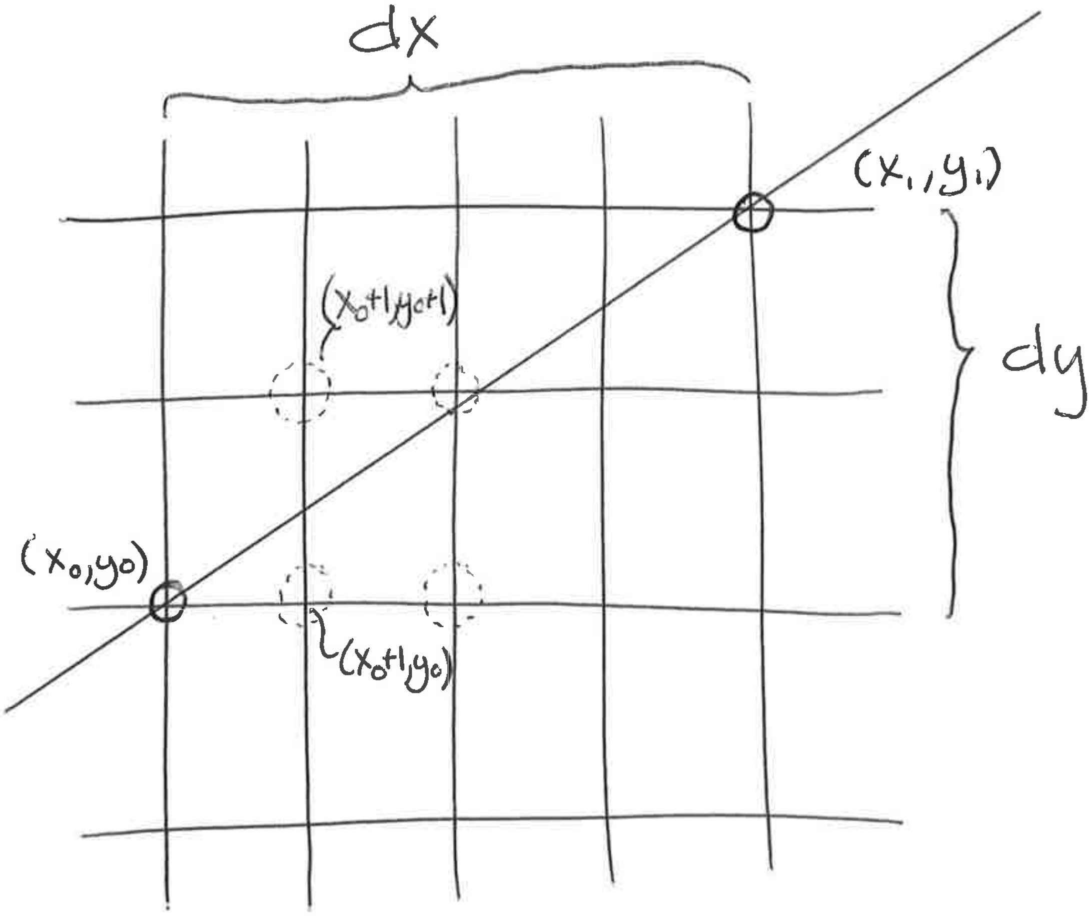

dx
(x_1, y_1)
dy
(x_0+1, y_0+1)
(x_0, y_0)
(x_0+1, y_0)

