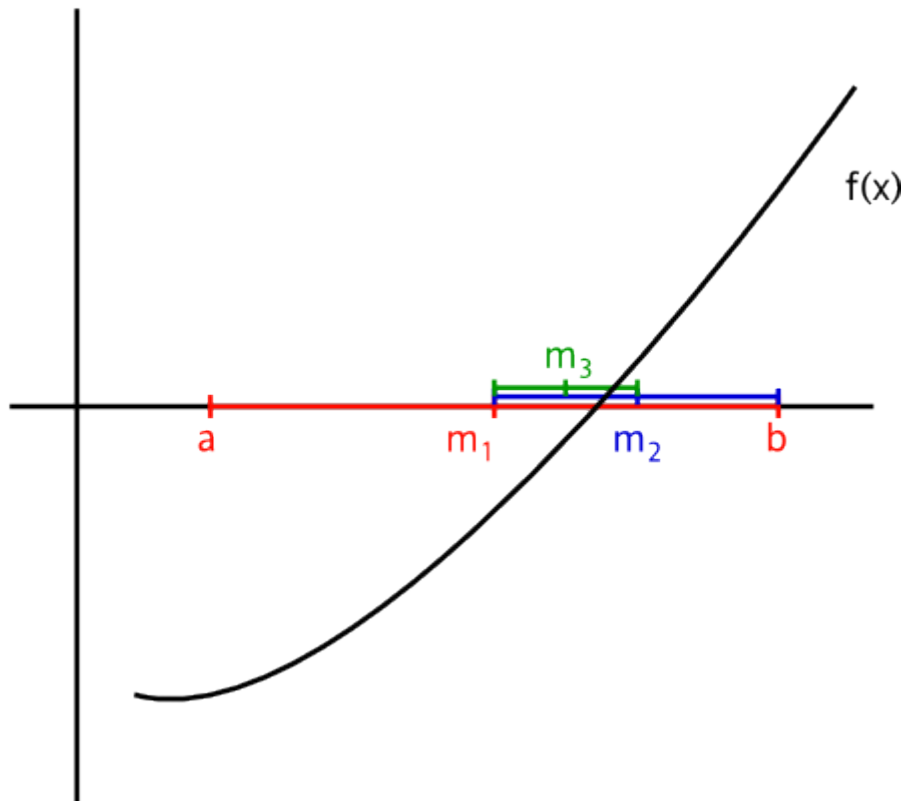


Bisection Method, is a Numerical Method, used for finding a root of an equation.

The method is based upon bisecting an interval that brackets(contains) the root repeatedly, until the approximate root is found.



In this post I will show you how to write a C Program in various ways to find the root of an equation using the Bisection Method.

The following is a simple version of the program that finds the root, and tabulates the different values at each iteration. Just like any other numerical method bisection method is also an iterative method, so it is advised to tabulate values at each iteration.

PROGRAM(Simple Version):

```

/*****
*****BISECTION  METHOD*****
*****
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*****/
#include<stdio.h>
#include<math.h>

/*Function whose root is to be determined*/
double f(double x){
    return 3*x+sin(x)-exp(x);
}

int main(){
    double a,b,c,eps;
    int maxSteps;

```

```

a:printf("Enter the initial guess a:\n");
scanf("%lf",&a);
printf("Enter the initial guess b:\n");
scanf("%lf",&b);
printf("Enter the desired accuracy:\n");
scanf("%lf",&eps);
printf("Enter the max. number of steps:\n");
scanf("%d",&maxSteps);
if(f(a)*f(b)<=0){
    int iter=1;
    /*Bisection Method begins that tabulates the various values at each iteration*/
printf("_____
_____ \n");
    printf("iter\t a\t b\t c\t f(c)\t |a-b|\n");
printf("_____
_____ \n");
    do{
        c=(a+b)/2;
        printf("%d.\t%lf\t%lf\t%lf\t%lf\t%lf\n",iter,a,b,c,f(c),fabs(a-b));
        if(f(a)*f(c)>0){
            a=c;
        }
        else if(f(a)*f(c)<0){
            b=c;
        }
        iter++;
    }while(fabs(a-b)>=eps&&iter<=maxSteps);
printf("_____
_____ \n\nOne of the roots of the given equation is:\n\n%lf\n\n",c);
    }
    else{
        printf("\nSorry! the root doesn't exist in the given interval.\nPlease enter a
different set of guesses.\n");
        goto a;
    }
}
}

