MATLAB

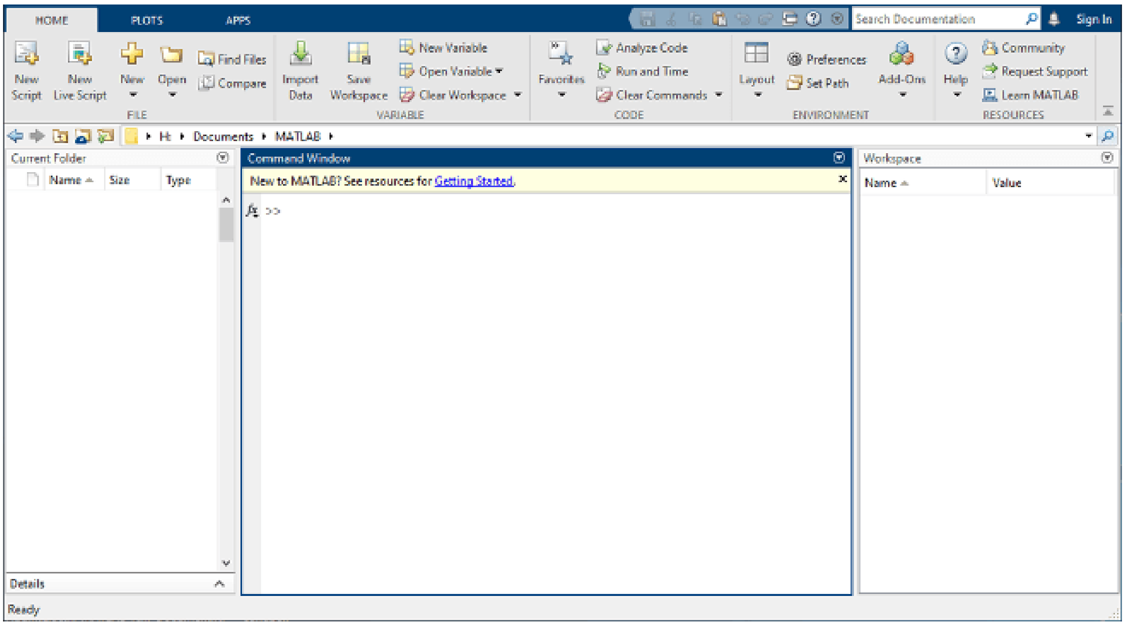
INTRODUCTION

MATLAB is a programming platform designed specially for engineers and scientists to analyse and design systems and products that transform our world. The heart of MATLAB is the MATLAB language, a matrix-based language allowing the most natural expression of computational mathematics.

How to Open MATLAB:

1. Click windows key + R. The run interface will be opened.
2. Click on the search bar and type MATLAB.
3. Press “OK”. The MATLAB will open.

After opening MATLAB, below interface will be open.



APPLICATION OF MATLAB:

1. Math and Computation.
2. Algorithm development.
3. Modelling, simulation, and prototyping.
4. Data analysis, exploration, and visualization.
5. Scientific and Engineering graphics.
6. Application development, including GUI building.

FEATURES OF MATLAB:

1. Interactive Environment: MATLAB provides an interactive environment that allows users to write and run code in real-time. This makes it easy to experiment with code and explore data.
2. Mathematical Functions: MATLAB has a large collection of built-in mathematical functions, including matrix operations, linear algebra, statistics, and signal processing.
3. Data Visualization: MATLAB provides powerful tools for data visualization, including 2D and 3D plotting, image processing, and animation.
4. Simulink: MATLAB's Simulink tool is a graphical programming environment for modelling, simulating, and analysing dynamic systems. It is widely used in control engineering, signal processing, and other fields.
5. Integration with Other Languages: MATLAB can be integrated with other programming languages, such as C and Java, allowing users to take advantage of the strengths of each language.
6. Collaboration: MATLAB allows users to share code, data, and results with others through built-in collaboration tools and integration with source control systems

MATLAB commands for limit, derivative and integration:

	Mathematical operation	MATLAB command
1.	$\lim_{x \to a} f(x)$	limit (f, x, a) or limit (f, a)
2.	$\lim_{x \to a^-} f(x)$	limit (f, x, a, 'left')
3.	$\lim_{x \to a^+} f(x)$	limit (f, x, a, 'right')
4.	$\frac{d}{dx}(y)$	diff (y)
5.	$\int y\, dx$	int (y)

Experiment No: 1

Objective: Find the root of the equation $x^3-2x-5=0$, [2, 3] correct to 3 places of decimals with error less than 0.001 using bisection method.

