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Practical No:04 Iteration Method

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

2. Algorithm:

1. Start

2. Define function as f(x)

3. Define convergent form g(x)

4. Input:
      a. Initial guess x0
      b. Tolerable Error e
      c. Maximum Iteration N

5. Initialize iteration counter: step = 1

6. Do

      x1 = g(x0)

      step = step + 1

      If step > N
            Print "Not Convergent"
            Stop
      End If

      x0 = x1

  While abs f(x1) > e

7. Print root as x1

8. Stop

3. <u>Code:</u>

```c
#include <stdio.h>
#include <math.h>
#include <stdlib.h>

#define phi(x) (7 + log10(x)) / (2)

// double differential(float x0)
// {
//     double grad = phi(x0 + 0.0000001 * x0) - phi(x0);
//     grad /= (0.0000001 * x0);

   // printf("gradient= %f\n", grad);
   // if (grad < 0)
   // {
   //     grad = grad - 2 * grad;
   // }
   // printf("|gradient|= %f\n", grad);

   // return grad;
// }

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);

   double grad= (y2 - y1) / (x2 - x1);
   printf("gradient= %f\n", grad);
   if (grad < 0)
   {
      grad = grad - 2 * grad;
   }
```

```c
    printf("|gradient|= %f\n", grad);

    return grad;
}

int main()
{
    int k = 0;
    double x1, x0;
    double allErr;
    printf("Enter the allowed Error: ");
    scanf(" %lf", &allErr);
    int i1, i2;
    printf("Enter the interval lower limit: ");
    scanf(" %d", &i1);
    printf("Enter the interval upper limit: ");
    scanf(" %d", &i2);

    printf("\nEnter the initial guess x0: ");
    scanf("%lf", &x0);
    {
        if (x0 <= i2 && x0 >= i1)
        {
            double grad = differential(x0);

            if (grad <= 1)
            {
                x1 = x0;
                do
                {
                    k++;
                    x0 = x1;
                    x1 = phi(x0);
                    printf("x after iteration %d is: %lf\n", k, x1);
                } while (fabs(x1 - x0) > allErr);
            }

            else
            {
                printf("|gradient|=%f is not less than 1, Hence cannot apply Iteration Method !!!!\n", grad);

                exit(0);
            }
```

```
            printf("\n\nOne root is %lf obtained at %d th iteration \n", x1, k);
        }
        else
        {
            printf("You entered wrong initial guess, needed something between %d a
nd %d !!!", i1, i2);
        }
    }
}
```

4. Output:

Enter the allowed Error: 0.0001
Enter the interval lower limit: 0
Enter the interval upper limit: 1

Enter the initial guess x0: 1
gradient= 0.217146
|gradient|= 0.217146
x after iteration 1 is: 3.500000
x after iteration 2 is: 3.772034
x after iteration 3 is: 3.788288
x after iteration 4 is: 3.789221
x after iteration 5 is: 3.789275