++++++++++++++++++ Lab 003 ++++++++++++++++++

++++++++++++++++++ 2154638 ++++++++++++++++++

CSCM70

CODE:

```
1)

% CSCM 70 ----------- LAB 03 -----------
% CSCM 70 ----------- 2154638 -----------
% ==================================================================
All parts in one also copied the diary in later command window Attached Screenshot
as well.
- Graphs listed below.



% first_der.m file
% CSCM 70 ----------- LAB 03 -----------
% CSCM 70 ----------- 2154638 -----------
% ==================================================================

% ==========================================================

function res = first_der(f,x,tolerance,h)
err = 1000;
% res = (f(x+h)-f(x-h))/(2*h);
 res = (f(x+h) - f(x))/h;
while err > tolerance
       h = h/10;
       end_res = res;
%      res = (f(x+h)-f(x-h))/(2*h);
       res = (f(x+h) - f(x))/h;
       err = abs(res - end_res);
end
end
```

```
2.)

---Continued after 1st question is over


% ==========================================================
```

OUTPUT : COMMAND WINDOW

1.)

```
>>
diary on
f1 = @(x) 5

f1 =

  <a href="matlab:helpPopup function_handle" style="font-weight:bold">function_handle</a> with value:

    @(x)5

first_der(f1,0,0.0001,0.01)

ans =

     0

f2 = @(x) x^2 -x;
first_der(f2,0,0.0001,0.01)

ans =

    -1

f3 = @(x) exp(2*x);
first_der(f3,0,0.0001,0.01)

ans =

    2.0000
```

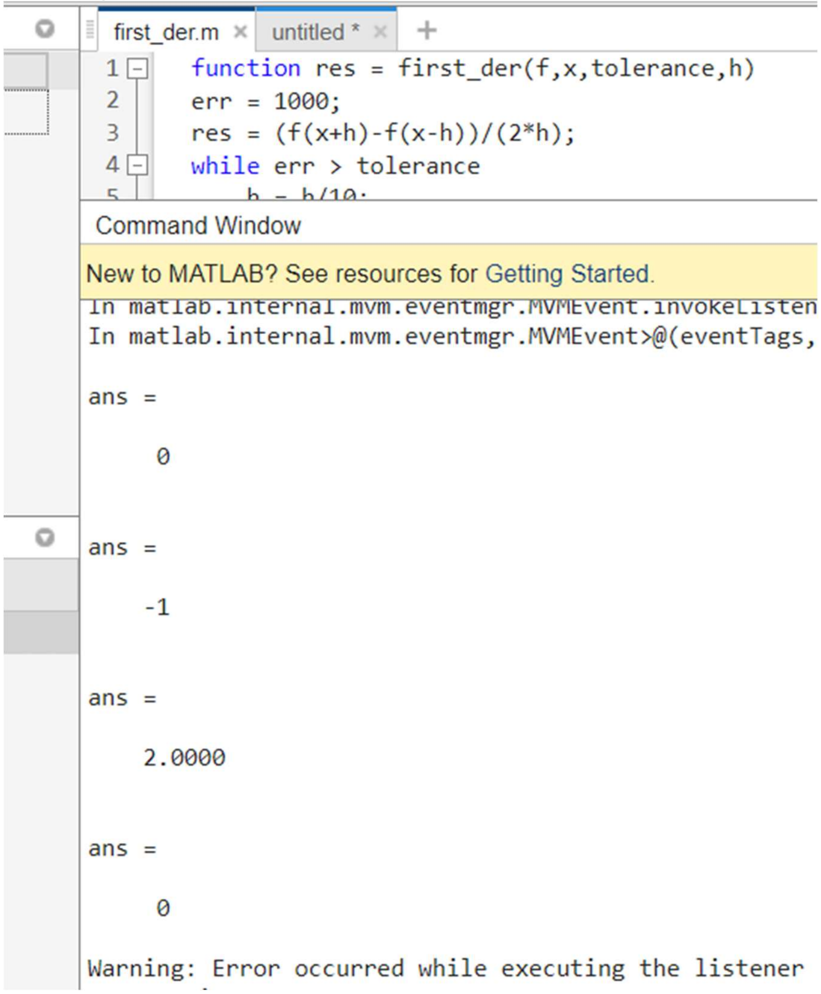
```
f4 = @(x) abs(x)


f4 =


  <a href="matlab:helpPopup function_handle" style="font-weight:bold">function_handle</a> with value:


    @(x)abs(x)


first_der(f4,0,0.0001,0.01)


ans =


     1

diary off
```