Working Expression:

This bisection method is a simple and robust numerical algorithm for finding the roots of a continuous function. The basic idea behind the bisection method is to repeatedly divide an interval in half and determine which half of the interval the root lies in, until the interval is sufficiently small, and the root is approximated with a desired accuracy.

Calculation and Output:

```
>> f=@(x)x^3-2*x-5;
>> a=2;
>> b=3;
>> tol=0.001;
>> while abs(a-b)>=tol
x0=(a+b)/2
if f(a)*f(x0)<0;
b=x0;
else
a=x0;
end
root=x0
end
```

```
x0 =

    2.5000


root =

    2.5000


x0 =

    2.2500


root =

    2.2500


x0 =

    2.1250


root =

    2.1250
```

```
x0 =

    2.0625


root =

    2.0625


x0 =

    2.0938


root =

    2.0938


x0 =

    2.1094


root =

    2.1094
```

```
x0 =

    2.1016


root =

    2.1016


x0 =

    2.0977


root =

    2.0977


x0 =

    2.0957


root =

    2.0957
```

```
x0 =

    2.0947


root =

    2.0947
```

Conclusion:

So, the required root is 2.0947. Hence, the output was successfully found.

Experiment No: 2

Objective: Find the root of the equation cosx-3x+1=0, [0, 1] correct to 4 places of decimals using bisection method.

Working Expression:

This bisection method is a simple and robust numerical algorithm for finding the roots of a continuous function. The basic idea behind the bisection method is to repeatedly divide an interval in half and determine which half of the interval the root lies in, until the interval is sufficiently small, and the root is approximated with a desired accuracy.

Calculation and Output:

```
>> f=@(x)cos(x)-3*x+1;
>> a=0;
>> b=1;
>> tol=0.0001;
>> while abs(a-b)>=tol
x0=(a+b)/2
if f(a)*f(x0)<0;
b=x0;
else
a=x0;
end
root=x0
end
```

```
x0 =

    0.5000

root =

    0.5000

x0 =

    0.7500

root =

    0.7500

x0 =

    0.6250

root =

    0.6250

x0 =

    0.5625

root =

    0.5625

x0 =

    0.5938

root =

    0.5938

x0 =

    0.6094

root =

    0.6094

x0 =

    0.6016

root =

    0.6016

x0 =

    0.6055

root =

    0.6055

x0 =

    0.6074

root =

    0.6074

x0 =

    0.6064

root =

    0.6064

x0 =

    0.6069

root =

    0.6069

x0 =

    0.6072

root =

    0.6072

x0 =

    0.6071

root =

    0.6071

x0 =

    0.6071

root =

    0.6071
```

Conclusion:

So, the required root is 0.6071. Hence, the output was successfully found.

Experiment No: 3

Objective: Find the root of the equation $e^{-x}-10x=0$, [0, 1] correct to 4 places of decimals using bisection method.

Working Expression:

This bisection method is a simple and robust numerical algorithm for finding the roots of a continuous function. The basic idea behind the bisection method is to repeatedly divide an interval in half and determine which half of the interval the root lies in, until the interval is sufficiently small, and the root is approximated with a desired accuracy.

