

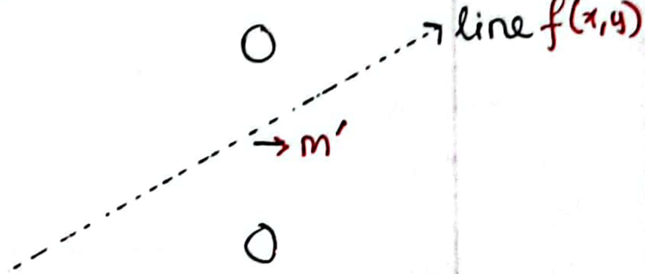
Case 1



Ø if we plug in the coordinates of m into the eqn of the line, the resulting value of the function will be -ve

$f(m) = -ve$

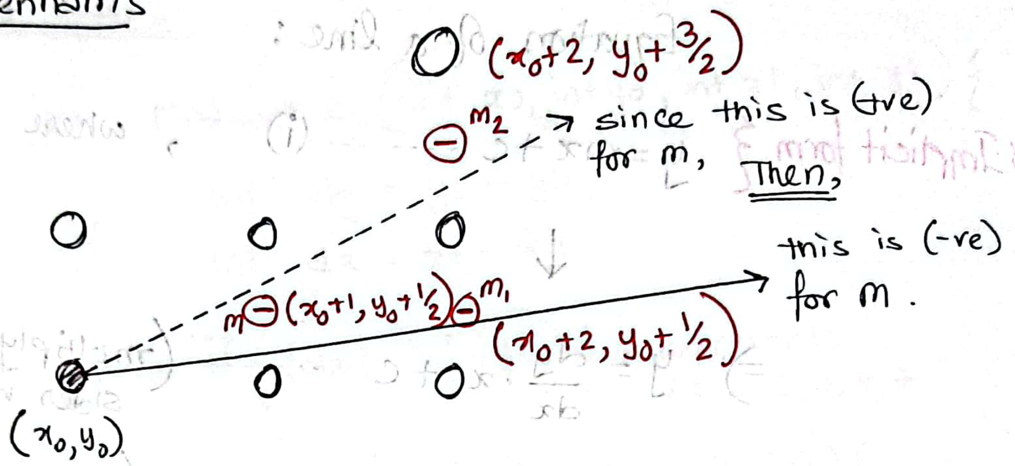
Case 2



Ø if we plug in the coordinates of m' into the eqn of the line, the resulting value of the function will be +ve

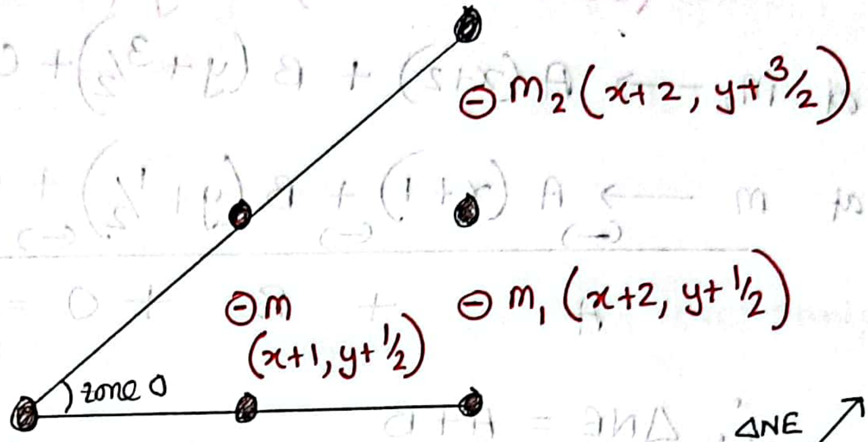
$f'(m') = +ve$

Bresenham's

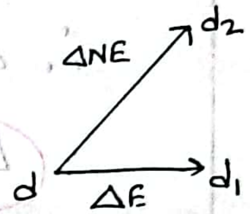


∅ we will be considering the rate of change (in the deviation from the midpoint) to further locate the pixels in the path.

Ø Designing the Algo for Zone 0.



arbitrary starting point (x,y)



(deviation at m_1, solving for ΔE)

at m_1, $\longrightarrow A(x+2) + B(y+1/2) + C = d_1$

at m, $\longrightarrow A(x+1) + B(y+1/2) + C = d$
$(-)\quad(-)\quad(-)\quad(-)$

$A + 0 + 0 = \underbrace{d_1 - d \approx \Delta E}_{\text{the rate of change of pixel for a horizontal movement.}}$

$\therefore A = \Delta E$

meaning, $\Delta E = dy$ ---- (i)

(deviation at m_2, solving for ΔNE)

at $m_2 \longrightarrow A(x+2) + B\left(y+\frac{3}{2}\right) + C = d_2$

at $m \longrightarrow \underset{(-)}{A(x+1)} \underset{(-)}{+} B\left(y+\frac{1}{2}\right) \underset{(-)}{+} C \underset{(-)}{=} d$

$A + B + 0 = \underbrace{d_2 - d = \Delta NE}_{\text{the rate of change in pixel for a corner movement.}}$

$\therefore \Delta NE = A + B$

$\Delta NE = dy - dx$ ---- (ii)

