

Task 2

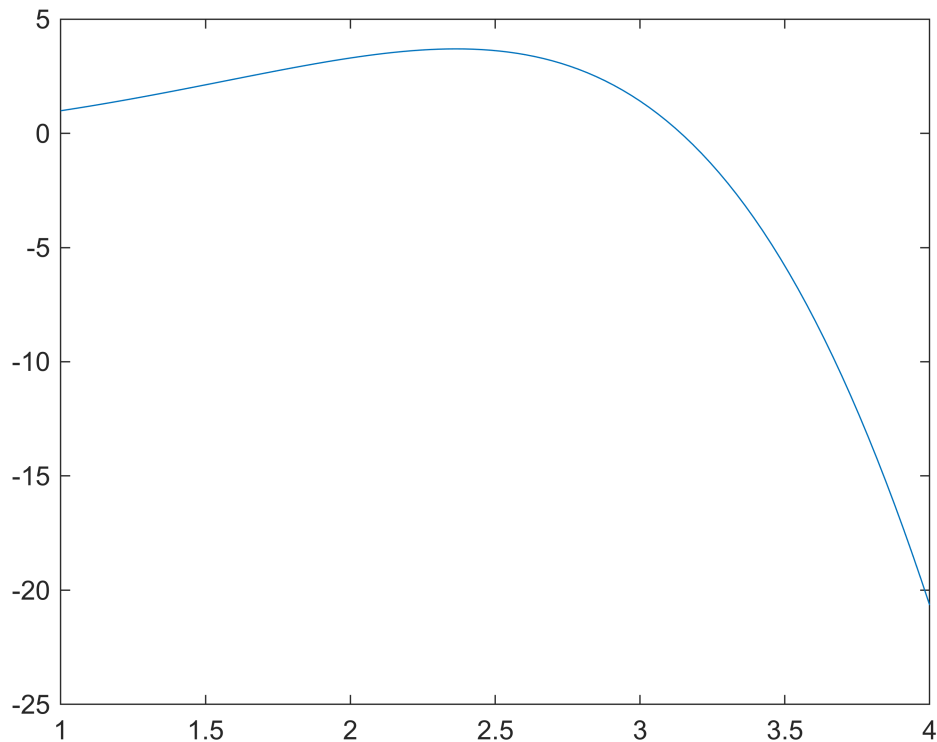
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1 Bisection $f(x) = \sin(x)\sinh(x)$; Limits = [1 4] [3]

```
%Bisection Method
%b
x = linspace(1, 4, 100);

function_sinh = sinh_function(x);
figure;
plot(x, function_sinh)
```



```
function_sinh = sinh_function(1)
```

```
function_sinh =
    0.988897705762865
```

```
function_sinh = sinh_function(4)
```

```
function_sinh =  
    -20.653077431533
```

1 Bisection $f(x) = (R^2 - x^2)^{1/2} - x \tan(x)$ [3]

```
x = linspace(4, 4.7, 100);  
function_R = Function_R(x);
```

(d) Create a script function to call the bisection function, in the call to the function include the parameters:

i. **f** – a string variable – the value of the file name of the functions defined in

(b) or (c)

ii. **a** – lower limit of the integration interval

iii. **b** – upper limit of the integration interval

iv. **tol** – accuracy to which the root is to be found – $1e-6$

v. **imax** – the maximum number of iterations – 50

(e) For each of the functions (b), (c) plot the function over the desired interval and indicate the position of the root with a 'o' marker, e.g. `figure(1);plot(x,y,'x_root,y_root','o')`, also plot out the value of the root on the title of the graph, e.g. `title(str2num(x_root))`.

```
%d and e  
tol = 1e-6;  
imax = 50;  
  
a = 4;  
b = 4.7;  
  
[root,counter] = bisect2( @Function_R, a, b, imax, tol);
```

```
ITERATION 0  
Lower guess = 4.000000  
Upper guess = 4.700000  
Mid-point = 4.350000
```

```
ITERATION 1  
Lower guess = 4.000000  
Upper guess = 4.350000  
Mid-point = 4.175000
```

```
ITERATION 2  
Lower guess = 4.175000  
Upper guess = 4.350000  
Mid-point = 4.262500
```

```
ITERATION 3  
Lower guess = 4.262500  
Upper guess = 4.350000  
Mid-point = 4.306250
```

ITERATION 4
Lower guess = 4.262500
Upper guess = 4.306250
Mid-point = 4.284375

ITERATION 5
Lower guess = 4.262500
Upper guess = 4.284375
Mid-point = 4.273437

ITERATION 6
Lower guess = 4.262500
Upper guess = 4.273437
Mid-point = 4.267969

ITERATION 7
Lower guess = 4.267969
Upper guess = 4.273437
Mid-point = 4.270703

ITERATION 8
Lower guess = 4.270703
Upper guess = 4.273437
Mid-point = 4.272070

ITERATION 9
Lower guess = 4.270703
Upper guess = 4.272070
Mid-point = 4.271387

ITERATION 10
Lower guess = 4.270703
Upper guess = 4.271387
Mid-point = 4.271045

ITERATION 11
Lower guess = 4.271045
Upper guess = 4.271387
Mid-point = 4.271216

ITERATION 12
Lower guess = 4.271045
Upper guess = 4.271216
Mid-point = 4.271130

ITERATION 13
Lower guess = 4.271045
Upper guess = 4.271130
Mid-point = 4.271088

ITERATION 14
Lower guess = 4.271088
Upper guess = 4.271130
Mid-point = 4.271109

ITERATION 15
Lower guess = 4.271088
Upper guess = 4.271109
Mid-point = 4.271098

ITERATION 16
Lower guess = 4.271088
Upper guess = 4.271098

Mid-point = 4.271093

ITERATION 17

Lower guess = 4.271093

Upper guess = 4.271098

Mid-point = 4.271096

ITERATION 18

Lower guess = 4.271093

Upper guess = 4.271096

Mid-point = 4.271094

ITERATION 19

Lower guess = 4.271094

Upper guess = 4.271096

Mid-point = 4.271095

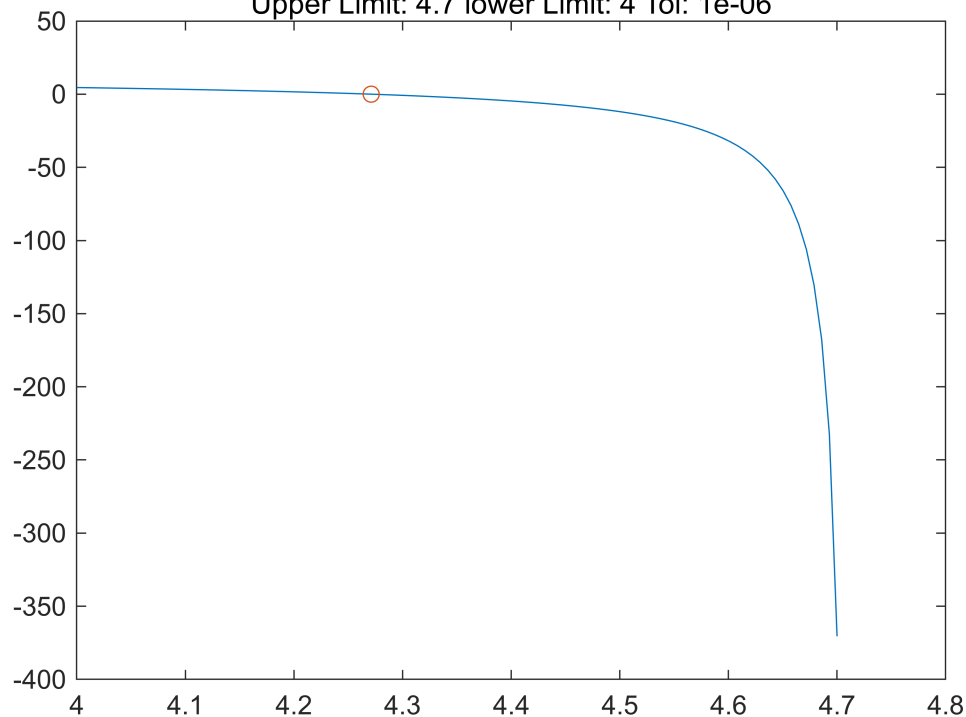
figure;

```
plot(x,function_R,root,0,'o')
```

```
title(['Root: ', num2str(root),' Number of iterations: ', num2str(counter),'  
Function : (sqrt(R.^2 - x.^2)) - x.*tan(x)'])
```

```
    subtitle(['Upper Limit: ', num2str(b),' lower Limit: ', num2str(a) ' Tol: ',  
num2str(tol)]);
```

Root: 4.2711 Number of iterations: 20 Function : (sqrt(R.² - x.²)) - x.*tan(x)
Upper Limit: 4.7 lower Limit: 4 Tol: 1e-06



```
x = linspace(1, 4, 100);
```

```
function_sinh = sinh_function(x);
```

```
figure;  
plot(x, function_sinh)  
hold on  
function_sinh = sinh_function(1)
```

```
function_sinh =  
    0.988897705762865
```

```
function_sinh = sinh_function(4)
```

```
function_sinh =  
   -20.653077431533
```

```
%% d  
tol = 1e-6;  
imax = 50;  
a = 1;  
b = 4;  
[root,counter] = bisect2( @sinh_function, a, b, imax, tol);
```

```
ITERATION 0  
Lower guess = 1.000000  
Upper guess = 4.000000  
Mid-point = 2.500000
```

```
ITERATION 1  
Lower guess = 2.500000  
Upper guess = 4.000000  
Mid-point = 3.250000
```

```
ITERATION 2  
Lower guess = 2.500000  
Upper guess = 3.250000  
Mid-point = 2.875000
```

```
ITERATION 3  
Lower guess = 2.875000  
Upper guess = 3.250000  
Mid-point = 3.062500
```

```
ITERATION 4  
Lower guess = 3.062500  
Upper guess = 3.250000  
Mid-point = 3.156250
```

```
ITERATION 5  
Lower guess = 3.062500  
Upper guess = 3.156250  
Mid-point = 3.109375
```

```
ITERATION 6  
Lower guess = 3.109375  
Upper guess = 3.156250  
Mid-point = 3.132812
```

```
ITERATION 7  
Lower guess = 3.132812  
Upper guess = 3.156250  
Mid-point = 3.144531
```