Calculation and Output:

```
>> f=@(x)exp(-x)-10*x;
>> a=0;
>> b=1;
>> tol=0.0001;
>> while abs(a-b)>=tol
x0=(a+b)/2
if f(a)*f(x0)<0;
b=x0;
else
a=x0;
end
root=x0
end
```

```
x0 =

    0.5000

root =

    0.5000

x0 =

    0.2500

root =

    0.2500

x0 =

    0.1250

root =

    0.1250
```

```
x0 =

    0.0625

root =

    0.0625

x0 =

    0.0938

root =

    0.0938

x0 =

    0.0781

root =

    0.0781
```

```
x0 =

    0.0859

root =

    0.0859

x0 =

    0.0898

root =

    0.0898

x0 =

    0.0918

root =

    0.0918
```

```
x0 =

    0.0908

root =

    0.0908

x0 =

    0.0913

root =

    0.0913

x0 =

    0.0911

root =

    0.0911
```

```
x0 =

    0.0912

root =

    0.0912

x0 =

    0.0912

root =

    0.0912
```

Conclusion:

So, the required root is 0.912. Hence, the output was successfully found.

Experiment No: 4

Objective: Using the trapezoidal rule, compute $\int_0^1 \frac{1}{1+x^2} dx$ with three points of intervals.

Working Expression:

The trapezoidal rule is a rule that evaluates the area under the curves by dividing the total area into smaller trapezoids rather than using rectangles. This integration works by approximating the region under the graph of a function as a trapezoid, and it calculates the area. This rule takes the average of the left and the right sum.

GENERAL FORMULA:

$$\int_a^b f(x)dx = 1/2[(y_0 + y_n) + 2(y_1 + y_2 + y_3 + \cdots + y_{n-1})]$$

Calculation and Output:

```
>> f=@(x)(1+x^2)^-1;
>> a=0;
>> b=1;
>> n=2;
>> h=(b-a)/n;
>> s=0.5*(f(a)+f(b));
>> for i=1:n-1
s=s+f(a+i*h);
end
>> I=h*s

I =

    0.7750
```

Conclusion:

The required value is 0.775 and hence the output was successfully found.

Experiment No: 5

Objective: Using the trapezoidal rule, compute $\int_0^\pi sinx\, dx$ with 4 intervals.

Working Expression:

The trapezoidal rule is a rule that evaluates the area under the curves by dividing the total area into smaller trapezoids rather than using rectangles. This integration works by approximating the region under the graph of a function as a trapezoid, and it calculates the area. This rule takes the average of the left and the right sum.

GENERAL FORMULA:

$$\int_a^b f(x)dx = 1/2[(y_0 + y_n) + 2(y_1 + y_2 + y_3 + \cdots + y_{n-1})]$$

Conclusion:

```
>> f=@(x)sin(x);
>> a=0;
>> b=pi;
>> n=4;
>> h=(b-a)/n;
>> s=0.5*(f(a)+f(b));
>> for i=1:n-1
s=s+f(a+i*h);
end
>> I=h*s

I =

    1.8961
```

Conclusion:

So, the required value is 1.8961 and hence, the output was successfully calculated.

Experiment No: 6

Objective: Using the Simpson's 1/3 rule, compute $\int_0^{0.2} \sqrt{1-2x^2}\,dx$ taking n=2.

Working Expression:

Simpson's 1/3 rule is a numerical integration method used to approximate the value of a definite integral of a function. It is a numerical integration method that uses a parabolic approximation to the integrand to estimate the integral.

More specifically, if we have a function f(x) that we want to integrate over the interval [a, b] and we divide this interval into n subintervals of equal width h=(b-a)/n, then Simpson's 1/3 rule can be formulated as:

$$\int_a^b f(x)dx = h/3\,[(y_0 + y_n) + 4(y_1 + y_3 + y_5 + \ldots. + y_{n-1}) + 2(y_2 + y_4 + y_6 + \ldots.. + y_{n-2})]$$

Calculation and Output:

```
>> f=@(x)(1-2*x^2)^0.5;
>> a=0;
>> b=0.2;
>> n=2;
>> h=(b-a)/n;
>> s=f(a)+f(b);
>> for i=1:n-1
s=s+4*f(a+i*b);
end
>> for k=2:2:n-2;
s=s-2*f(a+k*h);
end
>> I=(h/3)*s

I =

    0.1932
```

Conclusion:

So, the required value is 0.1932 and hence, the output was successfully calculated.

