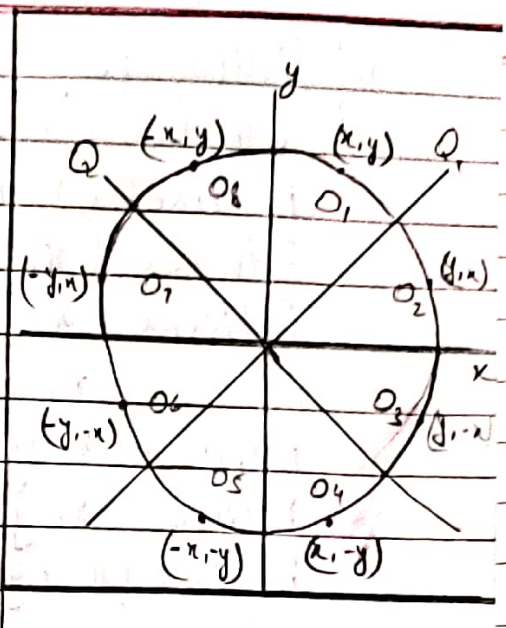
(6) Equation of Circle at centre

$$x^2 + y^2 = r^2$$

$$x^2 + y^2 - r^2 = 0$$

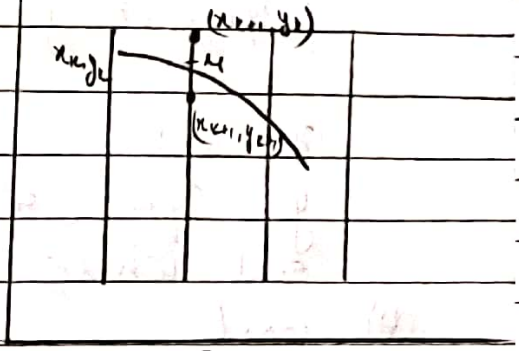
$$\Rightarrow \begin{cases} 0, & \text{Point lies on circle} \\ <0, & \text{lies inside circle} \\ >0, & \text{lies outside circle} \end{cases}$$



Now, Midpoint is

$$\left(\frac{x_{k+1} + x_{k+1}}{2}, \frac{y_k + y_{k-1}}{2}\right)$$

$$(x_m, y_m) = (x_{k+1}, y_k - 1/2)$$



Decision Parameter

$$p_k = (x_{k+1})^2 + (y_k - 1/2)^2 - r^2$$

$$p_{k+1} = (x_{k+1+1})^2 + (y_{k+1} - 1/2)^2 - r^2$$

$$p_{k+1} - p_k = (x_{k+1})^2 - (x_{k+1})^2 + (y_{k+1} - 1/2)^2 - (y_k - 1/2)^2$$

$$p_{k+1} = p_k + 2x_k + 3 + y_{k+1}^2 - y_k^2 - y_{k+1} + y_k$$

If $p_k < 0$, then $y_{k+1} = y_k$

$$p_{k+1} = p_k + 2x_k + 3$$

Else, $y_{k+1} = y_k - 1$

$$p_{k+1} = p_k + 2x_k - 2y_k + 5$$

Now, at starting point ($x_k = 0$ & $y_k = r$)

$$p_0 = (0+1)^2 + (r - 1/2)^2 - r^2$$

$$\boxed{p_0 = \frac{5}{4} - r}$$

Algorithm :-

i) Input centre (x_c, y_c) and radius r of circle.

ii) Initialize $y = r$, $x = 0$

iii) while ($x \leq y$) do

putPixel ($x_c + x$, $y_c + y$)

putPixel ($x_c - x$, $y_c + y$)

putPixel ($x_c + x$, $y_c - y$)

putPixel ($x_c - x$, $y_c - y$)

putPixel ($x_c + y$, $y_c + x$)

putPixel ($x_c - y$, $y_c + x$)

putPixel ($x_c + y$, $y_c - x$)

putPixel ($x_c - y$, $y_c - x$)

$x = x + 1$

$y = sqrt(r^2 - x^2)$

end while

iv) Exit