NEPAL ENGINEERING COLLEGE

(AFFILIATED TO POKHARA UNIVERSITY)

Changunarayan, Bhaktapur

REPORT ON:

Root of Nonlinear Equation Using Newton Raphson Method

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SUBMITTED TO:

Electrical and

Electronics

Experiment no:-3

TITLE:-

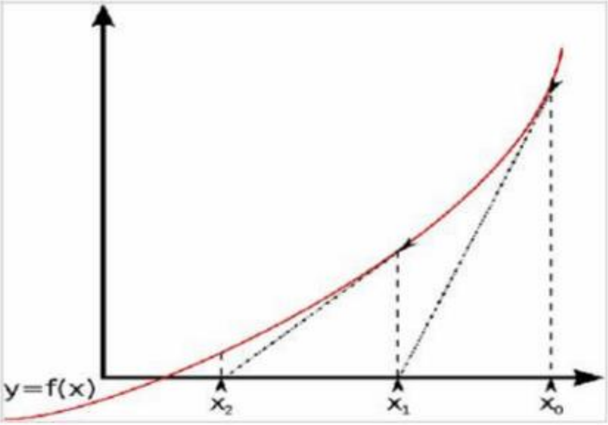
ROOT OF NONLINEAR EQUATION USING NEWTON RAPHSON METHOD

OBJECTIVE:-

To implement and calculate the root using the Newton Raphson method on Matlab and C-programming.

THEORY:-

Newton-Raphson method is based on a linear approximation of the function. Figure below give a graphical description. Starting from an initial estimate that is not too far from a root x, then extrapolate along the tangent to its intersection with x-axis, and take that as the next approximation. This is continued until either the successive x-value are sufficiently close, or the value of the function is sufficiently near zero.



