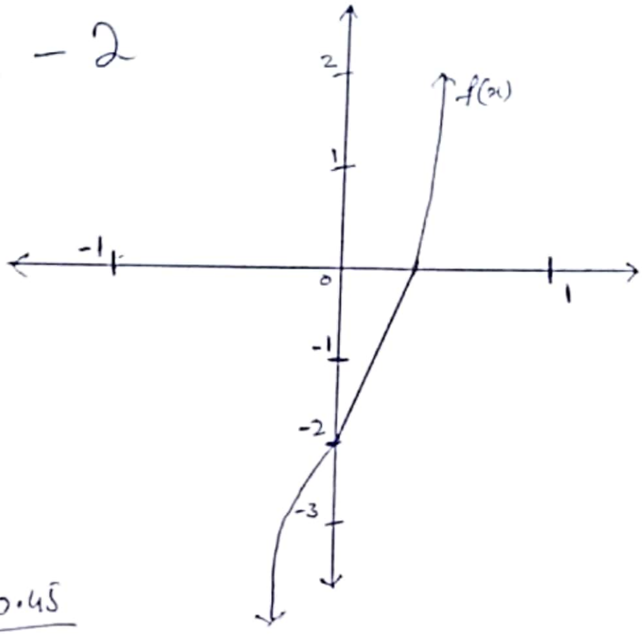
Rafay Aamir

Bsee 19047

NA Assignment 2

Q:-1

$$f(x) = 5x^3 - 5x^2 + 6x - 2$$



ⓐ find real roots graphically.

From the graph we ~~f.~~ can predict that the function is 0 at $x = 0.4$ or 0.45 so let's suppose the real roots/root of $f(x) = \frac{0.4+0.45}{2}$

roots $= 0.425$

from the graph the root of $f(x)$ lies between 0.4 and 0.425 whereas from (Desmos) root of $f(x)$ comes out to be $\boxed{0.4181}$

ⓑ

$x_l = 5.0$, $x_u = 5.1$

$x_r = \frac{5 + 5.1}{2} = 5.05$

x_l, x_u cannot be considered as the valid values to compute, it might be a typo so I assume the $x_l = 0$, $x_u = 1$

$x_r = \frac{0+1}{2} = 0.5$, $\varepsilon = \left|\frac{0.425-0.5}{0.425}\right| \times 100$

$\varepsilon = 17.647\%$

$f(x_r) = 0.375$

Now, let

$x_u = x_l = 0.5$, $x_l = 0$

$x_r = \frac{0+0.5}{2} = 0.25$, $\varepsilon = 41.17$

$f(x_r) < 0$, so $x_r = x_l = 0.25$, $x_u = 1$

using the same procedure

$x_r = 0.625$, $\varepsilon = 48.68\%$, $f(x_r) > 0$

$x_u = x_r = 0.625$, $x_l = 0.25$

$x_r = \frac{0.25 + 0.625}{2} = 0.4375$, $\varepsilon = 4.6\%$

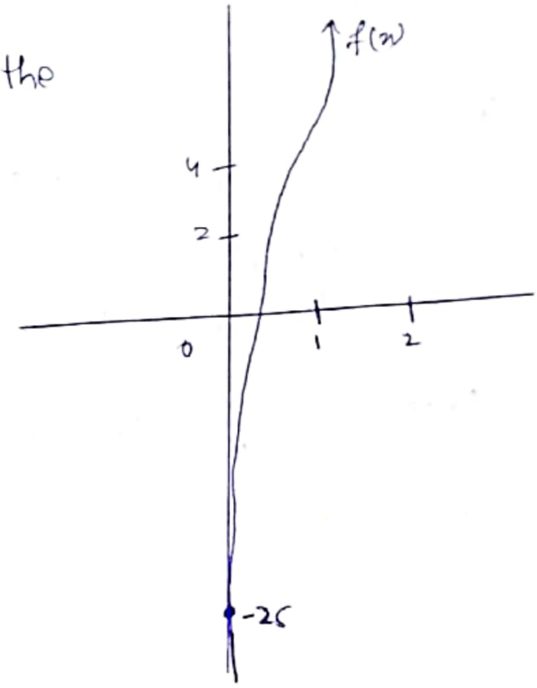
so

$\boxed{x_r = 0.4375}$

Q:-2

Solve $f(x) = 0.7x^5 - 8x^4 + 44x^3 - 90x^2 + 82x - 25$

(a) real root of $f(x)$ will be in the range of (0.5 to 0.6)



Actal root $= 0.5794$

(b)