ITERATION 8
Lower guess = 3.132812
Upper guess = 3.144531
Mid-point = 3.138672

ITERATION 9
Lower guess = 3.138672
Upper guess = 3.144531
Mid-point = 3.141602

ITERATION 10
Lower guess = 3.138672
Upper guess = 3.141602
Mid-point = 3.140137

ITERATION 11
Lower guess = 3.140137
Upper guess = 3.141602
Mid-point = 3.140869

ITERATION 12
Lower guess = 3.140869
Upper guess = 3.141602
Mid-point = 3.141235

ITERATION 13
Lower guess = 3.141235
Upper guess = 3.141602
Mid-point = 3.141418

ITERATION 14
Lower guess = 3.141418
Upper guess = 3.141602
Mid-point = 3.141510

ITERATION 15
Lower guess = 3.141510
Upper guess = 3.141602
Mid-point = 3.141556

ITERATION 16
Lower guess = 3.141556
Upper guess = 3.141602
Mid-point = 3.141579

ITERATION 17
Lower guess = 3.141579
Upper guess = 3.141602
Mid-point = 3.141590

ITERATION 18
Lower guess = 3.141590
Upper guess = 3.141602
Mid-point = 3.141596

ITERATION 19
Lower guess = 3.141590
Upper guess = 3.141596
Mid-point = 3.141593

ITERATION 20
Lower guess = 3.141590
Upper guess = 3.141593
Mid-point = 3.141592

```

ITERATION 21
Lower guess = 3.141592
Upper guess = 3.141593
Mid-point = 3.141592

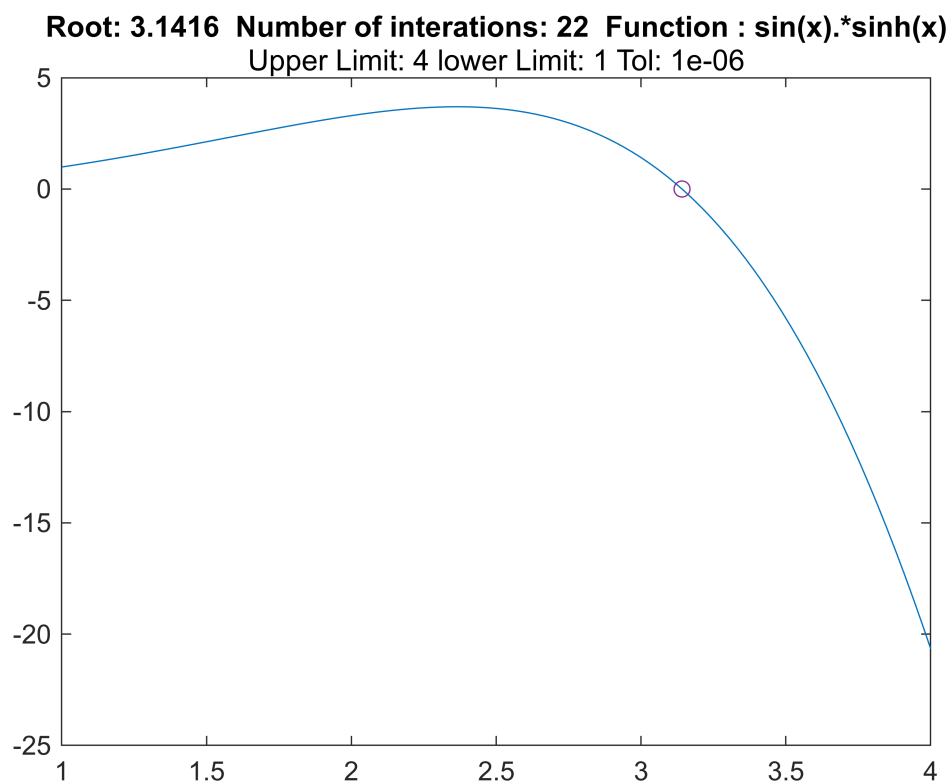
```

```

plot(x,function_sinh,root,0,'o')
hold off

title(['Root: ', num2str(root), ' Number of iterations: ', num2str(counter), '
Function : sin(x).*sinh(x)'])
    subtitle(['Upper Limit: ', num2str(b), ' lower Limit: ', num2str(a) ' Tol: ',
num2str(tol)]);

```



2 Newtons $f(x) = e^x - (1 + x + (x^2/2))$ [3]

```

%% Newtons Method
% first function
imax = 50;
tol = 1e-6;
syms x
Derv1_sym = diff(exp(x) - (1 + x + ((x^2)/2)));
x_guess = 5;
[x_next,counter] = Newton(@Function1,@Derv1, imax, tol, x_guess );

```

ITERATION 1
First Guess = 5.000000
Next guess = 4.087773

ITERATION 2
First Guess = 4.087773
Next guess = 3.241020

ITERATION 3
First Guess = 3.241020
Next guess = 2.487381

ITERATION 4
First Guess = 2.487381
Next guess = 1.849522

ITERATION 5
First Guess = 1.849522
Next guess = 1.337187

ITERATION 6
First Guess = 1.337187
Next guess = 0.944907

ITERATION 7
First Guess = 0.944907
Next guess = 0.656151

ITERATION 8
First Guess = 0.656151
Next guess = 0.449883

ITERATION 9
First Guess = 0.449883
Next guess = 0.305706

ITERATION 10
First Guess = 0.305706
Next guess = 0.206451

ITERATION 11
First Guess = 0.206451
Next guess = 0.138834

ITERATION 12
First Guess = 0.138834
Next guess = 0.093096

ITERATION 13
First Guess = 0.093096
Next guess = 0.062307

ITERATION 14
First Guess = 0.062307
Next guess = 0.041646

ITERATION 15
First Guess = 0.041646
Next guess = 0.027812

ITERATION 16
First Guess = 0.027812
Next guess = 0.018563

ITERATION 17
First Guess = 0.018563
Next guess = 0.012385

ITERATION 18
First Guess = 0.012385
Next guess = 0.008261

ITERATION 19
First Guess = 0.008261
Next guess = 0.005509

ITERATION 20
First Guess = 0.005509
Next guess = 0.003674

ITERATION 21
First Guess = 0.003674
Next guess = 0.002449

ITERATION 22
First Guess = 0.002449
Next guess = 0.001633

ITERATION 23
First Guess = 0.001633
Next guess = 0.001089

ITERATION 24
First Guess = 0.001089
Next guess = 0.000726

ITERATION 25
First Guess = 0.000726
Next guess = 0.000484

ITERATION 26
First Guess = 0.000484
Next guess = 0.000323

ITERATION 27
First Guess = 0.000323
Next guess = 0.000215

ITERATION 28
First Guess = 0.000215
Next guess = 0.000143

ITERATION 29
First Guess = 0.000143
Next guess = 0.000096

ITERATION 30
First Guess = 0.000096
Next guess = 0.000064

ITERATION 31
First Guess = 0.000064
Next guess = 0.000043

ITERATION 32
First Guess = 0.000043
Next guess = 0.000028

ITERATION 33
First Guess = 0.000028
Next guess = 0.000019

ITERATION 34
First Guess = 0.000019
Next guess = 0.000011

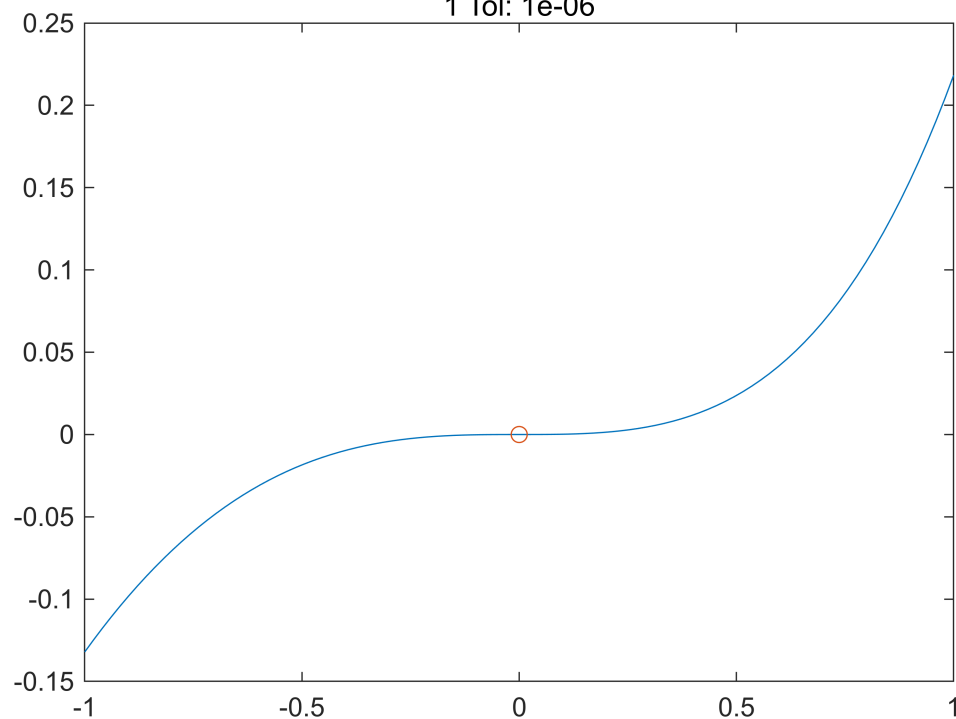
ITERATION 35
First Guess = 0.000011
Next guess = 0.000008

