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075BCT092

(1)

LAB - 1. Digital Differential Analyzer Algorithm.

THEORY

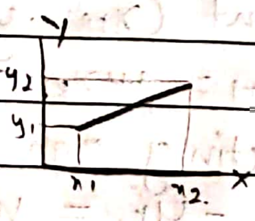
Digital differential analyzer (DDA) algorithm is scan conversion line algorithm based on calculating either Δx or Δy using the relation.

$$\Delta y = m\Delta x \quad , \quad \Delta x = \Delta y/m.$$

we sample the line at unit interval in one co-ordinate and determine corresponding integer values nearest the path for the other co-ordinate.

* left to Right.

1. $|m| < 1$



(a) m is positive.

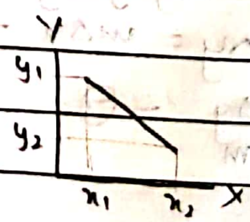
we know,

$$m = \Delta y/\Delta x. \qquad (\Delta x = 1)$$

since, $|m| < 1$. $\rightarrow$ sample at x-axis.

$x_{k+1} = x_k + 1.$ $\qquad$ $x_{k+1} = x_k + \Delta x.$

$\therefore y_{k+1} = y_k + m$ $\qquad$ $y_{k+1} = y_k + \Delta y.$



(b) m is negative.

we know,

$$m = \Delta y/\Delta x.$$

$\Delta x = x_2 - x_1$

$\Delta y = y_2 - y_1$

Since, $|m| < 1$ $\rightarrow$ Sample at x-axis.

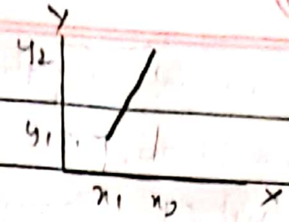
Δy must be negative.

$x_{k+1} = x_k + \Delta x = x_k + 1.$

$y_{k+1} = y_k + \Delta y = y_k - m.$

2. $|m| > 1$.

(a) m is positive.



we know,

$m = \Delta y / \Delta x$. $(\Delta y = 1)$

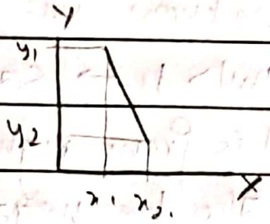
since, $|m| > 1 \rightarrow$ sample at y-axis.

$\therefore m = \frac{\Delta y}{\Delta x} \rightarrow m = \frac{1}{\Delta x} \rightarrow \Delta x = \frac{1}{m}$.

$\therefore x_{k+1} = x_k + 1/m$.

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

(b) m is negative.



we know,

$m = \Delta y / \Delta x$.

Since, $|m| > 1 \rightarrow$ sample at y-axis. $(\Delta y = 1)$

since m is negative, and is left to right, so, Δy must be negative,

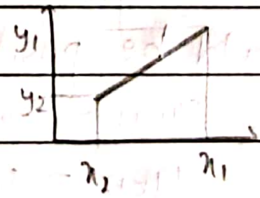
$x_{k+1} = x_k + 1/m$

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

* Right to left.

1. $|m| < 1$.

(a) m is positive.



we know, $m = \Delta y / \Delta x$.

Since, $|m| < 1 \rightarrow$ sample at x-axis.

since, it is from right to left so, Δx is negative.

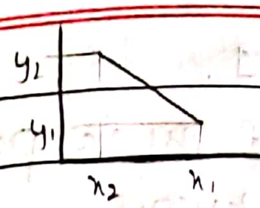
and Δy ~~is~~ should ~~B~~ also be negative as to m is positive.

$\therefore x_{k+1} = x_k - 1$.

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

③

ⓑ m is negative.



we know, $m = \Delta y / \Delta x$

since, $|m| < 1$ → sample at x-axis.

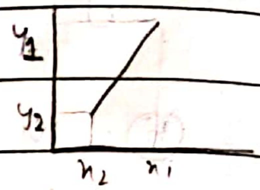
Since, it is from right to left. so, Δx is negative and Δy should be positive as m is negative.

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

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

2. $|m| > 1$.

ⓐ m is positive.



we know, $m = \Delta y / \Delta x$.

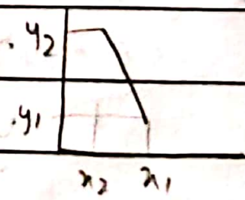
since, $|m| > 1$ → sample at y-axis.

since, it is from right to left, Δx is negative and Δy should also be negative as m is positive. So,

$x_{k+1} = x_k - 1/m$

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

ⓑ m is negative.



we know, $m = \Delta y / \Delta x$.

since, $|m| > 1$ → sample at y-axis.

Since, it is from right to left, Δx is negative and Δy should be positive as m is negative. So,

$x_{k+1} = x_k - 1/m$

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

Algorithm

step 1: Start.

2: Declare $(x_1, y_1), (x_2, y_2)$.

3: find $\Delta x = x_2 - x_1$, $\Delta y = y_2 - y_1$

4: If abs(Δx) > abs(Δy)
then step = abs(Δx)
Else step = abs(Δy).

5. ~~xinc = x_1, yinc = y_1~~

6 ~~plot (xinc~~

5 $xinc = \dfrac{\Delta x}{step}$

$yinc = \dfrac{\Delta y}{step}$

Here, x, y, xinc, yinc has floating point data type.

