**MidPoint Circle Algorithm**

It is based on the following function for testing the spatial relationship between the arbitrary point (x, y) and a circle of radius r centered at the origin:




Now, consider the coordinates of the point halfway between pixel T and pixel S

This is called midpoint (xi+1,yi-) and we use it to define a decision parameter:

            Pi=f (xi+1,yi-) = (xi+1)2+(yi-)2-r2 ...............equation 2

If Pi is -ve ⟹midpoint is inside the circle and we choose pixel T

If Pi is+ve ⟹midpoint is outside the circle (or on the circle)and we choose pixel S.

The decision parameter for the next step is:

Pi+1=(xi+1+1)2+(yi+1-)2- r2............equation 3

Since xi+1=xi+1, we have



If pixel T is choosen ⟹Pi<0

We have yi+1=yi

If pixel S is choosen ⟹Pi≥0

We have yi+1=yi-1



We can continue to simplify this in n terms of (xi,yi) and get



Now, initial value of Pi (0,r)from equation 2



We can put ≅1
∴r is an integer
So, P1=1-r

**Algorithm:**

**Step1:** Put x =0, y =r in equation 2
            We have p=1-r

**Step2:** Repeat steps while x ≤ y
            Plot (x, y)
            If (p<0)
Then set p = p + 2x + 3
Else
            p = p + 2(x-y)+5
            y =y - 1 (end if)
            x =x+1 (end loop)

**Step3:** End

**Program to draw a circle using Midpoint Algorithm:**

1. #include <graphics.h>
2. #include <stdlib.h>
3. #include <math.h>
4. #include <stdio.h>
5. #include <conio.h>
6. #include <iostream.h>
7.
8. class bresen
9. {
10. float x, y,a, b, r, p;
11. public:
12. void get ();
13. void cal ();
14. };
15. void main ()
16. {
17. bresen b;
18. b.get ();
19. b.cal ();
20. getch ();
21. }
22. Void bresen :: get ()
23. {
24. cout<<"ENTER CENTER AND RADIUS";
25. cout<< "ENTER (a, b)";
26. cin>>a>>b;
27. cout<<"ENTER r";
28. cin>>r;
29. }
30. void bresen ::cal ()
31. {
32. /\* request auto detection \*/
33. int gdriver = DETECT,gmode, errorcode;
34. int midx, midy, i;
35. /\* initialize graphics and local variables \*/
36. initgraph (&gdriver, &gmode, " ");
37. /\* read result of initialization \*/
38. errorcode = graphresult ();
39. if (errorcode ! = grOK)    /\*an error occurred \*/
40. {
41. printf("Graphics error: %s \n", grapherrormsg (errorcode);
42. printf ("Press any key to halt:");
43. getch ();
44. exit (1); /\* terminate with an error code \*/
45. }
46. x=0;
47. y=r;
48. putpixel (a, b+r, RED);
49. putpixel (a, b-r, RED);
50. putpixel (a-r, b, RED);
51. putpixel (a+r, b, RED);
52. p=5/4)-r;
53. while (x<=y)
54. {
55. If (p<0)
56. p+= (4\*x)+6;
57. else
58. {
59. p+=(2\*(x-y))+5;
60. y--;
61. }
62. x++;
63. putpixel (a+x, b+y, RED);
64. putpixel (a-x, b+y, RED);
65. putpixel (a+x, b-y, RED);
66. putpixel (a+x, b-y, RED);
67. putpixel (a+x, b+y, RED);
68. putpixel (a+x, b-y, RED);
69. putpixel (a-x, b+y, RED);
70. putpixel (a-x, b-y, RED);
71. }
72. }

**Output:**