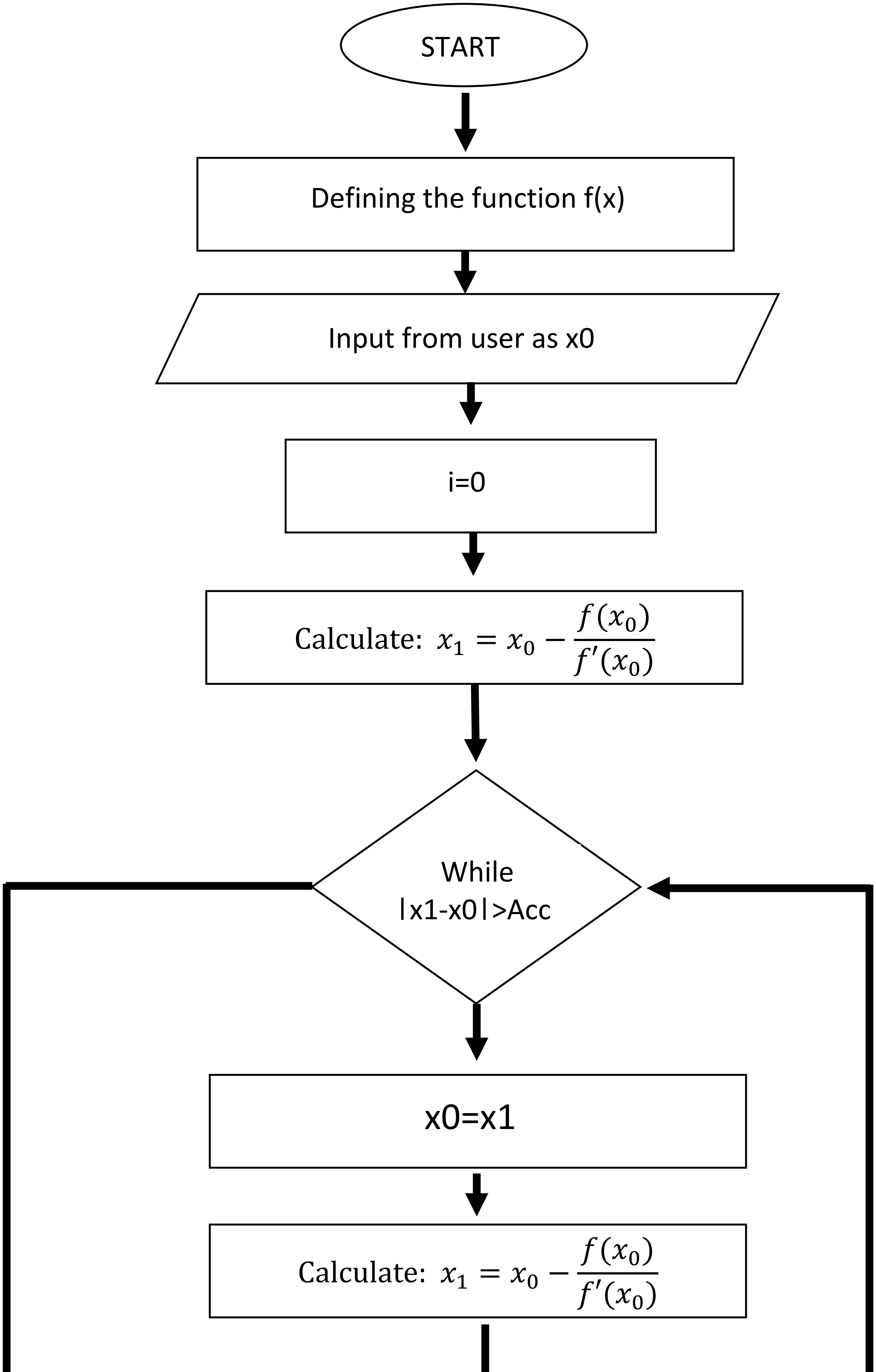
$$x_0 = Initial\ \ guess$$

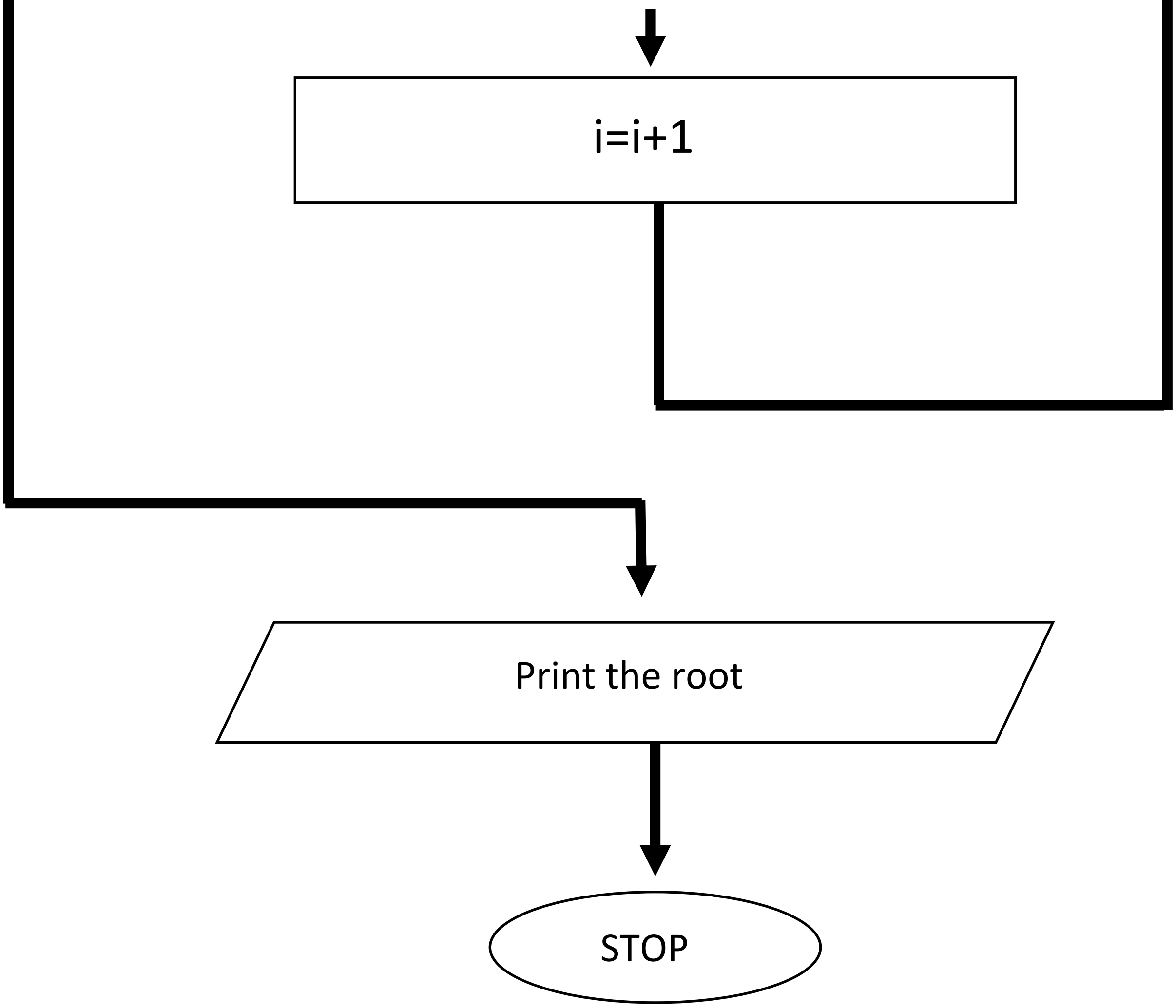
Next Estimated, $x_1 = x_0 - \frac{f(x_0)}{f\prime(x_0)}$