ITERATION 36
First Guess = 0.000008
Next guess = 0.000001

ITERATION 37
First Guess = 0.000001
Next guess = 0.000001

```
figure;  
x1 = linspace(-1, 1, 100);  
function1 = Function1(x1);  
% plot graph  
plot(x1,function1,x_next,0,'o')  
title(['Root: ', num2str(x_next), ' Number of iterations: ', num2str(counter), '  
Function : (exp(x) - (1 + x + ((x^2)/2)))'])  
subtitle([ num2str(a) ' Tol: ', num2str(tol)]);
```

Root: 8.6219e-07 Number of iterations: 37 Function : (exp(x) - (1 + x + ((x²)/2)))
1 Tol: 1e-06



2 Newtons $f(x) = 10\log(x)-x$ [3]

```
% Second Function
syms x
Derv2_syms = diff(10*log(x) - x) ;
x_guess = 1;
[x_next,counter] = Newton(@function2,@derv2, imax, tol, x_guess );
```

```
ITERATION 1
First Guess = 1.000000
Next guess = 1.111111
```

```
ITERATION 2
First Guess = 1.111111
Next guess = 1.118299
```

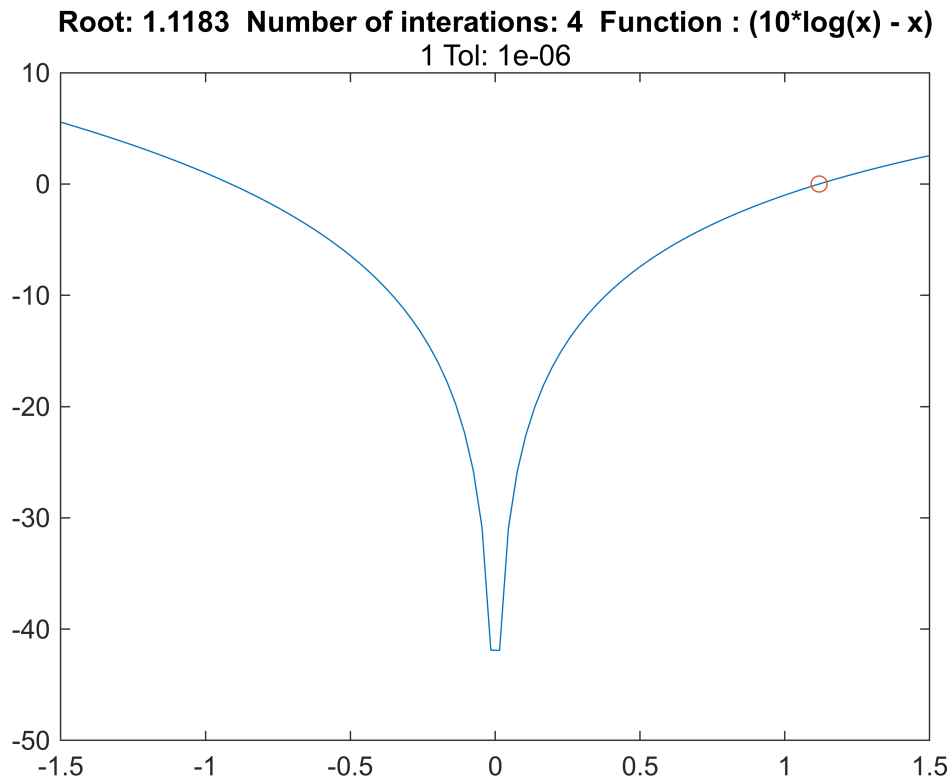
```
ITERATION 3
First Guess = 1.118299
Next guess = 1.118326
```

```
ITERATION 4
First Guess = 1.118326
Next guess = 1.118326
```

```
% plot graph
figure;
x1 = linspace(-1.5, 1.5, 100);
function_2 = function2(x1);
plot(x1,function_2,x_next,0,'o')
```

Warning: Imaginary parts of complex X and/or Y arguments ignored.

```
title(['Root: ', num2str(x_next), ' Number of iterations: ', num2str(counter), '
Function : (10*log(x) - x)'])
    subtitle([ num2str(a) ' Tol: ', num2str(tol)]);
```



3 Newtons Intersect [6]

%% Newtons Method- Intersection of two functions

```
syms x
derv4_syms = diff(100*exp(-x) - 5 * sin((pi*x)/2));

x_guess = 4;
imax = 20;
tol = 1e-6;

[x_next,counter] = Newton(@Function_4,@derv4, imax, tol, x_guess );
```

```
ITERATION 1
First Guess = 4.000000
Next guess = 4.189103
```

```
ITERATION 2
First Guess = 4.189103
Next guess = 4.194922
```

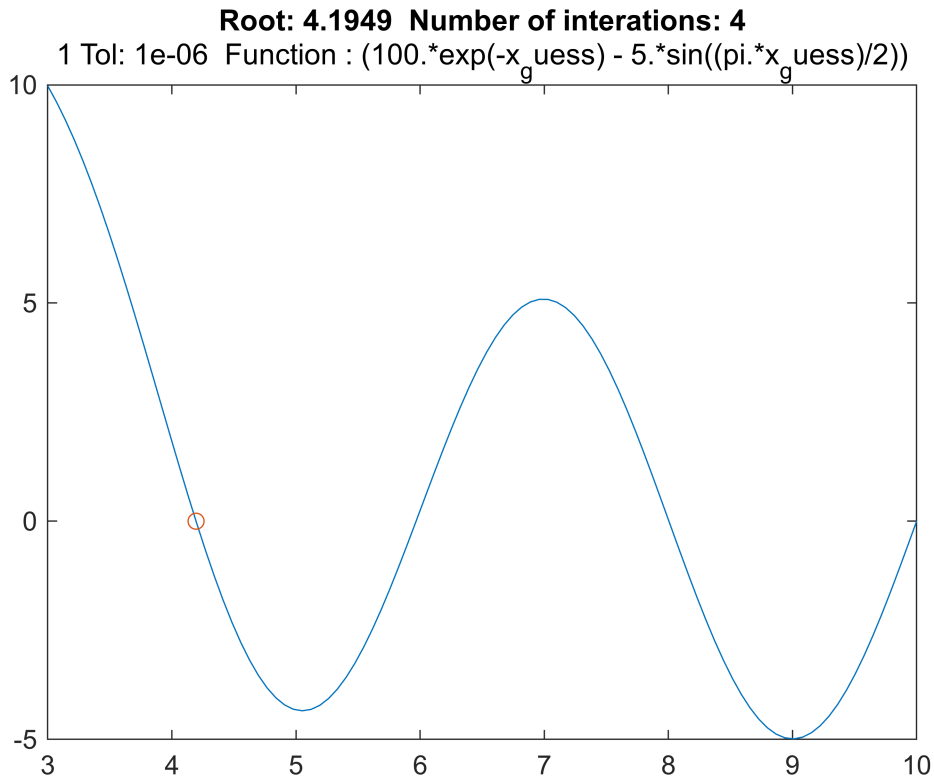
```
ITERATION 3
First Guess = 4.194922
Next guess = 4.194932
```

```
ITERATION 4
First Guess = 4.194932
Next guess = 4.194932
```

```

% plot graph
figure;
x1 = linspace(3, 10, 100);
function4 = Function_4(x1);
plot(x1,function4,x_next,0,'o')
title(['Root: ', num2str(x_next),' Number of iterations: ', num2str(counter)])
    subtitle([ num2str(a) ' Tol: ', num2str(tol),' Function : (100.*exp(-x_guess)
- 5.*sin((pi.*x_guess)/2))']);

```



%% Newtons Method - Intersection of two functions at 1e-10

```
tol = 1e-10;
```

```
[x_next,counter] = Newton(@Function_4,@derv4, imax, tol, x_guess );
```