$x_l = 0.5$, $x_u = 1.0$

$x_r = \frac{0.5+1}{2} = 0.75$, $\varepsilon = 30\%$

$x_u = 0.75$

$x_r = \frac{0.5+0.75}{2} = 0.625$, $\varepsilon = 7.87\%$

(c) $x_l = 0.5$, $x_u = 1.0$

$f(x_l) = -1.478$, $f(x_u) = 3.7$

$x_r = 1 - \frac{(3.7)(0.5-1)}{-1.478 - 3.7} = 0.6427$, $\varepsilon = \left|\frac{0.5794 - 0.6427}{0.5794}\right| \times 100 = 10.92$

$f(x_r) = 0.9184$

$f(x_l) \times f(x_r) = -1.3574$

Now as $f(x_l) \times f(x_r) < 0$ so, we have to take $x_u = x_r$

$x_l = 0.5$, $x_u = 0.6427$

$f(x_l) = -1.478$, $f(x_u) = 0.9184$

$x_r = 0.6427 - \frac{(0.9184)(0.5 - 0.6427)}{-1.478 - 0.9184}$

$x_r = 0.588$

$\varepsilon = \left|\frac{0.5794 - 0.588}{0.5794}\right| \times 100 = 1.4843\%$

$f(x_r) = 0.137$, $f(x_l) f(x_r) = -0.2025 < 0$

So let $x_u = x_r$

$x_l = 0.5$, $x_u = 0.588$

$f(x_l) = -1.478$, $f(x_u) = 0.137$

$$x_r = 0.588 - \frac{(0.137)(0.5 - 0.588)}{-1.478 - (0.137)} = 0.5805$$

$$\varepsilon = \left|\frac{0.5794 - 0.5805}{0.5794}\right| \times 100 = 0.19588\% < 0.2\%$$

Hence, $x_r = 0.5805$ can be consider as the real root of $f(x)$

Q:- 3

$$f(x) = x^{3.5} = 80$$

(a) $f(x) = x^{3.5} - 80$

let $f(x) = 0$, $x^{3.5} - 80 = 0$, $x^{3.5} = 80$

$$\log_{10}(x) = \frac{\log_{10}(80)}{3.5} = 0.54374$$

$$\log_{10}(x) = 0.54374$$

$$x = 3.4947$$

$$\boxed{x_r = 3.4947}$$

(b) $\varepsilon_s = 2.5\%$ $\qquad f(x) = x^{3.5} - 80$

$x_l = 2$, $x_u = 5$ $\qquad$ Actual value $= 3.4975$

$f(x_l) = -68.68$, $f(x_u) = 199.5$

$$x_r = 5 - \frac{(199.5)(2-5)}{-68.68 - 199.5}, \quad x_r = 2.76828, \quad \varepsilon = 20.85\%$$

$f(x_r) = -44.7$, as $f(x_l)f(x_r) > 0$ so

$x_l = x_r$, $x_u = 5$

$$x_r = 5 - \frac{(199.5)(2.76828 - 5)}{-44.7 - (+199.5)} = 3.1768, \quad \varepsilon = 9.17\%$$

$f(x_r) = -22.857$

as $f(x_l)f(x_r) > 0$, so $x_l = x_r$, $x_u = 5$

$x_l = 3.1768$

$$x_r = 5 - \frac{(199.5)(3.1768-5)}{(-22.857) - 199.5} = 3.3642, \quad \varepsilon = 3.8113\%$$

$f(x_r) = -10.163$

$f(x_l)f(x_r) > 0$, $x_l = x_r = 3.3642$, $x_u = 5$

$$x_r = 5 - \frac{(199.5)(3.3642 - 5)}{-10.163 - 199.5} = 3.4434, \quad \varepsilon = 1.5468\%$$

$\varepsilon < \varepsilon_s$

so, $x_r = 3.4434$ can be considered as the real root of $(x^{3.5} = 80)$ or $(x^{3.5} - 80)$