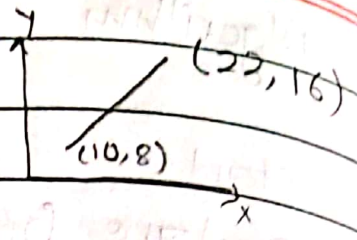
6. $x = x_1$, $y = y_1$

7 plot pixel (x, y).

8. for k = 0 to k = step
x = x + xinc
y = y + yinc.
plot pixel (Round (x), Round (y))
End loop

9 End.

Example:



(10, 8) , (22, 16)

$\Delta x = 12$

$\Delta y = 8$

$m = \Delta y / \Delta x = 8/12 = 0.667$

Here, $|m| < 1$.

and slope is positive.

Sample is at x-axis.

$\Delta x = 1$

$\Delta y = m$

$\therefore x = x + 1$

$y = y + m$

iteration	x	y	Plot(x, y)
0	11	8.667	(11, 9)
1.	12.	9.334	(12, 9)
2	13	10.001	(13, 10)
3	14.	10.668	(14, 11)
4	15	11.335	(15, 11)
5	16	12.002	(16, 12)
6.	17	12.669	(17, 13)
7	18	13.336	(18, 13)
8	19	14.003	(19, 14)
9.	20	14.67	(20, 15)
10	21	15.337	(21, 15)
11	22.	16.004	(22, 16)

6.

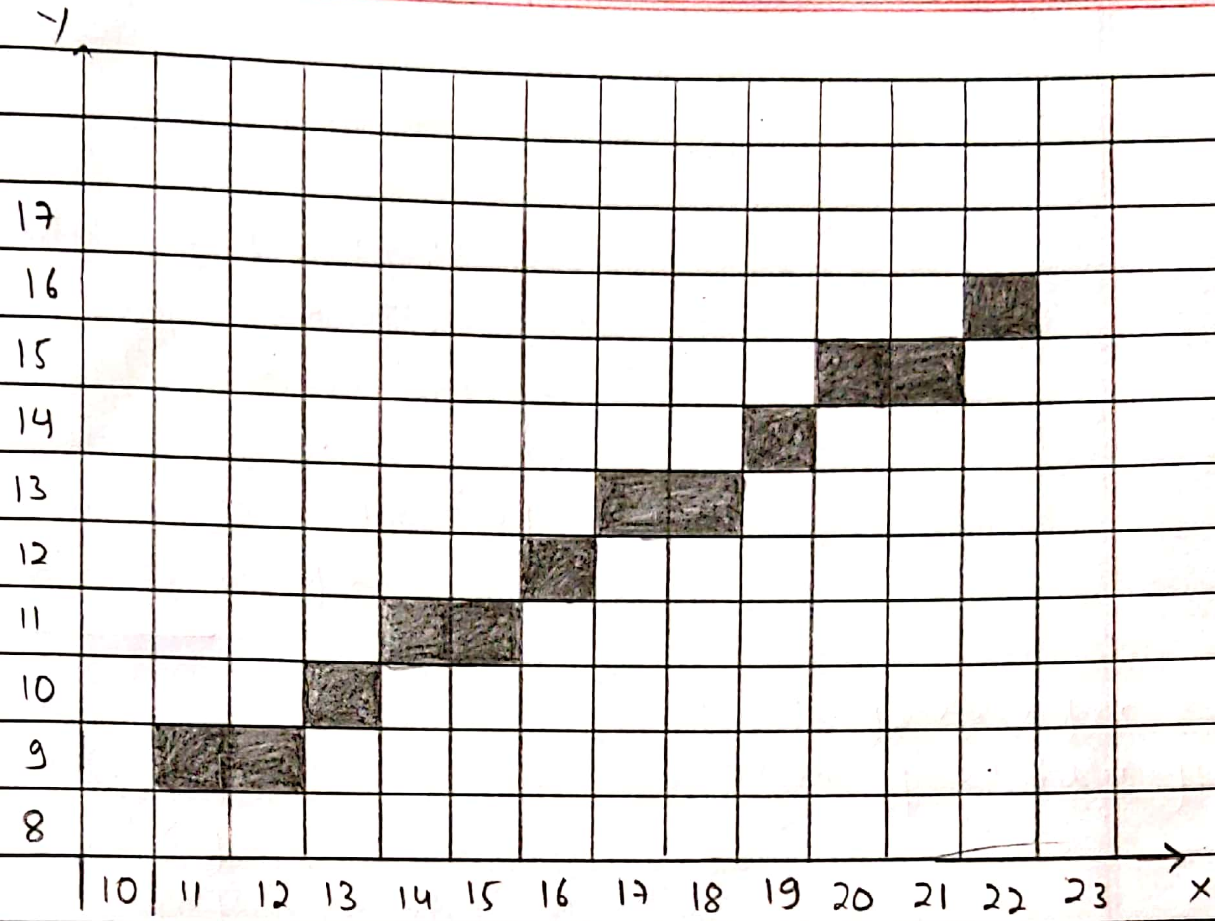


Fig: Graphical plot of pixel.

Discussion and conclusion

DDA algorithm is a faster method for calculating pixel position than $y=mx+c$ directly. It eliminates the multiplication in the equation by making user of raster characteristics. Although it is still computationally intensive due to the use of floating points, it is efficient than other methods.