Mechi Multiple Campus

(Tribhuvan University)

Bhadrapur, Jhapa

Lab Report of Mathematics-II (CAMT-154)

Faculty of Humanities & Social Sciences

Tribhuvan University

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Submitted To

Mechi Multiple Campus

Department of Bachelor in Computer

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ACKNOWLEDGEMENT

This project is specially designed to develop enhance the knowledge of student in Mathematica and MATLAB software. The assigned project is for the partial fulfillment of BCA (Bachelor in Computer Application) second semester student.

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I am also thankful to everyone who all supported me, for that I have completed my report effectively and moreover on time. They gave me many helpful comments which helped me a lot in preparing it.

CERTIFICATE FROM THE SUPERVISOR

This is to certify that the Lab Report entitled **“MATHEMATICA & MATLAB”** is an academic work done by “Santosh Bhandari” submitted in the partial fulfillment of the requirements for the degree of Bachelor of Computer Application at Faculty of Humanities and Social Sciences, Tribhuvan University under my guidance & supervision. To the best of my knowledge, the worked performed by him in the Lab Report is his own creation.

Signature of the Supervisor:

Name: Kumar Subedi

Designation: Professor

Date:

DECLERATION

I hereby declare that the project entitled **"Mathematica & MATLAB"** is a general concept of mathematical software, original work done by Santosh Bhandari, and this project work is submitted in the requirements for the award of the degree of Bachelor second Semester. The results enrolled in the report have not been submitted to any other university or institute for the award of degree of BCA.

Santosh Bhandari
BCA second Semester

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MATHEMATICA

Mathematica is a mathematical software package that can be used by any member of the Engineering Department. This seminar will show you what Mathematica can do, and will let you assess how useful it could be to you. Mathematica is a huge package with far more features than can be covered in a single afternoon. However, the seminar will show you the basics of enter problems and obtaining and displaying results. It will also show you how to explore the package for yourself and find the things that you are interested in. The majority of the seminar is devoted to giving you real hands on experience of using Mathematica. The main driving philosophy behind Mathematica is to produce a mathematical software package that is as close as possible to doing mathematics with a pen and paper. This shows itself in two ways. The appearance resembles normal mathematical text much closer than a program using a conventional programming language. You can easily use mathematical symbols like integral signs and Greek characters can be used in variable names. You can include explanatory text, with titles and subsections that make a Mathematica note book look more like a document than a program. However, the most important feature of Mathematica is that it can perform algebraic mathematics in addition to numerical mathematics. Computers mostly do numerical calculations. So for example, the expression y = x 2 takes the number x and squares it and puts the value into y. Using computational algebra the result y is a symbolic expression that can then be manipulated algebraically, differentiated and integrated using the same rules you use to manipulate equations.

Arithmetic Operations in Mathematica

Symbols	Operations
+	Add
-	Minus
Space or *	Multiply
/	Divide
^	Power

The Four Kinds of Bracket of Mathematica

(term)	Parentheses for grouping
f[x]	Square bracket for functions
{a, b, c}	Curly braces for list
a[[i]]	Double bracket for indexing(part [a,i])

Some Mathematical Functions

Sqrt[x]	$\sqrt{X}$
Exp[x]	e^x
Log[x]	$\log_e x$
Log[a, x]	$\log_a x$
Sin[x], Cos[x], Tan[x]	$\sin x, \cos x, \tan x$
Abs[x]	$\lvert x \rvert, Abssolute\ Value$
Mod[m, n]	M Modulo n
Pi	π
E	e

Some Examples:

```
In[1]:= 8 + 10
Out[1]= 18

In[2]:= 2^8
Out[2]= 256

In[4]:= 2^42 // N
Out[4]= 4.39805 × 10^12

In[5]:= Sqrt[225]
Out[5]= 15

In[6]:= Sqrt[6]
Out[6]= √6

In[7]:= Sqrt[6] // N
Out[7]= 2.44949

In[11]:= Sin[Pi / 4]
```

