Name: Bimal Parajuli
Registration No.: 20BDS0405
Exercise Number: 1_A (Mean value Theorem Using MATLAB)
MAT1011- Calculus for Engineers (MATLAB)
Date of Experiment: 29th Jan,Friday 2021

Mean value theorem:

Suppose that the function f (x)=y is continuous at every point of the closed interval [a,b] and differentiable at every point in (a,b) , then there is at least one number c in (a,b) so that

$$f'(c) = \frac{f(b) - f(a)}{b - a}$$

The following code shows the verification of Langrange's Mean Value Theorem for the function $f(x) = x^3 - 12x - 5$ on the interval [-4,4]

```
clear;
clc;
syms x y
f(x)=x^3-12*x-5;
I=[-4,4]; % Input the function and interval
a=I(1);b=I(2);
Df=diff(f,x);
m=(f(b)-f(a))/(b-a); %Slope of Secant Line
c=solve(Df==m, x);
c=c(a<c&c<b);
disp('Values of c lying in the interval I are');
disp(double(c));
T=f(c)+m*(x-c); %Tangents at x=c
disp('The Tangent Lines at c are');
disp(vpa(y==T,4));
```

Name: Bimal Parajuli
Registration No.: 20BDS0405
Exercise Number: 1_A (Mean value Theorem Using MATLAB)
MAT1011- Calculus for Engineers (MATLAB)
Date of Experiment: 29th Jan,Friday 2021

```
figure
fplot(f,I);
grid on;
hold on;
fplot(T, I, 'r'); %Tangent Lines
plot(c, double(f(c)), 'ko');
plot(I, double(f(I)), 'm'); %Secant Line
xlabel('x'); ylabel('y');
title('Demonstration of Lagranges Mean value theorem');
```

Output:

```
Values of c lying in the interval I are
-2.3094
  2.3094
The Tangent Lines at c are
y == 4.0*x + 19.63
y == 4.0*x -  29.63
```

Name: Bimal Parajuli
Registration No.: 20BDS0405
Exercise Number: 1_A (Mean value Theorem Using MATLAB)
MAT1011- Calculus for Engineers (MATLAB)
Date of Experiment: 29th Jan,Friday 2021