Running the 1.4 in the commented formula(`% res = (f(x+h)-f(x-h))/(2*h);`
) will result in :

```
f4 = @(x) abs(x)


f4 =


  <a href="matlab:helpPopup function_handle" style="font-weight:bold">function_handle</a> with value:


    @(x)abs(x)


first_der(f4,0,0.0001,0.01)


ans =
     1


>>
```

➔

The output on online editor was as below:



```
function res = first_der(f,x,tolerance,h)
err = 1000;
res = (f(x+h)-f(x-h))/(2*h);
while err > tolerance
    h = h/10;
```

Command Window

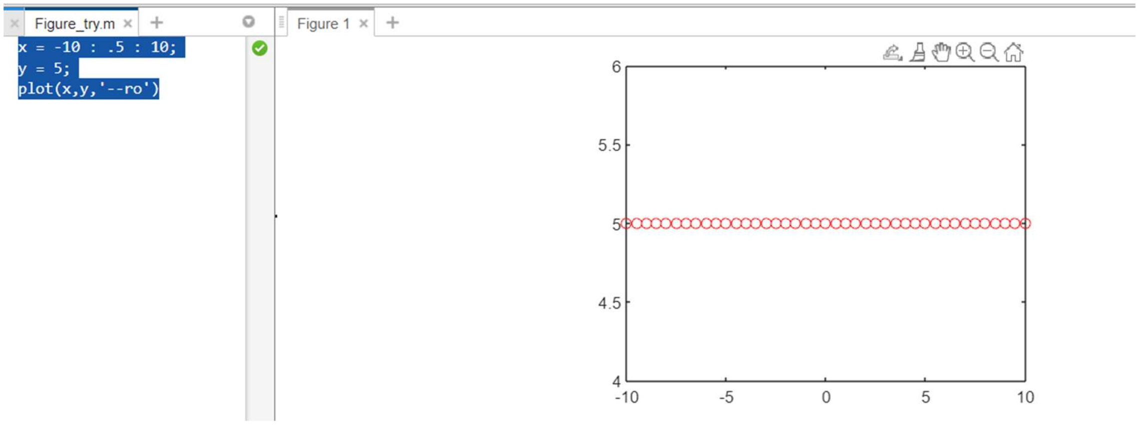
New to MATLAB? See resources for Getting Started.

```
In matlab.internal.mvm.eventmgr.MVMEvent.invokeListen
In matlab.internal.mvm.eventmgr.MVMEvent>@(eventTags,

ans =

     0


ans =

    -1


ans =

    2.0000


ans =

     0

Warning: Error occurred while executing the listener
```

GRAPHS: First try

Which is expected as per the below graphs of each of the above 4 equations:

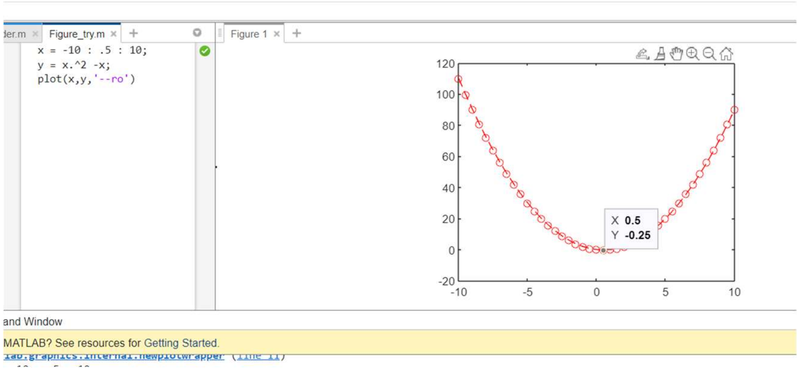
1.1



```
x = -10 : .5 : 10;
y = 5;
plot(x,y,'--ro')
```