Out[11]= $\frac{1}{\sqrt{2}}$

```
In[13]:= Log[3, 81]
Out[13]= 4
```

Limit and Continuity:

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```
In[1]:= Limit[x^2 - 5 x + 7, x → 1]
Out[1]= 3

In[28]:= Limit[(3 * x + 5) / (2 * x - 1), x → 1]
Out[28]= 8

In[29]:= Limit[(x^2 - 5 * x + 7) / (x^2 + 2 * x + 3), x → Infinity]
Out[29]= 1

In[30]:= Limit[(2 * Sqrt[(1 + x)] - Sqrt[(2 * x - 1)]) / x, x → Infinity]
Out[30]= 0

In[31]:= Limit[Sqrt[(x + 1)] - Sqrt[x], x → Infinity]
Out[31]= 0

In[32]:= Limit[(x^(2 / 3) - a^(2 / 3)) / (x - a), x → a]
```

Out[32]= $\frac{2}{3\,a^{1/3}}$

```
In[33]:= Limit[Sqrt[x] * (Sqrt[(x + 1)] - Sqrt[x]), x → Infinity]
```

Out[33]= $\frac{1}{2}$

Limit of Trigonometric, Exponential and Logarithmic Functions:

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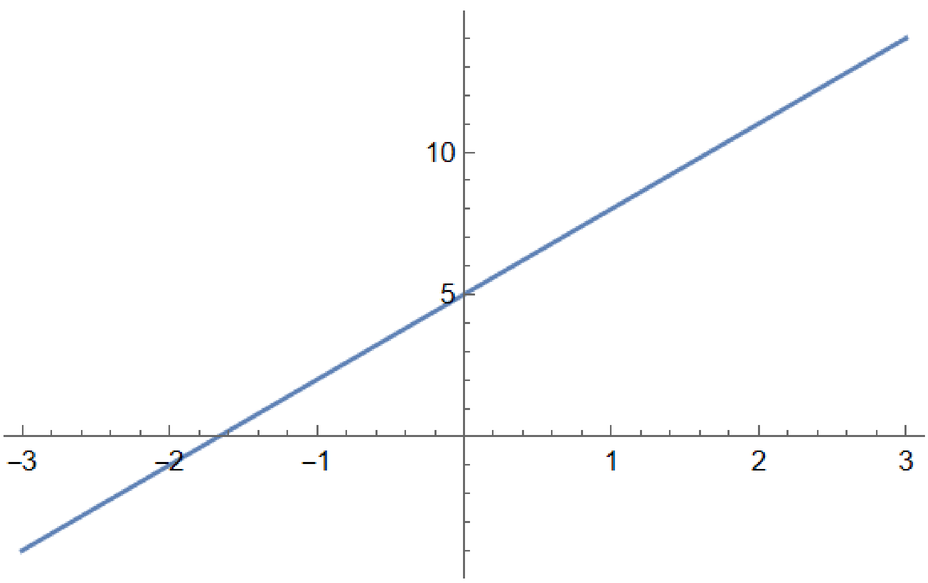
```
2

In[17]:= Limit[(Cos[2*x] - 1) / (Cos[x] - 1), x → 0]

Out[17]= 4

In[35]:= Limit[(Tan[x] - Tan[y]) / (x - y), x → y]

Out[35]= Sec[y]^2

In[39]:= Limit[Sec[x] - Tan[x], x → (Pi / 2)]

Out[39]= 0

In[40]:= Limit[(Sin[x] - Sin[c]) / (Sqrt[x] - Sqrt[c]), x → c]

Out[40]= 2 √c Cos[c]

In[41]:= Limit[(Exp[x] - 1) / (3*x), x → 0]

Out[41]= 1/3

In[43]:= Limit[(Log[(1 + 5*x)]) / (2*x), x → 0]

