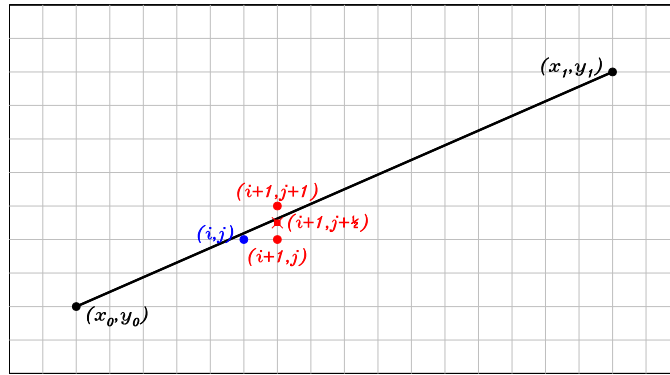


# Scan Conversion with Bresenham Algorithm

CSCI 4229/5229 Summer 2021



Let  $\delta x = x_1 - x_0$  and  $\delta y = y_1 - y_0$ , so that

$$y = \frac{\delta y}{\delta x}x + c, \quad c = y_0 - \frac{\delta y}{\delta x}x_0.$$

Multiply by  $2\delta x$ :

$$2y\delta x = 2x\delta y + 2c\delta x$$

Let  $K = 2c\delta x$  and define

$$F(x, y) = 2x\delta y - 2y\delta x + K$$

When  $F(x, y) = 0$  then  $(x, y)$  is on the line.

When  $F(x, y) > 0$  then  $(x, y)$  is below the line.

When  $F(x, y) < 0$  then  $(x, y)$  is above the line.

$$F(i, j) = 2i\delta y - 2j\delta x + K$$

$$\begin{aligned} F(i+1, j) &= 2(i+1)\delta y - 2j\delta x + K \\ &= 2i\delta y - 2j\delta x + K + 2\delta y \\ &= F(i, j) + 2\delta y \end{aligned}$$

$$\begin{aligned} F(i+1, j + \tfrac{1}{2}) &= 2(i+1)\delta y - 2(j + \tfrac{1}{2})\delta x + K \\ &= 2i\delta y - 2j\delta x + K + 2\delta y - \delta x \\ &= F(i, j) + 2\delta y - \delta x \end{aligned}$$

$$\begin{aligned} F(i+1, j+1) &= 2(i+1)\delta y - 2(j+1)\delta x + K \\ &= 2i\delta y - 2j\delta x + K + 2\delta y - 2\delta x \\ &= F(i, j) + 2\delta y - 2\delta x \end{aligned}$$

Start with  $F(x_0, y_0) = 0$

Evaluate  $F(i+1, j + \tfrac{1}{2}) = F(i, j) + 2\delta y - \delta x$ .

If  $F(i+1, j + \tfrac{1}{2}) > 0$ , the midpoint is below the line, so the next pixel is  $(i+1, j+1)$ , and  $F(i+1, j+1) = F(i, j) + 2\delta y - 2\delta x$ .

Otherwise the midpoint is above the line, so the next pixel is  $(i+1, j)$ , and  $F(i+1, j) = F(i, j) + 2\delta y$ .