ALGORITHM:-

1. Assign the initial value of x_0.
2. Evaluate $f(x_0)$ and $f'(x_0)$.
3. Compute $x_1 = x_0 - \frac{f(x_0)}{f\prime(x_0)}$
4. Set $x1$ = $x0$
5. If absolute value of $f(x0)$ is less than or equal to given limit, then $root$ = $x0$
6. Display the value of root.
7. Stop the program.

FLOW-CHART


START
Defining the function f(x)
Input from user as x0
i=0
Calculate: $x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$
While
|x1-x0|>Acc
x0=x1
Calculate: $x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$

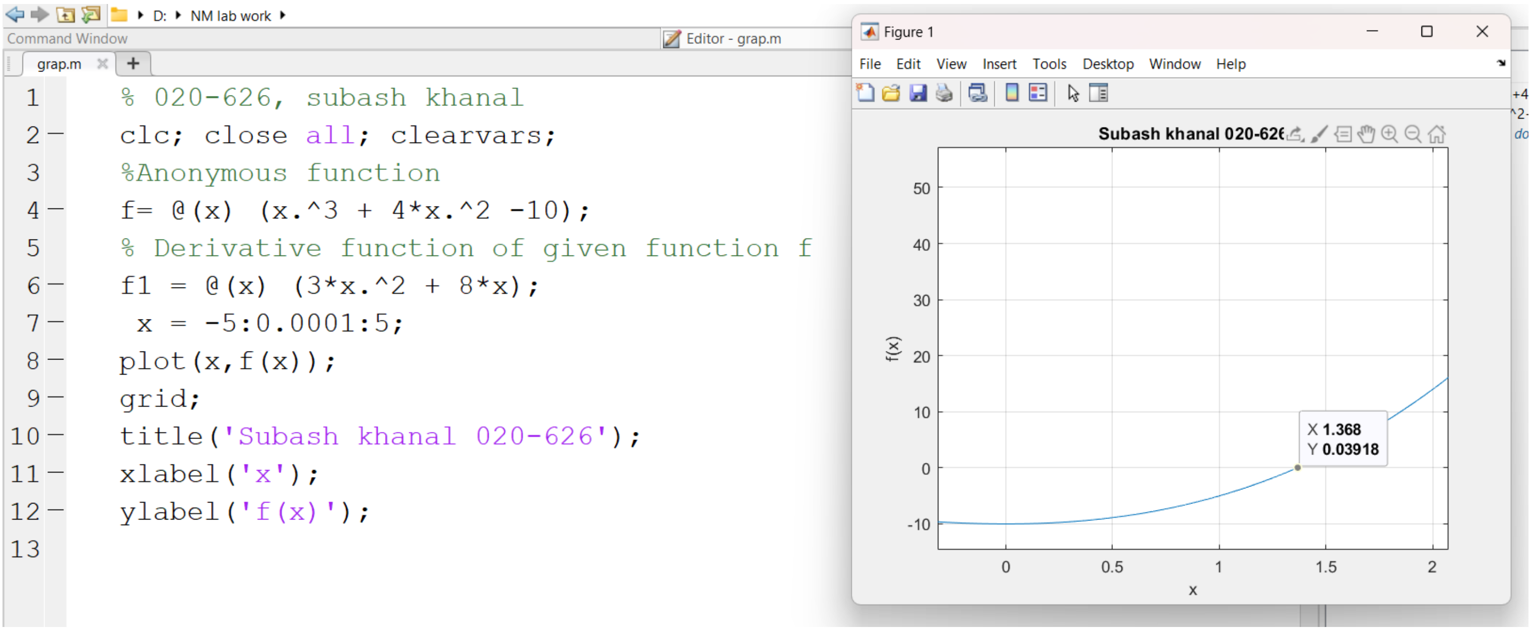

i=i+1
Print the root
STOP

Question: Implement above algorithm in MATLAB to calculate a root of the following equations

a) $\boldsymbol{x^3 + 4x^2 - 10}$

Solution:-

Graph of the given Function:-



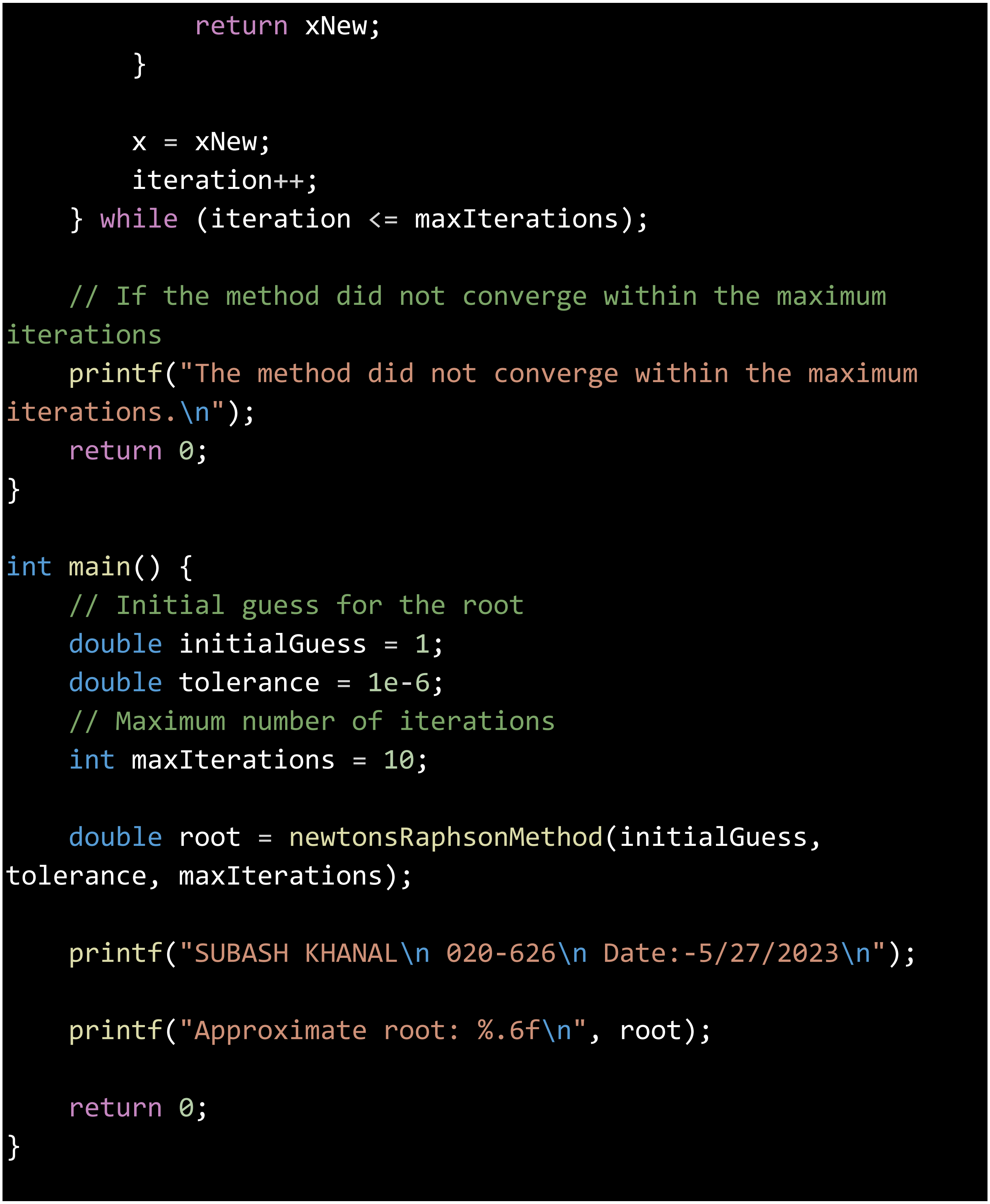
```
% 020-626, subash khanal
clc; close all; clearvars;
%Anonymous function
f= @(x) (x.^3 + 4*x.^2 -10);
% Derivative function of given function f
f1 = @(x) (3*x.^2 + 8*x);
 x = -5:0.0001:5;
plot(x,f(x));
grid;
title('Subash khanal 020-626');
xlabel('x');
ylabel('f(x)');
```