Breshenham

$(x_0, y_0) = (2,2) \quad (x_1, y_1) = (6, 4)$

$y = \cancel{k}mx + b \Rightarrow \quad m = \frac{4-2}{6-2} = \frac{2}{4} = 0.5$

$b = 1 \qquad y = \frac{dy}{dx} \cdot x + b \Rightarrow$

$dy \cdot x - dx \cdot y + dx \cdot b = 0$

$\Rightarrow \quad y = \frac{1}{2} \cdot x + 1$

$\Rightarrow \quad \frac{1}{2}x - y + 1 = 0 = f(x,y)$

Place on form of only integers

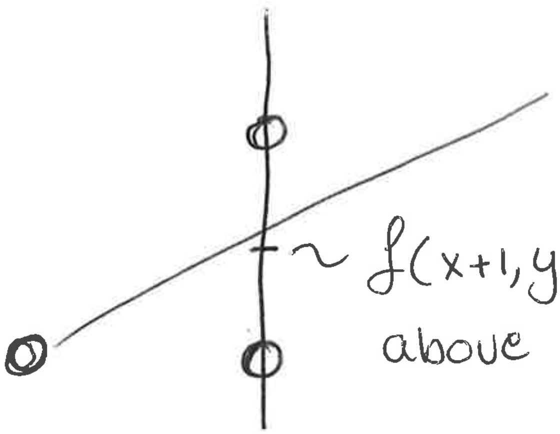
$f(x,y) = x - 2y + 2$

Condition:

$f(x,y) = 0$ on line

$f(x,y) > 0$ below line

$f(x,y) < 0$ above line



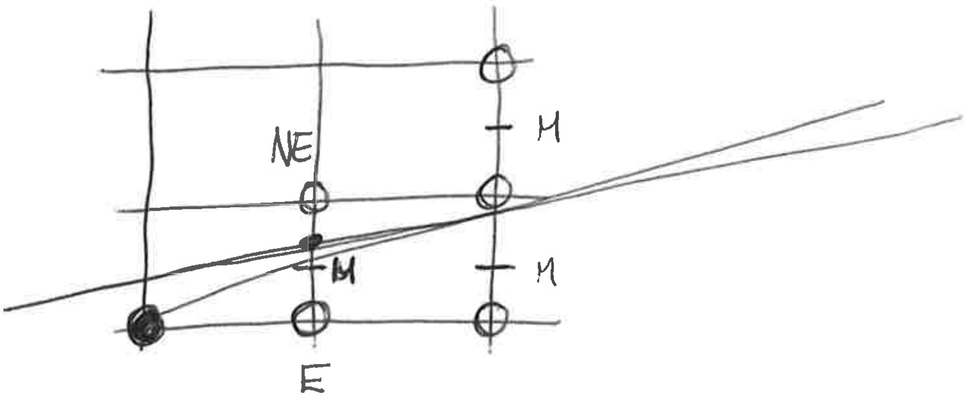
$f(x+1, y+\frac{1}{2})$ is this above or below line

$f(x+1, y+\frac{1}{2}) > 0 \Rightarrow$ plot $(x+1, y+1)$

$f(x+1, y+\frac{1}{2}) < 0 \Rightarrow$ plot $(x+1, y)$

$$d = f(x_p + 1, y_p + \tfrac{1}{2}) =$$

$$= a(x_p + 1) + b(y_p + \tfrac{1}{2}) + c$$



$d > 0 \Rightarrow NE$

$d < 0 \Rightarrow E$

$\underline{d < 0}$: (E)

$$d_{new} = f(x_p + 2, y_p + \tfrac{1}{2}) = a(x_p + 2) + b(y_p + \tfrac{1}{2}) + c$$

$$d_{new} - d_{old} = a(x_p + 2) + b(y_p + \tfrac{1}{2}) + c - (a(x_p + 1) + b(y_p + \tfrac{1}{2}) + c)$$

$$= a = dy$$

$\underline{d > 0}$: (NE)

$$d_{new} = f(x_p + 2, y_p + \tfrac{3}{2}) = a(x_p + 2) + b(y_p + \tfrac{3}{2}) + c$$

$$d_{new} - d_{old} = a(x_p + 2) + b(y_p + \tfrac{3}{2}) + c - (a(x_p + 1) + b(y_p + \tfrac{1}{2}) + c) =$$