```

The better version of the above code uses a function called 'bisection' to perform the bisection task and return the root.

However, this function won't tabulate the values at each iteration.

So in the following program I have also provided another function called 'printBisection' that would return the root as well as print the various values at each iteration.

PROGRAM(Better Version):

```

/*****
*****BISECTION METHOD*****
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*****/
#include<stdio.h>
#include<math.h>

```

```

/*Function whose root is to be determined*/
double f(double x){
    return x*x-4;
}
/*Function definition for bisection procedure[Returns the root if found or 999 for failure]*/
double bisection(double f(double x),double a, double b, double eps, int maxSteps){
    double c;
    if(f(a)*f(b)<=0){
        int iter=1;
        /*Bisection Method begins that tabulates the various values at each iteration*/
        do{
            c=(a+b)/2;
            if(f(a)*f(c)>0){
                a=c;
            }
            else if(f(a)*f(c)<0){
                b=c;
            }
            iter++;
        }while(fabs(a-b)>=eps&&iter<=maxSteps);
        return c;
    }
    else{
        return 999;
    }
}

/*The following function performs the bisection procedure and also prints the values of various variables at each iteration */
double printBisection(double f(double x),double a, double b, double eps, int maxSteps){
    double c;
    if(f(a)*f(b)<=0){
        int iter=1;
        /*Bisection Method begins that tabulates the various values at each iteration*/
        printf("_____\n");
        printf("iter\t a\t b\t c\t f(c)\t |a-b|\n");
        printf("_____\n");
        do{
            c=(a+b)/2;
            printf("%d.\t%lf\t%lf\t%lf\t%lf\t%lf\n",iter,a,b,c,f(c),fabs(a-b));
            if(f(a)*f(c)>0){
                a=c;
            }
            else if(f(a)*f(c)<0){
                b=c;
            }
            iter++;
        }while(fabs(a-b)>=eps&&iter<=maxSteps);
        printf("_____\n");
    }
    else{
        return 999;
    }
}

```

```

        \n\nOne of the roots of the given equation is:\n\n%lf\n\n\n",c);
    }
    else{
        printf("\nSorry! the root doesn't exist in the given interval.\nPlease enter a
different set of guesses.\n");
    }
}
main(){
    double a,b,eps;
    int maxSteps;
    printf("Enter the initial guess a:\n");
    scanf("%lf",&a);
    printf("\nEnter the initial guess b:\n");
    scanf("%lf",&b);
    printf("\nEnter the desired accuracy:\n");
    scanf("%lf",&eps);
    printf("Enter the max. number of steps:\n");
    scanf("%d",&maxSteps);
    printBisection(f,a,b,eps,maxSteps);
}

```

OUTPUT:

For x^3-27 :

```

Enter the initial guess a:
0
Enter the initial guess b:
10
Enter the desired accuracy:
0.000001
Enter the max. number of steps:
30

