DDA Algorithm-

DDA Algorithm is the simplest line drawing algorithm.

Procedure-

Given-

- Starting coordinates = (X_0, Y_0)
- Ending coordinates = (X_n, Y_n)

The points generation using DDA Algorithm involves the following steps-

Step-01:

Calculate ΔX, ΔY and M from the given input.

These parameters are calculated as-

- $\Delta X = X_n - X_0$
- $\Delta Y = Y_n - Y_0$
- $M = \Delta Y / \Delta X$

Step-02:

Find the number of steps or points in between the starting and ending coordinates.

if (absolute (ΔX) > absolute (ΔY))

Steps = absolute (ΔX);

else

Steps = absolute (ΔY);

Step-03:

Suppose the current point is (X_p, Y_p) and the next point is (X_{p+1}, Y_{p+1}).

Find the next point by following the below three cases-

Case 1: if M<1

X_{p+1} = round off (1 + X_p) Y_{p+1} = round off (M + Y_p)

Case 2: if M>1

X_{p+1} = round off (1/M + X_p) Y_{p+1} = round off (1 + Y_p)

Case 2: if M=1

X_{p+1} = round off (1 + X_p) Y_{p+1} = round off (1 + Y_p)

Step-04:

Keep repeating Step-03 until the end point is reached or the number of generated new points (including the starting and ending points) equals to the steps count.

Advantages of DDA Algorithm-

The advantages of DDA Algorithm are-

- It is a simple algorithm.
- It is easy to implement.
- It avoids using the multiplication operation which is costly in terms of time complexity.

Disadvantages of DDA Algorithm-

The disadvantages of DDA Algorithm are-

- There is an extra overhead of using round off( ) function.
- Using round off( ) function increases time complexity of the algorithm.
- Resulted lines are not smooth because of round off( ) function.
- The points generated by this algorithm are not accurate.

PRACTICE PROBLEMS BASED ON DDA ALGORITHM-

Problem-01:

Calculate the points between the starting point (5, 6) and ending point (8, 12).

Solution-

Given-

- Starting coordinates = $(X_0, Y_0) = (5, 6)$
- Ending coordinates = $(X_n, Y_n) = (8, 12)$

Step-01:

Calculate ΔX, ΔY and M from the given input.

- $\Delta X = X_n – X_0 = 8 – 5 = 3$
- $\Delta Y = Y_n – Y_0 = 12 – 6 = 6$
- $M = \Delta Y / \Delta X = 6 / 3 = 2$

Step-02:

Calculate the number of steps.

As $|\Delta X| < |\Delta Y| = 3 < 6$, so number of steps = $\Delta Y = 6$

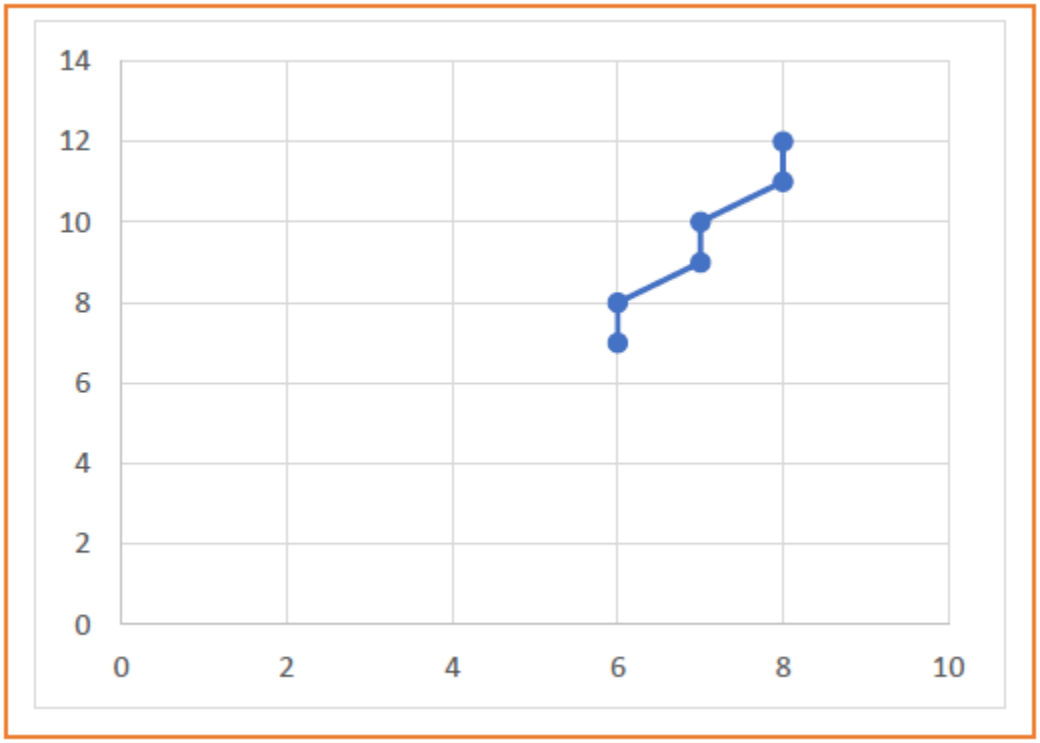
Step-03:

As M > 1, so case-03 is satisfied.

