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Practical No:02 Bisection Method

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

2. 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

3. 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 !!!!!