Bresenham Line Drawing Algorithm-

Given the starting and ending coordinates of a line,

Bresenham Line Drawing Algorithm attempts to generate the points between the starting and ending coordinates.

Procedure-

Given-

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

The points generation using Bresenham Line Drawing Algorithm involves the following steps-

Step-01:

Calculate ΔX and ΔY from the given input.

These parameters are calculated as-

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

Step-02:

Calculate the decision parameter P_k.

It is calculated as-

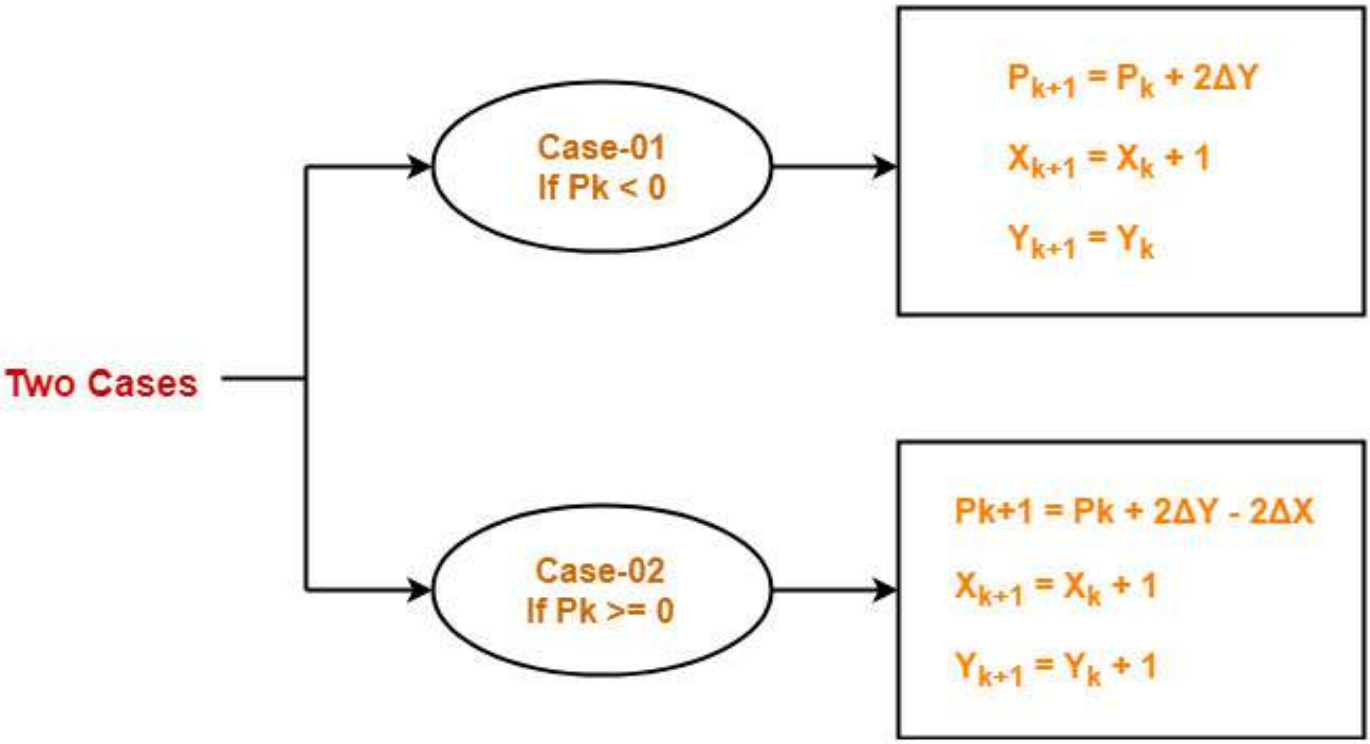
$$P_k = 2\Delta Y - \Delta X$$

Step-03:

Suppose the current point is (X_k, Y_k) and the next point is (X_{k+1}, Y_{k+1}).

Find the next point depending on the value of decision parameter P_k.

Follow the below two cases-



Step-04:

Keep repeating Step-03 until the end point is reached or number of iterations equals to (ΔX-1) times.

PRACTICE PROBLEMS BASED ON BRESENHAM LINE DRAWING ALGORITHM-

Problem-01:

Calculate the points between the starting coordinates (9, 18) and ending coordinates (14, 22).