Now, Step-03 is executed until Step-04 is satisfied.

X_p	Y_p	X_{p+1}	Y_{p+1}	**Round off** (X_{p+1}, Y_{p+1})

5	6	5.5	7	(6, 7)
		6	8	(6, 8)
		6.5	9	(7, 9)
		7	10	(7, 10)
		7.5	11	(8, 11)
		8	12	(8, 12)



Problem-02:

Calculate the points between the starting point (5, 6) and ending point (13, 10).

Solution-

Given-

- Starting coordinates = $(X_0, Y_0) = (5, 6)$
- Ending coordinates = $(X_n, Y_n) = (13, 10)$

Step-01:

Calculate ΔX, ΔY and M from the given input.

- $\Delta X = X_n - X_0 = 13 - 5 = 8$
- $\Delta Y = Y_n - Y_0 = 10 - 6 = 4$
- $M = \Delta Y / \Delta X = 4 / 8 = 0.50$

Step-02:

Calculate the number of steps.

As $|\Delta X| > |\Delta Y| = 8 > 4$, so number of steps = $\Delta X = 8$

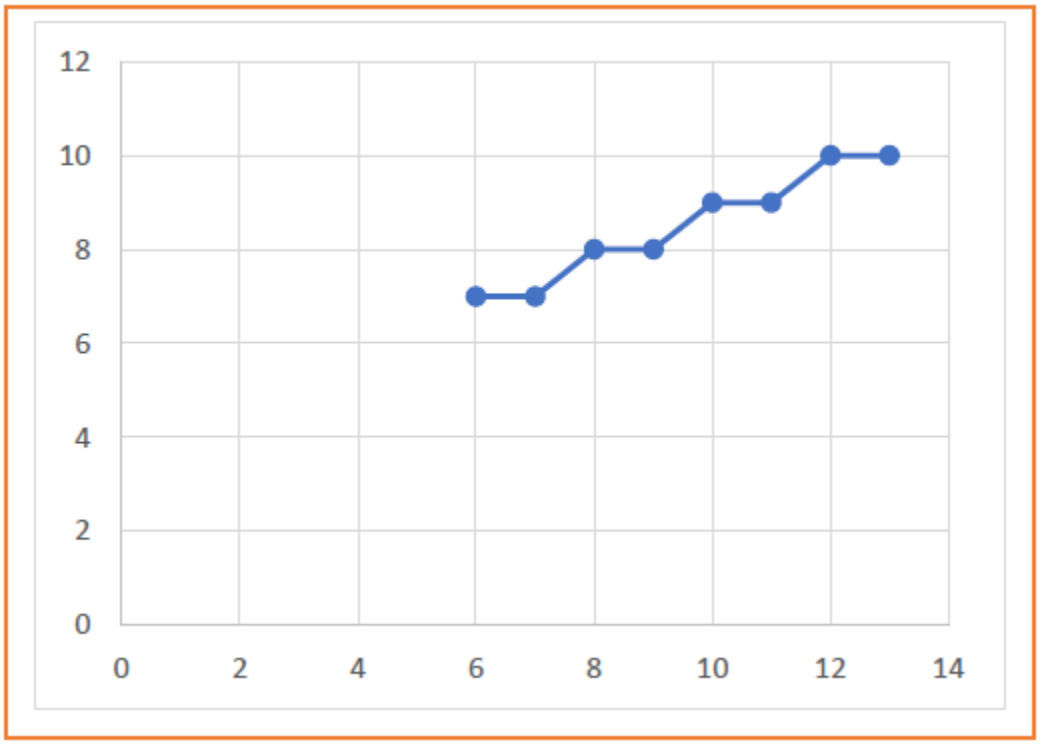
Step-03:

As $M < 1$, so case-01 is satisfied.

Now, Step-03 is executed until Step-04 is satisfied.

X_p	Y_p	X_{p+1}	Y_{p+1}	Round off (X_{p+1}, Y_{p+1})
5	6	6	6.5	(6, 7)

		7	7	(7, 7)
		8	7.5	(8, 8)
		9	8	(9, 8)
		10	8.5	(10, 9)
		11	9	(11, 9)
		12	9.5	(12, 10)
		13	10	(13, 10)



Problem-03:

Calculate the points between the starting point (1, 7) and ending point (11, 17).