Experiment No: 7

Objective: Using the Simpson's 1/3 rule, compute $\int_0^1 e^x\, dx$ taking n=6.

Working Expression:

Simpson's 1/3 rule is a numerical integration method used to approximate the value of a definite integral of a function. It is a numerical integration method that uses a parabolic approximation to the integrand to estimate the integral.

More specifically, if we have a function f(x) that we want to integrate over the interval [a, b] and we divide this interval into n subintervals of equal width h=(b-a)/n, then Simpson's 1/3 rule can be formulated as:

$$\int_a^b f(x)dx = h/3\,[(y_0 + y_n) + 4(y_1 + y_3 + y_5 + \ldots. + y_{n-1}) + 2(y_2 + y_4 + y_6 + \ldots.. + y_{n-2})]$$

Calculation and Output:

```
>> f=@(x)exp(x);
>> a=0;
>> b=1;
>> n=6;
>> h=(b-a)/n;
>> s=f(a)+f(b);
>> for i=1:n-1
s=s+4*f(a+i*h);
end
>> for k=2:2:n-2;
s=s-2*f(a+k*h);
end
>> I=(h/3)*s

I =

    1.7183
```

Conclusion:

So, the required value is 1.7183 and hence, the output was successfully calculated.

Experiment No: 8

Objective: Using the Simpson's 1/3 rule, compute $\int_0^{\pi} sinx\, dx$ taking n=6.

Working Expression:

Simpson's 1/3 rule is a numerical integration method used to approximate the value of a definite integral of a function. It is a numerical integration method that uses a parabolic approximation to the integrand to estimate the integral.

More specifically, if we have a function f(x) that we want to integrate over the interval [a, b] and we divide this interval into n subintervals of equal width h=(b-a)/n, then Simpson's 1/3 rule can be formulated as:

$$\int_a^b f(x)dx = h/3\,[(y_0 + y_n) + 4(y_1 + y_3 + y_5 + \ \dots . + y_{n-1})\ +\ 2(y_2 +\ y_4 + y_6 \\ +\ \dots . . + y_{n-2})]$$

Calculation and Output:

```
>> f=@(x)sin(x);
>> a=0;
>> b=pi;
>> n=6;
>> h=(b-a)/n;
>> s=f(a)+f(b);
>> for i=1:n-1
s=s+4*f(a+i*h);
end
>> for k=2:2:n-2;
s=s-2*f(a+k*h);
end
>> I=(h/3)*s

I =

    2.0009
```

Conclusion:

So, the required value is 2.0009 and hence, the output was successfully calculated.

Experiment No: 9

Objective: Using Newton-Raphson method, find a root of x^3-2x-5=0 lying between 2 and 3 correct to 3 places of decimals.

Working Expression:

Unlike the bisection method, the Newton-Raphson (N-R) technique requires only one inital value x_0, which we will refer to as the initial guess for the root. The Newton-Raphson method is an iterative technique to find the root of a real-valued function. Given a function f(x) and its derivative $f'(x)$, the iteration:

$$x_{n+1} = x_n - \frac{f(x_n)}{f\prime(x_n)}.$$

Calculation and Output:

```
>> f=@(x)x^3-2*x-5;
>> Df=@(x)3*x^2-2;
>> x0=2;
>> tol=0.001;

>> diff=1;
>> while diff>=tol
x1=x0-f(x0)/Df(x0);
diff=abs(x1-x0);
x0=x1;
end
>> root=x0

root =

    2.0946
```

Conclusion:

So, the required root is 2.094 and hence, the output is successfully calculated.

Experiment No: 10

Objective: Using Newton-Raphson method, find a root of x-cosx=0 to 3 places of decimals.