ITERATION 1

First Guess = 4.000000

Next guess = 4.189103

ITERATION 2

First Guess = 4.189103

Next guess = 4.194922

ITERATION 3

First Guess = 4.194922

Next guess = 4.194932

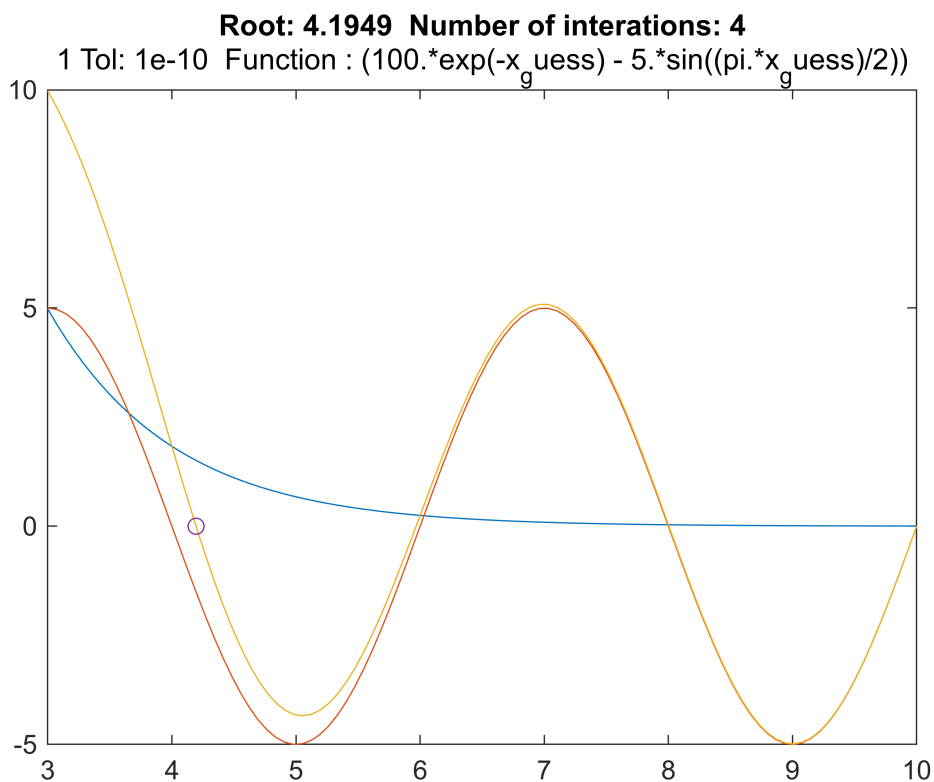
ITERATION 4

First Guess = 4.194932
Next guess = 4.194932

```
% plot graph
figure;
x1 = linspace(3, 10, 100);
function4 = Function_4(x1);

syms x
function5 = Function_5(x1);
function6 = Function_6(x1);

plot(x1,function5)
hold on
plot(x1,function6)
plot(x1,function4,x_next,0,'o')
hold off
title(['Root: ', num2str(x_next), ' Number of iterations: ', num2str(counter)])
    subtitle([ num2str(a) ' Tol: ', num2str(tol), ' Function : (100.*exp(-x_guess)
- 5.*sin((pi.*x_guess)/2))']);
```



4 Bracketing Bisect [6]

```

%% B Bisection method
f = @(x) 100 * exp(-x) - 5 * sin((pi * x) / 2); % Define the function
a = 4; % Start of interval
b = 10; % End of interval
tol = 1e-6; % Tolerance for root finding

% Find all roots in the interval
roots = bisectionAllRoots(f, a, b, tol)

```

```

roots = 1×4
    4.19493188476563    5.96737817382812    8.00425366210937 ...

```

```

% Display the results
disp('Roots found bisection:');

```

Roots found bisection:

```

disp(roots);

```

```

    4.19493188476563    5.96737817382812    8.00425366210937    9.99942211914063

```

4 Bracketing Newton [6]

```

%% Newtons Method
f = @(x) 100*exp(-x) - 5*sin((pi*x)/2);
roots = newtonsAllRoots(f, tol, imax)

