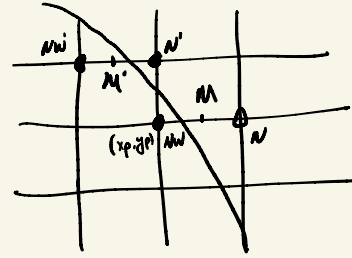


2) if NW is chosen ( $D_{old} \geq 0$ )



$$\begin{aligned} M &: (x_p + \frac{1}{2}, y_p) \\ M' &: (x_p - \frac{1}{2}, y_p + 1) \\ D_{old} &= (x_p + \frac{1}{2})^2 + y_p^2 - r^2 \\ &= x_p^2 - x_p + \frac{1}{4} + y_p^2 - r^2 \end{aligned}$$

$$\begin{aligned} D_{new} &= (x_p - \frac{1}{2})^2 + (y_p + 1)^2 - r^2 \\ &= x_p^2 - x_p + \frac{1}{4} + y_p^2 + 2y_p + 1 - r^2 \\ &= (x_p^2 - x_p + \frac{1}{4} + y_p^2 - r^2) + 2y_p + 1 \\ D_{new} &= D_{old} + 2y_p + 1 \text{ if } D_{old} \geq 0 \end{aligned}$$

(2V) Summary

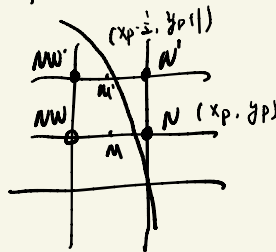
$$D_{start} = \frac{5}{4} - r$$

$$D_{new} = D_{old} + \begin{cases} 2y_p + 1 & (D_{old} < 0) \\ -2x_p + 2y_p + 1 & (D_{old} \geq 0) \end{cases}$$

$$\begin{aligned} \text{def: } \Delta y &= y_2 - y_1 > 0 \\ \Delta x &= x_2 - x_1 < 0 \\ (\text{Zurdegers}) \end{aligned}$$

(IV)

1) if N is chosen ( $D_{old} < 0$ )



$$\begin{aligned} D_{old} &= F(M) = (x_p - \frac{1}{2})^2 + y_p^2 - r^2 \\ &= x_p^2 - x_p + \frac{1}{4} + y_p^2 - r^2 \end{aligned}$$

$$\begin{aligned} D_{new} &= (x_p - \frac{1}{2})^2 + (y_p + 1)^2 - r^2 \\ &= x_p^2 - x_p + \frac{1}{4} + y_p^2 + 2y_p + 1 - r^2 \\ &= (x_p^2 - x_p + \frac{1}{4} + y_p^2 - r^2) + (2y_p + 1) \\ D_{new} &= D_{old} + 2y_p + 1 \text{ if } D_{old} < 0 \end{aligned}$$

$$\begin{aligned} (2) \quad M &= (x_p - \frac{1}{2}, y_p + 1) \\ D &= F(M) = (x_p - \frac{1}{2})^2 + (y_p + 1)^2 - r^2 \end{aligned}$$

$D < 0$  choose N

$D \geq 0$  choose NW

(V) compute D\_start

$$M: (x_1 - \frac{1}{2}, y_1 + 1)$$

$$\begin{aligned} D_{start} &= (x_1 - \frac{1}{2})^2 + (y_1 + 1)^2 - r^2 \\ &= x_1^2 - x_1 + \frac{1}{4} + y_1^2 + 2y_1 + 1 - r^2 \\ &= (x_1^2 + y_1^2 - r^2) + 2y_1 - x_1 + \frac{5}{4} \end{aligned}$$



$$\begin{aligned} &= 2y_1 - x_1 + \frac{5}{4} \\ &= \frac{5}{4} - r \\ \text{if } r=1, D_{start} &> 0 \\ \text{else if } r \geq 2, D_{start} &< 0 \end{aligned}$$