Introduction to MATLAB

LAB 1
Basics of MATLAB

- MATrix LABoratory
- A super-powerful graphing calculator
- Matrix based numeric computation
- Embedded functions
- Also a programming environment
- User defined functions
- Commands executed line by line
Outline

- LAB 1: User Interface, Vectors and Matrices
- LAB 2: Visualization
- LAB 3: MATLAB Scripts
- LAB 4: MATLAB Functions
MATLAB Main Window
MATLAB Script Window

```matlab
% MATLAB Script

x = 0:0.005:30;  
y = sin(12*pi.*x);  
subplot(2,1,1);  
plot(x,y);  
title('Y');  
xlabel('X');  
ylabel('sin(x)');  
grid on;  
axis tight;  

L = length(y);  
c = secon(1,L);  
for i=1:L  
z(1,i) = (1/(L-L-i+1)) * sum(y(1:L-i+1)).' * y(1:L-i+1);  
end  

subplot(2,1,2);  
stem(x,z);  
title('Rxx');  
xlabel('Lag');  
ylabel('Rxx');  
grid on;  
axis tight;
```
MATLAB Built-In Help System

- **MATLAB Help**
  - Includes detailed documentation
  - Invoke by typing ‘doc’ at command line

- **Search commands by keyword**
  - Type ‘lookfor keyword’ at command line

- **Lookup syntax of command**
  - Type ‘help functionname’ at command line
Interacting in the command window

- Type the commands at the command prompt (>>) in the command window
- Type ‘clc’ to clear all the previous commands and ‘clear all’ to delete existing variables in the workspace
- Type ‘who’ or ‘whos’ to get information about the variables
- Semicolon (;) at the end of a command stops the results from being displayed
- Variable ‘ans’ stores the last unassigned value (like a calculator)

Example:

```
>> 53
ans=
  53
>> x=53;
>> x=53
```

```
Creating Row Vectors

- **Row Vector**: comma or space separated values between brackets

  ```matlab
  >> row = [20 1.5 -33 0];
  >> row = [20,1.5,-33,0];
  ```

- **Command Window**:  
  ```matlab
  >> row=[20 1.5 -33 0]
  row =
  20.0000   1.5000   -33.0000    0
  ```

- **Workspace**:  
  ![Workspace screenshot](image)

  - **Name**: row  
    - **Value**: [20,1.5,-33,0]  
    - **Size**: 1x4  
    - **Bytes**: 32  
    - **Min**: -33  
    - **Max**: 20
Creating Column Vectors

- **Column Vector**: semicolon separated values between brackets

  ```matlab
  >> column=[20;1.5;-33;0];
  ```

- **Command Window**:
  ```matlab
  >> column=[20;1.5;-33;0]
  
column =
  
  20.0000
  1.5000
  -33.0000
  0
  ```

- **Workspace**:

![Workspace Image]
Creating Matrices

- Create Matrices like vectors

- Element by element:
  \[ \text{mat} = \begin{bmatrix} 5 & 3 & -10; & 6 & 1.2 & 8 \end{bmatrix} \]

- Large uniform matrices:
  - \( x = \text{zeros}(m,n); \quad m: \text{no. of rows} \quad n: \text{no. of columns} \)
  - \( y = \text{ones}(m,n); \)
  - \( z = \text{rand}(m,n); \quad \text{or} \quad z = \text{rand}(n); \)

- Vectors with values increasing linearly:
  - \( t = \text{Start} : \text{Increment} : \text{End}; \)
  - \( t = \text{linspace} \ (\text{Start}, \text{End}, \text{Number of Samples}); \)
Dimensions of Matrices

- **Number of rows and columns:**
  - \([\text{row}_x, \text{column}_x] = \text{size}(x)\);
  - \(\text{row}_x = \text{size}(x, 1)\);
  - \(\text{column}_x = \text{size}(x, 2)\);

- **Length of a matrix:**
  - \(\text{length}_x = \text{length}(x)\);

- **Number of elements in a matrix:**
  - \(\text{num}_x = \text{numel}(x)\);
Accessing Elements Inside a Matrix

- Accessing by “row number” and “column number”
  - \( a = x(m,n); \)
  - \( x(m,n) = 3; \)
- Accessing by “element number”
  - \( a = x(element\_number); \)
- Accessing an entire row:
  - \( r = x(m,:); \)
  - \( x(m,:) = [a\ b\ c\ d]; \)
- Accessing part of a column
  - \( c = x(2:4,n); \)
  - \( x(2:4,1) = [3\ 4\ 5]; \)

- Be careful about dimensions!
Searching Inside a Matrix

- Use the “find” command to return the “element no.”
  
  \[ \text{el_number} = \text{find (} x == 3 \text{)}; \]

- Use the “find” command to find the row and column no.
  
  \[ [ \text{row_no, column_no} ] = \text{find (} x == 3 \text{)}; \]

- **NOTE** the “==” sign!
Mathematical Operations

- **Matrix Multiplication**
  - \( a = b \times c \); multiplies two matrices
  - \( a = 3 \times b \); multiplies a scalar with a matrix

- **Element by element Operations**
  - \( a = b \times c \);
  - \( a = b ^{\wedge} c \);

- **Transpose operator turns a column vector to a row vector or vice versa:**
  - \( b = \text{transpose}(a) \);
  - \( b = a^{\prime} \);

- **Take note of the dimensions!!**
LAB 1 – Introduction to MATLAB

➢ Before starting the lab type “>> diary LAB_ONE” at command prompt

➢ After finishing everything type “>> diary off”

➢ Find the file “LAB_ONE” in the current directory and open with any word processor

➢ Edit the file and submit it for Lab1 report prior to the beginning of next class