```

```

ITERATION 1
First Guess = 4.000000
Next guess = 4.189103

```

```

ITERATION 2
First Guess = 4.189103
Next guess = 4.194922

```

```

ITERATION 3
First Guess = 4.194922
Next guess = 4.194932

```

```

ITERATION 4
First Guess = 4.194932
Next guess = 4.194932

```

```

ITERATION 1
First Guess = 4.060606
Next guess = 4.191453

```

```

ITERATION 2
First Guess = 4.191453
Next guess = 4.194928

```

```

ITERATION 3
First Guess = 4.194928
Next guess = 4.194932

```

```

ITERATION 4
First Guess = 4.194932

```

Next guess = 4.194932

ITERATION 1

First Guess = 4.121212

Next guess = 4.193656

ITERATION 2

First Guess = 4.193656

Next guess = 4.194931

ITERATION 3

First Guess = 4.194931

Next guess = 4.194932

ITERATION 1

First Guess = 4.181818

Next guess = 4.194883

ITERATION 2

First Guess = 4.194883

Next guess = 4.194932

ITERATION 3

First Guess = 4.194932

Next guess = 4.194932

ITERATION 1

First Guess = 4.242424

Next guess = 4.194188

ITERATION 2

First Guess = 4.194188

Next guess = 4.194931

ITERATION 3

First Guess = 4.194931

Next guess = 4.194932

ITERATION 1

First Guess = 4.303030

Next guess = 4.190429

ITERATION 2

First Guess = 4.190429

Next guess = 4.194926

ITERATION 3

First Guess = 4.194926

Next guess = 4.194932

ITERATION 4

First Guess = 4.194932

Next guess = 4.194932

ITERATION 1

First Guess = 4.363636

Next guess = 4.182173

ITERATION 2

First Guess = 4.182173

Next guess = 4.194886

ITERATION 3

First Guess = 4.194886

Next guess = 4.194932

ITERATION 4

First Guess = 4.194932

Next guess = 4.194932

ITERATION 1

First Guess = 4.424242

Next guess = 4.167532

ITERATION 2

First Guess = 4.167532

Next guess = 4.194730

ITERATION 3

First Guess = 4.194730

Next guess = 4.194932

ITERATION 4

First Guess = 4.194932

Next guess = 4.194932

ITERATION 1

First Guess = 4.484848

Next guess = 4.143904

ITERATION 2

First Guess = 4.143904

Next guess = 4.194277

ITERATION 3

First Guess = 4.194277

Next guess = 4.194931

ITERATION 4

First Guess = 4.194931

Next guess = 4.194932

ITERATION 1

First Guess = 4.545455

Next guess = 4.107533

ITERATION 2

First Guess = 4.107533

Next guess = 4.193213

ITERATION 3

First Guess = 4.193213

Next guess = 4.194931

ITERATION 4

First Guess = 4.194931

Next guess = 4.194932

ITERATION 1

First Guess = 4.606061

Next guess = 4.052713

ITERATION 2

First Guess = 4.052713

Next guess = 4.191139

ITERATION 3

First Guess = 4.191139

Next guess = 4.194927

ITERATION 4

First Guess = 4.194927

Next guess = 4.194932

ITERATION 5

First Guess = 4.194932

Next guess = 4.194932

ITERATION 1

First Guess = 4.666667

Next guess = 3.970236

ITERATION 2

First Guess = 3.970236

Next guess = 4.188127

ITERATION 3

First Guess = 4.188127

Next guess = 4.194918

ITERATION 4

First Guess = 4.194918

Next guess = 4.194932

ITERATION 5

First Guess = 4.194932

Next guess = 4.194932

ITERATION 1

First Guess = 4.727273

Next guess = 3.844112

ITERATION 2

First Guess = 3.844112

Next guess = 4.187616

ITERATION 3

First Guess = 4.187616

Next guess = 4.194916

ITERATION 4

First Guess = 4.194916

Next guess = 4.194932

ITERATION 5

First Guess = 4.194932

Next guess = 4.194932

ITERATION 1

First Guess = 4.787879

Next guess = 3.643779

ITERATION 2

First Guess = 3.643779

Next guess = 4.212116

ITERATION 3

First Guess = 4.212116

Next guess = 4.194842

ITERATION 4

First Guess = 4.194842

Next guess = 4.194932

ITERATION 5

First Guess = 4.194932

Next guess = 4.194932

ITERATION 1

First Guess = 4.848485

Next guess = 3.302377

ITERATION 2

First Guess = 3.302377

Next guess = 4.419934

ITERATION 3

First Guess = 4.419934

Next guess = 4.168833

ITERATION 4

First Guess = 4.168833

Next guess = 4.194748

ITERATION 5

First Guess = 4.194748

Next guess = 4.194932

ITERATION 6

First Guess = 4.194932

Next guess = 4.194932

ITERATION 1

First Guess = 4.909091

Next guess = 2.639713

ITERATION 2

First Guess = 2.639713

Next guess = 6.520592

ITERATION 3

First Guess = 6.520592

Next guess = 5.794053

ITERATION 4

First Guess = 5.794053

Next guess = 5.973957

ITERATION 5

First Guess = 5.973957

Next guess = 5.967381

ITERATION 6

First Guess = 5.967381

Next guess = 5.967379

ITERATION 7

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 4.969697

Next guess = 0.944533

ITERATION 2

First Guess = 0.944533

Next guess = 1.801381

ITERATION 3

First Guess = 1.801381

Next guess = 3.459032

ITERATION 4

First Guess = 3.459032

Next guess = 4.287457

ITERATION 5

First Guess = 4.287457

Next guess = 4.191760

ITERATION 6

First Guess = 4.191760

Next guess = 4.194929

ITERATION 7

First Guess = 4.194929

Next guess = 4.194932

ITERATION 8

First Guess = 4.194932

Next guess = 4.194932

ITERATION 1

First Guess = 5.030303

Next guess = -10.473391

ITERATION 2

First Guess = -10.473391

Next guess = -9.473391

ITERATION 3

First Guess = -9.473391

Next guess = -8.473384

ITERATION 4

First Guess = -8.473384

Next guess = -7.473389

ITERATION 5

First Guess = -7.473389

Next guess = -6.473440

ITERATION 6

First Guess = -6.473440

Next guess = -5.473403

ITERATION 7

First Guess = -5.473403

Next guess = -4.473025

ITERATION 8

First Guess = -4.473025

Next guess = -3.473299

ITERATION 9

First Guess = -3.473299

Next guess = -2.476085

ITERATION 10

First Guess = -2.476085

Next guess = -1.474093

ITERATION 11

First Guess = -1.474093

Next guess = -0.453231

ITERATION 12

First Guess = -0.453231

Next guess = 0.530358

ITERATION 13

First Guess = 0.530358

Next guess = 1.390272

ITERATION 14

First Guess = 1.390272

Next guess = 2.411334

ITERATION 15

First Guess = 2.411334

Next guess = 6.850450

ITERATION 16

First Guess = 6.850450

Next guess = 3.965400

ITERATION 17

First Guess = 3.965400

Next guess = 4.187988

ITERATION 18

First Guess = 4.187988

Next guess = 4.194918

ITERATION 19

First Guess = 4.194918

Next guess = 4.194932

ITERATION 20

First Guess = 4.194932

Next guess = 4.194932

ITERATION 1

First Guess = 5.090909

Next guess = 13.715589

ITERATION 2

First Guess = 13.715589

Next guess = 14.020554

ITERATION 3

First Guess = 14.020554

Next guess = 13.999982

ITERATION 4

First Guess = 13.999982

Next guess = 13.999989

ITERATION 5

First Guess = 13.999989

Next guess = 13.999989

ITERATION 1

First Guess = 5.151515

Next guess = 8.514748

ITERATION 2

First Guess = 8.514748

Next guess = 7.854067

ITERATION 3

First Guess = 7.854067

Next guess = 8.006910

ITERATION 4

First Guess = 8.006910

Next guess = 8.004253

ITERATION 5

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 5.212121

Next guess = 7.277565

ITERATION 2

First Guess = 7.277565

Next guess = 8.636518

ITERATION 3

First Guess = 8.636518

Next guess = 7.653681

ITERATION 4

First Guess = 7.653681

Next guess = 8.043066

ITERATION 5

First Guess = 8.043066

Next guess = 8.004194

ITERATION 6

First Guess = 8.004194

Next guess = 8.004253

ITERATION 7

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 5.272727

Next guess = 6.740232

ITERATION 2

First Guess = 6.740232

Next guess = 5.170113

ITERATION 3

First Guess = 5.170113

Next guess = 7.996028

ITERATION 4

First Guess = 7.996028

Next guess = 8.004253

ITERATION 5

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 5.333333

Next guess = 6.450381

ITERATION 2

First Guess = 6.450381

Next guess = 5.864009

ITERATION 3

First Guess = 5.864009

Next guess = 5.968992

ITERATION 4

First Guess = 5.968992

Next guess = 5.967379

ITERATION 5

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 5.393939

Next guess = 6.276203

ITERATION 2

First Guess = 6.276203

Next guess = 5.946159

ITERATION 3

First Guess = 5.946159

Next guess = 5.967413

ITERATION 4

First Guess = 5.967413

Next guess = 5.967379

ITERATION 5

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 5.454545

Next guess = 6.165182

ITERATION 2

First Guess = 6.165182

Next guess = 5.962910

ITERATION 3

First Guess = 5.962910

Next guess = 5.967380

ITERATION 4

First Guess = 5.967380

Next guess = 5.967379

ITERATION 5

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 5.515152

Next guess = 6.092217

ITERATION 2

First Guess = 6.092217

Next guess = 5.966612

ITERATION 3

First Guess = 5.966612

Next guess = 5.967379

ITERATION 4

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 5.575758

Next guess = 6.043753

ITERATION 2

First Guess = 6.043753

Next guess = 5.967336

ITERATION 3

First Guess = 5.967336

Next guess = 5.967379

ITERATION 4

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 5.636364

Next guess = 6.011787

ITERATION 2

First Guess = 6.011787

Next guess = 5.967419

ITERATION 3

First Guess = 5.967419

Next guess = 5.967379

ITERATION 4

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 5.696970

Next guess = 5.991242

ITERATION 2

First Guess = 5.991242

Next guess = 5.967400

ITERATION 3

First Guess = 5.967400

Next guess = 5.967379

ITERATION 4

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 5.757576

Next guess = 5.978697

ITERATION 2

First Guess = 5.978697

Next guess = 5.967385

ITERATION 3

First Guess = 5.967385

Next guess = 5.967379

ITERATION 4

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 5.818182

Next guess = 5.971716

ITERATION 2

First Guess = 5.971716

Next guess = 5.967380

ITERATION 3

First Guess = 5.967380

Next guess = 5.967379

ITERATION 4

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 5.878788

Next guess = 5.968457

ITERATION 2

First Guess = 5.968457

Next guess = 5.967379

ITERATION 3

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 5.939394

Next guess = 5.967444

ITERATION 2

First Guess = 5.967444

Next guess = 5.967379

ITERATION 3

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 6.000000

Next guess = 5.967411

ITERATION 2

First Guess = 5.967411

Next guess = 5.967379

ITERATION 3

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 6.060606

Next guess = 5.967189

ITERATION 2

First Guess = 5.967189

Next guess = 5.967379

ITERATION 3

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 6.121212

Next guess = 5.965611

ITERATION 2

First Guess = 5.965611

Next guess = 5.967379

ITERATION 3

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 6.181818

Next guess = 5.961421

ITERATION 2

