

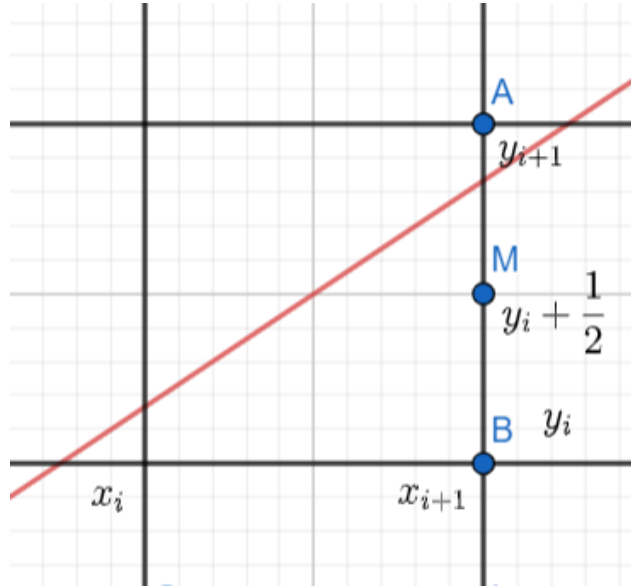
MID-POINT LINE GENERATION ALGORITHM

LÊ BÌNH DƯƠNG

E16CN – B16DCCN103

Segment: D(X1, Y1), D'(X2, Y2), c - Color

(provided that X1 < X2)



$$f(x, y) = ax + by + c; \quad dx = x_2 - x_1, \quad dy = y_2 - y_1$$

$$y = \frac{dy}{dx}x + B \leftrightarrow f(x, y) = 0 \leftrightarrow x \cdot dy - y \cdot dx + B \cdot dx = 0$$

$$\rightarrow a = dy, \quad b = -dx, \quad c = B \cdot dx$$

Ta có: $f(x, y) = 0 \forall (x, y)$ thuộc đường thẳng

$$\rightarrow d_i = f\left(x_i + 1, y_i + \frac{1}{2}\right) = a(x_i + 1) + b\left(y_i + \frac{1}{2}\right) + c$$

$$d \leq 0 \rightarrow y_{i+1} = y_i \rightarrow d_{i+1} = f\left(x_i + 2, y_i + \frac{1}{2}\right) = a(x_i + 2) + b\left(y_i + \frac{1}{2}\right) + c$$

$$d_{i+1} - d_i = a \rightarrow d_{i+1} = d_i + a = d_i + dy$$

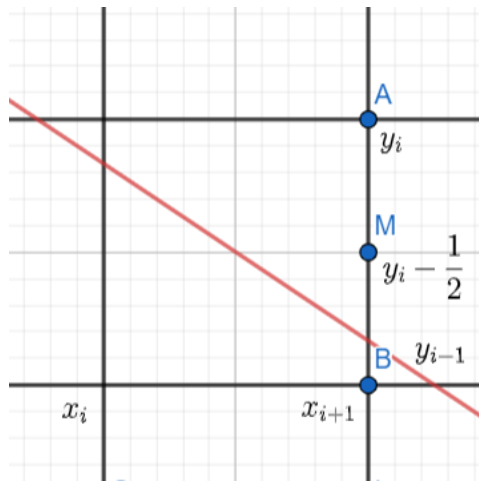
$$d > 0 \rightarrow y_{i+1} = y_i + 1 \rightarrow d_{i+1} = f\left(x_i + 2, y_i + \frac{3}{2}\right) = a(x_i + 2) + b\left(y_i + \frac{3}{2}\right) + c$$

$$d_{i+1} - d_i = a + b \rightarrow d_{i+1} = d_i + a + b = d_i + dy - dx$$

$$d_1 = f\left(x_1 + 1, y_1 + \frac{1}{2}\right) = a(x_1 + 1) + b\left(y_1 + \frac{1}{2}\right) + c = f(x_1, y_1) + a + \frac{b}{2} = a + \frac{b}{2} = dy - \frac{dx}{2}$$

