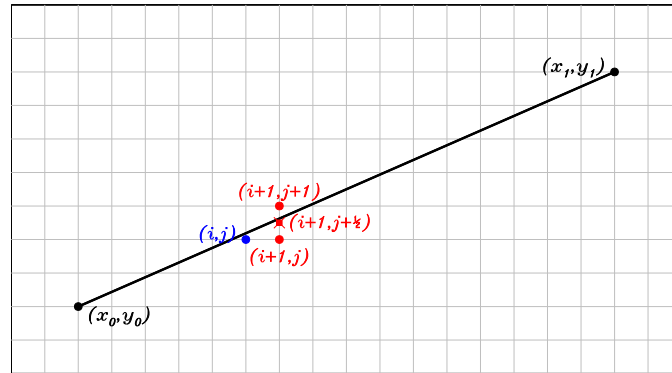


Scan Conversion with Bresenham Algorithm

CSCI 4229/5229 Fall 2022



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 $F(i+1, j) = F(i, j) + 2\delta y$.