**The Iteration Method for non-linear equation**

**Theory**

Let the equations be given by f(x,y) = 0, g(x,y) = 0 ……………………(1)

Whose real roots are required within a specified accuracy. As in the method of iteration for a single equation, it is assumed that the equations in (1) can be written in the following form,

x = F(x,y) and y = G(x,y) ………………(2)

where the functions F and G satisfy the conditions,

+ < 1 and + < 1…….(3)

In the neighborhood of the root. Let (x0,y0) be the initial approximation to a root (ζ , η) of the system (1). Then it is constructed the successive approximation according to the following formulae,

x1 = F(x0,y0) , y1 = G(x0,y0)

x2 = F(x1,y1) , y2 = G(x1,y1)

x3 = F(x2,y2) , y3 = G(x2,y2) …………… (4)

. . . . . . . . . . . . . . .

xn+1 = F(xn,yn) , yn+1 = G(xn,yn)

This process continues until the required accuracy is obtained.

**Code**

#include<bits/stdc++.h>

using namespace std;

double F(double y)

{

return sqrt(y\*y + 4.00);

}

double G(double x)

{

return sqrt(16.00 - x\*x);

}

int Check(double x,double y)

{

double dF,dG;

dF = y / sqrt(4.00 + y\*y);

dG = - ( x/sqrt(16.00 - x\*x) );

if(fabs(dF)<1.00 && fabs(dG)<1.00)

return 1;

else

return 0;

}

void Iteration(double x, double y)

{

double X,Y,m,n;

do

{

X = F(y);

Y = G(x);

m = x;

n = y;

x = X;

y = Y;

cout<<"x: "<<X<<"\ty: "<<Y<<"\tError rate (x) : "<<fabs(X-m)<<"\tError rate (y) : "<<fabs(Y-n)<<endl;

}while(fabs(X-m)>=0.1 && fabs(Y-n)>=0.1);

cout<<"\nFinal x: "<<X<<"\tFinal y: "<<Y<<endl;

}

int main()

{

double x,y;

int z;

cout<<" Assume the x0 : ";

cin>>x;

cout<<" Assume the y0 : ";

cin>>y;

z = Check(x,y);

if(z==1)

Iteration(x,y);

else

cout<<"Wrong Assumption"<<endl;

return 0;

}

**Output**

**Discussion**

In the above code, the iteration method of finding the roots of non-linear equations was performed. Here firstly the value of x0 and y0 were taken from the user input. After that the Check() function was called to check the condition of iteration method whether this assumption is suitable for further procedure or not. If the Check() returns 1 then the condition satisfies and Iteration() function is called where the equations no (4) from the theory were used with the help of a do while loop. The loop continues until the required accuracy level is reached. When the loop terminates , the actual value of x and y is obtained. Thus the iteration method for non-linear equations was successfully implemented.