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Bresenham's LINE ALGORITHM :

Eqn of the line is $y = mx + b$

for a given x y could be a fraction. But fractions cannot be plotted on the display unit.

Now for $0 < m < 1$

$$x_{k+1} = x_k + 1$$

But $y_{k+1} = y_k$ or $y_k + 1$

depending on d_1 and d_2

let actual y @ x_{k+1} be

$$y = m(x_k + 1) + b$$

$$\therefore d_1 = y - y_k$$

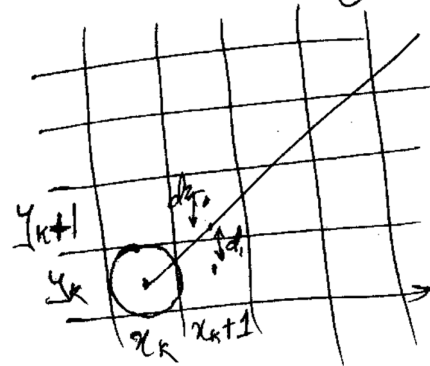
$$= m(x_k + 1) - y_k$$

$$\& d_2 = (y_k + 1) - y$$

$$= y_k + 1 - m(x_k + 1) - b$$

Difference

$$d_1 - d_2 = 2m(x_k + 1) - 2y_k + 2b - 1$$



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$$d_1 - d_2 = \frac{2\Delta y}{\Delta x} (x_k + 1) - 2y_k + 2b - 1$$

$$\therefore \Delta x (d_1 - d_2) = 2\Delta y x_k - 2\Delta x y_k + c \quad \text{--- (1)}$$

where $c = 2\Delta y + \Delta x(2b - 1)$

Let $P_k = \Delta x (d_1 - d_2)$ --- (2)

Sign of P_k is same as sign of $(d_1 - d_2)$
 [∴ we are now dealing with the Δx]

- If $d_1 - d_2 < 0$ or $P_k < 0$ the next pixel will be at (x_{k+1}, y_k) --- (3)
- If $d_1 - d_2 > 0$ or $P_k > 0$ the pixel will be at (x_{k+1}, y_{k+1})

To make calculations faster we develop an iterative method. (from (1) & (2))

$$P_{k+1} = 2\Delta y x_{k+1} - 2\Delta x y_{k+1} + c$$

$$\therefore P_{k+1} - P_k = 2\Delta y (x_{k+1} - x_k) - 2\Delta x (y_{k+1} - y_k)$$

But $x_{k+1} = x_k + 1$

$$\therefore P_{k+1} = P_k + 2\Delta y - 2\Delta x (y_{k+1} - y_k)$$

either 0 or 1 depends on P_k . (3)

$$P_0 = 2\Delta y - \Delta x$$

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For $n > 1$ same procedure can be done by interchanging the roles of x & y . i.e. $\Delta y = 1$ & $x_{k+1} = x_k$ or x_{k+1} based on the distances. For -ve slopes the procedure is similar, except that one coordinate decreases as the other increases.

NOTE: Special cases have to be dealt separately
i.e. $\Delta x = 0, |\Delta x| = |\Delta y|, \Delta y = 0$.

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/* Bresenhams Line Drawing Algorithm */

```
#include <graphics.h>
#include <stdio.h>
#include <math.h>
#include <conio.h>

void bshmline(int x1,int y1,int x2,int y2)
{
    int x=x1,y=y1,dx,dy,s1,s2;
    int length,i,dp,temp,swap=0;

    putpixel(x1,y1,WHITE);
    dx=abs(x2-x1);
    dy=abs(y2-y1);

    if(x2<x1) s1=-1;
    else if(x2>x1) s1=1;
    else s1=0;

    if(y2<y1) s2=-1;
    else if(y2>y1) s2=1;
    else s2=0;

    dp=2*dy-dx;

    if(dy>dx)
    {
        temp=dx;
        dx=dy;
        dy=temp;
        swap=1;
    }
}
```



```

for(i=1;k=dx;i++)
{
    if(dp<0)
    {
        if(swap) putpixel(x,y=y+s2,WHITE);
        else putpixel(x=x+s1,y,WHITE);
        dp+=2*dy;
    }
    else
    {
        putpixel(x=x+s1,y=y+s2,WHITE);
        dp=dp+2*dy-2*dx;
    }
}

void main()
{
    int x1,y1,x2,y2;
    int gdriver = VGA, gmode=VGAHI;
    initgraph(&gdriver, &gmode, "\\tc\\bgi");

    printf("Enter the starting co-ordinates: ");
    scanf("%d %d",&x1,&y1);
    printf("Enter the ending co-ordinates: ");
    scanf("%d %d",&x2,&y2);

    bshmline(x1,y1,x2,y2);
    getch();
    closegraph();
}

```

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