Solution-

Given-

- Starting coordinates = $(X_0, Y_0) = (9, 18)$
- Ending coordinates = $(X_n, Y_n) = (14, 22)$

Step-01:

Calculate ΔX and ΔY from the given input.

- $\Delta X = X_n - X_0 = 14 - 9 = 5$
- $\Delta Y = Y_n - Y_0 = 22 - 18 = 4$

Step-02:

Calculate the decision parameter.

P_k

$= 2\Delta Y - \Delta X$

$= 2 \times 4 - 5$

$= 3$

So, decision parameter $P_k = 3$

Step-03:

As $P_k >= 0$, so case-02 is satisfied.

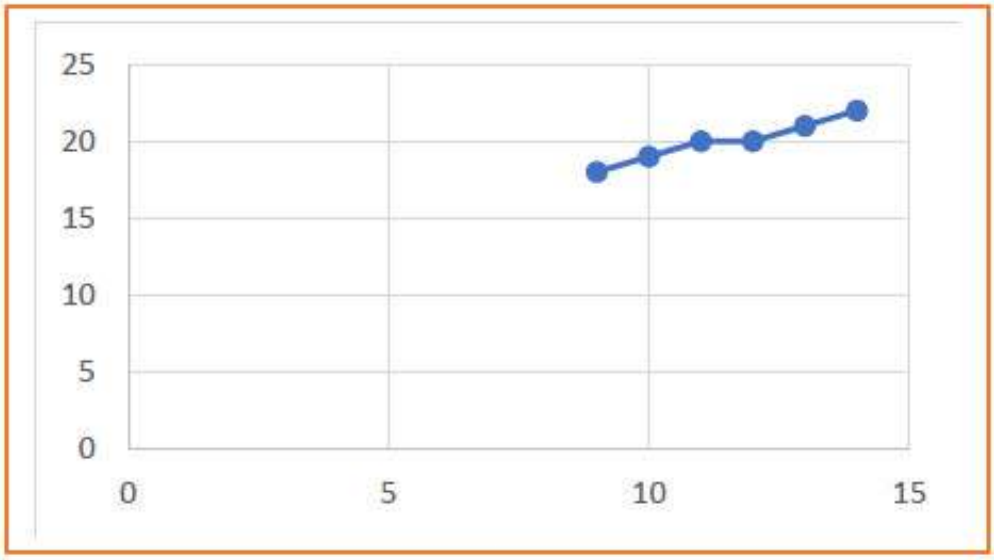
Thus,

- $P_{k+1} = P_k + 2\Delta Y - 2\Delta X = 3 + (2 \times 4) - (2 \times 5) = 1$
- $X_{k+1} = X_k + 1 = 9 + 1 = 10$
- $Y_{k+1} = Y_k + 1 = 18 + 1 = 19$

Similarly, Step-03 is executed until the end point is reached or number of iterations equals to 4 times.

(Number of iterations = $\Delta X - 1 = 5 - 1 = 4$)

P_k	P_{k+1}	X_{k+1}	Y_{k+1}
		9	18
3	1	10	19
1	-1	11	20
-1	7	12	20
7	5	13	21
5	3	14	22



Problem-02:

Calculate the points between the starting coordinates (20, 10) and ending coordinates (30, 18).

Solution-

Given-

- Starting coordinates = $(X_0, Y_0) = (20, 10)$
- Ending coordinates = $(X_n, Y_n) = (30, 18)$

Step-01:

Calculate ΔX and ΔY from the given input.

- $\Delta X = X_n - X_0 = 30 - 20 = 10$
- $\Delta Y = Y_n - Y_0 = 18 - 10 = 8$

Step-02:

Calculate the decision parameter.

P_k

$= 2\Delta Y - \Delta X$

$= 2 \times 8 - 10$

$= 6$

So, decision parameter $P_k = 6$

Step-03:

As $P_k >= 0$, so case-02 is satisfied.