Out[43]= 5/2
```

Some Graphs:

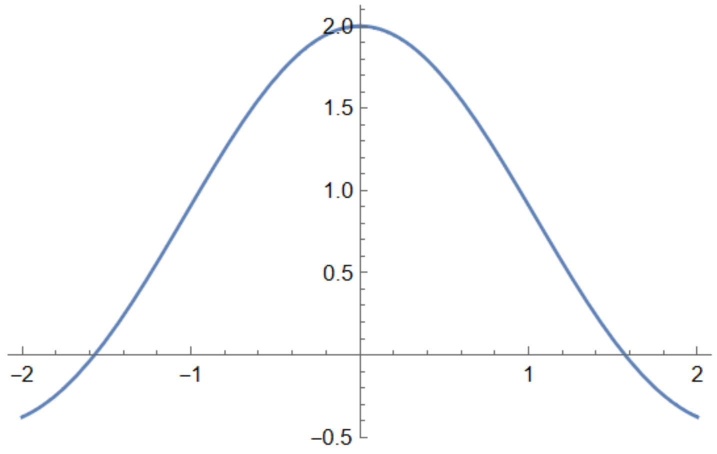
```
In[48]:= GraphicsRow[{Plot[(3*x + 5), {x, -3, 3}]}]
```

Out[48]=



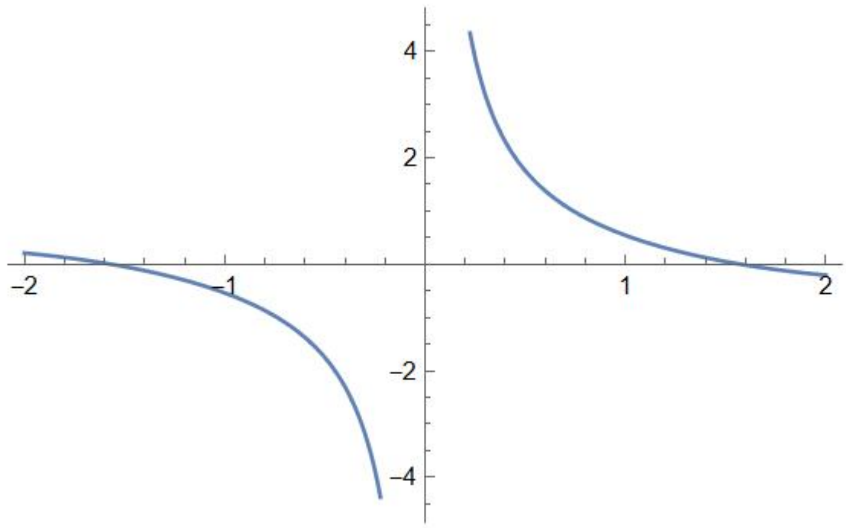
```
In[52]:= GraphicsRow[{Plot[Sin[2*x]/x, {x, -2, 2}]}]
```

Out[52]=




```
In[3]:= GraphicsRow[{Plot[Cos[x]/x, {x, -2, 2}]}]
```

Out[3]=



One Sided Limits:

Left and Right Hands Limit

```
In[58]:= (*Left Hand Limit*)Limit[Abs[x]/x, x → 0, Direction → 1]

Out[58]= -1

In[59]:= (*Right Hand Limit*)Limit[Abs[x]/x, x → 0, Direction → -1]

