Bresenham’s mid-point line drawing algorithm (Generalized version):

A generalized version of the Bresenham’s mid-point line drawing algorithm will work for any straight line (its starting and ending points can be in any octant).

Pseudocode:

```
Procedure Bresenham_line ($x_S$, $y_S$, $x_E$, $y_E$) //Starting and ending points of line are passed as arguments
Begin
    x = $x_{S,}$ y = $y_S$ // Initialization of starting point
    dx = Abs($x_E$ – $x_S$), dy = Abs($y_E$ – $y_S$)
    s1=Sign($x_E$ – $x_{S)}$, s2=Sign($y_E$ – $y_{S)}$

    If(dy>dx)
        Temp=dx
        dx=dy
        dy=Temp
        Swap=1
    Else
        Swap=0
    EndIf

    d = 2dy – dx // Initialization of decision variable d
    Steps=1
    SetPixel(x ,y)

    While(Steps≤dx)
    Begin
        If(d>0)
            x=x+s1
            y=y+s2
            d=d+2(dy-dx)
        Else
            If(Swap=1)
                y=y+s2
            Else
                x=x+s1
            EndIf
            d=d+2dy
        EndIf
        SetPixel(x ,y)
        Steps=Steps+1
    EndWhile
End
```

Functions used:

SetPixel(x, y) is used to plot the corresponding pixel defined by co-ordinate (x, y) on the screen.

Abs(k) returns absolute value of its argument k.

Sign() returns -1, 0, 1 as its argument (say, k) <0, =0 or >0 i.e. Sign(k)=k/Abs(k).

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Q. Find plotted pixels or plotted points of straight line P (4, 2), Q(6, 14) using Bresenham's mid-point line drawing algorithm.

Answer:

dx =2 , dy =12

s1=Sign(6-4)=Sign(2)=1, s1=Sign(14-2)=Sign(12)=1

d = -8

As, dy>dx, so swap them. Hence, dx=12, dy=2

Steps=1

Initialize, x =4, y = 2

Now 1st point (4, 2) is plotted

Next points will be:

Steps	**d**	**x**	**y**	**Plotted point**
1	-4	4	3	(4,3)
2	0	4	4	(4,4)
3	4	4	5	(4,5)
4	-16	5	6	(5,6)
5	-12	5	7	(5,7)
6	-8	5	8	(5,8)
7	-4	5	9	(5,9)
8	0	5	10	(5,10)
9	4	5	11	(5,11)
10	-16	6	12	(6,12)
11	-12	6	13	(6,13)
12	-8	6	14	(6,14)

Hence, the plotted points / pixels are: (4,3), (4,4), (4,5), (5,6), (5,7), (5,8), (5,9), (5,10), (5,11), (6,12), (6,13), (6,14).

HW. Find plotted pixels or plotted points of straight line P (4, -6), Q(2, 1) using Bresenham's mid-point line drawing algorithm.

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