Solution-

Given-

- Starting coordinates = $(X_0, Y_0) = (1, 7)$
- Ending coordinates = $(X_n, Y_n) = (11, 17)$

Step-01:

Calculate ΔX, ΔY and M from the given input.

- $\Delta X = X_n – X_0 = 11 – 1 = 10$
- $\Delta Y = Y_n – Y_0 = 17 – 7 = 10$
- $M = \Delta Y / \Delta X = 10 / 10 = 1$

Step-02:

Calculate the number of steps.

As $|\Delta X| = |\Delta Y| = 10 = 10$, so number of steps = $\Delta X = \Delta Y = 10$

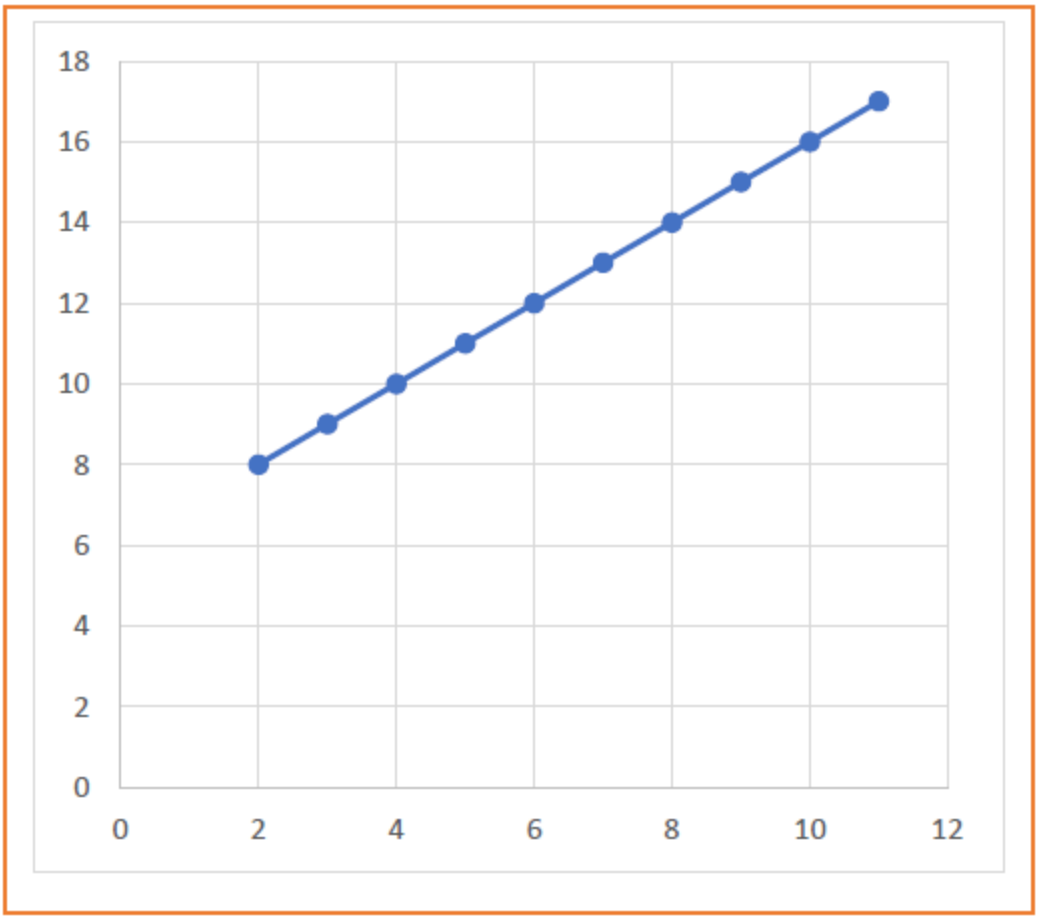
Step-03:

As M = 1, so case-02 is satisfied.

Now, Step-03 is executed until Step-04 is satisfied.

X_p	Y_p	X_{p+1}	Y_{p+1}	**Round off** (X_{p+1}, Y_{p+1})
1	7	2	8	(2, 8)

		3	9	(3, 9)
		4	10	(4, 10)
		5	11	(5, 11)
		6	12	(6, 12)
		7	13	(7, 13)
		8	14	(8, 14)
		9	15	(9, 15)
		10	16	(10, 16)
		11	17	(11, 17)


18
16
14
12
10
8
6
4
2
0
0
2
4
6
8
10
12