Working Expression:

Unlike the bisection method, the Newton-Raphson (N-R) technique requires only one inital value x_0, which we will refer to as the initial guess for the root. The Newton-Raphson method is an iterative technique to find the root of a real-valued function. Given a function f(x) and its derivative $f'(x)$, the iteration:

$$x_{n+1} = x_n - \frac{f(x_n)}{f\prime(x_n)}.$$

Calculation and Output:

```
>> f=@(x)x-cos(x);
>> Df=@(x)1+sin(x);
>> x0=0;
>> tol=0.001;
>> diff=1;
>> while diff>=tol
x1=x0-f(x0)/Df(x0);
diff=abs(x1-x0);
x0=x1;
end
>> root=x0

root =

    0.7391
```

Conclusion:

So, the required root is 0.739 and hence, the output is successfully calculated.

Experiment No: 11

Objective: Using MATLAB find,

1. $\frac{d}{dx}\frac{1}{\sqrt{x}}$
2. $\frac{d}{dx}(\log(3x-5))$
3. $\frac{d}{dx}e^{\sin(lnx)}$

Working Expression:

The derivative of a function represents the rate at which the function's output changes with respect to its input. In mathematical notation, if f(x) is a function, the derivative is denoted as $f'(x)$ or $\frac{dy}{dx}$.

Calculation and Output:

```
>> syms x
>> f=x^-(1/2);
>> diff(f)

ans =

-1/(2*x^(3/2))

>> syms x
>> f=log(3*x-2);
>> diff(f)

ans =

3/(3*x - 2)

>> syms x
>> f=exp(sin(log(x)));
>> diff(f)

ans =

(cos(log(x))*exp(sin(log(x))))/x
```

Conclusion:

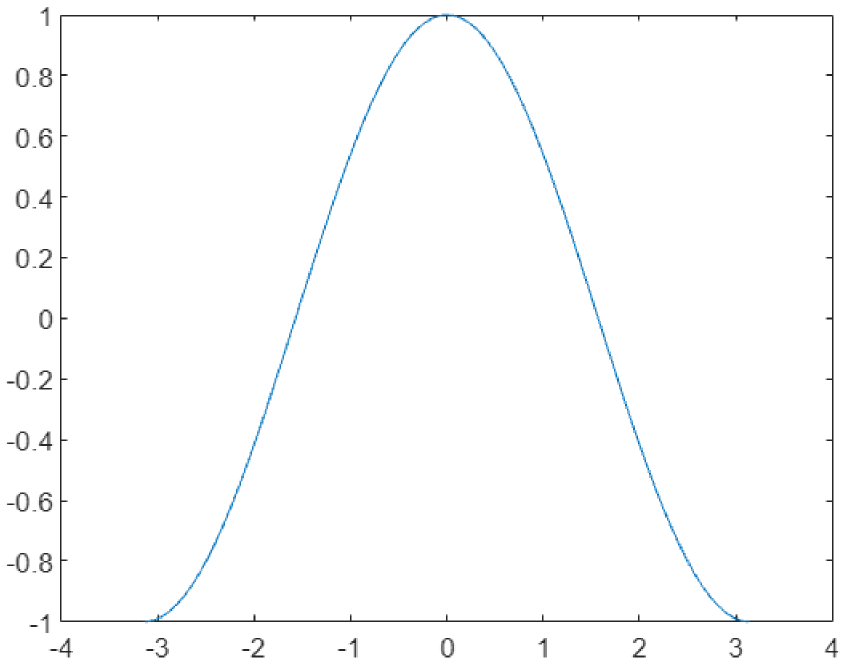
Hence, the derivative of $\frac{1}{\sqrt{x}}$ = - $\frac{1}{2\sqrt{x^3}}$, $(\log(3x-5) = \frac{3}{3x-2}$, $e^{\sin(lnx)} = \frac{\cos(lnx).e^{\sin(lnx)}}{x}$ was found using MATLAB.

Experiment No: 12

Objective: To obtain the graph of y=cos(x) from -π to π with increment 0.01.

Calculation and Output:

```
>> x=-pi:0.01:pi;
>> y=cos(x);
>> plot(x,y)
>>
```



Conclusion:

Hence, the graph was successfully plotted.