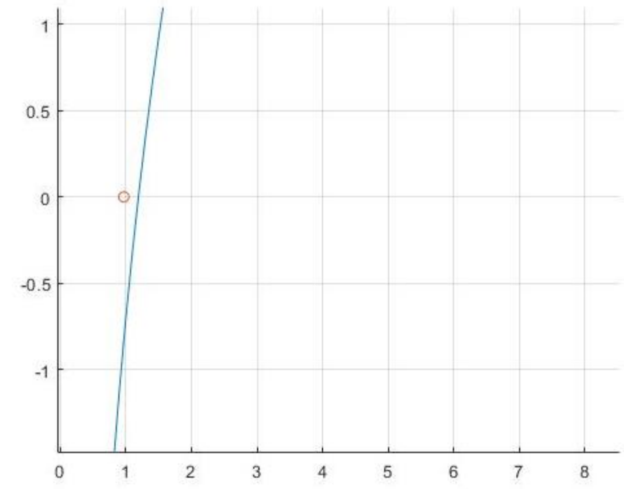
Q4

a) Code

```
% Bisection Method in MATLAB
a=input('Enter function with right-hand-side equals to zero:','s');
f=inline(a);
xl=input('Enter the initial guess (Xl) :');
xu=input('Enter the initial guess (Xu) :');
%Es=input('Enter the estimated error (Es) :');
if f(xu)*f(xl)<0
else
   fprintf('The guess is incorrect! Enter new guesses\n');
   xl=input('Enter the initial guess (Xl) :');
   xu=input('Enter the initial guess (Xu) :');
end
for i=1:4
   xr=(xu+xl)/2;
   if f(xu)*f(xr)<0
      xl=xr;
   else
      xu=xr;
   end


   if f(xl)*f(xr)<0
      xu=xr;
   else
      xl=xr;
   end


   xnew(1)=0;
   xnew(i)=xr;
   %if abs((xnew(i)-xnew(i-1))/xnew(i))<Es,break,end
end
x=0:0.1:100;
y= log(x.^4)-0.7;
hold on
plot(x,y)
grid on
scatter(xr,0)
str = ['After three iterations of the bisection method the required real positive root of the equation is: ', num2str(xr), '']
```

a) Command window

```
>> Q4_a
Enter function with right-hand-side equals to zero:x^4
-0.7
Enter the initial guess (Xl) :0.5
Enter the initial guess (Xu) :2

str =

   'After three iterations of the bisection method the
required real positive root of the equation is: 0.96875'
```



b) Code

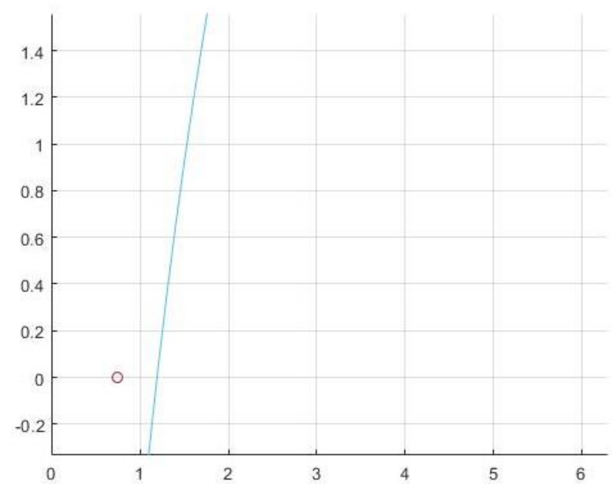
```
%False-position method
clc
syms x;
y = input('Enter function with right-hand-side equals to zero: ');
xl=input('Enter the initial guess (Xl) :');
xu=input('Enter the initial guess (Xu) :');


fa = double(subs(y,x,xl));
fb = double(subs(y,x,xu));


if fa*fb > 0
   disp('Given initial values do not bracket the root.');
else
   c = xl - (xl-xu) * fa/(fa-fb);
   fc = eval(subs(y,x,c));
   fprintf('\n\na\t\t\tb\t\t\tc\t\t\tf(c)\n');
   for i=1:4
      fprintf('%f\t%f\t%f\t%f\n',xl,xu,c,fc);
      if fa*fc< 0
         xu =c;
         fb = eval(subs(y,x,xu));
      else
         xl =c;
         fa = eval(subs(y,x,xl));
      end
      c = xl - (xl-xu) * fa/(fa-fb);
      fc = eval(subs(y,x,c));
   end
   fprintf('\nAfter three iterations of the False_position method the required real positive root of the equation is: %f\n', c);
   hold on
   grid on
   x=0:0.1:100;
   f=log(x.^4)-0.7;
   plot(0:0.1:100,f)
   scatter(c,0)
end
```

c) Command Window

Enter function with right-hand-side equals to zero: x^4
-0.7
Enter the initial guess (Xl) :.5
Enter the initial guess (Xu) :2

a	b	c	f(c)
0.500000	2.000000	0.560000	-0.601655
0.560000	2.000000	0.614484	-0.557425
0.614484	2.000000	0.663188	-0.506560
0.663188	2.000000	0.706029	-0.451520

After three iterations of the **False position method** the required real positive root of the equation is: **0.743121**



Comparison graph