Out[59]= 1
```

Differentiation:

Derivative of Algebraic functions

In[61]:= `D[2*x+5, x]`

Out[61]= 2

In[65]:= `D[3*x^3+ 2*x^2+x+5, x]`

Out[65]= $1+4x+9x^2$

In[66]:= `D[x+1/x, x]`

Out[66]= $1-\frac{1}{x^2}$

In[67]:= `D[1/(x^2-2*x+1)^(1/3), x]`

Out[67]= $-\frac{-2+2x}{3\left(1-2x+x^2\right)^{4/3}}$

In[73]:= `D[Sqrt[a*x^2+b*x+c], x]`

Out[73]= $\frac{b+2ax}{2\sqrt{c+bx+ax^2}}$

In[76]:= `D[x*Sqrt[(1+x^2)], x]`

Out[76]= $\frac{x^2}{\sqrt{1+x^2}}+\sqrt{1+x^2}$

Derivative of Trigonometric, Logarithmic and Exponential Functions

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In[77]:= `D[Sin[x], x]`

Out[77]= $\mathrm{Cos}[x]$

In[80]:= `D[Csc[x], x]`

Out[80]= $-\mathrm{Cot}[x]\,\mathrm{Csc}[x]$

In[83]:= `D[Sqrt[Tan[x]], x]`

Out[83]= $\frac{\mathrm{Sec}[x]^2}{2\sqrt{\mathrm{Tan}[x]}}$

In[84]:= `D[Sin[Sqrt[x]]/Sqrt[x], x]`

Out[84]= $\frac{\mathrm{Cos}\left[\sqrt{x}\right]}{2x}-\frac{\mathrm{Sin}\left[\sqrt{x}\right]}{2x^{3/2}}$

In[88]:= `D[Cos[6x] Cos[2x], x]`

Out[88]= $-2\,\mathrm{Cos}[6x]\,\mathrm{Sin}[2x]-6\,\mathrm{Cos}[2x]\,\mathrm{Sin}[6x]$

In[89]:= `D[x^2*Tan[x], x]`

Out[89]= $x^2\,\mathrm{Sec}[x]^2+2x\,\mathrm{Tan}[x]$

Application of Derivatives:

Maxima and Minima

```
In[96]:= Maximize[-3 * x^2 + 6 * x + 88, x]

Out[96]= {91, {x → 1}}
```

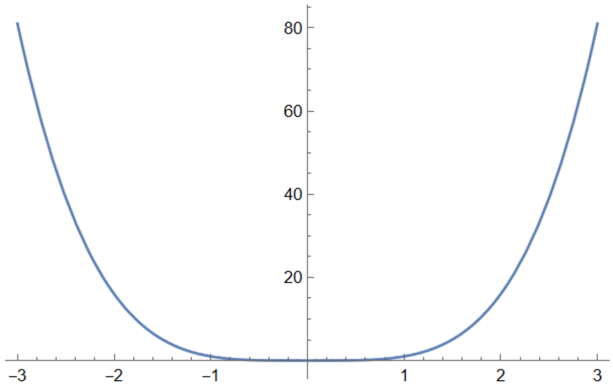
```
In[102]:= Minimize[3 * x^2 + 6 * x + 88, x]

Out[102]= {85, {x → -1}}
```

Some Graphs:

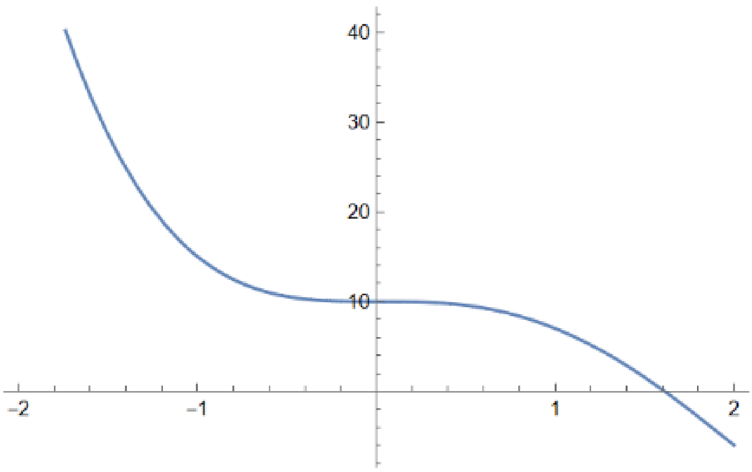
```
In[108]:= Plot[x^4, {x, -3, 3}]
```

Out[108]=



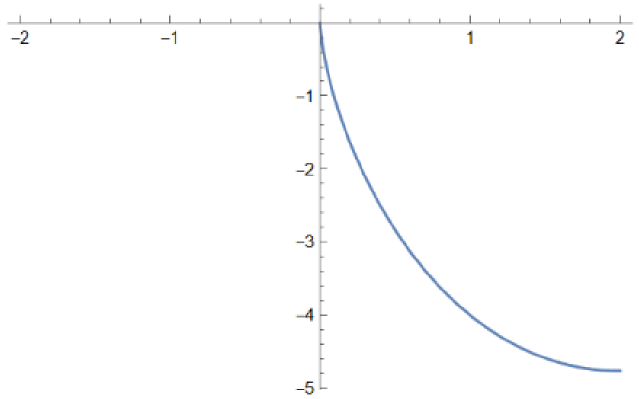

