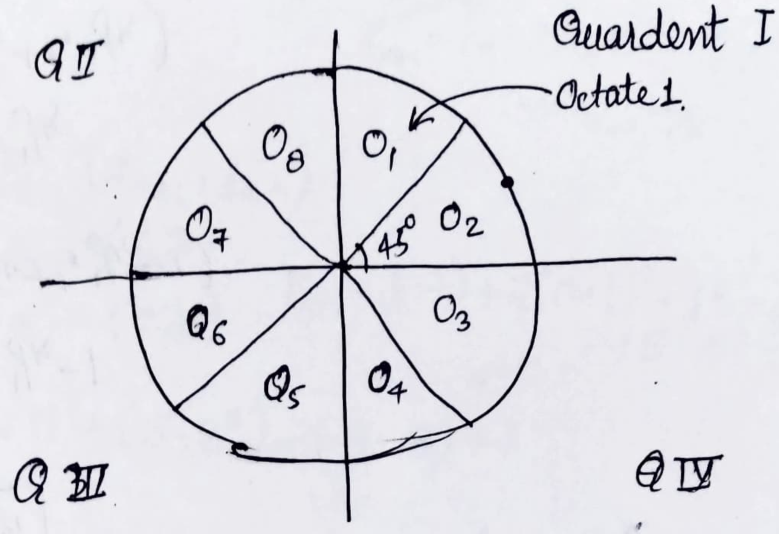
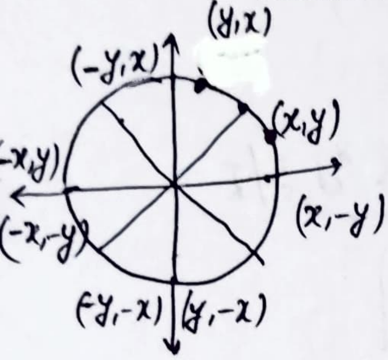
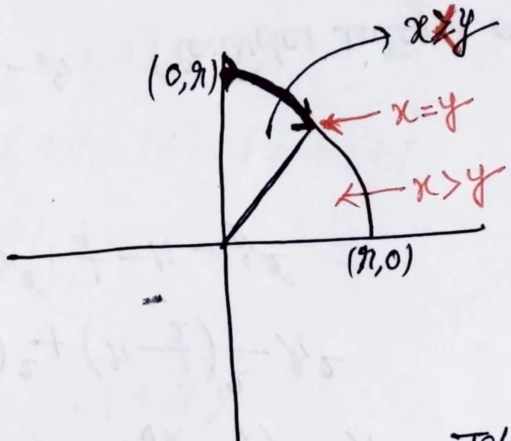
Mid-point Circle ⇒



Reflection of Quardent I





$x \longrightarrow$ unit interval

$y \longrightarrow ?$

y_K OR y_{K+1} $\longrightarrow y_K - 1$

Till $\underline{x \leq y}$

So

Next Coordinate may be

$(x_K + 1,\ y_K)$ OR $(x_K + 1,\ y_K - 1)$

$$\text{mid point} = \left(\frac{x_K + 1 + x_K + 1}{2},\ \frac{y_K + y_K - 1}{2}\right)$$

$$= \left[(x_K + 1),\left(y_K - \tfrac{1}{2}\right)\right]$$

put mid points in circle formula (eq^n)

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

$$P_K = (x_K + 1)^2 + \left(y_K - \tfrac{1}{2}\right)^2 - r^2 = 0$$

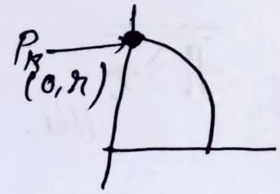
(Decision Parameter)

