Lab experiment 4

A. Maxima and Minima for a function of a single variable:

i) Critical points
ii) Second derivative test
iii) Plotting the points on the curve

i) Critical Points:

→ **Initialization:**

```
syms x  real
f= input('Enter the function f(x):')
```

OUTPUT:

```
Enter the function f(x):
x^2+sin(x)
```

→ **Solving the function for critical points:**

```
fx= diff(f,x)
```

OUTPUT:

```
fx =

2*x + cos(x)
```

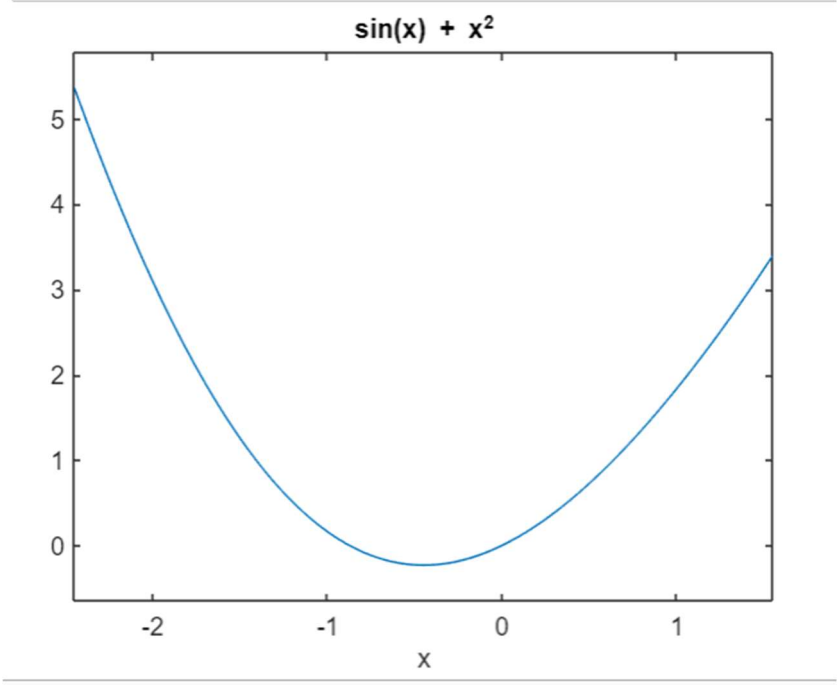
```
c = solve(fx)
```

OUTPUT:

```
c =

-0.450183611294873573036538696762 69
```

```
cmin = min(double(c));

cmax = max(double(c));

ezplot(f,[cmin-2,cmax+2])

fxx = diff(f,2)

hold on
```

OUTPUT:



ii) Second derivative test:

→ Check if each of the point is a maximum or a minimum or a point of inflection:

```
for i = 1:1:size(c)

    T1 = subs(fxx, x ,c(i) );

    T3= subs(f, x, c(i));

    if (double(T1)==0)

    sprintf('The point x is %d inflexion
    point',double (c(i)))

    else
```

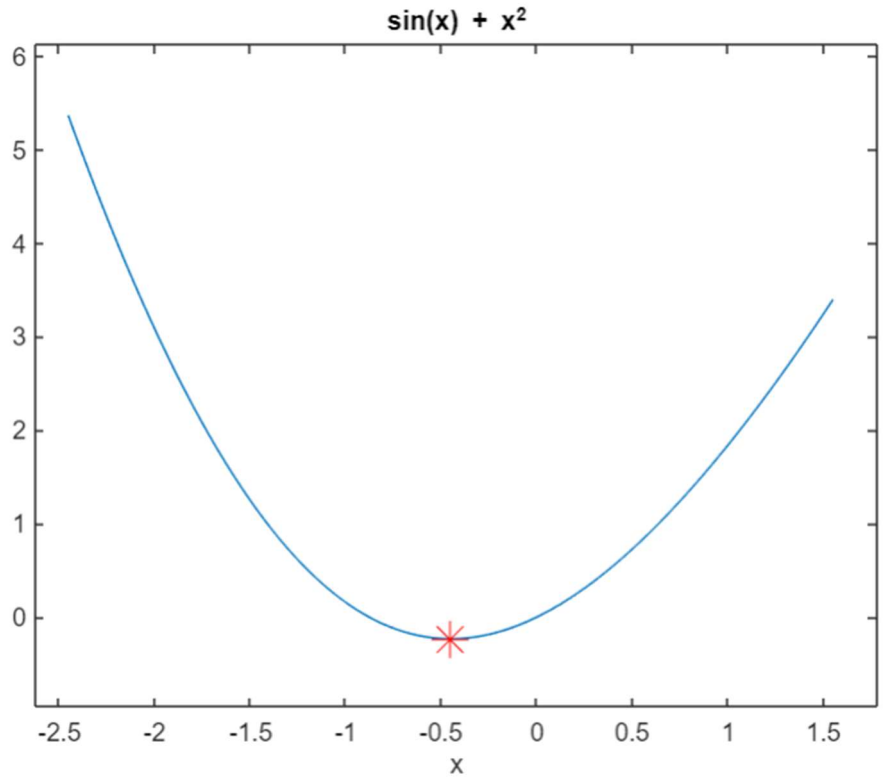
```
        if (double(T1) < 0)

            sprintf('The maximum point x is %d',
            double(c(i)))

            sprintf('The value of the function is
            %d', double (T3))

        else

        sprintf('The minimum point x is %d',
        double(c(i)))

        sprintf('The value of the function is %d',
        double (T3))

        end

        end
```