```
In[103]:= Plot[x^4 - 4 * x^3 + 10, {x, -2, 2}]
```

Out[103]=



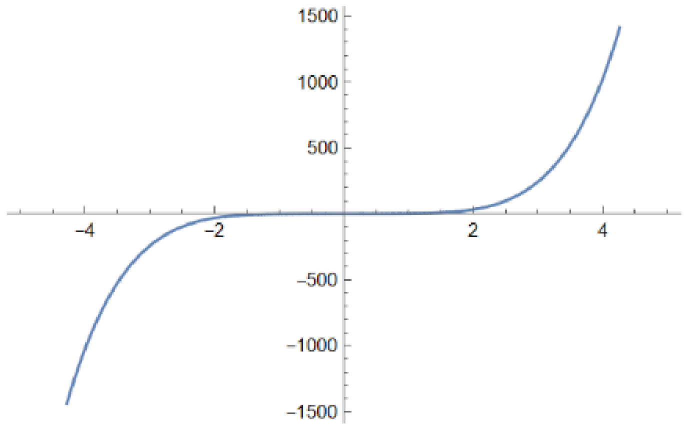
In[109]:= `Plot[x^(5/3) - 5*x^(2/3), {x, -2, 2}]`

Out[109]=



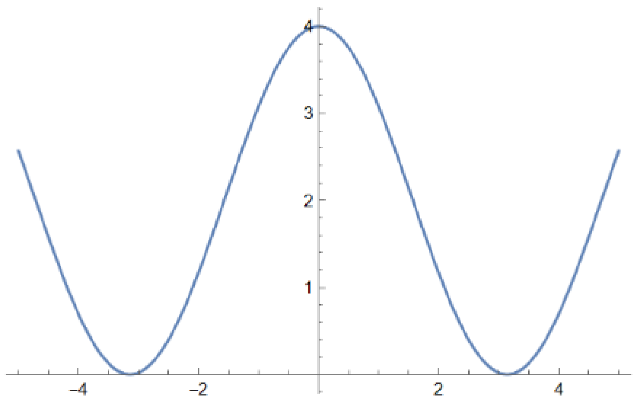
In[110]:= `Plot[x^5, {x, -5, 5}]`

Out[110]=



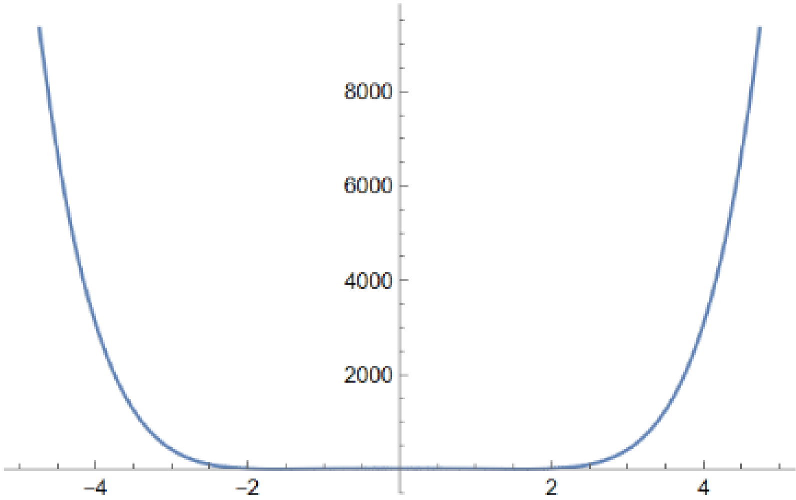
In[116]:= `Plot[(Cos[2*x] - 1) / (Cos[x] - 1), {x, -5, 5}]`

Out[116]=



In[118]:= `Plot[x^6 - 4 * x^4 + 10, {x, -5, 5}]`

Out[118]=



Integration:

Integration of Algebraic Functions

In[119]:= `Integrate[x + 1, x]`

Out[119]= $x + \frac{x^2}{2}$

In[120]:= `Integrate[a * x^2 + b * x + c, x]`

Out[120]= $c\,x + \frac{b\,x^2}{2} + \frac{a\,x^3}{3}$

In[121]:= `Integrate[Sqrt[x] + x^(1/3), x]`

Out[121]= $\frac{3\,x^{4/3}}{4} + \frac{2\,x^{3/2}}{3}$

In[123]:= `Integrate[Sqrt[2 - 5 * x], x]`

Out[123]= $-\frac{2}{15}\,(2 - 5\,x)^{3/2}$

In[124]:= `Integrate[(3 * x + 1) / (x - 2), x]`

Out[124]= $3 \times (-2 + x) + 7\,\mathrm{Log}[-2 + x]$

In[125]:= `Integrate[(x + (1 / x))^2, x]`

Out[125]= $-\frac{1}{x} + 2\,x + \frac{x^3}{3}$

Integration of Trigonometric, Exponential and Logarithmic Functions