$$P_{k+1} = (x_{k+1}+1)^2 + \left(y_{k+1} - \frac{1}{2}\right)^2 - r^2$$

$$P_{k+1} - P_k = (x_{k+1}+1)^2 + \left(y_{k+1} - \frac{1}{2}\right)^2 - \cancel{r^2}$$
$$- (x_k+1)^2 - \left(y_k - \frac{1}{2}\right)^2 + \cancel{r^2}$$
$$= ((x_k+1)+1)^2 + \left(y_{k+1} - \frac{1}{2}\right)^2 - (x_k+1)^2 - \left(y_k - \frac{1}{2}\right)^2$$
$$= \cancel{(x_k+1)^2} + 1 + 2(x_k+1) + y_{k+1}^2 + \cancel{\frac{1}{4}} - y_{k+1} - \cancel{(x_k+1)^2}$$
$$- \cancel{y_k^2} - \cancel{\frac{1}{4}} + \cancel{y_k}$$
$$= 2(x_k+1) + (y_{k+1}^2 - y_k^2) - (y_{k+1} - y_k) + 1$$

$$P_{k+1} = P_k + \left[2(x_k+1) + (y_{k+1}^2 - y_k^2) - (y_{k+1} - y_k) + 1\right]$$

Initial parameter $\Rightarrow$



$$P_k = (x_k+1)^2 + \left(y_k - \frac{1}{2}\right)^2 - r^2$$
$$= (0+1)^2 + \left(r - \frac{1}{2}\right)^2 - r^2$$
$$= 1 + \cancel{r^2} + \frac{1}{4} - r - \cancel{r^2}$$
$$= \frac{5}{4} - r$$
$$= 1.25 - r \quad \text{(Consider integer only)}$$
$$\boxed{P_k = 1 - r}$$

If $P_k \geq 0$

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

$N.P. = (x_k+1, y_k-1)$

If $P_k < 0$

$y_{k+1} = y_k$

$N.P. = (x_k+1, y_k)$

fill all seven octants based on this octant.

Eg:- Draw a circle with $r = 8$

$P_k = 1 - r$

$P_{k+1} = P_k + 2(x_k + 1) + (y_{k+1}^2 - y_k^2) - (y_{k+1} - y_k) + 1$

$P_0 = 1 - r = 1 - 8 = -7$

K	(x_k, y_k)	P_k	(x_{k+1}, y_{k+1})
1	(0,8)	−7	(1,8)
2	(1,8)	−4	(2,8)

$P_{k+1} = (-7) + 2(0+1)^2 + (8^2 - 8^2) - (8-8) + 1$
$= -4$

$P_{k+1} = (-4) + 2(1+1)^2 + (8^2 - 8^2) - (8-8) + 1$
$= -4 + 4 + 1 = 1$

K	(x_k, y_k)	P_k	(x_{k+1}, y_{k+1})
3	(2,8)	1	(3,7)

$P_{k+1} = 1 + 2(2+1) + (49 - 64) - (7-8) + 1$
$= 1 + 6 - 18 + 1 + 1$
$= 9 - 15$
$= -6$

K	(x_k, y_k)	P_k	(x_{k+1}, y_{k+1})
4	(3,7)	−6	(4,7)

$P_{k+1} = -6 + 2(3+1) + 0 - 0 + 1$
$= -6 + 8 + 1$
$= 3$

K	(x_k, y_k)	P_k	(x_{k+1}, y_{k+1})
5	(4,7)	3	(5,6)

$P_{k+1} = 3 + 2(4+1) + (36 - 49) - (6-7) + 1$
$= 3 + 10 - 14 + 1 + 1$
$= 2$

K	(x_k, y_k)	P_k	(x_{k+1}, y_{k+1})
6	(5,6)	2	(6,5)

Q1
(0,8)
(1,8)
(2,8)
(3,7)
(4,7)
(5,6)
(6,5)
(7,4) (7,3) (8,2) (8,1) (8,0)

Q2
(0,8)
(−1,8)
(−2,8)
(−3,7)
(−4,7)
(−5,6)
(−6,5)
(−7,4)
(−7,3)
(−8,2) (−8,1) (−8,0)

Q3
(0,−8)
(−1,−8)
(−2,−8)
(−3,−7)
(−4,−7)
(−5,6)
(−6,−5)
(−7,−4)
(−7,−3)
(−8,−2)
(−8,−1)
(−8,0)

Q4
(0,−8)
(1,−8)
(2,−8)
(3,−7)
(4,−7)
(5,−6)
(6,−5)
(7,−4)
(7,−3)
(8,−2)
(8,−1)
(8,0)