$$= a + b = dy - dx$$

$$d_0 = f(x_0+1, y_0+\tfrac{1}{2}) = a(x_0+1) + b(y_0+\tfrac{1}{2}) + c =$$

$$= \underbrace{a x_0 + b y_0 + c}_{F(x_0,y_0)} + a + \frac{b}{2} =$$

$$= F(x_0, y_0) + a + \frac{b}{2}$$

$F(x_0, y_0) = 0$ on line

$$\Rightarrow d_0 = a + \frac{b}{2} = dy - \frac{1}{2} dx$$

~~Division expensive~~

dy & dx integers

Multiply decision with 2

$\cancel{d_0}$ $F'(x,y) = 2 \cdot F(x,y) =$

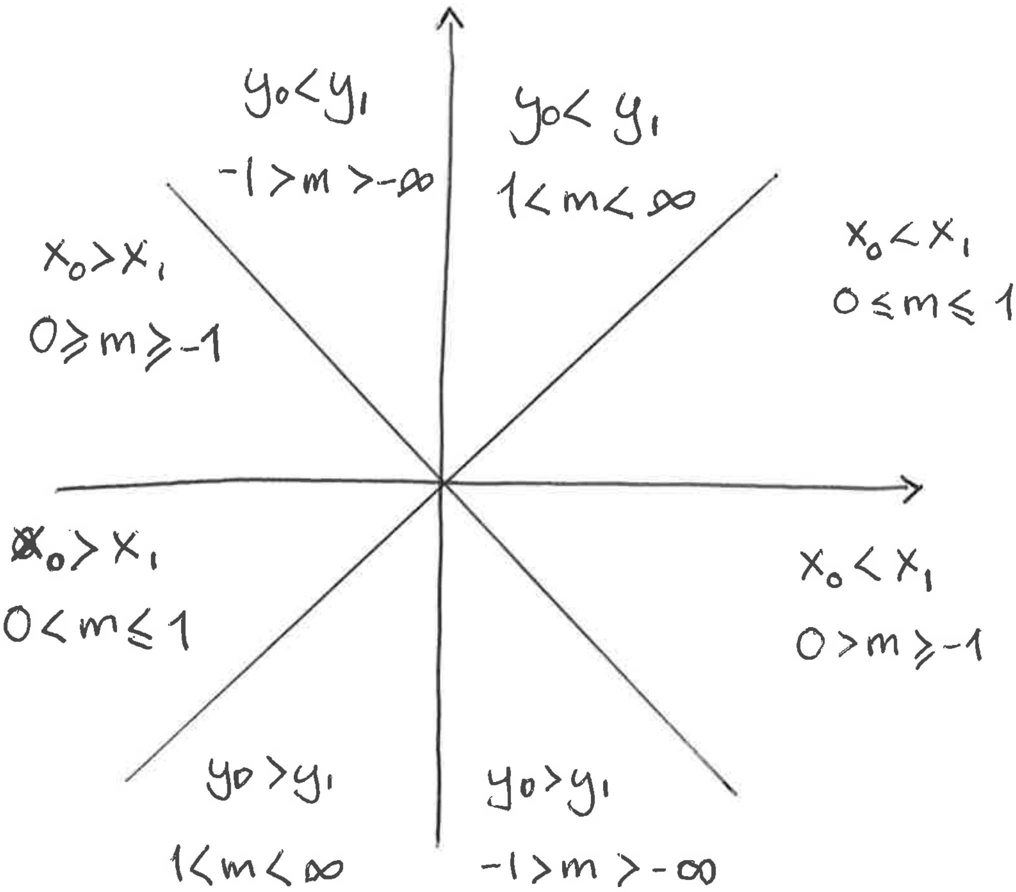
$\cancel{d_0 = 2dy - dx}$

$= 2(ax + by + c)$

$$\Rightarrow d_0 = 2dy - dx$$

$d \le 0$ (E): $\Delta d = 2dy$

$d > 0$ (NE): $\Delta d = 2dy - dx$


$y_0 < y_1$
$-1 > m > -\infty$
$y_0 < y_1$
$1 < m < \infty$
$x_0 > x_1$
$0 \geq m \geq -1$
$x_0 < x_1$
$0 \leq m \leq 1$
$x_0 > x_1$
$0 < m \leq 1$
$x_0 < x_1$
$0 > m \geq -1$
$y_0 > y_1$
$1 < m < \infty$
$y_0 > y_1$
$-1 > m > -\infty$