DDA (Digital Differential Analyzer) Algorithm

↳ The DDA Algorithm is a Line-drawing Algorithm used in computer graphics to rasterize a line between two given points. It is an incremental scan-conversion method that works by calculating intermediate points to form a straight Line.

Algorithm

1. input start point given points (x_1, y_1) and (x_2, y_2)
2. Compute $dx = x_2 - x_1$
   $dy = y_2 - y_1$ & find slope $(m) = \frac{y_2 - y_1}{x_2 - x_1}$
   $= ?$
3. Check

If Abs $\Delta x \geq$ Abs Δy
$|\Delta x| \geq |\Delta y|$
then, $\Delta x = 1$ Assume
step1

$$x_n = x_i + 1$$
$$y_n = y_i + m$$

if $|\Delta x| < |\Delta y|$
then, $\Delta y = 1$ Assume
step2

$$x_n = x_i + \frac{1}{m}$$
$$y_n = y_i + 1$$

4. If there is float value, find Round value of it using Round function and draw the table & Line.
5. Repeat selective step ~~till end~~ until reach the end points (x_2, y_2).

Example Apply DDA Algorithm to find the points for a line (1,1) to (4,3).

⇒ x_1, y_1 and (x_2, y_2)
(1, 1) 4, 3

⇒ $dx(\Delta x) = x_2 - x_1$
$= 4 - 1$
$= 3$

$dy(\Delta y) = y_2 - y_1$
$= 3 - 1$
$= 2$

Now

$\Delta x = 3$
$\Delta y = 2$

find slope $m = \frac{\Delta y}{\Delta x} = \frac{2}{3} = 0.67$

Checks step 1

✓ If $|\Delta x| \geq |\Delta y|$

then

$\Delta x = 1$ Assume

$x_n = x_i + 1$

$y_n = y_i + m$

inthis, $|\Delta x| \geq |\Delta y|$

$3 > 2$

Step 2

If $|\Delta x| < |\Delta y|$

then

$\Delta y = 1$ Assume

$x_n = x_i + \frac{1}{m}$

$y_n = y_i + 1$

Repeat step 1 until reaching end points (4,3)

x_i	y_i	x_n	y_n	Rounds
1	1	2	1.67	(2,2)
2	1.67	3	2.34	(3,2)
3	2.34	4	3.01	(4,3)

Henle, Line drawing points are (1,1), (2,2), (3,2) and (4,3) Ans

Practice Questions

Q.1 find the points for the line from (2,3) to (10,8) using DDA Algorithm.

Q.2 Draw a line using DDA Algorithm between (4,2) & (10,5).

Q.3 find the raster points for a line from (1,1) to (5,4) using DDA Algorithm.

What is Bresenham's line drawing Algorithm?

⇒ Bresenham's line drawing Algorithm is an accurate and efficient line drawing Algorithm.

→ Bresenham's Line drawing Algorithm converts Line only using incremental integer calculations.

Pre Requisites for Bresenham's L.D.A.

Case

The slope of line should be less than 1.

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

Algorithm

1. input two end points and store the left endpoint as (x_0, y_0).
2. plot the first endpoint (x_0, y_0).
3. Calculate 4 constants:
   - Δx
   - Δy
   - $2\Delta y$
   - $2\Delta y - 2\Delta x$
4. Calculate Initial Decision parameter $P_0 = 2\Delta y - \Delta x$
5. At each x, along the line starting with $k=0$, perform the following test:

   If $P_k < 0$ then plot (x_{k+1}, y_k)

find new $P_{k+1} = P_k + 2\Delta y$

(P1) If $P_k < 0$

then plot $\rightarrow (x_{k+1}, y_{k+1})$

find new (P1) $\rightarrow P_{k+1} = P_k + (2\Delta y - 2\Delta x)$

Example

$(19, 38)$ $(28, 45)$.
x_1 y_1 x_2 y_2

$$m = \frac{\Delta y}{\Delta x} = \frac{45-38}{28-19} = \frac{7}{9} = 0.78$$

$m < 1$

Step 2 plot left endpoint as first endpoint

Step 3 Calculate h constants:

$\Delta x = 9$

$\Delta y = 7$

$2\Delta y = 2 \times 7 = 14$

$2\Delta y - 2\Delta x = 14 - 2 \times 9$

$= 14 - 18$

$= -4$

	P_x	x_1	y
		19	38
P_0	5	20	39
P_1	1	21	40
P_2	-3	22	40
P_3	11	23,	41
P_4	7	24	42
P_5	3	25	43
P_6	-1	26	43
P_7	13	27	44
P_8	9	28	45

Step 4: $P_0 = 2\Delta y - \Delta x$

$= 14 - 9$

$= 5$

$P_0 > 0$ then,

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

$= (19+1, 38+1)$ 20, 39

$P_1 = P_0 + (2\Delta y - 2\Delta x)$
$= 5 + (-4)$
$= 1$

$P_1 > 0$
Next point to plot $= (x_{k+1}, y_{k+1})$
$= 21, 40$

$P_2 = P_1 + (2\Delta y - 2\Delta x)$
$= 1 + (-4)$
$= -3$

$P_2 < 0$
then
~~$P_{k+1} = P_k + 2\Delta y$~~
Next point to plot $= (x_{k+1}, y_k)$
$= (21+1, 40)$
$= (22, 40)$

$P_3 = P_2 + 2\Delta y$
$= -3 + 2 \times 7$
$= -3 + 14$
$= 11$

Since $P_3 > 0$
Next point to plot (x_{k+1}, y_{k+1})
$(22+1, 40+1)$
$(23, 41)$

$P_4 = P_3 + (2\Delta y - 2\Delta x)$
$= 11 + (-4)$
$= 7$

Similarly complete this question

Practice Questions

(1). Use Bresenham's Algorithm to draw a line from (2,3) to (10,8).

(2) find the raster points for a line (5,5) to (12,9) using Bresenham's Algorithm.

(3). Implement Bresenham's line Algorithm for the line segment (1,1) to (6,7).