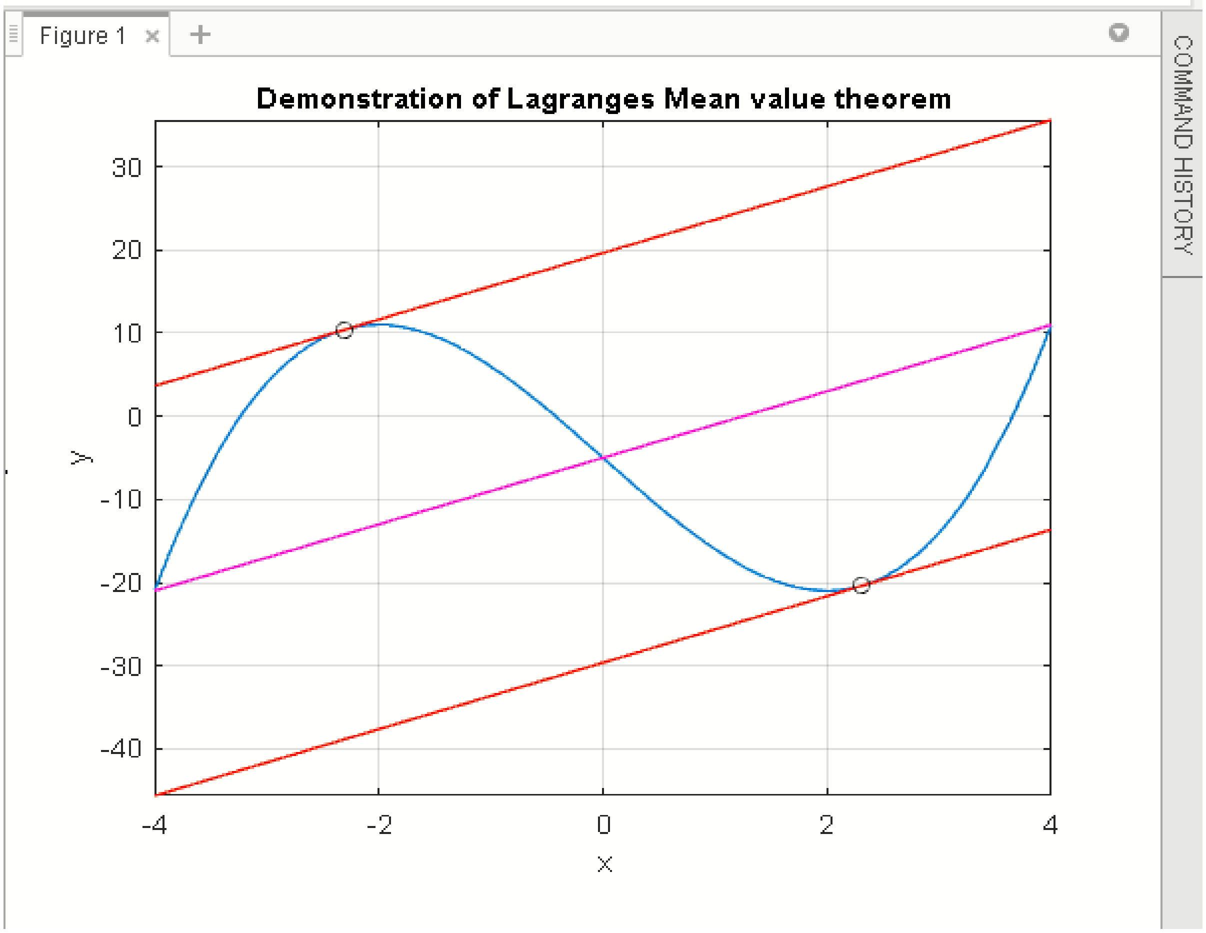
```matlab
clear
clc
syms x y
f(x)=x^3-12*x-5;I=[-4,4]; % Input the function and interval
a=I(1);b=I(2);
Df=diff(f,x);
m=(f(b)-f(a))/(b-a); %Slope of Secant Line
c=solve(Df==m, x);
c=c(a<c&c<b);
disp('Values of c lying in the interval I are');
disp(double(c));
T=f(c)+m*(x-c); %Tangents at x=c
disp('The Tangent Lines at c are');
disp(vpa(y==T,4));
figure
fplot(f,I);
grid on;
hold on;
fplot(T, I, 'r'); %Tangent Lines
plot(c, double(f(c)), 'ko');
plot(I, double(f(I)), 'm'); %Secant Line
xlabel('x');
ylabel('y');
title('Demonstration of Lagranges Mean value theorem');
```

Name: Bimal Parajuli
Registration No.: 20BDS0405
Exercise Number: 1_A (Mean value Theorem Using MATLAB)
MAT1011- Calculus for Engineers (MATLAB)
Date of Experiment: 29th Jan,Friday 2021

COMMAND WINDOW

```
Values of c lying in the interval I are
   -2.3094
    2.3094


The Tangent Lines at c are
y == 4.0*x + 19.63
y == 4.0*x - 29.63
```



Name: Bimal Parajuli
Registration No.: 20BDS0405
Exercise Number: 1_A (Mean value Theorem Using MATLAB)
MAT1011- Calculus for Engineers (MATLAB)
Date of Experiment: 29th Jan,Friday 2021

Name: Bimal Parajuli
Registration No.: 20BDS0405
Exercise Number: 1_A (Mean value Theorem Using MATLAB)
MAT1011- Calculus for Engineers (MATLAB)
Date of Experiment: 29th Jan,Friday 2021