→ **Plot the critical points on the graph**

```
 % plot the critical points
plot(double(c(i)), double(T3), 'r*', 'markersize',
15);

 end
```

OUTPUT:

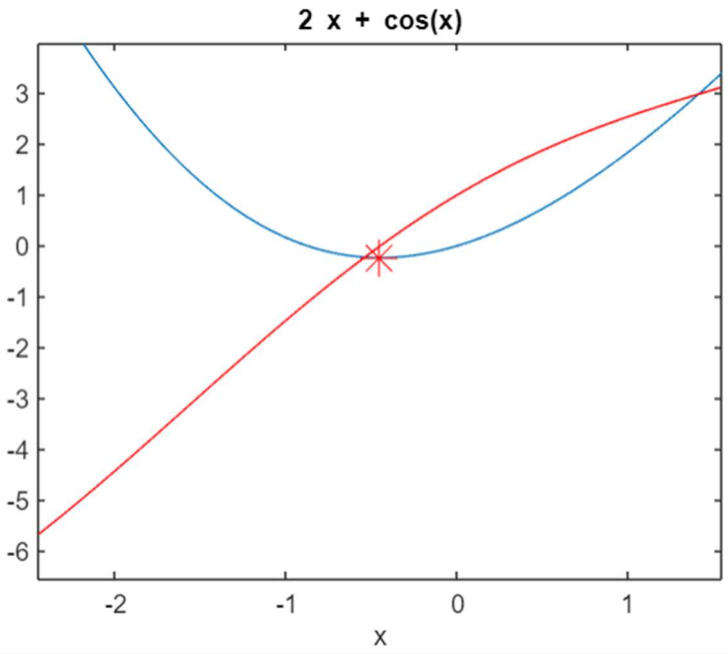
```
ans =

    'The minimum point x is -4.501836e-01'


ans =

    'The value of the function is -2.324656e-01'
```



Visualization of all the functions:

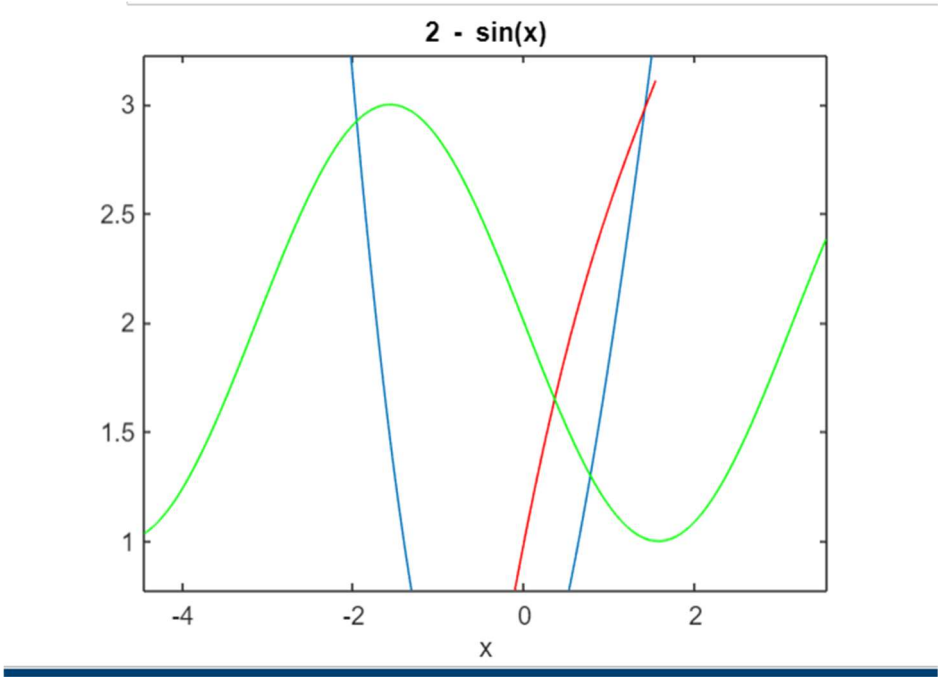
```
h=ezplot(fx,[cmin-2,cmax+2])

set(h,'color','r')

hold on
```

OUTPUT:



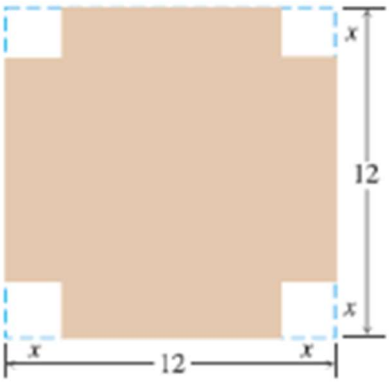

```
pause
e=ezplot(fxx,[cmin-4,cmax+4])
```

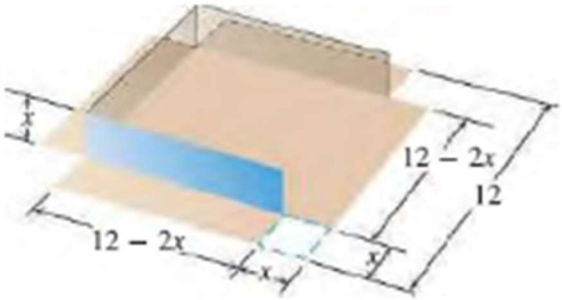
```
set(e,'color','g')

hold off
```



Practice Problems:

1. An open-top box is to be made by cutting small congruent squares from the comers of a 12-in.-by-12-in. sheet of tin and bending up the sides. How large should the squares cut from the corners be to make the box hold as much as possible?





$$V(x) = x(12-2x)^2 = 4x^3 - 48x^2 + 144x$$

CODE:

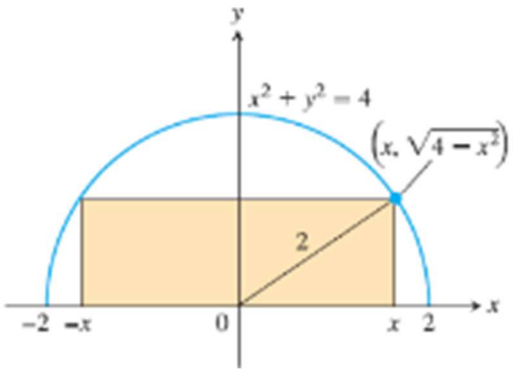
```
clc
close all
clear all
syms x real
f= input('Enter the function f(x):');
fx= diff(f,x);
c=solve(fx)
cmax = max(double(c));
hold on
fxx= diff(fx,x);
for i = 1:1:size(c)
    T1=subs(fxx,x,c(i));
    T3=subs(f,x,c(i));
```

```
    if (double(T1)==0)
        sprintf('The point x is %d inflexionpoint',double (c(i)))
    else
        if (double(T1) < 0)
            sprintf('The value of the squares that can be cut to maximise the
.                                                       volumes=%d',c(i))
        end
    end
end
```

OUTPUT:

```
Enter the function f(x):
((12-(2*x))^2)*x

c =

2
6


ans =

    'The value of the squares that can be cut to maximise the volumes=2'
```

2. A rectangle is to be inscribed in a semicircle of radius 2. What is the largest area the rectangle can have, and what are its dimensions?



Length :2x, Height: $\sqrt{4-x^2}$ Area: 2x $\sqrt{4-x^2}$. A(x)= 2x $\sqrt{4-x^2}$.

CODE:

```
clc
close all
clear all
syms x real
f= input('Enter the function f(x):');
fx= diff(f,x);
c=solve(fx)
cmax = max(double(c));
hold on
fxx= diff(fx,x);
for i = 1:1:size(c)
    T1=subs(fx,x,c(i));
    T3=subs(f,x,c(i));
    if (double(T1)==0)
       if(c(i)>0)
         sprintf('The point x is %d ',double (c(i)))
         d=(c(i)*sqrt(4-(c(i)^2)))
         sprintf('length is %d',2*double(c(i)))

         sprintf('breadth is %d',sqrt(4-(double(c(i))^2)))
         sprintf('area is %d',2*d)
       end
    end
end
```

OUTPUT:

```
Enter the function f(x):
2*x*sqrt(4-x^2)

c =

 2^(1/2)
```

```
-2^(1/2)


ans =

    'The point x is 1.414214e+00 '


d =

2


ans =

    'length is 2.828427e+00'


ans =

    'breadth is 1.414214e+00'


ans =

    'area is 4'
```

B. Finding a definite Integral for a given function:

Command: int (function, lower limit, upper limit)

```
syms x
f=input('enter the function f(x):');
```

OUTPUT:

```
enter the function f(x):
x^2+sin(x)
```

```
a=input('enter lower limit of x ');
```

OUTPUT:

```
enter lower limit of x
0
```

```
b=input('enter the upper limit of x');
```

OUTPUT:

```
enter the upper limit of x
10
```

```
z=int(f,a,b)
```

OUTPUT:

```
z =

1003/3 - cos(10)
```