$0 < K < 1$

```
void midPoint(int X1, int Y1, int X2, int Y2, int c)
{
    int dx = X2 - X1;
    int dy = Y2 - Y1;
    int d = dy - (dx/2);
    int y = Y1;
    for(int x = X1; x<=X2; x++)
    {
        putpixel(x, y, c);
        if (d<=0)
            d += dy;
        else
        {
            d += (dy - dx);
            y++;
        }
    }
}
```



$$f(x, y) = ax + by + c; \quad dx = x_2 - x_1, \quad dy = y_2 - y_1$$

$$y = \frac{dy}{dx}x + B \leftrightarrow f(x, y) = 0 \leftrightarrow x \cdot dy - y \cdot dx + B \cdot dx = 0$$

$$\rightarrow a = dy, \quad b = -dx, \quad c = B \cdot dx$$

Ta có: $f(x, y) = 0 \forall (x, y)$ thuộc đường thẳng

$$\rightarrow d_i = f\left(x_i + 1, y_i - \frac{1}{2}\right) = a(x_i + 1) + b\left(y_i - \frac{1}{2}\right) + c$$

$$d \leq 0 \rightarrow y_{i+1} = y_i - 1 \rightarrow d_{i+1} = f\left(x_i + 2, y_i - \frac{3}{2}\right) = a(x_i + 2) + b\left(y_i - \frac{3}{2}\right) + c$$

$$d_{i+1} - d_i = a - b \rightarrow d_{i+1} = d_i + a - b = d_i + dy + dx$$

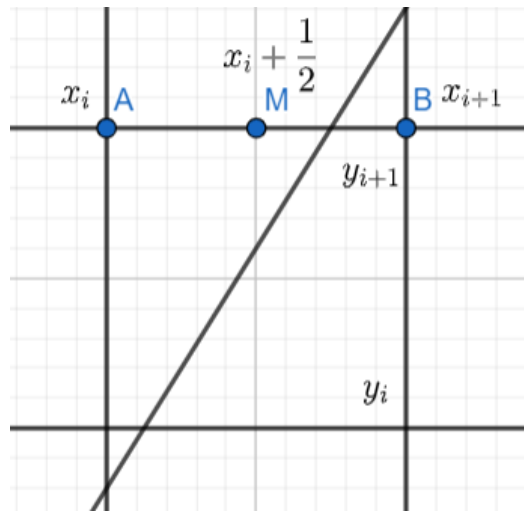
$$d > 0 \rightarrow y_{i+1} = y_i \rightarrow d_{i+1} = f\left(x_i + 2, y_i - \frac{1}{2}\right) = a(x_i + 2) + b\left(y_i - \frac{1}{2}\right) + c$$

$$d_{i+1} - d_i = a \rightarrow d_{i+1} = d_i + a = d_i + dy$$

$$d_1 = f\left(x_1 + 1, y_1 - \frac{1}{2}\right) = a(x_1 + 1) + b\left(y_1 - \frac{1}{2}\right) + c = f(x_1, y_1) + a - \frac{b}{2} = a - \frac{b}{2} = dy + \frac{dx}{2}$$

$$-1 < K < 0$$

```
void midPoint(int X1, int Y1, int X2, int Y2, int c)
{
    int dx = X2 - X1;
    int dy = Y2 - Y1;
    int d = dy + (dx/2);
    int y = Y1;
    for(int x = X1; x<=X2; x++)
    {
        putpixel(x, y, c);
        if (d<=0)
        {
            d += (dy + dx);
            y--;
        }
        else
            d += dy;
    }
}
```



$$f(x, y) = ax + by + c; \quad dx = x_2 - x_1, \quad dy = y_2 - y_1$$

$$y = \frac{dy}{dx}x + B \Leftrightarrow f(x, y) = 0 \Leftrightarrow x \cdot dy - y \cdot dx + B \cdot dx = 0$$

$$\rightarrow a = dy, \quad b = -dx, \quad c = B \cdot dx$$

Ta có: $f(x, y) = 0 \forall (x, y)$ thuộc đường thẳng

$$\rightarrow d_i = f\left(x_i + \frac{1}{2}, y_i + 1\right) = a\left(x_i + \frac{1}{2}\right) + b(y_i + 1) + c$$

$$d \leq 0 \rightarrow x_{i+1} = x_i + 1 \rightarrow d_{i+1} = f\left(x_i + \frac{3}{2}, y_i + 2\right) = a\left(x_i + \frac{3}{2}\right) + b(y_i + 2) + c$$