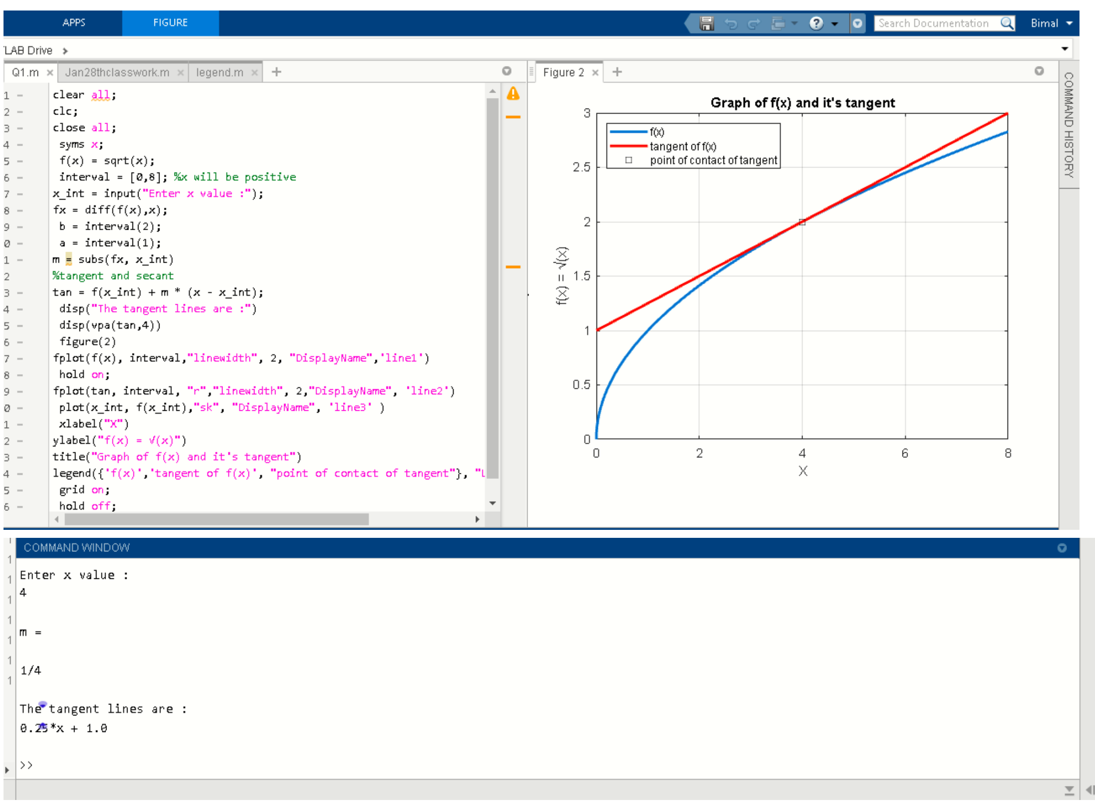
Exercise:

Problem 1: Using MATLAB, find the tangent to the curve y= $\sqrt{x}$ at x=4 and show it graphically.

```
clear;
clc;
close all;
 syms x;
 f(x) = sqrt(x);
 interval = [0,8]; %x will be positive
x_int = input("Enter x value :")
fx = diff(f(x),x)
 b = interval(2);
 a = interval(1);
m = subs(fx, x_int)
%tangent and secant
tan = f(x_int) + m * (x - x_int);
 disp("The tangent lines are :")
 disp(vpa(tan,4))
 figure(2)
fplot(f(x), interval,"linewidth", 2, "DisplayName",'line1')
 hold on;
fplot(tan, interval, "r","linewidth", 2,"DisplayName", 'line2')
```

Name: Bimal Parajuli
Registration No.: 20BDS0405
Exercise Number: 1_A (Mean value Theorem Using MATLAB)
MAT1011- Calculus for Engineers (MATLAB)
Date of Experiment: 29th Jan,Friday 2021

```
plot(x_int, f(x_int),"sk", "DisplayName", 'line3' )
xlabel("X")
ylabel("f(x) = √(x)")
title("Graph of f(x) and it's tangent")
legend({'f(x)','tangent of f(x)', "point of contact of tangent"},
"Location", "NorthWest")
grid on;
hold off;
```



Name: Bimal Parajuli
Registration No.: 20BDS0405
Exercise Number: 1_A (Mean value Theorem Using MATLAB)
MAT1011- Calculus for Engineers (MATLAB)
Date of Experiment: 29th Jan,Friday 2021

Name: Bimal Parajuli
Registration No.: 20BDS0405
Exercise Number: 1_A (Mean value Theorem Using MATLAB)
MAT1011- Calculus for Engineers (MATLAB)
Date of Experiment: 29th Jan,Friday 2021

