MID-POINT LINE ALGORITHM (Contd*)

Equation of a line :

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

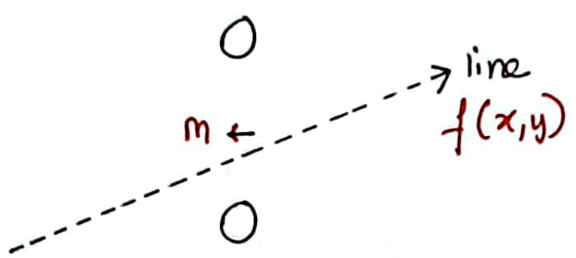
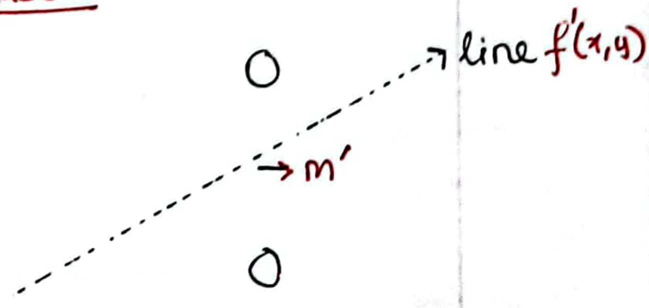
$\downarrow$

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

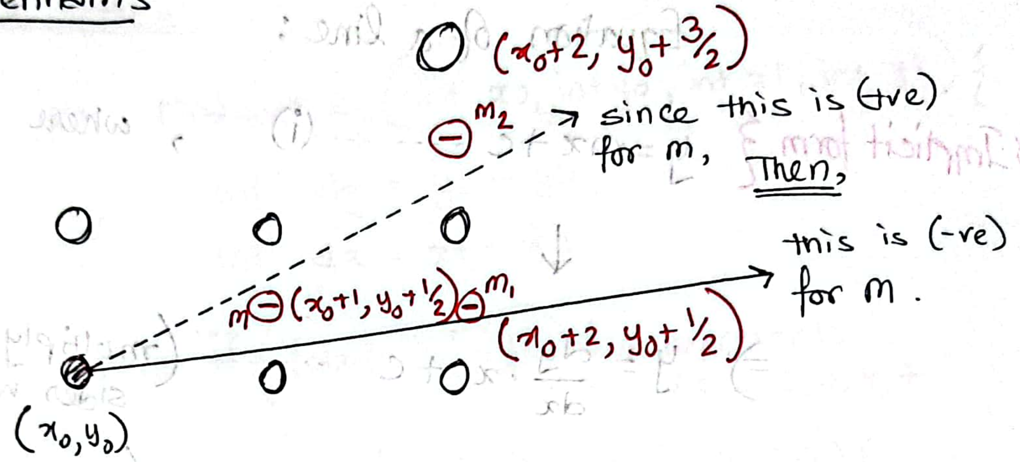
$\Rightarrow dx \cdot y = dy \cdot x + dx \cdot c$ ..... (take $dx \cdot y$ to the right hand side)

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

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

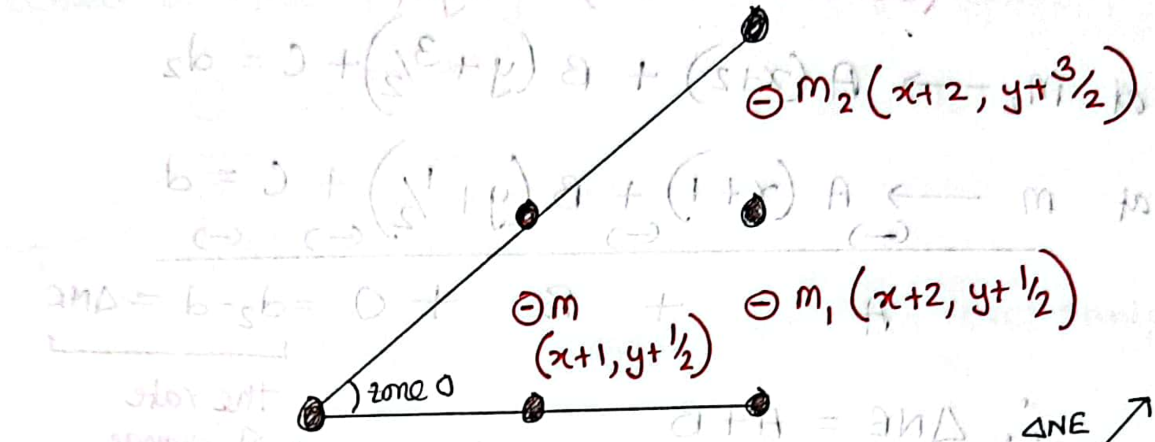
case 1	case 2
	
Ø if we plug in the coordinates of m into the eqn of the line, the resulting value of the function will be (+ve)	Ø if we plug in the coordinates of m into the eqn of the line, the resulting value of the function will be (-ve)
$f(m) = +ve$	$f'(m') = -ve$

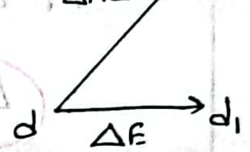
Bresenham's



Ø 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.





(deviation at M_1, solving for ΔE)

at M_1, $\longrightarrow A(x+2) + B(y+1/2) + C = d_1$

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

$$\underline{\quad (-) \qquad\qquad (-) \qquad\qquad (-) \qquad (-) \quad}$$

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

$\therefore A = \Delta E$

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

(deviation at M_2, solving for ΔNE)

at $M_2 \longrightarrow A(x+2) + B(y+3/2) + C = d_2$

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

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

$\therefore \Delta NE = A + B$

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

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

at M, $A(x_0+1) + B(y_0+1/2) + C = d_{init}$

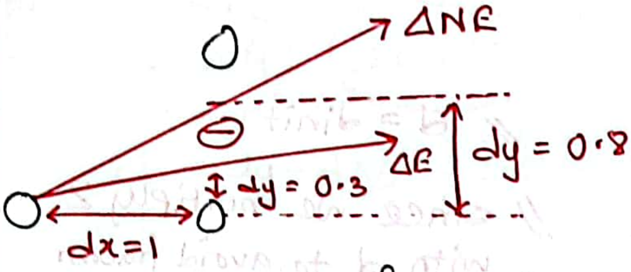
$\Rightarrow \underbrace{Ax_0 + By_0 + C}_{} + A + B/2 = d_{init}$

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

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

$\Rightarrow d_{init} = dy - dx/2$ —— (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

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

$dE = 2 \cdot dy = +8$

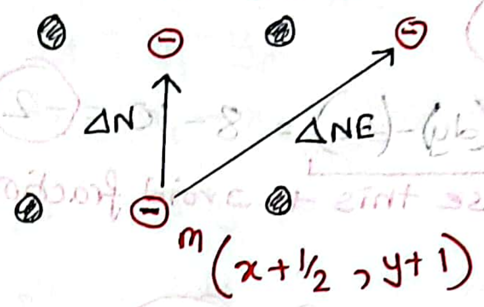
$dNE = 2(dy - dx) = 2(4-10) = -12$

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

$m_1\left(x+\tfrac{1}{2},\, y+2\right)$ $m_2\left(x+\tfrac{3}{2},\, y+2\right)$



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

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

∅ ΔN

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

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

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

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

∅ ΔNE

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

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

$$A + B = \Delta NE$$

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

∅ dinit

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

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

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