Bresenham Line Drawing Algorithm.

(i) calculate the slope.

$m \rightarrow \frac{\text{Starting point}}{\text{End Point}}$

$\underline{m < 1}$

x - Unit Interval

$x_{k+1} = x_k + 1$

$y_{k+1} = ?$

$\underline{m > 1}$

y - Unit Interval

$y_{k+1} = y_k + 1$

$x_{k+1} = ?$

$\underline{m = 1}$

$x_{k+1} = x_k + 1$

$y_{k+1} = y_k + 1.$

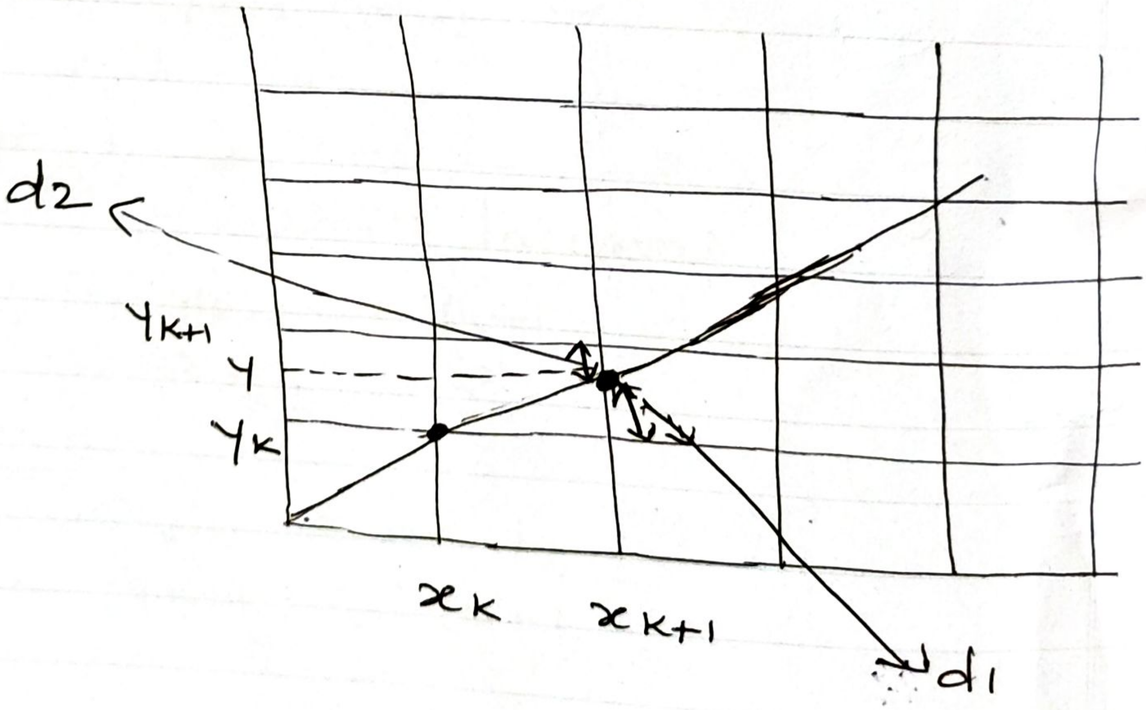
Case ($m<1$)

Line Formula is,

$$y = mx + c$$

$$\boxed{y = m(x_k + 1) + c} \text{ ——— } (1)$$

Find the y value. x_{k+1}.



$$\boxed{\text{Decision Paramater} = \Delta x\,(d_1 - d_2)}$$

d_1 = distance between y and y_k.

d_2 = Distance between y_{k+1} and y.

$$y = m(x_k + 1) + c)$$

$$P_K = \Delta x\,(d_1 - d_2)$$

To Find $\Delta x\,(d_1 - d_2)$

$$d_1 = y - y_k$$

$$d_1 = m(x_k - 1) + c - y_k.$$

$$d_2 = y_{k+1} - y.$$

substitute equation ① in d_2.

$$d_2 = y_{k+1} - m(x_{k+1}) - c)$$

$$d_1 - d_2 = m(x_{k+1}) + c - y_k - y_k - 1 + m(x_{k+1}) + c$$

$$\boxed{d_1 - d_2 = 2m(x_k + 1) - 2y_k + 2c - 1}$$

$$\Delta x (d_1 - d_2) =$$

$$\Delta x \left[2 \cdot \frac{\Delta y}{\Delta x} (x_k + 1) - 2y_k + 2c - 1 \right]$$

$$\Delta x (d_1 - d_2) = 2 \Delta y x_k + 2 \Delta y - 2 \Delta x y_k + 2 \Delta x c - \Delta x$$

$$\boxed{\begin{aligned} P_k = {} & 2\Delta y x_k + 2\Delta y \\ & - 2\Delta x y_k + \Delta x(2c-1) \end{aligned}}$$

$$P_{k+1} = 2\Delta y x_{k+1} + 2\Delta y - 2\Delta x y_{k+1} + \Delta x (2c-1).$$

To Find the next decision parameter.

$$P_{k+1} - P_k = 2\Delta y\, x_{k+1} + \cancel{2\Delta y} - 2\Delta x\, y_{k+1} + \Delta x(2\cancel{c} - 1)$$

$$- 2\Delta y\, x_k - 2\cancel{\Delta y} + 2\Delta x\, y_k - \Delta x(2\cancel{c} - 1)$$

$$P_{k+1} - P_k = 2\Delta y(x_{k+1} - x_k) - 2\Delta x(y_{k+1} - y_k)$$

$$P_{k+1} - P_k = 2\Delta y (x_{k+1} - x_k) - 2\Delta x (y_{k+1} - y_k)$$

$$\boxed{P_{k+1} = P_k + 2\Delta y - 2\Delta x (y_{k+1} - y_k)}$$

$\therefore$ $y = m(x_k + 1) + c$ —— (1)

