Start MATLAB

Start → NUnet → Applications →
Statistical and Computational packages →
MATLAB Release 13 → MATLAB 6.5

Prompt “>>” will appear in the **command window**

Today:

- MATLAB overview
- In-class HW: Chapter 1, Problems 3-4
- Continue MATLAB introduction
    1. Initializing variables
    2. Math Functions
    3. Transposing
    4. Built in functions
    5. Special Matrices

HW due next week (Wed/Th)

- Read Chapters 1 - 2
- Chapter 2, Problems 2, 3, 5

MATLAB = **MAT**rix **LAB**oratory

- by *The Math Works, Inc.*
- Powerful mathematical computational tool
- Developed to work with matrices
- Many engineers & scientists use this tool
- Use interactively

or

- Create a MATLAB program script (m-file)

Try a simple program

```
%   Try this.  Type each line exactly as it appears & hit enter key.
sqrt (16)
sqrt (144)
ans/2
%   Now try this
x=1
x=x+1
%   Program to compute average temperature and plot data
time=[0,1,2,3,4,5,6];
temp=[0,1,4,9,16,25,36];
avgtemp=mean(temp)
%   You should have gotten 13 for avgtemp
%    Now try the graph
plot (time,temp), title('Results'), xlabel('Time, minutes'),…
ylabel ('Temperature, degrees F'), grid

%    close graphing window when done
```

MATLAB notes - 1

- **>>** is the MATLAB command window prompt
- **%** starting a line is a comment
- There are built in functions like: **sqrt** and **mean**
- When you do a calculation, result is stored in **ans**
- x=x+1 is an assignment (not an algebraic equation)
- **;** at end of line suppresses displaying results
- **up arrow** will retrieve prior command lines

MATLAB notes - 2

- **Scalar** : single number – ex: 5.3 (1x1 matrix)
- **Vector** : row of numbers or column of numbers (1-D array)
  – ex: temp=[0,1,4,9,16,25,36] - 1 row 7 columns (1x7)
- **Matrix** : rows and columns (2-D array)
  – ex: Array1 = [-1, 0, 6.2, 5
  4, 0, 10, 14
  -7, 8, -18, 0]
  Array1 is a 3 x 4 matrix
- A(2,3) refers to element in 2nd row, 3rd column =10
- **MATLAB INDEXING BEGINS WITH 1! (UNLIKE C++)**

In defining a matrix, use:

- Commas or spaces to separate elements
- Semi-colons or “enter key” (next line) to separate rows

Variable names

```
%   clear the command window (but not the variables already defined)
clc

%   try this using lower case
x=1;
y= 2;
%   try this using upper case
X=5;
Y= 8;
Z=X*Y
%   case matters!!  Upper & lower case make it a DIFFERENT variable!

who         %   shows your variables
whos        %   shows your variables + sizes

% Variable names start with a letter
% OK to contain letters, numbers, and underscore.
1A=5*5      %   error! – variable names must start with a letter

X=pi*2      %   pi is a built-in function
```

Try creating matrices

```
%  Create a 2 x 3 matrix
A=[1,2,3; 4,5,6]
%  OK to use variables to define another
B=[A; 5,6,7]
%  try this
C(3,2)=1
%  defined element in 3rd row, 2nd column to be 1
%  prior elements (not defined), set to 0
C(2,2)=5
%  replaced single element

%  Generate vectors using the colon operator :
D=1:8              %  generates all #'s between 1 and 8
E=0 : 2 : 10       %  generates between 0 and 10 in increments of 2
F=10 : -0.5  : 6   %  ok to use non-integer increments & negative #s
%  end value doesn't have to be an exact multiple of the increment
G=0 : pi/2  : 10

whos       %  check variables again
quit       %  close MATLAB session by typing quit
```

In-class assignment

Chapter 1, Problems 3-4 (10 minutes).

Get handout if you don’t have your textbook.

Initializing variables

1. **Explicit List** (we just did this)

   – examples:

   A=[1,2,3; 4,5,6]

   B=[A; 7,8,9]

2. **Colon Operator** – (just did this; you will see this again in HW assignment) … very powerful.
3. **User asked to input from keyboard**
4. **Read from a data file**

Now try this

X1=1

X2=2

X3=3

X4=4

X5=5

X_combined=[X1, X2, X3, X4, X5]

In-class homework

Chapter 1 – Problem #4 … One possibility using pseudocode:

1. Add station 1 ratings then divide by 3 to get Average1
2. Add station 2 ratings then divide by 5 to get Average2
3. Add station 3 ratings then divide by 6 to get Average3
4. Add station 4 ratings then divide by 2 to get Average4
5. Average5 is equal to Station 5 rating (only 1 rating for station 5)
6. Display bar graph of 5 stations averages (Average1 thru Average5)
7. Determine maximum of the 5 averages
8. Sum the 5 averages and divide by 5 to get the mean

```
% try the code for problem 4
Average1=(10.6+9.8+4.5)/3
Average2=(5.6+7.2+3.4+5.8+5.9)/5
Average3=(1.3+1.5+1.8+2.1+1.2+1.1)/6
Average4=(6.5+6.2)/2
Average5=3.4
% put the averages into an array so you can use MATLAB functions
station_averages=[Average1,Average2,Average3,Average4,Average5]
bar(station_averages)
max(station_averages)
mean(station_averages)
```

Colon Operator

```
% try this
M=[1,2,3; 4,5,6; 7,8,9]
% Select Columns
C1=M( : ,1)
C2=M(:,2)
% Select a Submatrix
S1=M(2:3, 1:2)
% Make a long column
C3=M( : )
```

User input

% try this

z=input('Enter values for z in brackets:')

User must type values within brackets or get an empty matrix

User could type [0, 1, -1, 2.2] and then hit enter key

Math Functions

* **scalar math** : for 2 scalars or for scalar and a single matrix)
* **matrix math** : start with **element by element** (assume same size matrix)

Addition: A+B

Subtraction: A-B

Multiplication: A.*B

Division: A./B

Exponentiation: A.^B

Transposing

* **use single quote to turn rows into columns**

% try this

```
X=[2, 3, 5; 4, 10, 5]
X_transpose=X’
```

% try this

```
x=0:5
y=0:5:25
[x’ y’]
```

More MATLAB

- **Built in functions: pi, i or j**

  i or j = square root of -1 (complex numbers)

- **Special Matrices**

  - matrix of zeros

  ```
  A=zeros(3,2)
  B=[1,2,3;4,5,6]
  C=zeros(size(B))
  ```

  - matrix of ones

  ```
  D=ones(3,2)
  E=[1,2,3;4,5,6]
  F=ones(size(E))
  ```

Homework assignment

Reading Assignment:

Chapters 1 & 2 in MATLAB book.

Homework due next Wed/Thurs (3/17-18):

Chapter 2- Problems 2, 3, & 5.