MID-POINT LINE ALGORITHM (Contd*)

LECTURE 4

Equation of a line:

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

↓

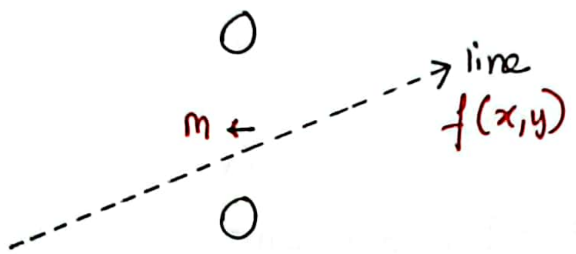
$\Rightarrow y = \frac{dy}{dx} . x + c$ .... (multiply both sides with dx)

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

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

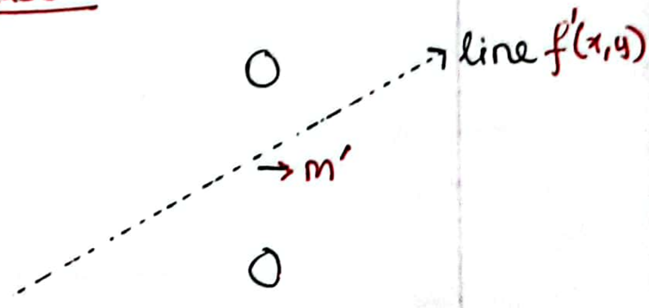
Ø Explicit form { $\boxed{A.x + B.y + C = 0}$ ...... (ii)

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)

Case 2

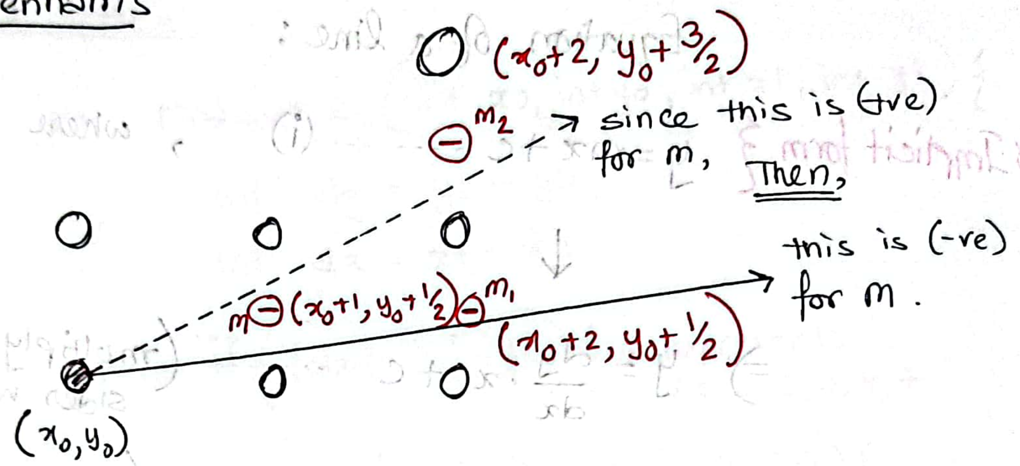


Ø if we plug in the coordinates of m into the eqn of the line, the resulting value of the function will be (-ve)