So from the above the root is nearly equal to -1.368.

Using C-programming

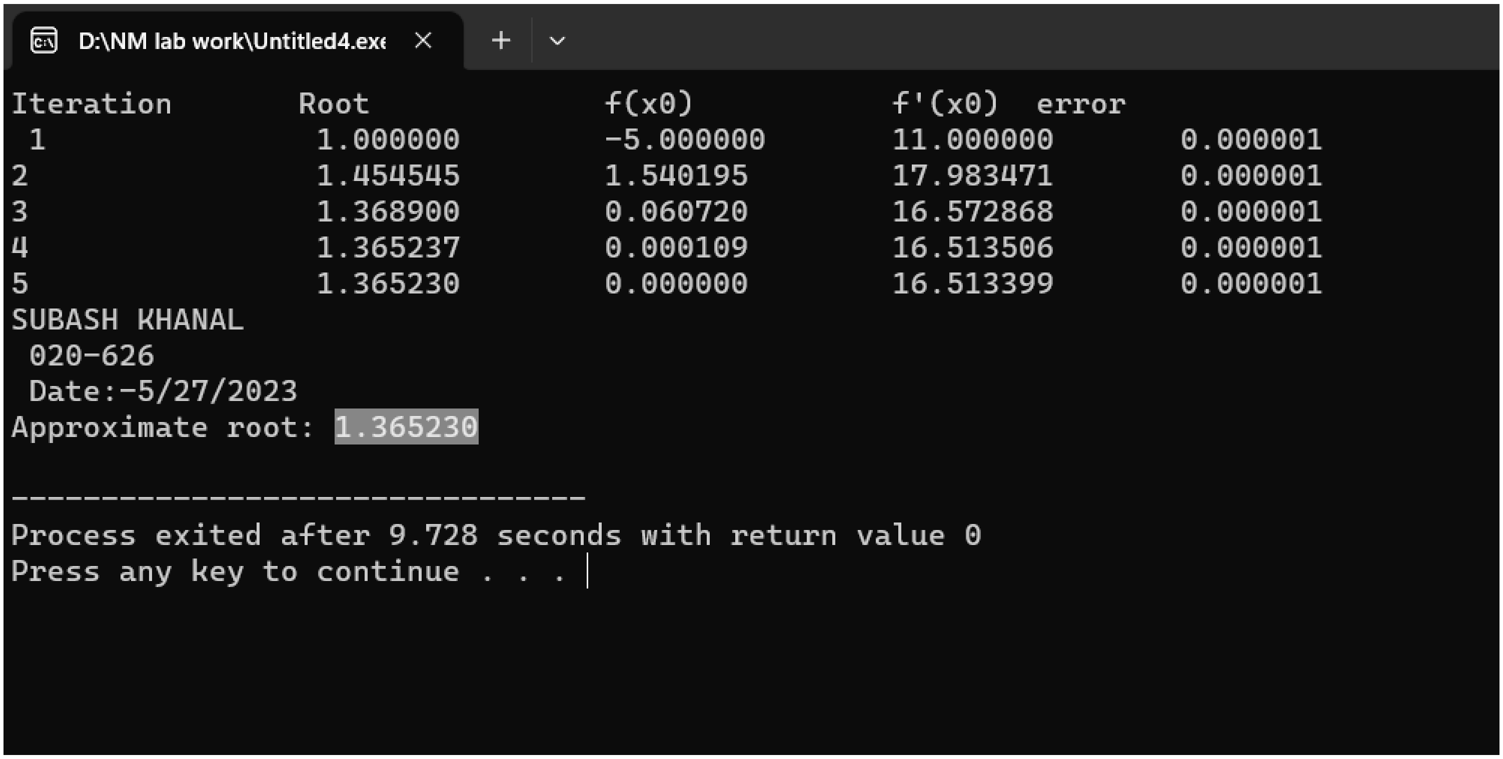
Syntax:-

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

// Function for which we want to find the root
double myFunction(double x) {
    return x * x * x + 4 *x* x - 10;
}

