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BRESENHAM'S LINE ALGORITHM

- It is mid-point Algorithm.
- Incremental Algorithm.

It determines the point of an n-dimensional raster that should be selected in order to form a close approximation to a straight line between points.

- It is efficient because (integer, sub, Multiplication)
- The operation performed rapidly.

Algorithm:- Mid-Point line drawing Algorithm.

start co-ordinate (x_1, y_1)
end co-ordinate (x_2, y_2)

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step 1:- Calculate 'Δx' and 'Δy'.

$$\Delta x = x_2 - x_1;$$

$$\Delta y = y_2 - y_1;$$

Step 2:- Calculate the slope:-

$$\text{slope}(m) = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\Delta y}{\Delta x}$$

Now, we get two condition:-

$[m > 1]$ and $[m < 1]$

Step 3:- Calculate the decision parameter.

if $(m < 1)$ $\boxed{P_K = 2\Delta y - \Delta x}$

and

if $(m \geq 1)$ $\boxed{P_K = 2\Delta x - \Delta y}$

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Step 4:- Based on the decision parameter we have to create the next move:-

Case 1:- if $[m < 1]$ and $[P_K < 0]$

then,

$$x_{K+1} = x_K + 1$$

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

$$P_{K+1} = P_K + 2\Delta y$$

Case 2:- if $[m < 1]$ and $[P_K \geq 0]$

$$x_{K+1} = x_K + 1$$

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

$$P_{K+1} = P_K + 2\Delta y - 2\Delta x$$

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Case 3:- if $[m > 1]$ and $[P_K < 0]$

then;

$$x_{K+1} = x_K$$

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

$$P_{K+1} = P_K + 2\Delta x$$

Case 4:- if $[m > 1]$ and $[P_K \geq 0]$

then,

$$x_{K+1} = x_K + 1$$

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

$$P_{K+1} = P_K + 2\Delta x - 2\Delta y$$

Step 5:- Repeat the step 4 until the end point is not reached.

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PROBLEM :-

Q. From the given point draw the lines segment using mid-point Algo.

$(x_1, y_1) = (1,1)$

$(x_2, y_2) = (5,3)$

Sol^n :- step 1 :- $\Delta x = x_2 - x_1 = 5-1 = 4$

$\Delta y = y_2 - y_1 = 3-1 = 2$

step 2 :-

slope (m) $= \frac{\Delta y}{\Delta x} = \frac{2}{4} = 0.5$

Now, $\{m < 1\}$

step 3 :- $P_K = 2\Delta y - \Delta x$

$= 2\times2 - 4$

$= 0$

Here, $P_K \geq 0$

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step 4 :- $\{m < 1\}$ and $\{P_K \geq 0\}$

$x_{K+1} = x_K + 1 = 1+1 = 2$

$y_{K+1} = y_K + 1 = 1+1 = 2$

$P_{K+1} = P_K + 2\Delta y - 2\Delta x$

$= 0 + 2\times2 - 2\times4$

$\quad 2 \quad -4$

Here; $P_K < 0$

Iteration 2 $[m < 1]$ and $[P_K < 0]$

$x_{K+1} = x_K + 1 = 2+1 = 3$

$y_{K+1} = y_K = 2$

$P_{K+1} = P_K + 2\Delta y = -4 + 2\times2$

$= 0$

Here, $P_K \geq 0$

Iteration 3 :- $[m < 1]$ and $[P_K \geq 0]$

$x_{K+1} = x_K + 1 = 3 + 1 = 4$

$y_{K+1} = y_K + 1 = 2 + 1 = 3$

$P_{K+1} = P_K + 2\Delta y - 2\Delta x$

$= 0 + 2 \times 2 - 2 \times 4$

$= -4$

Here, $P_K < 0$

Iteration 4 :- $[m < 1]$ and $[P_K < 0]$

$x_{K+1} = x_K + 1 = 4 + 1 = 5$

$y_{K+1} = y_K = 3$

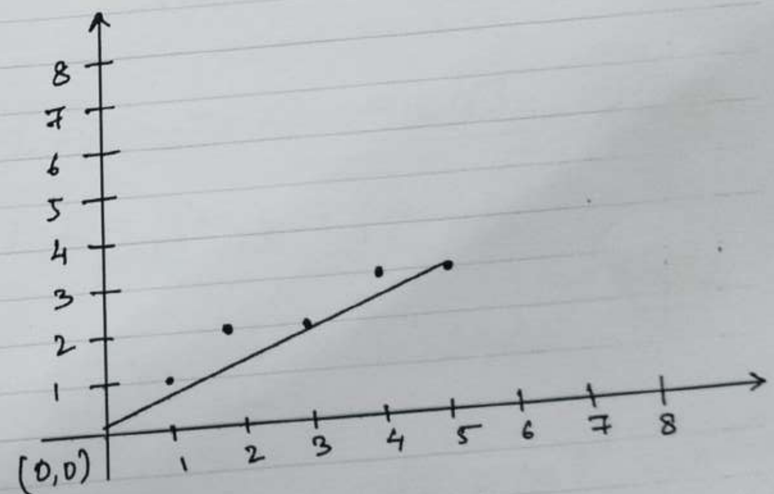
$P_{K+1} = P_K + 2\Delta y$

$= -4 + 4$

$= 0$

Step 5 :- Stop the iteration and create the table.

Iteration	P_K	x_K	y_K	x_{K+1}	y_{K+1}
0	0	1	1	2	2
1	-4	2	2	3	2
2	0	3	2	4	3
3	-4	4	3	5	3
4	0	5	3	—	—



Q2:- Create the line Segment using given points.

$(x_1, y_1) = (0, 0)$
$(x_2, y_2) = (2, 3)$

Sol^n:- step 1:- $\Delta x = x_2 - x_1 = 2 - 0 = 2$

$\Delta y = y_2 - y_1 = 3 - 0 = 3$

step 2:-

$$\text{Slope}(m) = \frac{dy}{dx} = \frac{3}{2} = 1.5$$

$\{m \geq 1\}$

step 3:- Decision Parameter

$$P_k = 2\Delta x - \Delta y$$
$$= 2 \times 2 - 3$$
$$= 1 \geq 0$$

(10)

step 4:- if $[m > 1]$ and $[P_k \geq 0]$

Iteration 1:-

$x_{k+1} = x_k + 1 = 0 + 1 = 1$

$y_{k+1} = y_k + 1 = 0 + 1 = 1$

$$P_{k+1} = P_k + 2\Delta x - 2\Delta y$$
$$= 1 + 4 - 6$$
$$= 5 - 6$$
$$= -1$$

Here, $P_k < 0$

Iteration 2:- if $[m > 1]$ and $[P_k < 0]$

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

$y_{k+1} = y_k + 1 = 1 + 1 = 2$

$$P_{k+1} = P_k + 2\Delta x$$
$$= -1 + 2 \times 2$$
$$= 3 \geq 0$$

Iteration 3:- if $[m>1]$ and $[P_K \geq 0]$

$x_{K+1} = x_K + 1 = 1+1 = 2$

$y_{K+1} = y_K + 1 = 2+1 = 3$

$P_{K+1} = P_K + 2\Delta x - 2\Delta y$

$= 3 + 2 \times 2 - 2 \times 3$

$= 3 + 4 - 6$

$= 1 \geq 0$

Step 5:- stop the iteration

Iteration	P_K	x_K	y_K	x_{K+1}	y_{K+1}
0	1	0	0	1	1
1	-1	1	1	1	2
2	3	1	2	2	3
3	1	2	3	—	—