$f(m) = +ve$	$f'(m') = -ve$

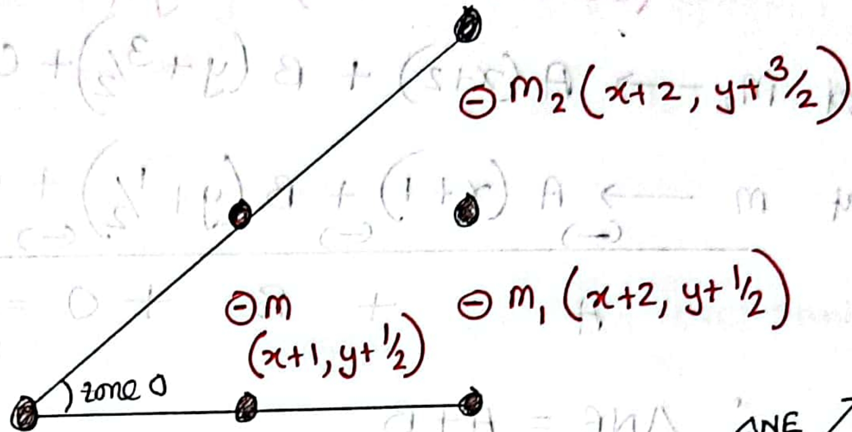
If dinit = +ve, under the mid point
If dinit = -ve, over the mid point

Bresenham's

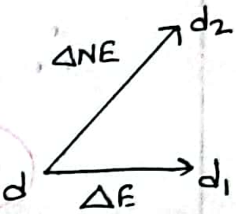


∅ we will be considering the rate of change (in the deviation from the midpoint) to further locate the pixels in the path.

Ø Designing the Algo for Zone 0.



arbitrary starting point (x,y)



(deviation at M_1, solving for ΔE)

$$\text{at } M_1,\longrightarrow A(x+2)+B\left(y+\tfrac{1}{2}\right)+C=d_1$$

$$\text{at } M,\longrightarrow \underset{(-)}{A(x+1)}\ \underset{(-)}{+}\ B\left(y+\tfrac{1}{2}\right)\ \underset{(-)}{+}\ C\ \underset{(-)}{=}\ d$$

$$A \quad + \quad 0 \quad + 0 = \underbrace{d_1 - d \approx \Delta E}$$

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

$(-) \quad (-) \quad (-) \quad (-)$

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

$\therefore \Delta NE = A + B$

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

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

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

It decide the next move of the pixel. Mostly for the first move.

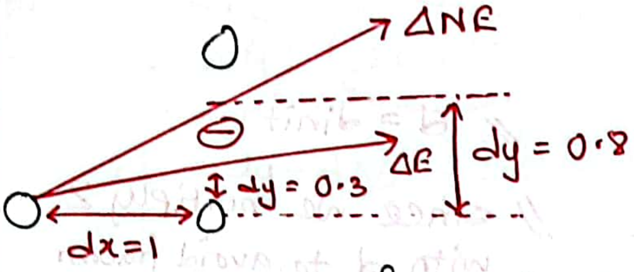
$\Rightarrow \underbrace{Ax_0 + By_0 + C}_{} + A + \frac{B}{2} = d_{init}$

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)

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



∅ for ΔNE, where line goes over midpoint.

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

∅ 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                  // d = dinit.
        dx = x1 - x0
        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)
        }

}
```

For zone 0,3,4,7 >> x increase by 1
As all this zone x goes parallel
For zone 1,2,5,6 >> y increase by 1
As all this zone y goes parallel

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

$dy = 4$, $dx = 10$

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

If dinit >= 0, it is over the mid point or y increases by 1 which is NE.

If dinit < 0, it is under the mid point or y remains same which is E.

$dE = 2 \cdot dy = +8$

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

If move to E, dinit += dE

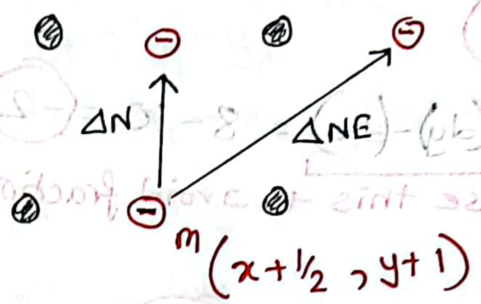
if move to NE, dinit += dNE

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

$0 + B + 0 = \Delta N$

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

∅ ΔNE

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

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

$A + B = \Delta NE$

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

∅ dinit

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

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

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