First Guess = 5.961421

Next guess = 5.967381

ITERATION 3

First Guess = 5.967381

Next guess = 5.967379

ITERATION 4

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 6.242424

Next guess = 5.953166

ITERATION 2

First Guess = 5.953166

Next guess = 5.967393

ITERATION 3

First Guess = 5.967393

Next guess = 5.967379

ITERATION 4

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 6.303030

Next guess = 5.939060

ITERATION 2

First Guess = 5.939060

Next guess = 5.967446

ITERATION 3

First Guess = 5.967446

Next guess = 5.967379

ITERATION 4

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 6.363636

Next guess = 5.916773

ITERATION 2

First Guess = 5.916773

Next guess = 5.967642

ITERATION 3

First Guess = 5.967642

Next guess = 5.967379

ITERATION 4

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 6.424242

Next guess = 5.883115

ITERATION 2

First Guess = 5.883115

Next guess = 5.968326

ITERATION 3

First Guess = 5.968326

Next guess = 5.967379

ITERATION 4

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 6.484848

Next guess = 5.833488

ITERATION 2

First Guess = 5.833488

Next guess = 5.970604

ITERATION 3

First Guess = 5.970604

Next guess = 5.967379

ITERATION 4

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 6.545455

Next guess = 5.760910

ITERATION 2

First Guess = 5.760910

Next guess = 5.978188

ITERATION 3

First Guess = 5.978188

Next guess = 5.967384

ITERATION 4

First Guess = 5.967384

Next guess = 5.967379

ITERATION 5

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 6.606061

Next guess = 5.654120

ITERATION 2

First Guess = 5.654120

Next guess = 6.004761

ITERATION 3

First Guess = 6.004761

Next guess = 5.967415

ITERATION 4

First Guess = 5.967415

Next guess = 5.967379

ITERATION 5

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 6.666667

Next guess = 5.493585

ITERATION 2

First Guess = 5.493585

Next guess = 6.114827

ITERATION 3

First Guess = 6.114827

Next guess = 5.965877

ITERATION 4

First Guess = 5.965877

Next guess = 5.967379

ITERATION 5

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 6.727273

Next guess = 5.242031

ITERATION 2

First Guess = 5.242031

Next guess = 6.966576

ITERATION 3

First Guess = 6.966576

Next guess = -9.038048

ITERATION 4

First Guess = -9.038048

Next guess = -8.038041

ITERATION 5

First Guess = -8.038041

Next guess = -7.038066

ITERATION 6

First Guess = -7.038066

Next guess = -6.038114

ITERATION 7

First Guess = -6.038114

Next guess = -5.037934

ITERATION 8

First Guess = -5.037934

Next guess = -4.037580

ITERATION 9

First Guess = -4.037580

Next guess = -3.038909

ITERATION 10

First Guess = -3.038909

Next guess = -2.041528

ITERATION 11

First Guess = -2.041528

Next guess = -1.031676

ITERATION 12

First Guess = -1.031676

Next guess = -0.012458

ITERATION 13

First Guess = -0.012458

Next guess = 0.916468

ITERATION 14

First Guess = 0.916468

Next guess = 1.770575

ITERATION 15

First Guess = 1.770575

Next guess = 3.348027

ITERATION 16

First Guess = 3.348027

Next guess = 4.372816

ITERATION 17

First Guess = 4.372816

Next guess = 4.180420

ITERATION 18

First Guess = 4.180420

Next guess = 4.194873

ITERATION 19

First Guess = 4.194873

Next guess = 4.194932

ITERATION 20

First Guess = 4.194932

Next guess = 4.194932

ITERATION 1

First Guess = 6.787879

Next guess = 4.818155

ITERATION 2

First Guess = 4.818155

Next guess = 3.497743

ITERATION 3

First Guess = 3.497743

Next guess = 4.265765

ITERATION 4

First Guess = 4.265765

Next guess = 4.193173

ITERATION 5

First Guess = 4.193173

Next guess = 4.194931

ITERATION 6

First Guess = 4.194931

Next guess = 4.194932

ITERATION 1

First Guess = 6.848485

Next guess = 4.003999

ITERATION 2

First Guess = 4.003999

Next guess = 4.189247

ITERATION 3

First Guess = 4.189247

Next guess = 4.194922

ITERATION 4

First Guess = 4.194922

Next guess = 4.194932

ITERATION 5

First Guess = 4.194932

Next guess = 4.194932

ITERATION 1

First Guess = 6.909091

Next guess = 1.948766

ITERATION 2

First Guess = 1.948766

Next guess = 4.106205

ITERATION 3

First Guess = 4.106205

Next guess = 4.193167

ITERATION 4

First Guess = 4.193167

Next guess = 4.194931

ITERATION 5

First Guess = 4.194931

Next guess = 4.194932

ITERATION 1

First Guess = 6.969697

Next guess = -11.221511

ITERATION 2

First Guess = -11.221511

Next guess = -10.221512

ITERATION 3

First Guess = -10.221512

Next guess = -9.221510

ITERATION 4

First Guess = -9.221510

Next guess = -8.221502

ITERATION 5

First Guess = -8.221502

Next guess = -7.221518

ITERATION 6

First Guess = -7.221518

Next guess = -6.221572

ITERATION 7

First Guess = -6.221572

Next guess = -5.221459

ITERATION 8

First Guess = -5.221459

Next guess = -4.221060

ITERATION 9

First Guess = -4.221060

Next guess = -3.221894

ITERATION 10

First Guess = -3.221894

Next guess = -2.224835

ITERATION 11

First Guess = -2.224835

Next guess = -1.218690

ITERATION 12

First Guess = -1.218690

Next guess = -0.196782

ITERATION 13

First Guess = -0.196782

Next guess = 0.757093

ITERATION 14

First Guess = 0.757093

Next guess = 1.605269

ITERATION 15

First Guess = 1.605269

Next guess = 2.859927

ITERATION 16

First Guess = 2.859927

Next guess = 5.502946

ITERATION 17

First Guess = 5.502946

Next guess = 6.104609

ITERATION 18

First Guess = 6.104609

Next guess = 5.966248

ITERATION 19

First Guess = 5.966248

Next guess = 5.967379

ITERATION 20

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 7.030303

Next guess = 18.027903

ITERATION 2

First Guess = 18.027903

Next guess = 17.999982

ITERATION 3

First Guess = 17.999982

Next guess = 18.000000

ITERATION 4

First Guess = 18.000000

Next guess = 18.000000

ITERATION 1

First Guess = 7.090909

Next guess = 11.281053

ITERATION 2

First Guess = 11.281053

Next guess = 12.628022

ITERATION 3

First Guess = 12.628022

Next guess = 11.665540

ITERATION 4

First Guess = 11.665540

Next guess = 12.034676

ITERATION 5

First Guess = 12.034676

Next guess = 12.000044

ITERATION 6

First Guess = 12.000044

Next guess = 12.000078

ITERATION 7

First Guess = 12.000078

Next guess = 12.000078

ITERATION 1

First Guess = 7.151515

Next guess = 9.709748

ITERATION 2

First Guess = 9.709748

Next guess = 10.021345

ITERATION 3

First Guess = 10.021345

Next guess = 9.999413

ITERATION 4

First Guess = 9.999413

Next guess = 9.999422

ITERATION 5

First Guess = 9.999422

Next guess = 9.999422

ITERATION 1

First Guess = 7.212121

Next guess = 9.028084

ITERATION 2

First Guess = 9.028084

Next guess = 23.931543

ITERATION 3

First Guess = 23.931543

Next guess = 24.000265

ITERATION 4

First Guess = 24.000265

Next guess = 24.000000

ITERATION 5

First Guess = 24.000000

Next guess = 24.000000

ITERATION 1

First Guess = 7.272727

Next guess = 8.658521

ITERATION 2

First Guess = 8.658521

Next guess = 7.596660

ITERATION 3

First Guess = 7.596660

Next guess = 8.068504

ITERATION 4

First Guess = 8.068504

Next guess = 8.004005

ITERATION 5

First Guess = 8.004005

Next guess = 8.004253

ITERATION 6

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 7.333333

Next guess = 8.434311

ITERATION 2

First Guess = 8.434311

Next guess = 7.922554

ITERATION 3

First Guess = 7.922554

Next guess = 8.004652

ITERATION 4

First Guess = 8.004652

Next guess = 8.004253

ITERATION 5

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 7.393939

Next guess = 8.289358

ITERATION 2

First Guess = 8.289358

Next guess = 7.982927

ITERATION 3

First Guess = 7.982927

Next guess = 8.004258

ITERATION 4

First Guess = 8.004258

Next guess = 8.004253

ITERATION 5

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 7.454545

Next guess = 8.192196

ITERATION 2

First Guess = 8.192196

Next guess = 7.998347

ITERATION 3

First Guess = 7.998347

Next guess = 8.004253

ITERATION 4

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 7.515152

Next guess = 8.125898

ITERATION 2

First Guess = 8.125898

Next guess = 8.002647

ITERATION 3

First Guess = 8.002647

Next guess = 8.004253

ITERATION 4

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 7.575758

Next guess = 8.080514

ITERATION 2

First Guess = 8.080514

Next guess = 8.003845

ITERATION 3

First Guess = 8.003845

Next guess = 8.004253

ITERATION 4

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 7.636364

Next guess = 8.049779

ITERATION 2

First Guess = 8.049779

Next guess = 8.004161

ITERATION 3

First Guess = 8.004161

Next guess = 8.004253

ITERATION 4

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 7.696970

Next guess = 8.029513

ITERATION 2

First Guess = 8.029513

Next guess = 8.004235

ITERATION 3

First Guess = 8.004235

Next guess = 8.004253

ITERATION 4

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 7.757576

Next guess = 8.016783

ITERATION 2

First Guess = 8.016783

Next guess = 8.004250

ITERATION 3

First Guess = 8.004250

Next guess = 8.004253

ITERATION 4

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 7.818182

Next guess = 8.009428

ITERATION 2

First Guess = 8.009428

Next guess = 8.004253

ITERATION 3

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 7.878788

Next guess = 8.005773

ITERATION 2

First Guess = 8.005773

Next guess = 8.004253

ITERATION 3

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 7.939394

Next guess = 8.004446

ITERATION 2

First Guess = 8.004446

Next guess = 8.004253

ITERATION 3

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 8.000000

Next guess = 8.004253

ITERATION 2

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 8.060606

Next guess = 8.004083

ITERATION 2

First Guess = 8.004083

Next guess = 8.004253

ITERATION 3

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 8.121212

Next guess = 8.002823

ITERATION 2

First Guess = 8.002823

Next guess = 8.004253

ITERATION 3

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 8.181818

Next guess = 7.999279

ITERATION 2

First Guess = 7.999279

Next guess = 8.004253

ITERATION 3

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 8.242424

Next guess = 7.992074

ITERATION 2

First Guess = 7.992074

Next guess = 8.004254

ITERATION 3

First Guess = 8.004254

Next guess = 8.004253

ITERATION 1

First Guess = 8.303030

