PRESIDENCY UNIVERSITY

Private University Estd. in Karnataka State by Act No. 41 of 2013

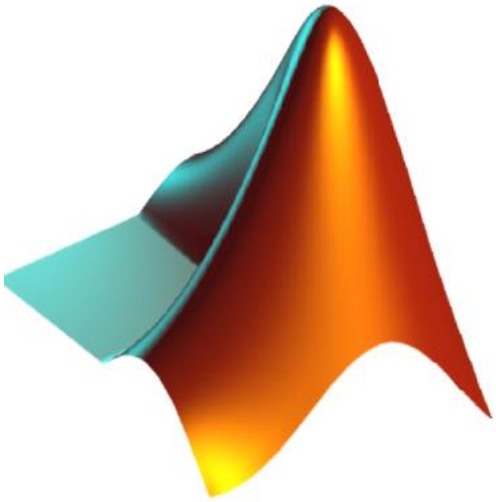
PRESIDENCY GROUP OVER 40 YEARS OF ACADEMIC WISDOM

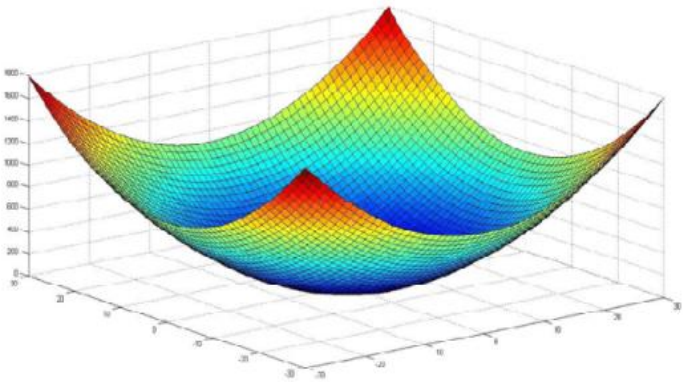
Department of Mathematics

Optimization for Data Science (CSE3037)

MATLAB-Programming

Lab Manual





List of Laboratory Tasks:

Introductory Task: Introduction to usage of the software and simple programming tasks
Experiment No. 1: Finding minimum and maximum of a function
Experiment No. 2: Multivariate Visualization
Experiment No. 3: Linear Programming Problem
Experiment No. 4: Linear Regression
Experiment No. 5: Logistic Regression
Experiment No. 6: Curve fitting using optimization
Experiment No. 7: Nonlinear optimization
Experiment No. 8: Particle swarm optimization
Experiment No. 9: Gradient Descent method

Engineers and scientist's world wise use MATLAB to solve complicated real-world problems. Analyse data and visualize ideas lead to a better understanding of complex systems. This course walks you through the basics of using MATLAB including performing calculation with commands, importing data from external sources and visualizing data through plotting functions. The name MATLAB stands for Matrix Laboratory. It is an excellent tool for

¬ Linear algebra computations
¬ Data analysis
¬ Signal processing
¬ Optimization
¬ Numerical solution of ordinary differential equations (ODEs) and many other types of scientific computations

MATLAB programming language: One can compute the solution for a given problem by using

- Built in functions
- User-written functions

Getting started with MATLAB:

1. Double click the MATLAB shortcut on window desktop.
2. MATLAB automatically loads all the program files provided by MATH Works for
MATLAB and other MATH Work products.
3. Desktop appears containing tools for managing files, variables and applications
associated with MATLAB

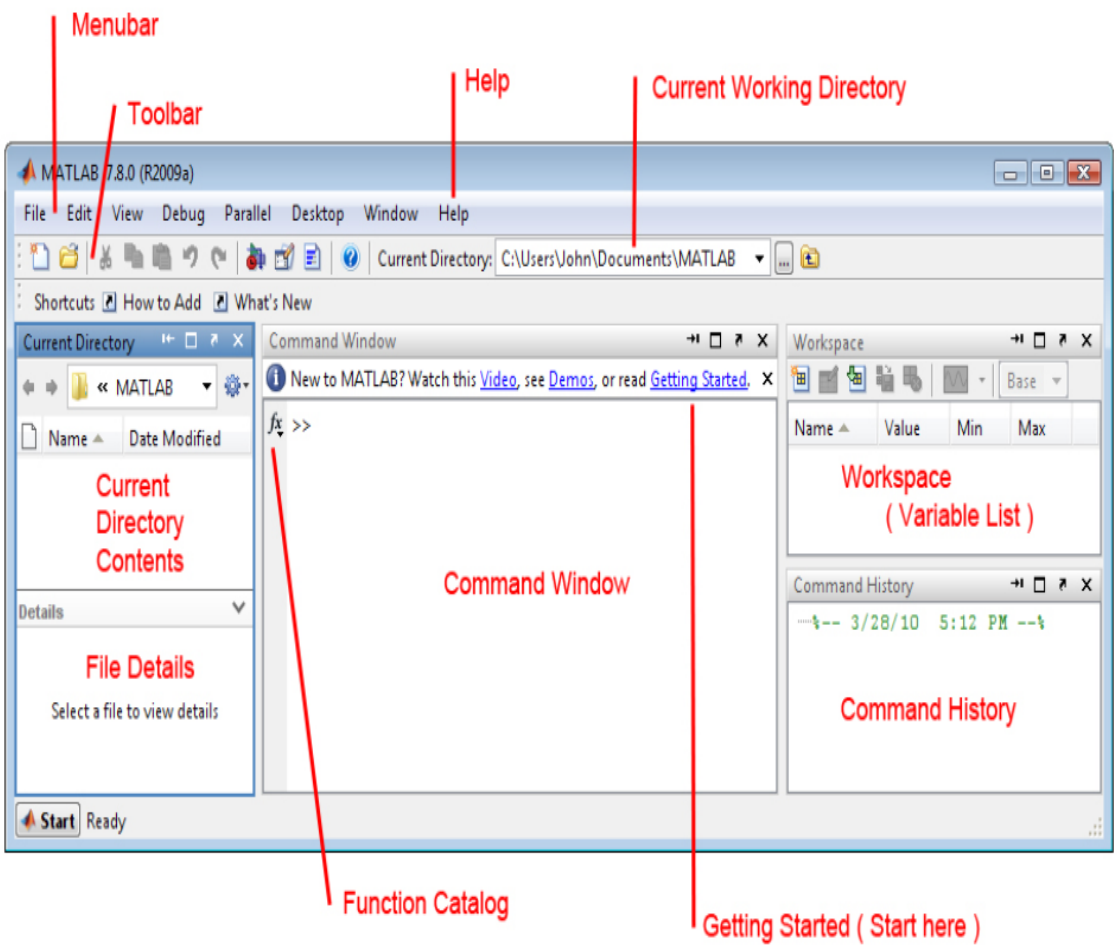
This desktop majorly consists of the following:

a) Command window
b) Command history window
c) Workspace window
d) Variable editor window
e) Current folder/directory

Note:

1. >> **Prompt** indicates that MATLAB is ready to accept input from user, it is also known as the **command line**.
2. **clc** command clears the command window only. Variables remain stored in memory space. **clear/clear all** command clears all the variables from the command window and command history window.

The MATLAB Work Environment



Basics

```
exp(5) %exponential
log(7) %log with base e
log10(7) %log with base 10
sin(pi/3) %trigonomrtry
syms x y %syms used to define variables
solve(x-6) %solve itself equates to zero
solve(x^2-5*x+6)
solve(x^3-1,x)
p=[1 2 4]; %a row array
a=p'; %transpose of an array
q=[9;6;3]; %a column array
A=[0 8 7;7 5 4;2 3 6]; % a matrix
det(A) %determinant of a matrix
inv(A) %inverse of a matrix
c=-10:10; %print numbers from -10 to 10 with common difference 1
sum(c) %sum of all terms in the sequence
k=-10:1.5:30; %starting value -10 with common difference 1.5 goes till 30
p.*p; %array multiplication term wise
%solving system of equations
e1=3*x+4*y-10;
e2=-x+2*y-15;
[x,y]=solve(e1,e2);
```

```
syms x y
f=x^3+6*x-5; %defining a function of x
subs(f,3) %substituting value of x as 3 in f
diff(f,x) %differentiating f w.r.t x once
diff(f,x,2) %differentiating f w.r.t x twice
g=x^2*y+x+y;
diff(g,x) %differentiating g w.r.t x
diff(g,y) %differentiating g w.r.t y
int(f,-1,3) %integrating function f from -1 to 3
```

Experiment 1: Finding minimum and maximum of a function

```
syms x y real
f=input('Enter the function f(x,y):')
dfx=diff(f,x);
dfy=diff(f,y);
eqns=[dfx==0,dfy==0];
S=solve(eqns,[x y], 'Real', true);
disp(S)
disp(x)
G=S.x;
disp(G)
H=S.y;
disp(H);
dfxx=diff(dfx,x);
dfyy=diff(dfy,y);
dfxy=diff(dfy,x);
A=subs(dfxx,S);
disp(A);
disp(length(A));
B=subs(dfxy,S);
C=subs(dfyy,S);
e1=subs(f,S);
for i=1: length(A)
if A(i)*C(i)-B(i)*B(i)>0 & A(i)<0
fprintf('The Maximum point is %d %d',[G(i), H(i)]);
fprintf('\n');
fprintf('The maximum value is %d',e1(i));
fprintf('\n');
elseif A(i)*C(i)-B(i)*B(i)>0 & A(i)>0
fprintf('Minimum point is %d %d',[G(i), H(i)]);
fprintf('\n');
fprintf('The minimum value is %d',e1(i));
fprintf('\n');
elseif A(i)*C(i)-B(i)*B(i)<0
fprintf('Saddle point is %d %d',[G(i), H(i)]);
fprintf('\n');
else A(i)*C(i)-B(i)*B(i)==0
fprintf('No conclusion can be drawn for %d %d',[G(i), H(i)]);
fprintf('\n');
end
end
```

Output

```
Enter the function f(x,y):
x^3+y^3-3*x-12*y+20

f =

x^3 - 3*x + y^3 - 12*y + 20

    x: [4x1 sym]
    y: [4x1 sym]

x

-1
 1
-1
 1

-2
-2
 2
 2

-6
 6
-6
 6

     4

The Maximum point is -1 -2
The maximum value is 38
No conclusion can be drawn for 1 -2
No conclusion can be drawn for -1 2
Minimum point is 1 2
The minimum value is 2
```

Problem description: Find minima and maxima if exists for the function $f(x) = 2x^3 - 6xy + y^2 + 4y$.