Ø we still need to solve for the initial deviation / d_{init}, at m, for starting points (x_0, y_0)

at m, $A(x_0+1) + B\left(y_0+\frac{1}{2}\right) + C = d_{init}$

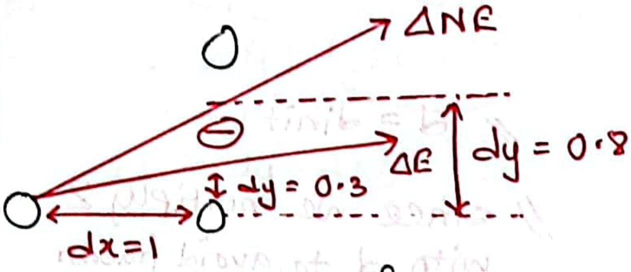
$\Rightarrow \underbrace{Ax_0 + By_0 + C}_{} + A + \frac{B}{2} = d_{init}$

since (x_0, y_0) is a coordinate from the line $Ax_0 + By_0 + C = 0$

$\Rightarrow d_{init} = A + \frac{B}{2}$

$\Rightarrow d_{init} = dy - \frac{dx}{2}$ — (iii)

Ø Now, we need figure out if we'll move to ΔE / ΔNE based on the polarity of the value for dinit.



Ø for ΔNE, where line goes over midpoint.

$$d_{init} = dy - \frac{dx}{2} = 0.8 - \frac{1}{2} = 0.3 \; (+ve)$$

Ø for ΔE, where line goes below midpoint.

$$d_{init} = 0.3 - \frac{1}{2} = -0.2 \; (-ve)$$

* ∴ We can conclude that for a +ve value for d the movement will be ΔNE,

AND,

for a −ve value for d the movement will be ΔE.

Pseudo Code (MPL zone 0):

```
drawline (x0, y0, x1, y1){

    dy = y1 - y0
    dx = x1 - x0                // d = dinit.
    d  = 2dy - dx               // since we multiply 2
                                   with d to avoid fraction
    dE = 2dy                    // we need to multiply
    dNE = 2(dy - dx)            // dE & dNE with 2 as
                                   well.

    x = x0
    y = y0
    draw(x, y);
    while (x <= x2){
        if (d <= 0){  // for ΔE movement
                         only x increases.
            x++
            d+ = dE   // add dE to
                         current value
        }                of d
        else{  // for ΔNE movement x, y both
                                     increase by 1.
            x++
            y++
            d+ = dNE   // add dNE to
                          current value
        }                 of d.
        draw(x, y)
    }
}
```

Q1) Draw (30,50) to (40,54) using MPL

dy = 4 , dx = 10

$d = dy - dx/2 = \underbrace{2(dy) - (dx)}_{\text{use this to avoid fraction.}} = 8 - 10 = -2$

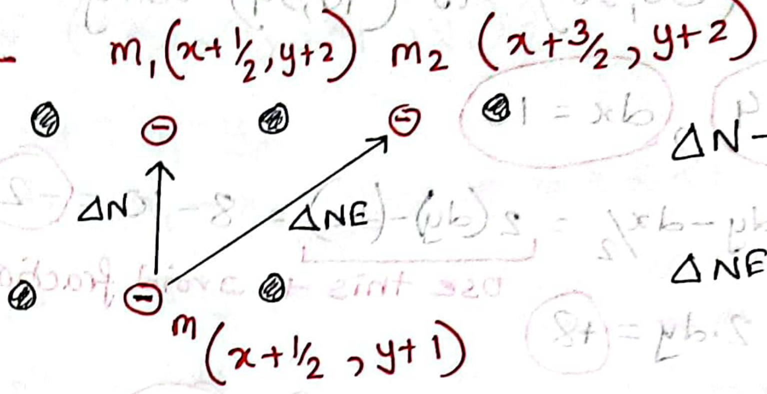
$dE = 2 \cdot dy = +8$

$dNE = 2(dy - dx) = 2(4 - 10) = -12$

x	y	d	ΔE/ΔNE	(PIXEL)
30	50	-2	ΔE	(30,50)
31	50	6	ΔNE	(31,50)
32	51	-6	ΔE	(32,51)
33	51	2	ΔNE	(33,51)
34	52	-10	ΔE	(34,52)
35	52	-2	ΔE	(35,52)
36	52	6	ΔNE	(36,52)
37	53	-6	ΔE	(37,53)
38	53	2	ΔNE	(38,53)
39	54	-10	ΔE	(39,54)
40	54	-2	ΔE	(40,54) → done

Home Assignment Design for Zone 1 & Zone 5

Zone 1



$\Delta N \rightarrow x = x$
$y = y+1$

$\Delta NE \rightarrow x = x+1$
$y = y+1$

ΔN

at m_1: $A(x+\frac{1}{2}) + B(y+2) + C = d_1$

at m: $(-)\; A(x+\frac{1}{2}) \underset{(-)}{+} B(y+1) \underset{(-)}{+} C = \underset{(-)}{d}$

$$0 + B + 0 = \Delta N$$

$\therefore \Delta N = -dx \longrightarrow$ we'll use $[-2dx]$

ΔNE

at m_2: $A(x+\frac{3}{2}) + B(y+2) + C = d_2$

at m: $(-)\; A(x+\frac{1}{2}) \underset{(-)}{+} B(y+1) \underset{(-)}{+} C = \underset{(-)}{d}$

$$A + B = \Delta NE$$

$\therefore \Delta NE = dy - dx \longrightarrow$ we'll use $[2(dy-dx)]$

dinit

at m (x_0, y_0): $A(x_0+\frac{1}{2}) + B(y_0+1) + C = \text{dinit}$

$$\frac{A}{2} + B = \text{dinit}$$

$\therefore \text{dinit} = \frac{dy}{2} - dx \longrightarrow$ we'll use $[dy - 2dx]$