

The Iteration Method

Theory

It is a method that requires one starting value of x . This value doesn't need bracket the root. For finding the root of the equation $f(x)=0$ it is needed to rewrite the equation in the following form, $x = G(x)$. Then the value of x is assumed. And then in each iteration the value of X_n and the value of X_{n+1} is determined along with their difference. This iteration continues until,

$$|X_{n+1} - X_n| < \frac{\text{Eps} * (1 - \max(G'(x))_{[m,n]})}{\max(G'(x))_{[m,n]}}$$

Where, Eps = the given error rate decimal point e.g. 10^{-4}

m = lower limit

n = upper limit

Code

```
#include<bits/stdc++.h>
using namespace std;
#define Error (0.0001 * (1-0.1602))/0.1602
double f(double x)
{
    return pow((5-x),(1.0/3.0));
}

double Iteration(double x)
{
    int i=0;
    double xn=x,m=f(x);
    cout<<"-----"<<endl;
    cout<<"| i "<<" | "<<"x"<<" | "<<"xi + 1 | Error Rate |"<<endl;
    cout<<"-----"<<endl;
    do
    {
        xn = m;
        m = f(xn);
        printf("| %d | %0.5lf | %0.5lf | %0.6lf | \n",i,xn,m,fabs(m-xn));
        i++;
    }while(fabs(m-xn)>=Error);
    cout<<"-----"<<endl;
    cout<<"The value of x is: "<<m<<endl;
}
```

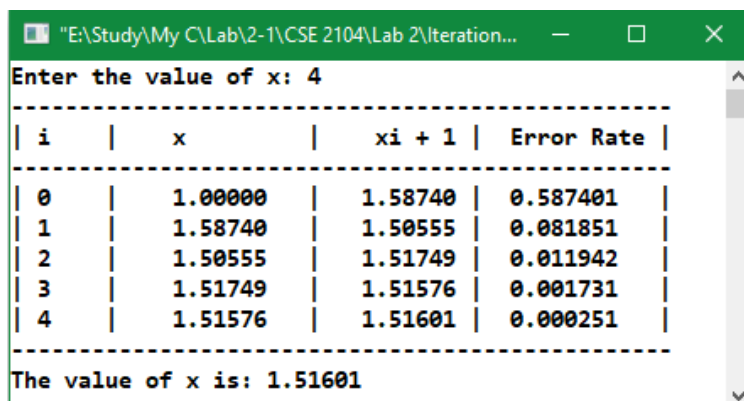
```

int main()
{
    double a;
    cout<<"Enter the value of x: ";
    cin>>a;
    Iteration(a);

    return 0;
}

```

Output



i	x	xi + 1	Error Rate
0	1.00000	1.58740	0.587401
1	1.58740	1.50555	0.081851
2	1.50555	1.51749	0.011942
3	1.51749	1.51576	0.001731
4	1.51576	1.51601	0.000251

The value of x is: 1.51601

Discussion

In the following code, In the function named Iteration(), At first $f(x)$ return value was assigned to m and x was assigned to X_n then a do while loop was used where the value of m was assigned to X_n and the return value of $f(x_n)$ was assigned to m . After that the value of I, x_n, m and the difference of two consecutive x 's value were printed as a tabular form.