1-3 : Bresenham's algorithm

Bresenham algorithm seeks to select the optimum raster locations to represent a straight line. To accomplish this the algorithm always increment by one unit in either X or Y depending on the slop of the line. The slop of the line represent the error between the location of the real line and the location of the drawn line.

The algorithm is cleverly constructed so that only the sign of this error need be examined.

Bresenham algorithm for the first octant : $\{ 0 \leq \Delta Y \leq \Delta X \}$

```
Start

 X=X1
 Y=Y1

 DX=X2-X1
 DY=Y2-Y1

 E= (DY / DX) – 0.5

 For I=1 to DX
 Begin
      Plot (X,Y)
      While (E ≥ 0 )
                   Y=Y+1
                   E=E-1
      End While
      X=X+1
      E=E + ( DY / DX )
 End

 Finish
```

Example 3 : Consider the line from (0,0) to (5,5)
Rasterize the line with Bresenham algorithm

Sol 3 : X=0 ; Y=0 ; DX=5 ; DY=5 ; E=0.5

I	Plot	E	X	Y
		0.5	0	0
1	(0,0)	-0.5	0	1
		0.5	1	1
2	(1,1)	-0.5	1	2
		0.5	2	2
3	(2,2)	-0.5	2	3
		0.5	3	3
4	(3,3)	-0.5	3	4
		0.5	4	4
5	(4,4)	-0.5	4	5
		0.5	5	5

1-4 : Integer Bresenham algorithm

Bresenham algorithm requires the use of floating point arithmetic and division to calculate the slop of the line and to evaluate the error term. The speed of the algorithm can be increased by using integer arithmetic and eliminating the division.

Since only the sign of the error term is important, the simple transformation

$$\bar{E} = E * 2 * \Delta X$$

of the error term in the previous algorithm yields an integer algorithm. This allows the algorithm to be efficiently implemented in hardware.

So : $E=\{ (DY / DX) – 0.5 \} * 2 \Delta X \Rightarrow E= 2 \Delta Y - \Delta X$

$E= \{ E-1 \} * 2 \Delta X \Rightarrow E= E - 2 \Delta X$

$E= \{ E + (DY / DX) \} * 2 \Delta X \Rightarrow E = E+ 2 \Delta Y$

Bresenham's integer algorithm for the first octant $\{ 0 \leq \Delta Y \leq \Delta X \}$
i.e. slop between zero and one

```
 Start

X=X1
Y=Y1

dX=X2-X1
dY=Y2-Y1

E= 2 ΔY - ΔX

For I=1 to dX
Begin
    Plot (X,Y)

    While (E ≥ 0 )
    Begin
        Y=Y+1
        E= E - 2 ΔX
    End While

    X=X+1
    E = E+ 2 ΔY

Next I

 Finish
```