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Semester: 3

Date: October 10, 2021

**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

1. Stop
2. **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, 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 and %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