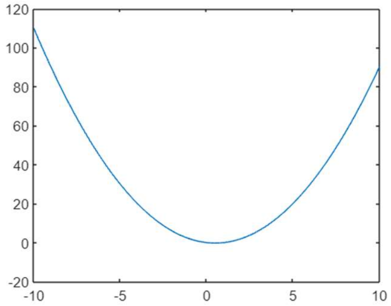
1.2

```
x = -10 : .25 : 10;
y = x.^2 -x;
plot(x,y)
```

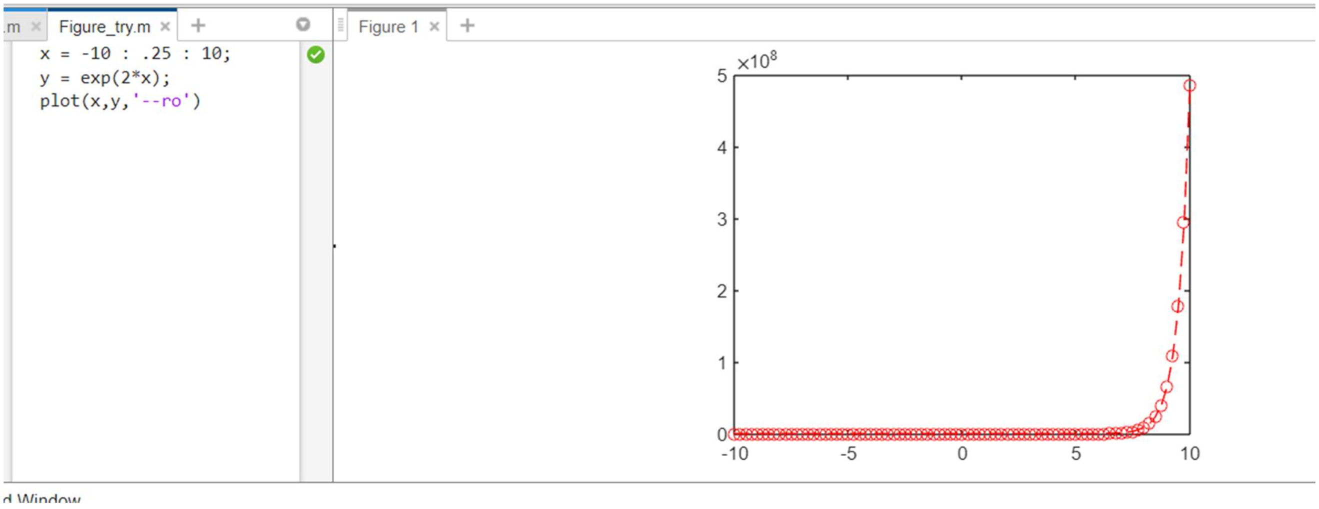


```
x = -10 : .5 : 10;
y = x.^2 -x;
plot(x,y,'--ro')
```

MATLAB? See resources for Getting Started.

