find the root of non-linear equation using Newton-Raphson Method in MATLAB.

Example 1: Write a MATLAB code to solve that equation: $f(x) = x^3 - 0.165x^2 + 3.993 * 10^{-4}$ using Newton-Raphson Method with initial guess (x0 = 0.05) to 3 iterations and also, plot that function.

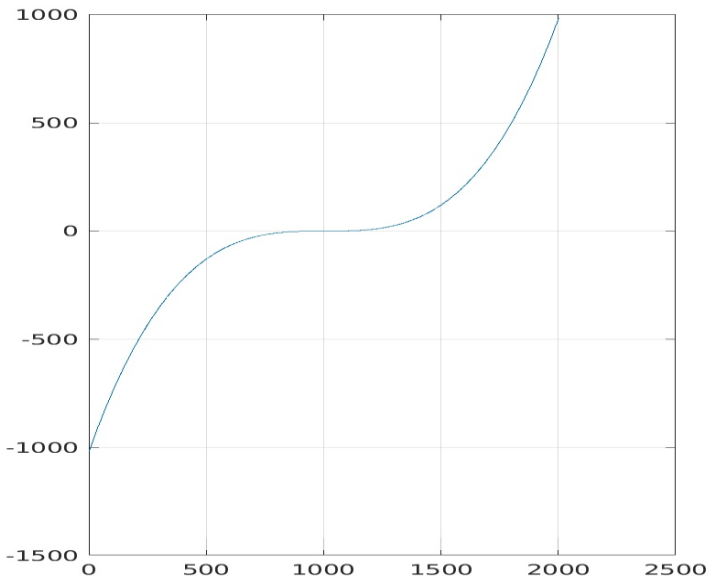
Solution:

Try it in Editor window

```
x = 0.05;
x_old = 100;
x_true = 0.0623776;
iter = 0;
while abs(x_old-x) > 10^-3 && x ~= 0
   x_old = x;
   x = x - (x^3 - 0.165*x^2 + 3.993*10^-4)/(3*x^2 - 0.33*x);
   iter = iter + 1;
   fprintf('Iteration %d: x=%.20f, err=%.20f\n', iter, x, x_true-x);
end
```

To plot the function, use the following:

```
x = -10:0.01:10;
f = x.^3 - 0.165*x.^2 + 3.993*10^-4;
figure;
plot(f)
grid on
```



Example 2: Write a program to find the roots of the following equations using N-R method: Create a script file and type the following code

$F(x) = 2e^{-x} - sin(x) = 0$, with initial guess $x_1 = 0$.

```
Newton-Raphson method.
clear; clc
%first plot the function plot(f)
x=0:0.05:4;
f=@(x) 2* exp (-x)- sin(x);

plot(x,f(x));grid
fd=@(x) -2* exp (-x)- cos(x);
x1=input ('x1=');
tol=0.001;
i = 0;
while abs(f(x1)) > tol
        f1=f(x1);
        f1d=fd(x1);
        x2=x1-(f1/f1d);
        f2=f(x2);
        x1=x2;
        i = i + 1;
       fprintf('%9.6f %13.6f \n',x2,f2)
end
```

```
ans: x2= 0.921016        x1=1
     x2= 3.046659        x1=3
```

Find the root of non-linear equation using Bisection Method in MATLAB.

Example 3: Create a script file and type the following code

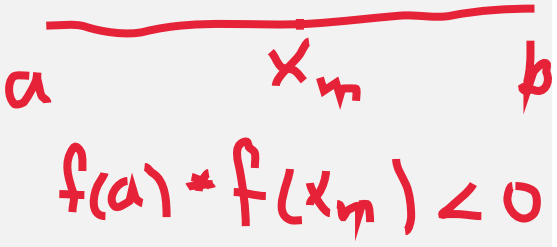
Write a program to find the roots of the following equations using bisection method:

$f = x^3 + 4x^2 - 10$ where $x \in [0,5]$

Try Bisection Method code in Editor window

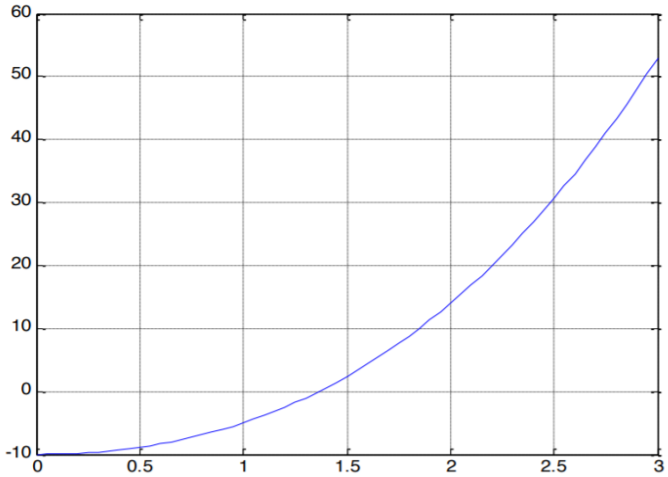
```
clear all; clc
% first plot the function x=0:0.05:5;
 f=@(x) (x.^3)+(4*(x.^2))-10;
plot(x, f(x)); grid
a=input ('a=');
b=input ('b=');
 tol=0.00001;
i=0
 while (abs(a-b)> tol);
        fa=f(a); fb=f(b);
        c=(a+b)/2;
        fc=f(c);
        fprintf('%13.4f %13.4f %13.4f %13.4f \n',a,b,c,fc)
       if (fa *fc > 0);
          a=c;
       else
           b=c;
       end
      i=i+1;
end
```

x=0:0.01:5



ans c= 1.365173 for [1 2]

The function f has the following plot



Example 4: Create a script file and type the following code

Write a program to find the roots of the following equations using bisection method:

$f = x^3 - 6x^2 + 10x - 4$, with $x \in [0, 4]$

Solution

```
clear all; clc
% first plot the function
x=0:0.05:4;
f=@(x) (x.^3)-(6.*(x.^2))+10*x - 4;
plot(x,f(x));grid
a=input ('a=');
b=input ('b=');
tol=0.00001;
i=0
while (abs(a-b)> tol);
       fa=f(a);
       fb=f(b);
       c=(a+b)/2;
       fc=f(c);
      fprintf ('%13.4f %13.4f %13.4f %13.4f \n',a,b,c,fc)
     if (fa *fc > 0);
         a=c;
     else
         b=c;
      end
      i=i+1;
 end
```

ans c= 0.585793 for [0 1]

c= 1.999992 for [1.5 2.5]

c = 3.414207 for [3 4]