```

iter	a	b	c	f(c)	a-b
1.	0.000000	10.000000	5.000000	98.000000	10.000000
2.	0.000000	5.000000	2.500000	-11.375000	5.000000
3.	2.500000	5.000000	3.750000	25.734375	2.500000
4.	2.500000	3.750000	3.125000	3.517578	1.250000
5.	2.500000	3.125000	2.812500	-4.752686	0.625000
6.	2.812500	3.125000	2.968750	-0.834991	0.312500
7.	2.968750	3.125000	3.046875	1.285503	0.156250
8.	2.968750	3.046875	3.007813	0.211487	0.078125
9.	2.968750	3.007813	2.988281	-0.315172	0.039063
10.	2.988281	3.007813	2.998047	-0.052700	0.019531
11.	2.998047	3.007813	3.002930	0.079179	0.009766
12.	2.998047	3.002930	3.000488	0.013186	0.004883
13.	2.998047	3.000488	2.999268	-0.019771	0.002441
14.	2.999268	3.000488	2.999878	-0.003296	0.001221
15.	2.999878	3.000488	3.000183	0.004944	0.000610
16.	2.999878	3.000183	3.000031	0.000824	0.000305
17.	2.999878	3.000031	2.999954	-0.001236	0.000153
18.	2.999954	3.000031	2.999992	-0.000206	0.000076
19.	2.999992	3.000031	3.000011	0.000309	0.000038
20.	2.999992	3.000011	3.000002	0.000051	0.000019
21.	2.999992	3.000002	2.999997	-0.000077	0.000010
22.	2.999997	3.000002	3.000000	-0.000013	0.000005
23.	3.000000	3.000002	3.000001	0.000019	0.000002
24.	3.000000	3.000001	3.000000	0.000003	0.000001

One of the roots of the given equation is:

3.000000

For x^2-4 :

```
Enter the initial guess a:
0
Enter the initial guess b:
12
Enter the desired accuracy:
0.000001
Enter the max. number of steps:
30
```

iter	a	b	c	f(c)	a-b
1.	0.000000	12.000000	6.000000	32.000000	12.000000
2.	0.000000	6.000000	3.000000	5.000000	6.000000
3.	0.000000	3.000000	1.500000	-1.750000	3.000000
4.	1.500000	3.000000	2.250000	1.062500	1.500000
5.	1.500000	2.250000	1.875000	-0.484375	0.750000
6.	1.875000	2.250000	2.062500	0.253906	0.375000
7.	1.875000	2.062500	1.968750	-0.124023	0.187500
8.	1.968750	2.062500	2.015625	0.062744	0.093750
9.	1.968750	2.015625	1.992188	-0.031189	0.046875
10.	1.992188	2.015625	2.003906	0.015640	0.023438
11.	1.992188	2.003906	1.998047	-0.007809	0.011719
12.	1.998047	2.003906	2.000977	0.003907	0.005859
13.	1.998047	2.000977	1.999512	-0.001953	0.002930
14.	1.999512	2.000977	2.000244	0.000977	0.001465
15.	1.999512	2.000244	1.999878	-0.000488	0.000732
16.	1.999878	2.000244	2.000061	0.000244	0.000366
17.	1.999878	2.000061	1.999969	-0.000122	0.000183
18.	1.999969	2.000061	2.000015	0.000061	0.000092
19.	1.999969	2.000015	1.999992	-0.000031	0.000046
20.	1.999992	2.000015	2.000004	0.000015	0.000023
21.	1.999992	2.000004	1.999998	-0.000008	0.000011
22.	1.999998	2.000004	2.000001	0.000004	0.000006
23.	1.999998	2.000001	2.000000	-0.000002	0.000003
24.	2.000000	2.000001	2.000000	0.000001	0.000001

One of the roots of the given equation is:

2.000000

Related Posts:

[Bisection Method C++ Program](#)

[Bisection Method Lab Manual \(Contains Flow-Chart and Algorithm\)](#)



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I'm a physicist specializing in computational material science with a PhD in Physics from Friedrich-Schiller University Jena, Germany. I write efficient codes for simulating light-matter interactions at atomic scales. I like to develop Physics, DFT, and Machine Learning related apps and software from time to time. Can code in most of the popular languages. I like to share my knowledge in Physics and applications using this Blog and a YouTube channel.

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