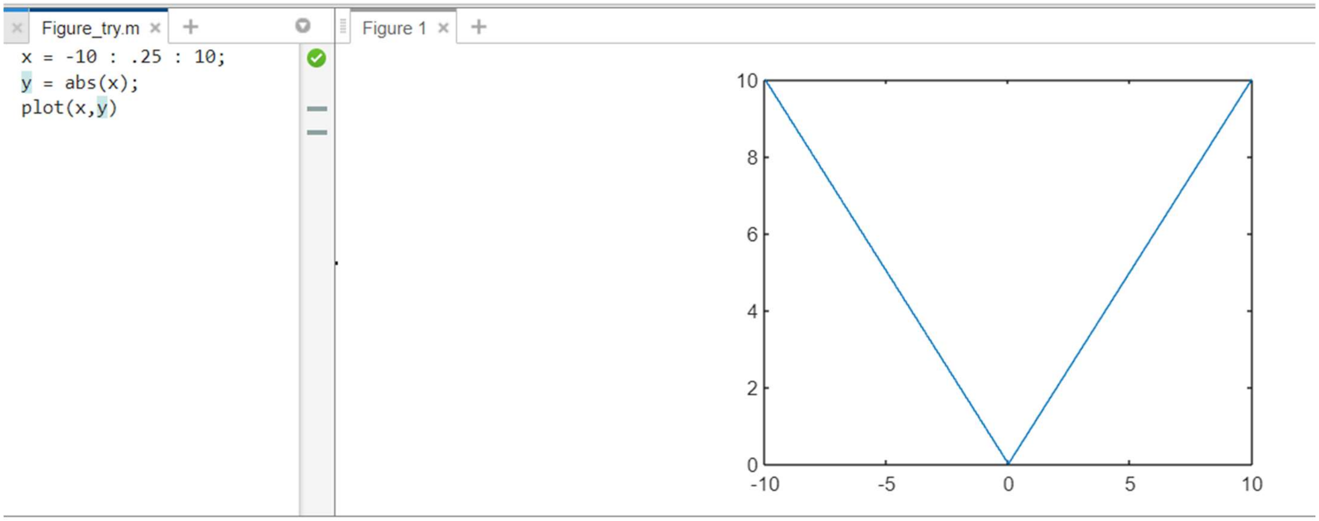


1.3



```
x = -10 : .25 : 10;
y = exp(2*x);
plot(x,y,'--ro')
```

1.4



```
x = -10 : .25 : 10;
y = abs(x);
plot(x,y)
```

ANOTHER TRY FOR 1.4)

```

% CSCM 70 ----------- LAB 03 -----------
% CSCM 70 ----------- 2154638 -----------
% ==================================================================

% ==========================================================

% function res = first_diff(f,x,tolerance,h)
function res = first_diff()
f = @(x) abs(x) ;
x = 0;
tolerance = 0.0001;
h = 0.01;
err_rhs = 1000;
err_lhs = 1000;


% res = (f(x+h)-f(x-h))/(2*h);
res_rhs = (f(x+h) - f(x))/h;
res_lhs = (f(x) - f(x-h))/h;

tolerance = 0.0001;
h = 0.01;
% RHS
while err_rhs > tolerance
main_res_rhs = res_rhs;
res_rhs = (f(x+h) - f(x))/h;
err_rhs = (res_rhs - main_res_rhs);
res_err_rhs = err_rhs;

```

```
➔ end
➔
➔ tolerance = 0.0001;
➔ h = 0.01;
➔ % LHS
➔ while err_lhs > tolerance
➔ main_res_lhs = res_lhs;
➔ res_lhs = (f(x) - f(x-h))/h;
➔ err_lhs = (res_lhs - main_res_lhs);
➔ res_err_lhs = err_lhs;
➔
➔ end
➔ % res = res_err_rhs - res_err_lhs;
➔  disp(res_err_rhs)
➔  disp(res_err_lhs)
➔ end
➔
```

COMMAND WINDOW O/P

```
>> f = @(x) abs(x);

>>

>> first_diff()

   0



   0
```

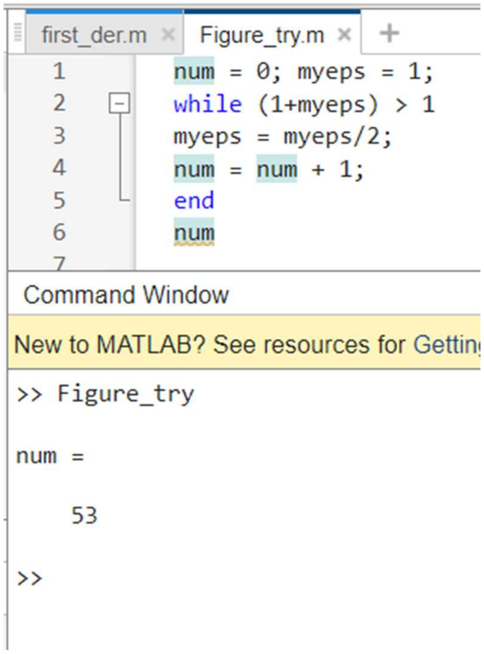
>> So basically, it should be 1 and -1 the left and right limit for both of them and So it should turn to NAN or not defined.