// Derivative of the function
double myFunctionDerivative(double x) {
    return 3 * x * x +8*x;
}

// Newton's Raphson method
double newtonsRaphsonMethod(double initialGuess, double
tolerance, int maxIterations) {
    double x = initialGuess;
    int iteration = 1;

    printf("Iteration\tRoot\t\t f(x0)\t\t f'(x0)\t error\n ");

    do {
        double f = myFunction(x);
        double fDerivative = myFunctionDerivative(x);

        double xNew = x - f / fDerivative;

        printf("%d\t\t %.6f\t %f\t %f\t %f\t\n", iteration,
x,f,fDerivative,tolerance);

        // Check for convergence
        if (fabs(xNew - x) < tolerance) {
```



```c
            return xNew;
        }

        x = xNew;
        iteration++;
    } while (iteration <= maxIterations);

    // If the method did not converge within the maximum
iterations
    printf("The method did not converge within the maximum
iterations.\n");
    return 0;
}

int main() {
    // Initial guess for the root
    double initialGuess = 1;
    double tolerance = 1e-6;
    // Maximum number of iterations
    int maxIterations = 10;

    double root = newtonsRaphsonMethod(initialGuess,
tolerance, maxIterations);

    printf("SUBASH KHANAL\n 020-626\n Date:-5/27/2023\n");

    printf("Approximate root: %.6f\n", root);

    return 0;
}
```

Output:-



```
Iteration        Root             f(x0)            f'(x0)  error
 1                1.000000        -5.000000        11.000000        0.000001
2                 1.454545        1.540195         17.983471        0.000001
3                 1.368900        0.060720         16.572868        0.000001
4                 1.365237        0.000109         16.513506        0.000001
5                 1.365230        0.000000         16.513399        0.000001
SUBASH KHANAL
 020-626
 Date:-5/27/2023
Approximate root: 1.365230