$$d_{i+1} - d_i = a + b \rightarrow d_{i+1} = d_i + a + b = d_i + dy - dx$$

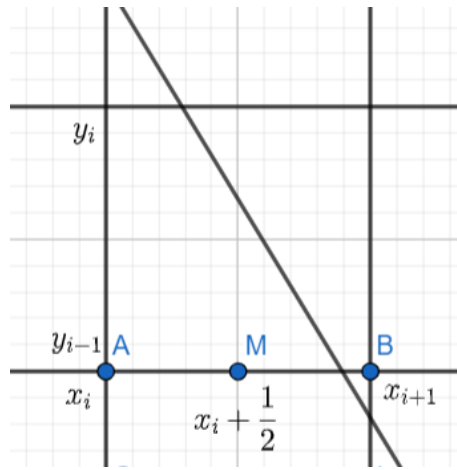
$$d > 0 \rightarrow x_{i+1} = x_i \rightarrow d_{i+1} = f\left(x_i + \frac{1}{2}, y_i + 1\right) = a\left(x_i + \frac{1}{2}\right) + b(y_i + 1) + c$$

$$d_{i+1} - d_i = b \rightarrow d_{i+1} = d_i + b = d_i - dx$$

$$d_1 = f\left(x_1 + \frac{1}{2}, y_1 + 1\right) = a\left(x_1 + \frac{1}{2}\right) + b(y_1 + 1) + c = f(x_1, y_1) + \frac{a}{2} + b = \frac{a}{2} + b = \frac{dy}{2} - dx$$

K > 1

```
void midPoint(int X1, int Y1, int X2, int Y2, int c)
{
    int dx = X2 - X1;
    int dy = Y2 - Y1;
    int d = (dy/2) - dx;
    int x = X1;
    for(int y = Y1; y <= Y2; y++)
    {
        putpixel(x, y, c);
        if (d <= 0)
        {
            d += (dy - dx);
            x++;
        }
        else
            d -= dx;
    }
}
```



$$f(x, y) = ax + by + c; \quad dx = x_2 - x_1, \quad dy = y_2 - y_1$$

$$y = \frac{dy}{dx}x + B \leftrightarrow f(x, y) = 0 \leftrightarrow x \cdot dy - y \cdot dx + B \cdot dx = 0$$

$$\rightarrow a = dy, \quad b = -dx, \quad c = B \cdot dx$$

Ta có: $f(x, y) = 0 \forall (x, y)$ thuộc đường thẳng

$$\rightarrow d_i = f\left(x_i + \frac{1}{2}, y_i - 1\right) = a\left(x_i + \frac{1}{2}\right) + b(y_i - 1) + c$$

$$d \leq 0 \rightarrow x_{i+1} = x_i \rightarrow d_{i+1} = f\left(x_i + \frac{1}{2}, y_i - 2\right) = a\left(x_i + \frac{1}{2}\right) + b(y_i - 2) + c$$

$$d_{i+1} - d_i = -b \rightarrow d_{i+1} = d_i - b = d_i + dx$$

$$d > 0 \rightarrow x_{i+1} = x_i + 1 \rightarrow d_{i+1} = f\left(x_i + \frac{3}{2}, y_i - 2\right) = a\left(x_i + \frac{3}{2}\right) + b(y_i - 2) + c$$

$$d_{i+1} - d_i = a - b \rightarrow d_{i+1} = d_i + a - b = d_i + dy + dx$$

$$d_1 = f\left(x_1 + \frac{1}{2}, y_1 - 1\right) = a\left(x_1 + \frac{1}{2}\right) + b(y_1 - 1) + c = f(x_1, y_1) + \frac{a}{2} - b = \frac{a}{2} - b = \frac{dy}{2} + dx$$

K > -1

```
void midPoint(int X1, int Y1, int X2, int Y2, int c)
{
    int dx = X2 - X1;
    int dy = Y2 - Y1;
    int d = (dy/2) + dx;
    int x = X1;
    for(int y = Y1; y >= Y2; y--)
    {
        putpixel(x, y, c);
        if (d <= 0)
            d += dx;
        else
        {
            d = d + dy + dx;
            x++;
        }
    }
}
```