Next guess = 7.979527

ITERATION 2

First Guess = 7.979527

Next guess = 8.004261

ITERATION 3

First Guess = 8.004261

Next guess = 8.004253

ITERATION 4

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 8.363636

Next guess = 7.959462

ITERATION 2

First Guess = 7.959462

Next guess = 8.004312

ITERATION 3

First Guess = 8.004312

Next guess = 8.004253

ITERATION 4

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 8.424242

Next guess = 7.928915

ITERATION 2

First Guess = 7.928915

Next guess = 8.004562

ITERATION 3

First Guess = 8.004562

Next guess = 8.004253

ITERATION 4

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 8.484848

Next guess = 7.883652

ITERATION 2

First Guess = 7.883652

Next guess = 8.005597

ITERATION 3

First Guess = 8.005597

Next guess = 8.004253

ITERATION 4

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 8.545455

Next guess = 7.817289

ITERATION 2

First Guess = 7.817289

Next guess = 8.009506

ITERATION 3

First Guess = 8.009506

Next guess = 8.004253

ITERATION 4

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 8.606061

Next guess = 7.719631

ITERATION 2

First Guess = 7.719631

Next guess = 8.024000

ITERATION 3

First Guess = 8.024000

Next guess = 8.004244

ITERATION 4

First Guess = 8.004244

Next guess = 8.004253

ITERATION 5

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 8.666667

Next guess = 7.573191

ITERATION 2

First Guess = 7.573191

Next guess = 8.082104

ITERATION 3

First Guess = 8.082104

Next guess = 8.003820

ITERATION 4

First Guess = 8.003820

Next guess = 8.004253

ITERATION 5

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 8.727273

Next guess = 7.345106

ITERATION 2

First Guess = 7.345106

Next guess = 8.401236

ITERATION 3

First Guess = 8.401236

Next guess = 7.941979

ITERATION 4

First Guess = 7.941979

Next guess = 8.004423

ITERATION 5

First Guess = 8.004423

Next guess = 8.004253

ITERATION 6

First Guess = 8.004253

Next guess = 8.004253

ITERATION 1

First Guess = 8.787879

Next guess = 6.965252

ITERATION 2

First Guess = 6.965252

Next guess = -8.262158

ITERATION 3

First Guess = -8.262158

Next guess = -7.262172

ITERATION 4

First Guess = -7.262172

Next guess = -6.262226

ITERATION 5

First Guess = -6.262226

Next guess = -5.262127

ITERATION 6

First Guess = -5.262127

Next guess = -4.261726

ITERATION 7

First Guess = -4.261726

Next guess = -3.262459

ITERATION 8

First Guess = -3.262459

Next guess = -2.265415

ITERATION 9

First Guess = -2.265415

Next guess = -1.260023

ITERATION 10

First Guess = -1.260023

Next guess = -0.237963

ITERATION 11

First Guess = -0.237963

Next guess = 0.721151

ITERATION 12

First Guess = 0.721151

Next guess = 1.569869

ITERATION 13

First Guess = 1.569869

Next guess = 2.774345

ITERATION 14

First Guess = 2.774345

Next guess = 5.885086

ITERATION 15

First Guess = 5.885086

Next guess = 5.968270

ITERATION 16

First Guess = 5.968270

Next guess = 5.967379

ITERATION 17

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 8.848485

Next guess = 6.252192

ITERATION 2

First Guess = 6.252192

Next guess = 5.951341

ITERATION 3

First Guess = 5.951341

Next guess = 5.967397

ITERATION 4

First Guess = 5.967397

Next guess = 5.967379

ITERATION 5

First Guess = 5.967379

Next guess = 5.967379

ITERATION 1

First Guess = 8.909091

Next guess = 4.546151

ITERATION 2

First Guess = 4.546151

Next guess = 4.107022

ITERATION 3

First Guess = 4.107022

Next guess = 4.193195

ITERATION 4

First Guess = 4.193195

Next guess = 4.194931

ITERATION 5

First Guess = 4.194931

Next guess = 4.194932

ITERATION 1

First Guess = 8.969697

Next guess = -3.921744

ITERATION 2

First Guess = -3.921744

Next guess = -2.923407

ITERATION 3

First Guess = -2.923407

Next guess = -1.925570

ITERATION 4

First Guess = -1.925570

Next guess = -0.913206

ITERATION 5

First Guess = -0.913206

Next guess = 0.102320

ITERATION 6

First Guess = 0.102320

Next guess = 1.015069

ITERATION 7

First Guess = 1.015069

Next guess = 1.881575

ITERATION 8

First Guess = 1.881575

Next guess = 3.785415

ITERATION 9

First Guess = 3.785415

Next guess = 4.190659

ITERATION 10

First Guess = 4.190659

Next guess = 4.194926

ITERATION 11

First Guess = 4.194926

Next guess = 4.194932

ITERATION 12

First Guess = 4.194932

Next guess = 4.194932

ITERATION 1

First Guess = 9.030303

Next guess = 22.803827

ITERATION 2

First Guess = 22.803827

Next guess = 20.803676

ITERATION 3

First Guess = 20.803676

Next guess = 18.805168

ITERATION 4

First Guess = 18.805168

Next guess = 16.790343

ITERATION 5

First Guess = 16.790343

Next guess = 14.927661

ITERATION 6

First Guess = 14.927661

Next guess = 9.348982

ITERATION 7

First Guess = 9.348982

Next guess = 10.391680

ITERATION 8

First Guess = 10.391680

Next guess = 9.941048

ITERATION 9

First Guess = 9.941048

Next guess = 9.999589

ITERATION 10

First Guess = 9.999589

Next guess = 9.999422

ITERATION 11

First Guess = 9.999422

Next guess = 9.999422

ITERATION 1

First Guess = 9.090909

Next guess = 13.553606

ITERATION 2

First Guess = 13.553606

Next guess = 14.091114

ITERATION 3

First Guess = 14.091114

Next guess = 13.999362

ITERATION 4

First Guess = 13.999362

Next guess = 13.999989

ITERATION 5

First Guess = 13.999989

Next guess = 13.999989

ITERATION 1

First Guess = 9.151515

Next guess = 11.785054

ITERATION 2

First Guess = 11.785054

Next guess = 12.008638

ITERATION 3

First Guess = 12.008638

Next guess = 12.000078

ITERATION 4

First Guess = 12.000078

Next guess = 12.000078

ITERATION 1

First Guess = 9.212121

Next guess = 11.054788

ITERATION 2

First Guess = 11.054788

Next guess = 18.418962

ITERATION 3

First Guess = 18.418962

Next guess = 17.926810

ITERATION 4

First Guess = 17.926810

Next guess = 18.000324

ITERATION 5

First Guess = 18.000324

Next guess = 18.000000

ITERATION 6

First Guess = 18.000000

Next guess = 18.000000

ITERATION 1

First Guess = 9.272727

Next guess = 10.667868

ITERATION 2

First Guess = 10.667868

Next guess = 9.559135

ITERATION 3

First Guess = 9.559135

Next guess = 10.086700

ITERATION 4

First Guess = 10.086700

Next guess = 9.998878

ITERATION 5

First Guess = 9.998878

Next guess = 9.999422

ITERATION 6

First Guess = 9.999422

Next guess = 9.999422

ITERATION 1

First Guess = 9.333333

Next guess = 10.436223

ITERATION 2

First Guess = 10.436223

Next guess = 9.915162

ITERATION 3

First Guess = 9.915162

Next guess = 9.999925

ITERATION 4

First Guess = 9.999925

Next guess = 9.999422

ITERATION 5

First Guess = 9.999422

Next guess = 9.999422

ITERATION 1

First Guess = 9.393939

Next guess = 10.287753

ITERATION 2

First Guess = 10.287753

Next guess = 9.978027

ITERATION 3

First Guess = 9.978027

Next guess = 9.999430

ITERATION 4

First Guess = 9.999430

Next guess = 9.999422

ITERATION 5

First Guess = 9.999422

Next guess = 9.999422

ITERATION 1

First Guess = 9.454545

Next guess = 10.188839

ITERATION 2

First Guess = 10.188839

Next guess = 9.993661

ITERATION 3

First Guess = 9.993661

Next guess = 9.999422

ITERATION 4

First Guess = 9.999422

Next guess = 9.999422

ITERATION 1

First Guess = 9.515152

Next guess = 10.121657

ITERATION 2

First Guess = 10.121657

Next guess = 9.997911

ITERATION 3

First Guess = 9.997911

Next guess = 9.999422

ITERATION 4

First Guess = 9.999422

Next guess = 9.999422

ITERATION 1

First Guess = 9.575758

Next guess = 10.075839

ITERATION 2

First Guess = 10.075839

Next guess = 9.999058

ITERATION 3

First Guess = 9.999058

Next guess = 9.999422

ITERATION 4

First Guess = 9.999422

Next guess = 9.999422

ITERATION 1

First Guess = 9.636364

Next guess = 10.044910

ITERATION 2

First Guess = 10.044910

Next guess = 9.999346

ITERATION 3

First Guess = 9.999346

Next guess = 9.999422

ITERATION 4

First Guess = 9.999422

Next guess = 9.999422

ITERATION 1

First Guess = 9.696970

Next guess = 10.024578

ITERATION 2

First Guess = 10.024578

Next guess = 9.999409

ITERATION 3

First Guess = 9.999409

Next guess = 9.999422

ITERATION 4

First Guess = 9.999422

Next guess = 9.999422

ITERATION 1

First Guess = 9.757576

Next guess = 10.011848

ITERATION 2

First Guess = 10.011848

Next guess = 9.999420

ITERATION 3

First Guess = 9.999420

Next guess = 9.999422

ITERATION 4

First Guess = 9.999422

Next guess = 9.999422

ITERATION 1

First Guess = 9.818182

Next guess = 10.004522

ITERATION 2

First Guess = 10.004522

Next guess = 9.999422

ITERATION 3

First Guess = 9.999422

Next guess = 9.999422

ITERATION 1

First Guess = 9.878788

Next guess = 10.000903

ITERATION 2

First Guess = 10.000903

Next guess = 9.999422

ITERATION 3

First Guess = 9.999422

Next guess = 9.999422

ITERATION 1

First Guess = 9.939394

Next guess = 9.999604

ITERATION 2

First Guess = 9.999604

Next guess = 9.999422

ITERATION 3

First Guess = 9.999422

Next guess = 9.999422

ITERATION 1

First Guess = 10.000000

```
Next guess = 9.999422
```

```
ITERATION 2
```

```
First Guess = 9.999422
```

```
Next guess = 9.999422
```

```
Roots found in the interval [4, 10]:
```

```
Root 1: 4.194932
```

```
Root 2: 5.967379
```

```
Root 3: 8.004253
```

```
Root 4: 9.999422
```

```
roots = 4×1
```

```
4.19493157220298
```

```
5.96737875568623
```

```
8.00425314682914
```

```
9.99942161562971
```

```
% Display the results
```

```
disp('Roots found for newtons:');
```

```
Roots found for newtons:
```

```
disp(roots);
```

```
4.19493157220298
```

```
5.96737875568623
```

```
8.00425314682914
```

```
9.99942161562971
```

(c) Plot equation (**) for the range $4 \leq x \leq 10$, Indicating the position of all roots with a 'o' marker

```
%% 4. Bracketing (Multiple Roots)
```

```
f = @(x) 100 * exp(-x) - 5 * sin((pi * x) / 2); % Define the function
```

```
d = @(x) -100 * exp(-x) - (5 * pi / 2) * cos((pi * x) / 2); % Define the derivative
```

```
imax = 100; % Maximum iterations
```

```
tol = 1e-10; % Tolerance
```

```
interval = [4, 10]; % Search interval
```

```
num_subintervals = 100; % Number of subintervals for bracketing
```

```
find_all_roots(f, d, a, b, imax, tol);
```

```
disp('Roots found for bracketing:');
```

```
Roots found for bracketing:
```

```
plot(x1,function5)
```

```
hold on
```

