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**Practical No:02 Bisection Method**

**Objective:** To find root of the equation using Bisection method.

1. **Algorithm:**

1. Start

2. Define function f(x)

3. Input

a. Lower and Upper guesses x0 and x1

b. tolerable error e

4. If f(x0)\*f(x1) > 0

print "Incorrect initial guesses"

goto 3

End If

5. Do

x2 = (x0+x1)/2

If f(x0)\*f(x2) < 0

x1 = x2

Else

x0 = x2

End If

while abs(f(x2) > e

6. Print root as x2

7. Stop

1. **Code:**

#include <stdio.h>

#include <math.h>

#include <stdlib.h>

#define phi(x) (pow(2.718282, -1 \* x) - sin(x))

double differential(double x0)

{

    const double delta = 1.0e-10;

    double x1 = x0 - delta;

    double x2 = x0 + delta;

    double y1 = phi(x1);

    double y2 = phi(x2);

    // printf("gradient= %f\n", grad);

    return (y2 - y1) / (x2 - x1);

    // return (pow(-2.718282, -1\*x)-cos(x));

}

int main()

{

    int k = 0;

    double x1, x0, f0, f1, x2, f2;

    int step = 1, N;

    double allErr;

    printf("Enter the allowed Error: ");

    scanf(" %lf", &allErr);

    printf("Enter the interval lower limit (initial guess 'a'): ");

    scanf(" %lf", &x0);

    printf("Enter the interval upper limit (initial guess 'b'): ");

    scanf(" %lf", &x1);

    f0 = phi(x0);

    f1 = phi(x1);

    if (f0 \* f1 > 0.0)

    {

        printf("\n\nIncorrect Initial Guesses !!!!!!\n");

    }

    printf("Enter maximum iteration:  ");

    scanf("%d", &N);

    {

        {

            printf("\nStep\t\ta\t\tb\t\tf(a)\t\tf(b)\t\tc=(a+b)/2\t\tf(c)\n\n");

            do

            {

                x2=(x0+x1)/2;

                f2= phi(x2);

                printf("%d\t\t%f\t%f\t%f\t%f\t%f\t%f\n", step, x0, x1, f0, f1, x2, f2);

                step = step + 1;

                if (step > N)

                {

                    printf("%d iterations Completed !!!!!\n", N);

                    exit(0);

                }

                if (f0 \* f2 < 0)

                {

                    x1 = x2;

                    f1 = f2;

                }

                else

                {

                    x0 = x2;

                    f0 = f2;

                }

            } while (fabs(f1) > allErr);

            printf("\nRoot is: %f\n", x1);

        }

    }

}

**4. Output:**

Enter the allowed Error: 0.0001

Enter the interval lower limit (initial guess 'a'): 0

Enter the interval upper limit (initial guess 'b'): 1

Enter maximum iteration: 12

Step a b f(a) f(b) c=(a+b)/2 f(c)

1 0.000000 1.000000 1.000000 -0.473592 0.500000 0.127105

2 0.500000 1.000000 0.127105 -0.473592 0.750000 -0.209272

3 0.500000 0.750000 0.127105 -0.209272 0.625000 -0.049836

4 0.500000 0.625000 0.127105 -0.049836 0.562500 0.036480

5 0.562500 0.625000 0.036480 -0.049836 0.593750 -0.007221

6 0.562500 0.593750 0.036480 -0.007221 0.578125 0.014495

7 0.578125 0.593750 0.014495 -0.007221 0.585938 0.003603

8 0.585938 0.593750 0.003603 -0.007221 0.589844 -0.001817

9 0.585938 0.589844 0.003603 -0.001817 0.587891 0.000891

10 0.587891 0.589844 0.000891 -0.001817 0.588867 -0.000464

11 0.587891 0.588867 0.000891 -0.000464 0.588379 0.000213

12 0.588379 0.588867 0.000213 -0.000464 0.588623 -0.000125

12 iterations Completed !!!!!