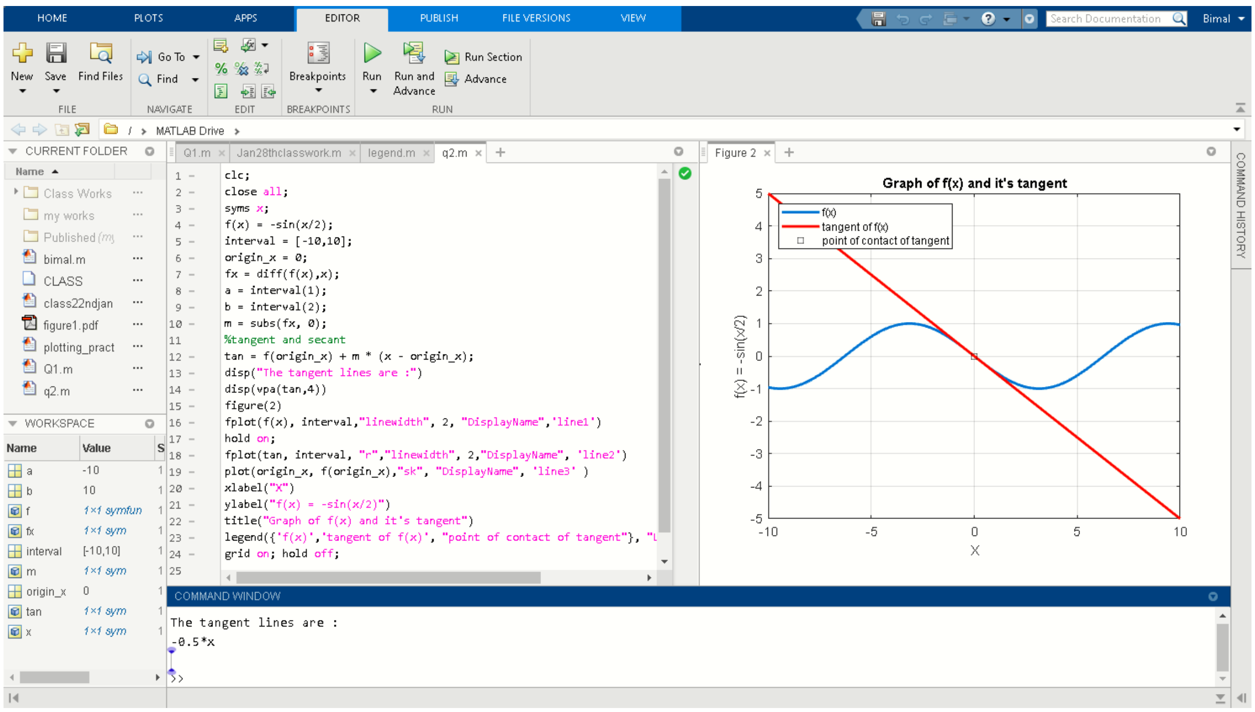
Problem 3:

Using MATLAB find the tangent to the curves y = -sin(x/2) at the origin and show it graphically.

```
clear;
 clc;
close all;
syms x;
f(x) = -sin(x/2);
interval = [-10,10];
origin_x = 0
fx = diff(f(x),x)
a = interval(1);
b = interval(2);
m = subs(fx, 0)
%tangent and secant
tan = f(origin_x) + m * (x - origin_x);
disp("The tangent lines are :")
disp(vpa(tan,4))
figure(2)
fplot(f(x), interval,"linewidth", 2, "DisplayName",'line1')
hold on;
fplot(tan, interval, "r","linewidth", 2,"DisplayName", 'line2')
plot(origin_x, f(origin_x),"sk", "DisplayName", 'line3' )
```

Name: Bimal Parajuli
Registration No.: 20BDS0405
Exercise Number: 1_A (Mean value Theorem Using MATLAB)
MAT1011- Calculus for Engineers (MATLAB)
Date of Experiment: 29th Jan,Friday 2021

```
xlabel("X")
ylabel("f(x) = -sin(x/2)")
title("Graph of f(x) and it's tangent")
legend({'f(x)','tangent of f(x)', "point of contact of tangent"},
"Location", "NorthWest")
grid on; hold off;
```