```
In[130]:= Integrate[Sin[x], x]
Out[130]= -Cos[x]

In[139]:= Integrate[Sec[x] * Tan[x], x]
Out[139]= Sec[x]

In[142]:= Integrate[2 * Cos[2 x] - 3 * Sin[3 x], x]
Out[142]= Cos[3 x] + Sin[2 x]

In[152]:= Integrate[Sqrt[(1 + Cos[x])], x]
```

Out[152]= $2\sqrt{1+\text{Cos}[x]}\ \text{Tan}\left[\frac{x}{2}\right]$

```
In[153]:= Integrate[Sin[4 x] * Cos[2 x], x]
```

Out[153]= $-\frac{1}{2}\text{Cos}[x]^2-\frac{1}{12}\text{Cos}[6x]$

```
In[151]:= Integrate[(Exp[2 x] + Exp[x] + 3) / Exp[x], x]
```

Out[151]= $-3\,e^{-x}+e^{x}+x$

Integration of Definite Functions

```
In[154]:= Integrate[x + 4, {x, 0, 2}]
Out[154]= 10

In[158]:= Integrate[1 + Cos[x], {x, 0, Pi}]
Out[158]= π

In[161]:= Integrate[1 / (x^2 + 1), {x, 0, Infinity}]
```

Out[161]= $\frac{\pi}{2}$

MATLAB

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include:

- Math and computation
- Algorithm development
- Modeling, simulation, and prototyping
- Data analysis, exploration, and visualization
- Scientific and engineering graphics
- Application development, including Graphical User Interface building

MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. This allows you to solve many technical computing problems, especially those with matrix and vector formulations, in a fraction of the time it would take to write a program in a scalar non-interactive language such as C or Fortran.

The name MATLAB stands for matrix laboratory. MATLAB was originally written to provide easy access to matrix software developed by the LINPACK and EISPACK projects, which together represent the state-of-the-art in software for matrix computation.

MATLAB has evolved over a period of years with input from many users. In university environments, it is the standard instructional tool for introductory and advanced courses in mathematics, engineering, and science. In industry, MATLAB is the tool of choice for high-productivity research, development, and analysis.

MATLAB features a family of application-specific solutions called toolboxes. Very important to most users of MATLAB, toolboxes allow you to *learn* and *apply* specialized technology. Toolboxes are comprehensive collections of MATLAB functions (M-files) that extend the MATLAB environment to solve particular classes of problems. Areas in which toolboxes are available include signal processing, control systems, neural networks, fuzzy logic, wavelets, simulation, and many others.

MATLAB

- First Open Command Window of MATLAB.