--------------------------------
Process exited after 9.728 seconds with return value 0
Press any key to continue . . .
```

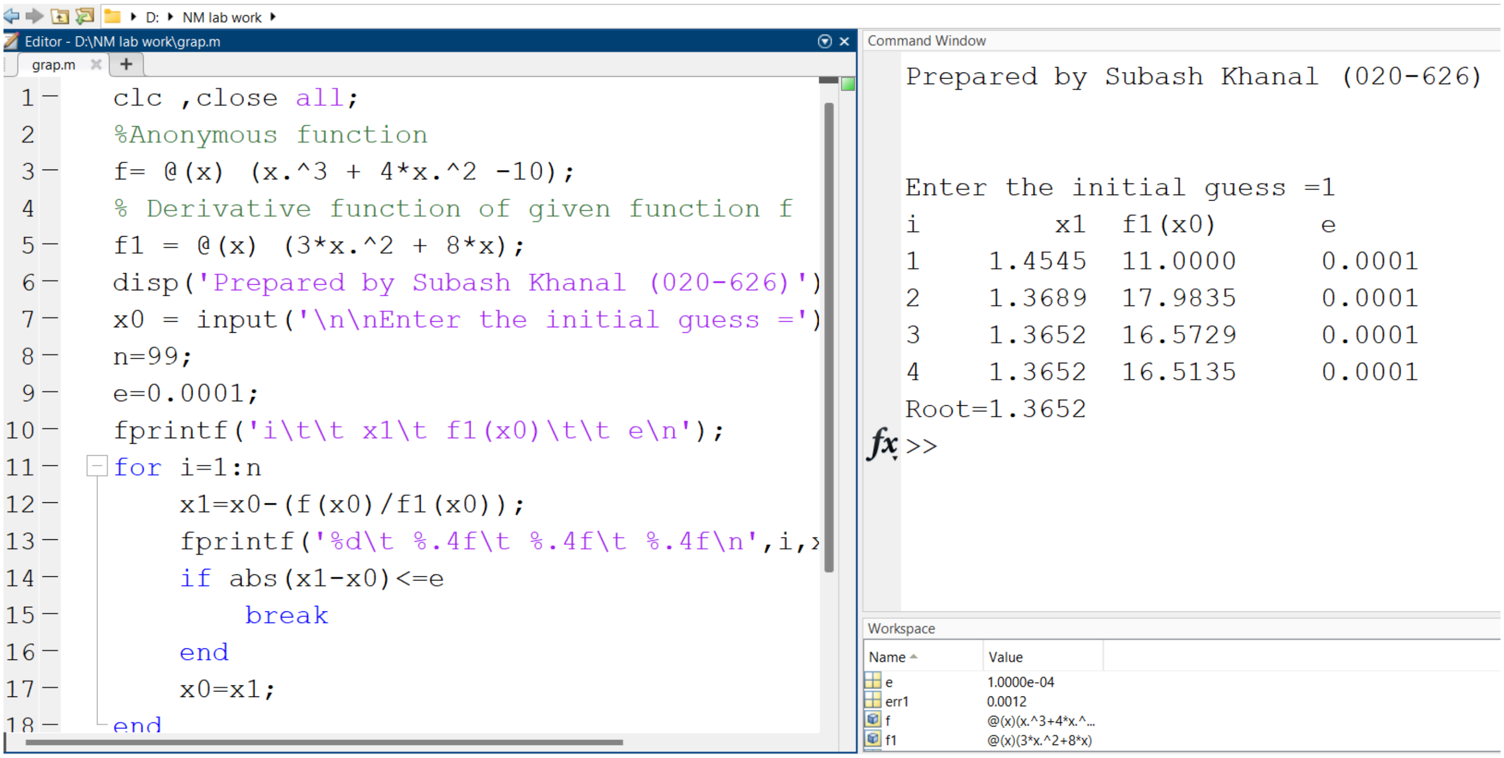
The root of the given function is highlighted in the output of c-programming output which was 1.365230 which is nearly equal to -1.368 which was interception/root from Matlab graph.

Using Matlab.

Syntax:-

```
clc ,close all;
%Anonymous function
f= @(x) (x.^3 + 4*x.^2 -10);
% Derivative function of given function f
f1 = @(x) (3*x.^2 + 8*x);
disp('Prepared by Subash Khanal (020-626)')
x0 = input('\n\nEnter the initial guess =');
n=99;
e=0.0001;
fprintf('i\t\t x1\t f1(x0)\t\t e\n');
for i=1:n
    x1=x0-(f(x0)/f1(x0));
    fprintf('%d\t %.4f\t %.4f\t %.4f\n',i,x1,f1(x0),e)
    if abs(x1-x0)<=e
        break
    end
    x0=x1;
end
fprintf('Root=%.4f\n',x1);
if(i==n)
    fprintf('Maximum iteration reached')
end
```

Output:-



```
clc ,close all;
%Anonymous function
f= @(x) (x.^3 + 4*x.^2 -10);
% Derivative function of given function f
f1 = @(x) (3*x.^2 + 8*x);
disp('Prepared by Subash Khanal (020-626)')
x0 = input('\n\nEnter the initial guess =')
n=99;
e=0.0001;
fprintf('i\t\t x1\t f1(x0)\t\t e\n');
for i=1:n
    x1=x0-(f(x0)/f1(x0));
    fprintf('%d\t %.4f\t %.4f\t %.4f\n',i,x
    if abs(x1-x0)<=e
        break
    end
    x0=x1;
end
```

```
Prepared by Subash Khanal (020-626)


Enter the initial guess =1
i         x1   f1(x0)       e
1     1.4545  11.0000      0.0001
2     1.3689  17.9835      0.0001
3     1.3652  16.5729      0.0001
4     1.3652  16.5135      0.0001
Root=1.3652
fx >>
```

Name ▲	Value
e	1.0000e-04
err1	0.0012
f	@(x)(x.^3+4*x.^...
f1	@(x)(3*x.^2+8*x)

Description:-

From above program from c-programming and matlab it was clear that root are same using any and also from the graph. So, using above program we can find the root.

Conclusion:-

Hence, from above we can implement and calculate the root using the Newton Raphson’s method on Matlab and C-programming.