Name: Bimal Parajuli
Registration No.: 20BDS0405
Exercise Number: 1_A (Mean value Theorem Using MATLAB)
MAT1011- Calculus for Engineers (MATLAB)
Date of Experiment: 29th Jan,Friday 2021

Problem 4:

Verify Rolle’s theorem for the function (x + 2)3 (x - 3)4 in the interval [-2, 3]. Plot the curve along with the secant joining the end points and the tangents at points which satisfy Rolle’s theorem.

```
clear all; clc; close all;
syms x;
f(x) = ((x+2)^3) * ((x-3)^4);
interval = [-2,3];
a = interval(1);
b = interval(2);
fx = diff(f(x),x)
%for Rolle's theorem f'(c) = 0
fc = (f(b) - f(a))/(b-a);
fprintf("The value of f'(c) is equal to = %d \n",double(fc))
disp(" So, we can move to the second condition.")
crit = solve(fx == fc, x);
crit = crit(crit > a & crit < b);
fprintf("The critical point/s which lies between (%i,%i) = %d
\n",...
 a, b,double(crit))
```

Name: Bimal Parajuli
Registration No.: 20BDS0405
Exercise Number: 1_A (Mean value Theorem Using MATLAB)
MAT1011- Calculus for Engineers (MATLAB)
Date of Experiment: 29th Jan,Friday 2021

```
disp("Hence, Rolle's Theorem verified for f(x)")
%tangent and secant
tan = f(crit) + fc * (x - crit);
disp("The tangent lines are :")
disp(vpa(tan,7))
figure(2)
fplot(f(x), interval,"linewidth", 2, "DisplayName",'line1')
hold on;
fplot(tan, interval, "r","linewidth", 2,"DisplayName", 'line2')
plot(interval, f(interval), "--m","linewidth", 2, "DisplayName",
'line3')
plot(crit, f(crit),"sk", "DisplayName", 'line4' )
xlabel("X")
ylabel("f(x) = (x+2)^3 * (x-3)^4")
title("Graph of f(x) and it's tangent")
legend({'f(x)','tangent of f(x)',"secant of f(x)", "point of contact
of tangent"}, "Location",
"NorthWest")
grid on;
hold off;
```