2.)

Answer 2:

That is as per the documentation at https://in.mathworks.com/help/matlab/ref/eps.html expression `d = eps` returns the distance from 1.0 to the next larger double-precision number, that is, 2^{-52}. Therefore the loop runs 52 times + 1(exit loop), hence num = 53.

```
num = 0; myeps = 1;
while (1+myeps) > 1
myeps = myeps/2;
num = num + 1;
end
num
```



```
num = 0; myeps = 1;
while (1+myeps) > 1
myeps = myeps/2;
num = num + 1;
end
num
```

```
>> Figure_try

num =

    53

>>
```

The output comes as expected as per the documentation.

Epsilon in simple sense means that after some values the computer will round up the decimals and because of that some errors are created.
In this above example we understood the epsilon error. This error is caused because of the storage problem. After certain number computer cannot visualize the errors.

Machine error = Machine epsilon

3.)

Answer 3:

Code:

```
% CSCM 70 ----------- LAB 03 -----------
% CSCM 70 ----------- 2154638 -----------
% ==================================================================

% ==========================================================

% function res =sign_der(f,x,h)
function res =sign_der()
f = @(x) sin(x);
x = .5;
h = 1;
% res = (f(x+h)-f(x-h))/(2*h);
res = (f(x+h) - f(x))/h;
i=1;
for i= 1 :20
      h = h/10;
    % disp(h)
%     res = (f(x+h)-f(x-h))/(2*h);
    res = (f(x+h) - f(x))/h;
    disp([i res]);
    i = i + 1;
    disp(res)
end
% disp(h)
end
```

Output:

```
>> diary '03_third_question_all_parts.txt'

>> diary on

>> sign_der()

    1.0000    0.8522



    0.8522



    2.0000    0.8752



    0.8752
```

```
3.0000    0.8773

0.8773

4.0000    0.8776

0.8776

5.0000    0.8776

0.8776

6.0000    0.8776

0.8776

7.0000    0.8776

0.8776

8.0000    0.8776

0.8776

9.0000    0.8776

0.8776
```

```
   10.0000    0.8776

    0.8776

   11.0000    0.8776

    0.8776

   12.0000    0.8776

    0.8776

   13.0000    0.8776

    0.8776

   14.0000    0.8771

    0.8771

   15.0000    0.8882

    0.8882

   16.0000    1.1102

    1.1102

    17     0
```

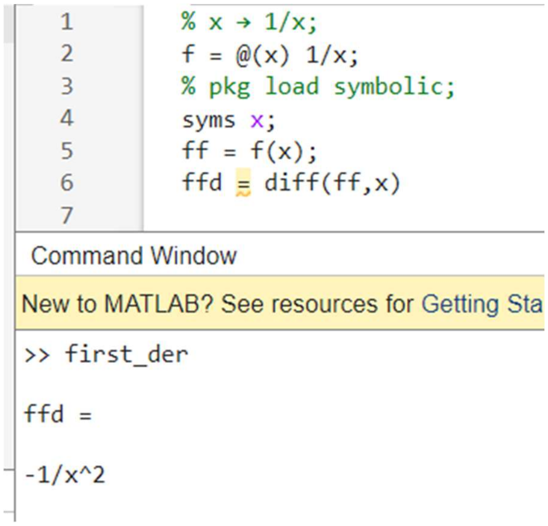
```
     0

    18     0

     0

    19     0

     0

    20     0

     0


ans =

     0

>> diary off
>>
```

The value of derivative of sin(x) crosses comes out at zero. This is the case as the value exceeded even the maximum value of the function at 16 step itself , hence zero came as the answer.

And after the 16th step we will get the values as 0 itself. As the computer will keep on progressing till 20th iteration.