- Enter the matrix by assigning the variable.
- Perform any operation using arithmetic operators.

Arithmetic Operations in MATLAB

Symbols	**Operations**
+	Addition
-	Subtraction
*	Multiplication
/	Left Division
\	Right Division
^	Power

Built in Function of MATLAB

Command	**Function**
abs( )	Absolute Value
exp( )	Exponential Function
sqrt( )	Square Root
log( )	Logarithmic Function

Some Trigonometric Functions in MATLAB

Command	**Function**
sin ( )	Sine
cos ( )	Cosine
tan ( )	Tangent
cot ( )	Cotangent
sec ( )	Secant
csc ( )	Cosecant

Assigning Scalars & Performing Division

```
>> a=50;
>> b=5;
>> a/b

ans =

    10
```

Assigning Matrices & Performing Multiplication

```
>> a=[1,3,2;5,6,8;8,2,0]

a =

     1     3     2
     5     6     8
     8     2     0

>> b=[6,9,4;6,7,3;0,3,2]

b =

     6     9     4
     6     7     3
     0     3     2

>> a*b

ans =

    24    36    17
    66   111    54
    60    86    38
```

Simpson's 1/3 Rule

```
f=@(x) (sqrt(1+x^3));
a=0;
b=2;
n=4;
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+i*h);
end
I=(h/3)*s
```

Command Window

```
>> simpson

I =

    3.0138
```

Trapezoidal Rule

```
f= @ (x) sin(x);
a=0;
b=pi;
n=6;
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
```

Command Window

```
>> Trapezoidal

I =

    1.9541
```

Linear Programming Problem (LPP)

To Find the Minimization of LLP

```
>> f=[-7;5];
>> B=[6;6;0;0];
>> A=[1 2;4 3;-1 0; 0 -1];
>> [x,fmin] = linprog (f,A,B)

Optimal solution found.


x =

    1.5000
         0


fmin =

  -10.5000
```

LLP by Matrix Inversion Method

Example 1:-

-2x + 2y + z = -4

-8x + 7y – 4z = -47

9x - 8y + 5z = 55

```
>> A=[-2,2,1;-8,7,-4;9,-8,5];
>> B=[-4,-47,55]';
>> X=A\B

X =

    3.0000
   -1.0000
    4.0000
```

Example 2:-

$2a + 3b = 4$

$4a - c = 5$

$4b + 3c = -5$

```
>> X=[2,3,0;4,0,-1;0,4,3];
>> Y=[4,5,-5]';
>> Z=X\Y

Z =

    0.5000
    1.0000
   -3.0000
```

LLP by Gauss-Seidel Method

Example:

$4x - y + z = 8$

$2x + 5y + 2z = 3$

$x + 2y + 4z = 11$

From the given Equation, We have

$x = 1/4\ (8 + y - z)$

$y = 1/5\ (3 - 2x - 2z)$

$z = 1/4\ (11 - x - 2y)$

Initially, x=0, y=0, z=0

```
f1=@(x,y,z) (1/4)*(8+y-z);
f2=@(x,y,z) (1/5)*(3-2*x-2*z);
f3=@(x,y,z) (1/4)*(11-x-2*y);
x=0;y=0;z=0;
for i=1:10
    f1(x,y,z);
    f2(x,y,z);
    f3(x,y,z);
    x=f1(x,y,z);
    y=f2(x,y,z);
    z=f3(x,y,z);
end
```

Command Window

```
>> gauss_seidel
>> x

x =

    1.0000

>> y

y =

   -1.0000

>> z

z =

    3.0000
```