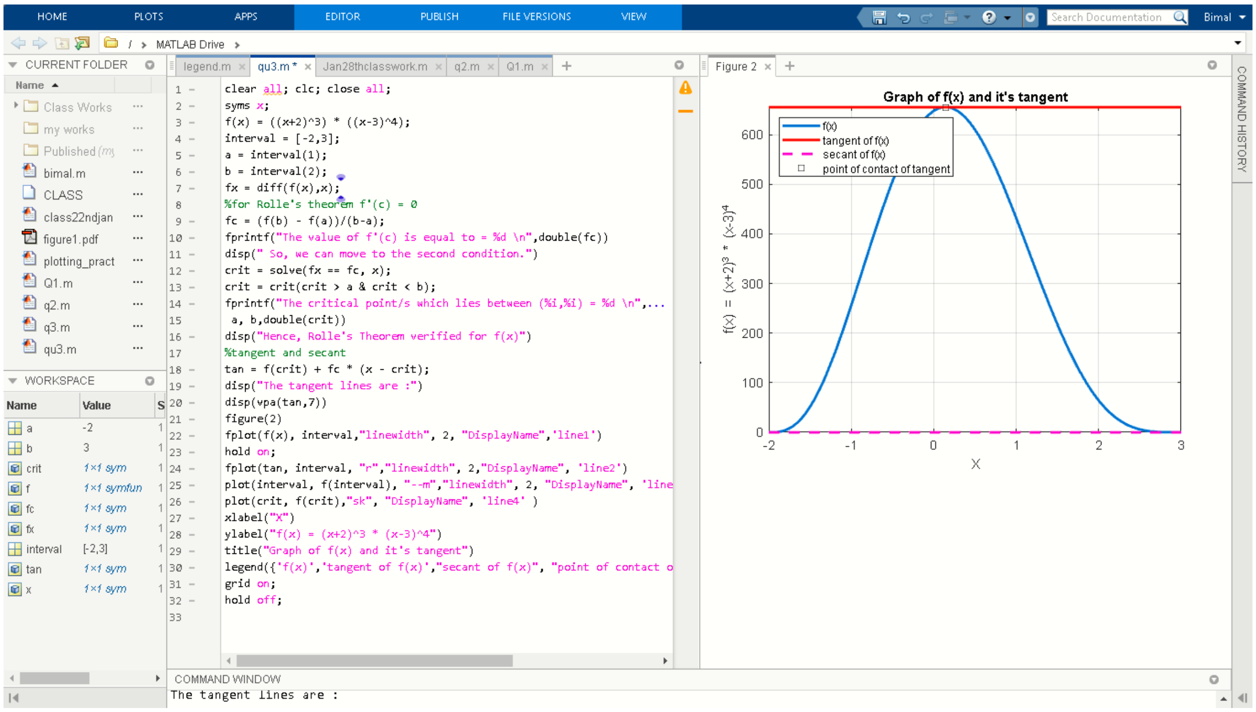
Name: Bimal Parajuli

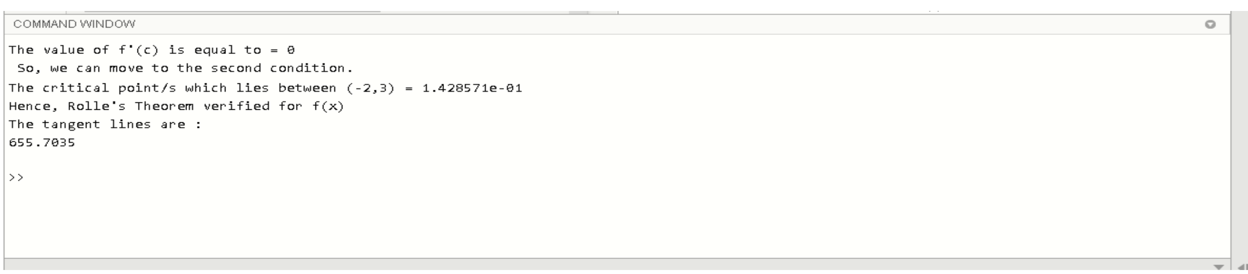
Registration No.: 20BDS0405

Exercise Number: 1_A (Mean value Theorem Using MATLAB)

MAT1011- Calculus for Engineers (MATLAB)

Date of Experiment: 29th Jan,Friday 2021





Name: Bimal Parajuli
Registration No.: 20BDS0405
Exercise Number: 1_A (Mean value Theorem Using MATLAB)
MAT1011- Calculus for Engineers (MATLAB)
Date of Experiment: 29th Jan,Friday 2021

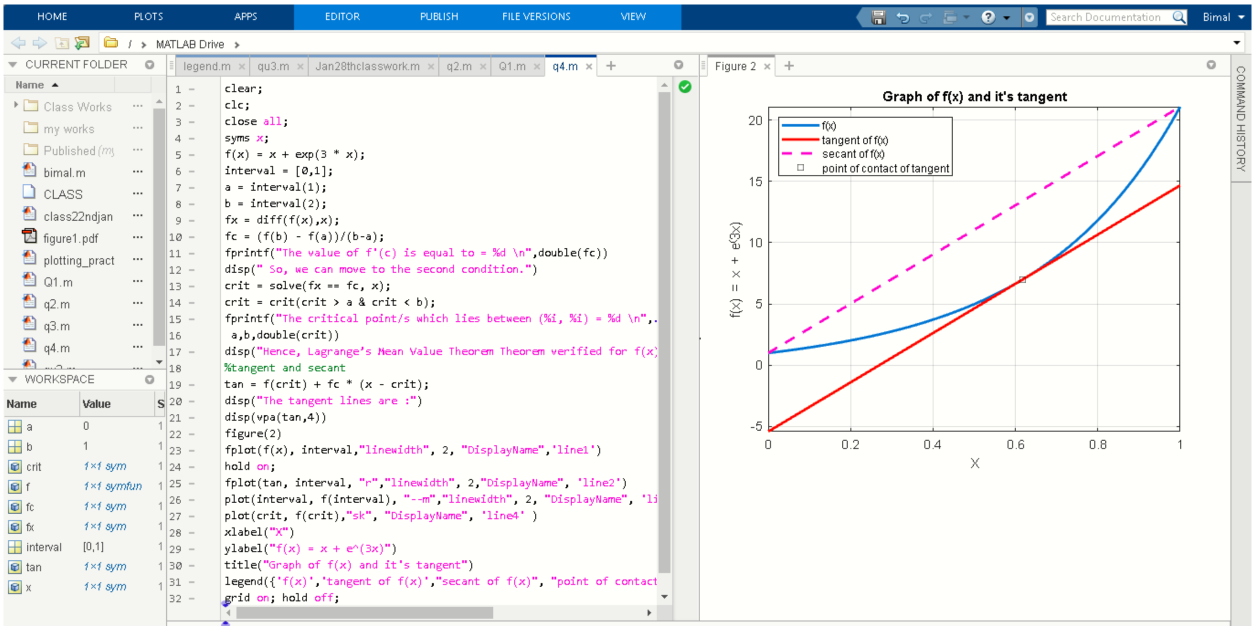
Problem 5:

Verify Lagrange's mean value theorem for the function f(x) = x + e^{3x} in the interval [0,1]. Plot the curve along with the secant joining the end points and the tangents at points which satisfy Lagrange's mean value theorem.

```
clear;
clc;
close all;
syms x;
f(x) = x + exp(3 * x);
interval = [0,1];
a = interval(1);
b = interval(2);
fx = diff(f(x),x);
fc = (f(b) - f(a))/(b-a);
fprintf("The value of f'(c) is equal to = %d \n",double(fc))
disp(" So, we can move to the second condition.")
crit = solve(fx == fc, x);
crit = crit(crit > a & crit < b);
fprintf("The critical point/s which lies between (%i, %i) = %d
\n",...
```

```
 a,b,double(crit))
disp("Hence, Lagrange’s Mean Value Theorem Theorem verified
for f(x)")
%tangent and secant
tan = f(crit) + fc * (x - crit);
disp("The tangent lines are :")
disp(vpa(tan,4))
figure(2)
fplot(f(x), interval,"linewidth", 2, "DisplayName",'line1')
hold on;
fplot(tan, interval, "r","linewidth", 2,"DisplayName", 'line2')
plot(interval, f(interval), "--m","linewidth", 2, "DisplayName",
'line3')
plot(crit, f(crit),"sk", "DisplayName", 'line4' )
xlabel("X")
ylabel("f(x) = x + e^(3x)")
title("Graph of f(x) and it's tangent")
legend({'f(x)','tangent of f(x)',"secant of f(x)", "point of contact
of tangent"}, "Location", "NorthWest")
grid on; hold off;
```

Name: Bimal Parajuli
Registration No.: 20BDS0405
Exercise Number: 1_A (Mean value Theorem Using MATLAB)
MAT1011- Calculus for Engineers (MATLAB)
Date of Experiment: 29th Jan,Friday 2021




```
COMMAND WINDOW

The value of f'(c) is equal to = 2.008554e+01
 So, we can move to the second condition.
The critical point/s which lies between (0, 1) = 6.167728e-01
Hence, Lagrange's Mean Value Theorem Theorem verified for f(x)
The tangent lines are :
20.09*x - 5.41
```

Name: Bimal Parajuli
Registration No.: 20BDS0405
Exercise Number: 1_A (Mean value Theorem Using MATLAB)
MAT1011- Calculus for Engineers (MATLAB)
Date of Experiment: 29th Jan,Friday 2021

Name: Bimal Parajuli
Registration No.: 20BDS0405
Exercise Number: 1_A (Mean value Theorem Using MATLAB)
MAT1011- Calculus for Engineers (MATLAB)
Date of Experiment: 29th Jan,Friday 2021

Name: Bimal Parajuli
Registration No.: 20BDS0405
Exercise Number: 1_A (Mean value Theorem Using MATLAB)
MAT1011- Calculus for Engineers (MATLAB)
Date of Experiment: 29th Jan,Friday 2021