Answer 4

One:

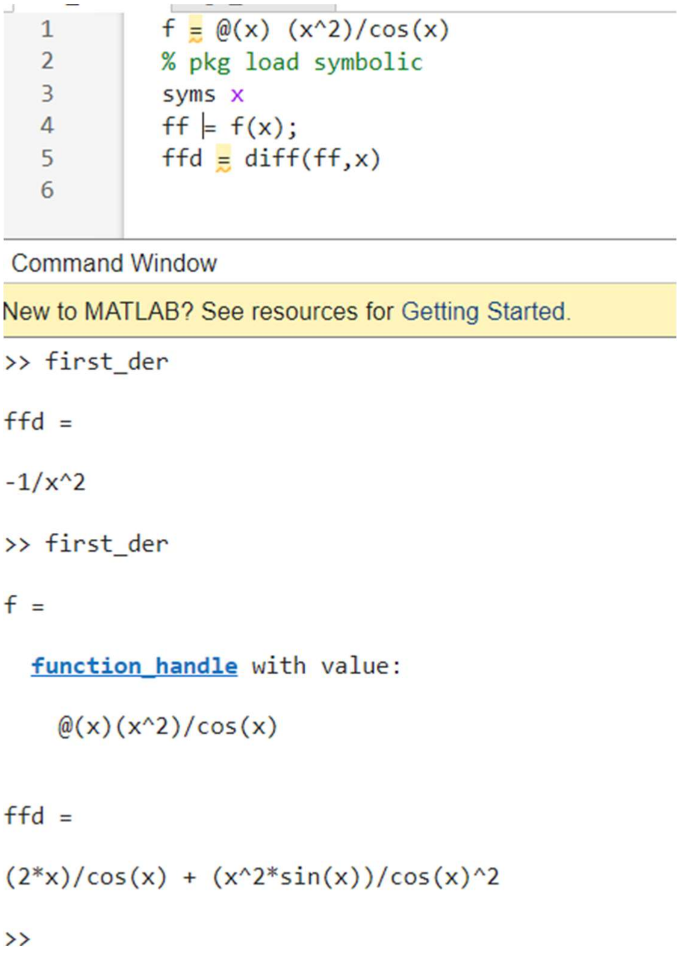


```
% x → 1/x;
f = @(x) 1/x;
% pkg load symbolic;
syms x;
ff = f(x);
ffd = diff(ff,x)
```

New to MATLAB? See resources for Getting Sta

```
>> first_der

ffd =

-1/x^2
```

Two



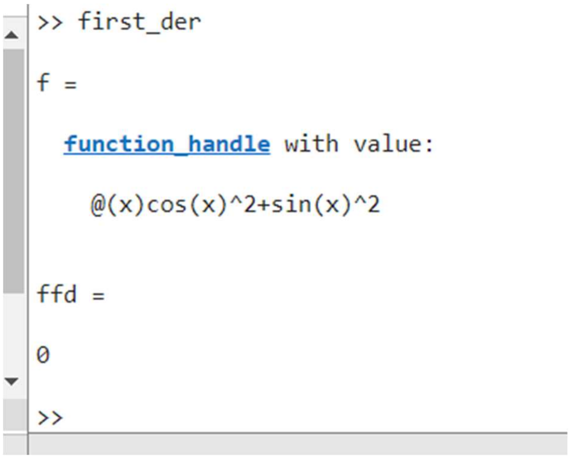
```
f = @(x) (x^2)/cos(x)
% pkg load symbolic
syms x
ff = f(x);
ffd = diff(ff,x)
```

Command Window

New to MATLAB? See resources for Getting Started.

```
>> first_der

ffd =

-1/x^2

>> first_der

f =

  function_handle with value:

    @(x)(x^2)/cos(x)


ffd =

(2*x)/cos(x) + (x^2*sin(x))/cos(x)^2

>>
```

Third



```
>> first_der

f =

  function_handle with value:

    @(x)cos(x)^2+sin(x)^2


ffd =

0

>>
```

++++++++++++++++++ Lab 003 END ++++++++++++++++++

++++++++++++++++++ 2154638 ++++++++++++++++++

CSCM70