$P_k = \Delta x (d_1 - d_2)$.

$$P_k = 2\Delta y x_k + 2\Delta y - 2\Delta x y_k + \Delta x (2c - 1).$$

To Find P_K,

$$P_K = 2\Delta y x_K + 2\Delta y - 2\Delta x y_K +$$
$$\Delta x (2 (y - m(x) - 1).$$

$$\boxed{\begin{aligned} y &= mx + c \\ c &= y - mx \end{aligned}}$$

$$2\Delta y x_K + 2\Delta y - 2\Delta x y_K +$$
$$\Delta x (2y - 2 \cdot \frac{\Delta y}{\Delta x} \cdot x - 1)$$

$$= 2\Delta y x_k + 2\Delta y - 2\Delta x y_k +$$

$$2\Delta x y - 2\Delta y x - \Delta x.$$

Substitute x_k and y_k.

$$P_k = 2\Delta y x_k + 2\Delta y - 2\Delta x y_k +$$

$$2\Delta x y_k - 2\Delta y x_k - \Delta x.$$

$$\boxed{P_k = 2\Delta y - \Delta x} \quad \text{——} \quad (2)$$

$$P_{k+1} = P_k + 2\Delta y - 2\Delta x (y_{k+1} - y_k)$$

if $(P_k \geq 0)$,

$x_{k+1} = x_k + 1$

$y_{k+1} = y_k + 1$.

Next point (x_{k+1}, y_{k+1}).

if $(P_k < 0)$

$x_k = x_k + 1$.

$\hookrightarrow$ Unit Interval.

$y_{k+1} = y_k$.

$\hookrightarrow$ y moves in previous value.

if ($P_K < 0$)
Select Previous value.
(Lower boundary).

if ($P_K \geq 0$)
Select upper value.

Summerize,

1. calculate the distance.
(i) Distance d_1
distance between
Y and Y_K.
(ii) Distance d_2
Distance between
Y and Y_{K+1}

2. Substitute both distance,

$$y = m(x_k + 1) + c$$

3. To Find P_k

(i) Decision Parameter

(ii) Next Decision Parameter

4. To Solve the problem based on the decision parameter.

$P_k > 0$ and $P_k < 0$.

Example:

$$P_K = 2\Delta y - \Delta x$$

$$P_{K+1} = P_K + 2\Delta y - 2\Delta x\,(y_{K+1} - y_K)$$

if ($P_K \geq 0$)

$$y_{K+1} = y_K + 1.$$

$NC = (x_K + 1, y_K + 1)$.

if ($P_K < 0$)

$$y_{K+1} = y_K.$$

Next Coordinate $= (x_K + 1, y_K)$.

if $(m<1)$

$P_k = 2\Delta y - \Delta x$.

$P_{k+1} = P_k + 2\Delta y - 2\Delta x\,(y_{k+1} - y_k)$.

$P_k \geq 0 \Rightarrow y_{k+1} = y_k + 1$.

$NC = (x_{k+1}, y_{k+1})$

$P_k < 0 \Rightarrow y_{k+1} = y_k$.

$NC = (x_{k+1}, y_k)$.

if $(m>1)$

$P_k = 2\Delta x - \Delta y$

$P_{k+1} = P_k + 2\Delta x - 2\Delta y(x_{k+1} - x_k)$.

$P_k \geq 0 \Rightarrow x_{k+1} = x_k + 1$

$P_k < 0 \Rightarrow x_{k+1} = x_k$.

$P_k \geq 0 \Rightarrow NC = (x_k+1), (y_k+1)$.

$P_k < 0 \Rightarrow NC = (x_k, y_k+1)$.

(35, 40) (43, 45).

$m = \frac{5}{8} = 0.6$ $\boxed{m < 1}$

$P_K = 2\Delta y - \Delta x$

$P_{K+1} = P_K + 2\Delta y - 2\Delta x\,(y_{K+1} - y_K)$

$P_K > 0 = (y_{K+1} = y_K + 1).$

$Nc = (x_{K+1},\ y_{K+1}).$

$P_K < 0 = y_{K+1} = y_K.$

$Nc = (x_{K+1},\ y_K).$

Initial Decision Parameter.

$P_k = 10 - 8 = 2$

$P_k > 0$

$\Delta x = 8$
$\Delta y = 5$
$2\Delta x = 16$
$2\Delta y = 10$

k	(x_k, y_k)	P_k	(x_{k+1}, y_{k+1})
0	(35, 40)	2	(36, 41)

$$\boxed{P_{k+1} = 2 + 10 - 16(1) = -4}$$

k	(x_k, y_k)	P_k	(x_{k+1}, y_{k+1})
1	(36, 41)	-4	(37, 41)

$$\boxed{P_{k+1} = -4 + 10 - 16(0) = 6}$$

2 (37, 41) 6 (38, 42)

$$\boxed{P_{k+1} = 6 + 10 - 16(1) = 0}$$

3 (38, 42) 0 (39, 43)

$$\boxed{P_{k+1} = 0 + 10 - 16(1) = -6}$$

4 (39, 43 -6 (40, 43)

$$\boxed{P_{k+1} = -6 + 10 - 16(0) = 4}$$

5 (40, 43) 4 (41, 44)

$$\boxed{P_{k+1} = 4 + 10 - 16(1) = 0}$$

6 (41, 44) 0 (42, 45)

$$\boxed{P_{k+1} = 0 + 10 - 16(1) = -6}$$

7 (42, 45) -6 (43, 45).

Points are,
(35, 40) (37, 41), (38, 42), (39, 43),
(40, 43) (41, 44), (42, 45), (43, 45).