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Practical No:03 Newton Raphson Method

Objective: To find root of the equation using Newton Raphson method.

2. Algorithm:

1. Start

2. Define function as f(x)

3. Define derivative of function as g(x)

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

5. Initialize iteration counter step = 1

6. Do
    If g(x0) = 0
        Print "Mathematical Error"
        Stop
    End If

    x1 = x0 - f(x0) / g(x0)
    x0 = x1

    step = step + 1

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

  While abs f(x1) > e

7. Print root as x1

8. Stop

3. <u>Code:</u>

```
#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, g0;
   int step = 1, N;
   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);
   printf("Enter maximum iteration:\n");
```

```
   scanf("%d", &N);
   {
      if (x0 <= i2 && x0 >= i1)
      {
         printf("\nStep\t\tx0\t\tf(x0)\t\tf'(x0)\t\tx1\t\tf(x1)\n");
         do
         {
            g0 = differential(x0);
            f0 = phi(x0);
            if (g0 == 0.0)
            {
               printf("Mathematical Error.");
               exit(0);
            }

            x1 = x0 - (f0 / g0);

            printf("%d\t\t%f\t%f\t%f\t%f\t%f\n", step, x0, f0, g0, x1, f1);
            x0 = x1;

            step = step + 1;

            if (step > N)
            {
               printf("Not Convergent.");
               exit(0);
            }

            f1 = phi(x1);

         } while (fabs(f1) > allErr);

         printf("\nRoot is: %f\n", x1);
      }
      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: 4

Enter the initial guess x0: 1
Enter maximum iteration:
10

Step	x0	f(x0)	f'(x0)	x1	f(x1)
1	1.000000	-0.473592	-0.908182	0.478528	0.000000
2	0.478528	0.159222	-1.507369	0.584157	0.159222
3	0.584157	0.006079	-1.391753	0.588525	0.006079

Root is: 0.588525