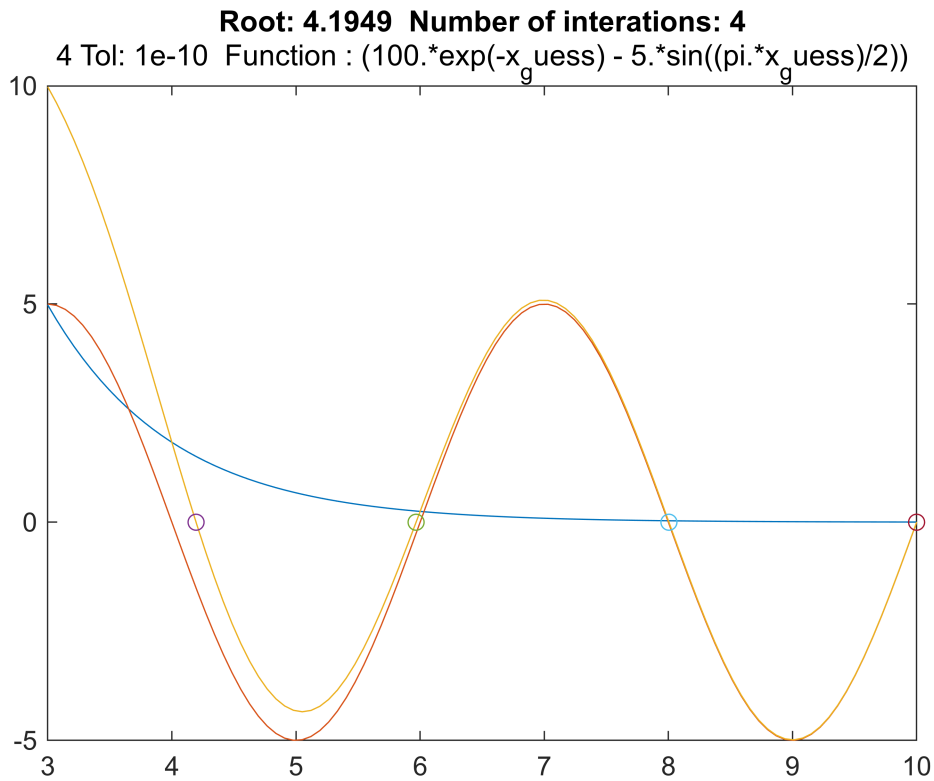
```
plot(x1,function6)
```

```
plot(x1,function4,root1,0,'o',root2,0,'o',root3,0,'o',root4,0,'o')
```

```
hold off
```

```
title(['Root: ', num2str(x_next), ' Number of iterations: ', num2str(counter)])
```

```
    subtitle([ num2str(a) ' Tol: ', num2str(tol), ' Function : (100.*exp(-x_guess)  
- 5.*sin((pi.*x_guess)/2))']);
```



Below the function can be found for all used above

```
function function_sinh = sinh_function(x)

function_sinh = sin(x).*sinh(x);

end
```

$f(x) = (R^2 - x^2)^{1/2} - x \tan(x)$

```
function [function_R] = Function_R(x)
R = 10;
function_R = (sqrt(R.^2 - x.^2)) - x.*tan(x);
end
```

newton

```
%%
function [x_next,counter] = Newton(f,d,imax, tol, x_guess )

% Set iteration counter
counter=1;
```

```

% Set next guess to infinity to fool while condition
abs_diff_between_guess=inf;

% Start iterating - note stop conditions
while (abs_diff_between_guess>tol) && (counter<=imax)

    % Calculate values of the function at the guess
    f_at_guess_first=feval(f,x_guess);

    % Calculate derivative of the function at the guess
    df_dx_at_guess_first=feval(d,x_guess);

    % Calculate next point using secant formula
    x_next = x_guess - f_at_guess_first/df_dx_at_guess_first;

    % Output to screen
    fprintf('ITERATION %i \r',counter)
    fprintf('First Guess = %10.6f \r',x_guess)
    fprintf('Next guess = %10.6f \r \r',x_next)

% To test tolerance
abs_diff_between_guess=abs(x_guess-x_next);

% Update the guesses
x_guess=x_next;

% Increment counter
counter=counter+1;

end
counter = counter-1;
end

```

derv 1

```

function [Derv1] = Derv1(x_guess)

Derv1 = exp(x_guess) - x_guess - 1 ;

end

```

bi section with tol

```

function [mid_point,counter] = bisect2(f, a, b, imax, tol)

% Set iteration counter

```

```

%
counter=0;
x_guess_l=a;
x_guess_u=b;

while (abs(x_guess_u-x_guess_l)>tol && counter<imax)
    f_at_guess_l=feval(f,x_guess_l);
    f_at_guess_u=feval(f,x_guess_u);
    % Calculate mid-point
    mid_point=(x_guess_l+x_guess_u)/2;
    f_at_mid_point=feval(f,mid_point);

    % Output to screen
    fprintf('ITERATION %i \r',counter)
    fprintf('Lower guess = %10.6f \r',x_guess_l)
    fprintf('Upper guess = %10.6f \r',x_guess_u)
    fprintf('Mid-point = %10.6f \r \r',mid_point)

    % Decision
    if f_at_mid_point*f_at_guess_u<=0
        x_guess_l=mid_point;
    else
        x_guess_u=mid_point;
    end
    counter=counter+1;
end
end

```

Function1

```

function [Function1] = Function1(x_guess)

Function1 = exp(x_guess) - (1 + x_guess + ((x_guess.^2)/2));

end

```

function 2

```

function [Function2] = function2(x_guess)
Function2 = 10*log(x_guess) - x_guess ;
end

```

Derv 2

```

function [Derv2]= derv2(x_guess)

Derv2 = 10/x_guess- 1;
end

```

Function 4

```
function [function_4] = Function_4(x_guess)

function_4 = 100.*exp(-x_guess) - 5.*sin((pi.*x_guess)/2);

end
```

derv4

```
function [Derv4]= derv4(x_guess)

Derv4 = - 100*exp(-x_guess) - (5*pi*cos((pi*x_guess)/2))/2 ;

end
```

Function 5

```
function [function_5] = Function_5(x_guess)

function_5 = 100.*exp(-x_guess) ;

end
```

Function 6

```
function [function_6] = Function_6(x_guess)

function_6 = - 5.*sin((pi.*x_guess)/2);

end
```

bisection multi roots

```
function roots = bisectionAllRoots(f, a, b, tol)
    % bisectionAllRoots: Finds all roots in the interval [a, b] using the
    % bisection method.
    %
    % Inputs:
    %   f   - function handle
    %   a   - start of interval
    %   b   - end of interval
    %   tol - tolerance for convergence
    %
    % Output:
    %   roots - array of roots found in the interval

    % Define the number of subintervals for root finding
```

```

num_intervals = 1000; % Increase if more precision is needed
x = linspace(a, b, num_intervals + 1);
roots = [];

% Iterate over subintervals
for i = 1:num_intervals
    x1 = x(i);
    x2 = x(i + 1);

    % Check if there is a sign change in the interval
    if feval(f, x1) * feval(f, x2) < 0
        % Use bisection method to find the root in this subinterval
        root = bisect(f, x1, x2, 1000, tol); % Assuming bisect function is
available
        roots = [roots, root];
    end
end

% Remove duplicates (due to numerical errors)
roots = unique(roots);
end

```

Newton brack

```

function roots = newtonsAllRoots(f, tol, imax)
    % Define the interval
    a = 4; % Start of interval
    b = 10; % End of interval

    % Define starting guesses within the interval (spaced grid)
    start_points = linspace(a, b, 100);

    % Container for storing unique roots
    roots = [];

    % Loop through each starting guess
    for i = 1:length(start_points)
        x_guess = start_points(i);
        [x_root, ~] = Newton(f, @(x) numerical_derivative(f, x), imax, tol,
x_guess);

        % Check if the root is unique within the tolerance
        if all(abs(roots - x_root) > tol) && x_root >= a && x_root <= b
            roots = [roots; x_root]; % Add new root to the list
        end
    end

    % Display the found roots
    fprintf('Roots found in the interval [%d, %d]:\n', a, b);
    for i = 1:length(roots)

```

```

        fprintf('Root %d: %10.6f\n', i, roots(i));
    end
end

function df = numerical_derivative(f, x)
    h = 1e-6; % Small step for numerical differentiation
    df = (f(x + h) - f(x - h)) / (2 * h);
end

```

Bracket function for plot to find all

```

function roots = find_all_roots(f, d, a, b, imax, tol)

    % Initialize
    roots = []; % Variable to store all roots
    intervals = linspace(a, b, 1000); % Divide interval into small sections

    root_counter = 1; % Counter for dynamic variable naming

    for i = 1:length(intervals) - 1
        x1 = intervals(i);
        x2 = intervals(i+1);

        % Check for a sign change (indicating a root exists)
        if feval(f, x1) * feval(f, x2) < 0
            % Use Bisection to find an approximate root
            root_bisection = bisect(f, x1, x2, imax, tol);

            % Refine using Newton's method
            [root_newton, ~] = newton(f, d, root_bisection, imax, tol);

            % Add to roots array if unique
            if isempty(roots) || all(abs(roots - root_newton) > tol)
                roots = [roots; root_newton];

                % Dynamically assign variable for each root
                assignin('base', sprintf('root%d', root_counter), root_newton);
                root_counter = root_counter + 1;
            end
        end
    end

end

function [root, counter] = bisect(f, a, b, imax, tol)
    % Bisection Method Implementation
    counter = 0;
    x1 = a;
    x3 = b;
    f1 = feval(f, x1);
    f3 = feval(f, x3);

```

```

if f1 * f3 > 0
    error('No root in the specified interval');
end

for counter = 1:imax
    x2 = (x1 + x3) / 2;
    f2 = feval(f, x2);
    if abs(f2) < tol || (x3 - x1) / 2 < tol
        root = x2;
        return;
    end
    if f1 * f2 < 0
        x3 = x2;
    else
        x1 = x2;
    end
end
root = (x1 + x3) / 2;
warning('Maximum iterations reached, result may not be within tolerance');
end

function [root, counter] = newton(f, df, x_guess, imax, tol)
% Newton's Method Implementation
counter = 0;
while counter < imax
    f_val = feval(f, x_guess);
    df_val = feval(df, x_guess);
    if abs(df_val) < tol
        error('Derivative near zero, method fails');
    end
    x_next = x_guess - f_val / df_val;
    if abs(x_next - x_guess) < tol
        root = x_next;
        return;
    end
    x_guess = x_next;
    counter = counter + 1;
end
root = x_guess;
warning('Maximum iterations reached, result may not be within tolerance');
end

```