Mid Point Circle Drawing Algorithm :

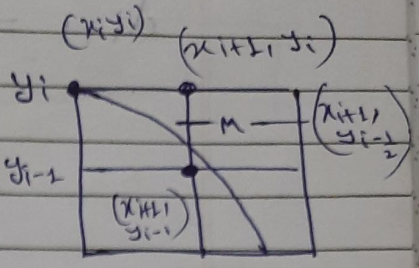
Circle eqn : $x^2 + y^2 = r^2$

$f(x,y) \Rightarrow x^2 + y^2 - r^2$

$f(x,y) < 0$, (x,y) is inside the circle

$f(x,y) = 0$ on circle.

$f(x,y) > 0$ (x,y) is outside the circle



- $d_i = f_{circle}\left(x_{i+1}, y_i - \frac{1}{2}\right) = (x_{i+1})^2 + \left(y_i - \frac{1}{2}\right)^2 - r^2$

Initial value $x_i = 0$

$y_i = r$

put the value

$= (0+1)^2 + \left(r - \frac{1}{2}\right)^2 - r^2$

$= 1 + r^2 - 2 \cdot r \cdot \frac{1}{2} + \frac{1}{4} - r^2$

$= 1 - r + \frac{1}{4}$

$\boxed{d_i = 1.25 - r}$

$d_i = (x_{i+1})^2 + \left(y_i - \frac{1}{2}\right)^2 - r^2$

$= (x_{i+1})^2 + y_i^2 - y_i + \frac{1}{4} - r^2$ ——— (1)

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

$= x_{i+1}^2 + 2x_{i+1} + 1 + y_{i+1}^2 - y_{i+1} + \frac{1}{4} - r^2$

$$d_{i+1} = (x_{i+1})^2 + 2(x_{i+1}) + 1 + (y_{i+1})^2 - y_{i+1} + \frac{1}{4} - r^2$$

from eq (1)

$$= d_i - y_i^2 + y_i + 2(x_{i+1}) + 1 + (y_{i+1})^2 - y_{i+1}$$

$$= d_i + 2(x_{i+1}) + (y_{i+1})^2 - y_i^2 - y_{i+1} + y_i + 1 \quad \text{(II)}$$

Case 1 $d_i < 0$ then $y_{i+1} = y_i$

$$d_{i+1} = d_i + 2(x_{i+1}) + y_i^2 - y_i^2 - y_i + y_{i+1}$$

$$= d_i + 2(x_{i+1}) + 1$$

Case 2 $d_i > 0$ then $y_{i+1} = y_i - 1$

$$d_{i+1} = d_i + 2(x_{i+1}) + (y_i - 1)^2 - y_i^2 - y_i - 1 + y_i + 1$$

$d_{i+1} = d_i + 2(x_{i+1}) + y_i^2 - 2y_i + 1 - y_i^2$

$$d_{i+1} = d_i + 2(x_{i+1}) - 2y_i + 1$$

Q:- Using Midpoint circle algorithm plot a circle whose radius = 10 units

$p_i = 1 - r$

$p_i < 0 \quad p_i = p + 2x + 1$

$p_i \geq 0 \quad p_i = p + 2x - 2y + 1$

S.No.	x	y	p	Plot (x, y)
1.	0	10	-9	Plot (0, 10)
2.	1	10	-6	Plot (1, 10)
3.	2	10	-1	Plot (2, 10)
4.	3	10	6	Plot (3, 10)
5.	4	9	-3	Plot (4, 9)
6.	5	9	8	Plot (5, 9)
7.	6	8	5	Plot (6, 8)
8.	7	7	6	

Step 1 :- $1 - 10 \Rightarrow -9$

Step 2 :- $-9 + 2x1 + 1 \Rightarrow -6$

Step 3 :- $-6 + 2x2 + 1 \Rightarrow -1$

Step 4 :- $-1 + 2x3 + 1 \Rightarrow 6$

Step 5 :- $6 + 2 \times 4 - 2 \times 9 + 1$

$6 + 8 - 18 + 1 \Rightarrow -3$

Step 6 :- $-3 + 2 \times 5 + 1 \Rightarrow 8$

Step 7 :- $8 + 2 \times 6 - 2 \times 8 + 1$

$8 + 12 - 16 + 1 \Rightarrow 5$