MID-POINT LINE ALGORITHM (Contd*)

LECTURE 4

Equation of a line:

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

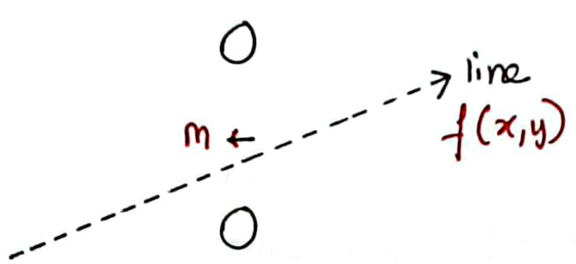
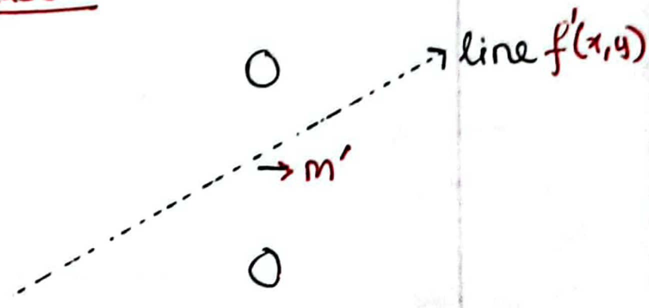
$\downarrow$

$\Rightarrow y = \frac{dy}{dx} \cdot x + c$ .... (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 $\left\{ \; \boxed{A.x + B.y + C = 0} \right.$ ...... (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)
$f(m) = +ve$	$f'(m') = -ve$

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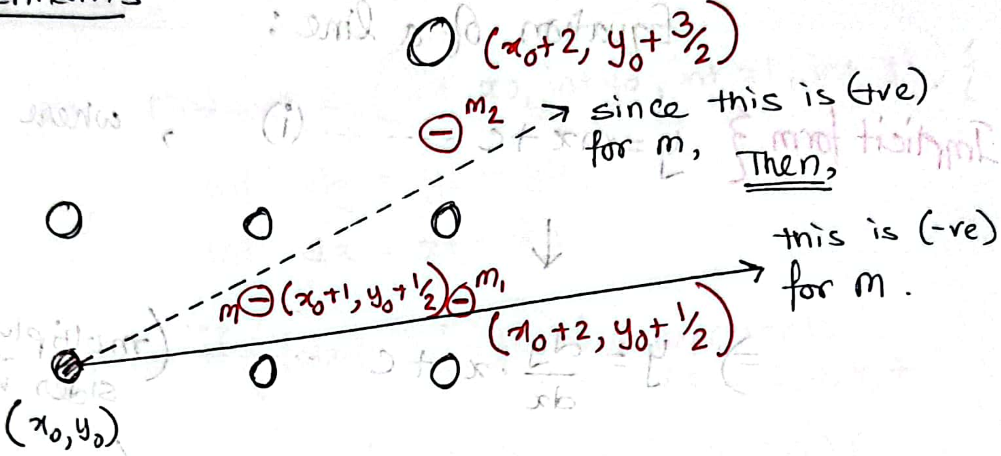
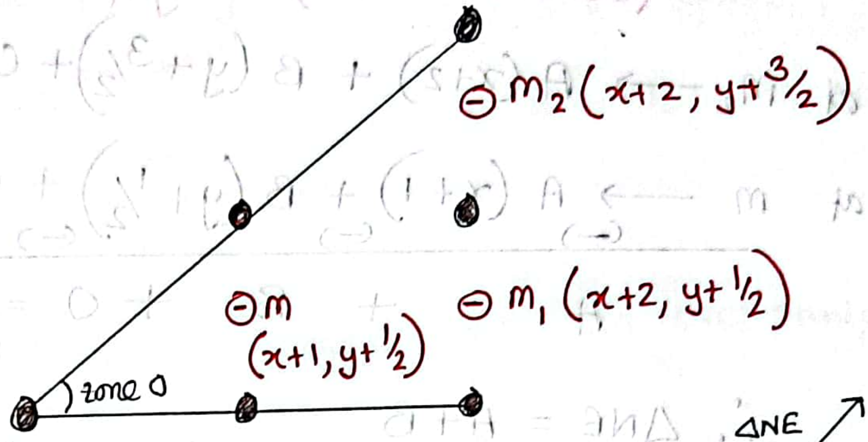
Bresenham's

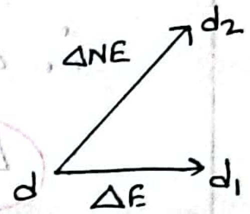


∅ we will be considering the rate of change (in the deviation from the midpoint) to further locate the pixels in the path.

Designing the Algo for Zone 0.



arbitrary starting point



(deviation at M_1, solving for ΔE)

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

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

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

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

$A + B + 0 = \underbrace{d_2 - d}_{} = \Delta NE$

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

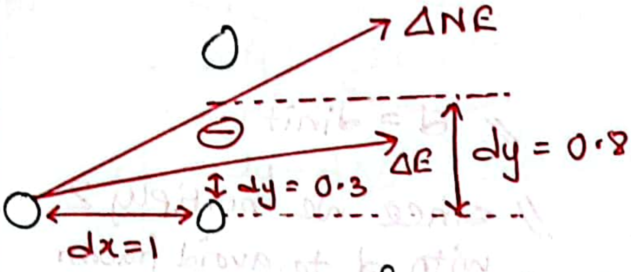
$\Rightarrow \underbrace{Ax_0 + By_0 + C}_{} + A + \frac{B}{2} = d_{init}$

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)

x increment

x, y both increment

* ΔNE $\xrightarrow{\text{Next}}$ x+, y+

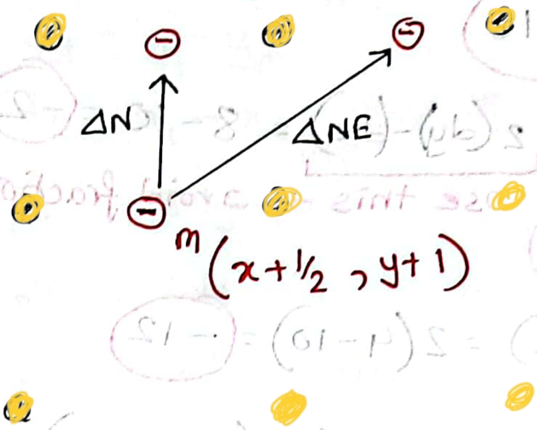
* ΔE → x+

→ done

Home Assignment Design for Zone 1 & Zone 5

Zone 1

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



$m\left(x+\frac{1}{2}, y+1\right)$

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

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

∅ ΔN

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

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

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

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

∅ ΔNE

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

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

$$A + B = \Delta NE$$

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

∅ dinit

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

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

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