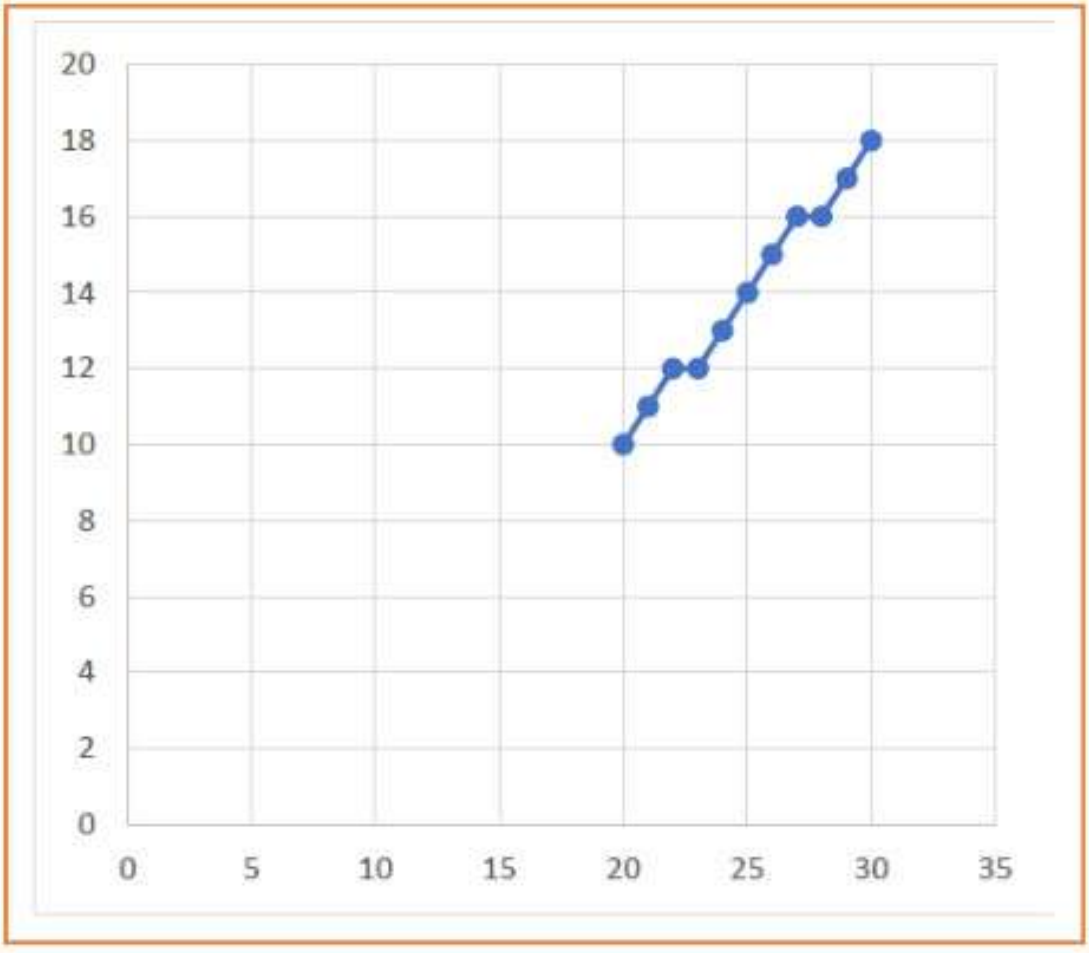
Thus,

- $P_{k+1} = P_k + 2\Delta Y - 2\Delta X = 6 + (2 \times 8) - (2 \times 10) = 2$
- $X_{k+1} = X_k + 1 = 20 + 1 = 21$
- $Y_{k+1} = Y_k + 1 = 10 + 1 = 11$

Similarly, Step-03 is executed until the end point is reached or number of iterations equals to 9 times.

(Number of iterations = $\Delta X - 1 = 10 - 1 = 9$)

P_k	P_{k+1}	X_{k+1}	Y_{k+1}
		20	10
6	2	21	11
2	-2	22	12
-2	14	23	12
14	10	24	13
10	6	25	14
6	2	26	15
2	-2	27	16
-2	14	28	16
14	10	29	17
10	6	30	18



Advantages of Bresenham Line Drawing Algorithm-

The advantages of Bresenham Line Drawing Algorithm are-

- It is easy to implement.
- It is fast and incremental.
- It executes fast but less faster than DDA Algorithm.
- The points generated by this algorithm are more accurate than DDA Algorithm.
- It uses fixed points only.

Disadvantages of Bresenham Line Drawing Algorithm-

The disadvantages of Bresenham Line Drawing Algorithm are-

- Though it improves the accuracy of generated points but still the resulted line is not smooth.
- This algorithm is for the basic line drawing.
- It can not handle diminishing jaggies.

To gain better understanding about Bresenham Line Drawing Algorithm,