

01-MATLAB Environment

Text: Chapter 1.1-1.5

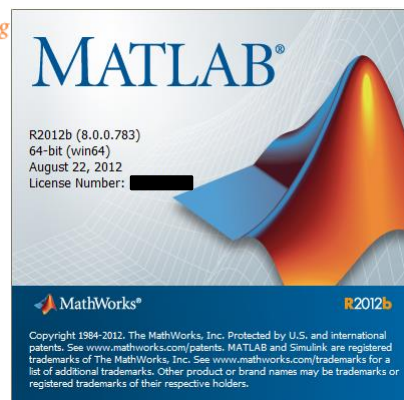
ECEGR 101

Engineering Problem Solving with Matlab

Professor Henry Louie

MATLAB[®]
The Language of Technical Computing

MATLAB Environment





Overview

- What is Matlab
- Matlab Desktop
- Matlab as a Calculator
- Order of Operations



What is MATLAB?

- Data analysis and visualization tool
- Powerful support for matrices and matrix operations
- Graphics capabilities
- Programming language
- Toolboxes: sets of MATLAB programs designed to support a particular task.
- MATLAB = matrix laboratory



Uses of MATLAB

- Math and computation
- Algorithm development
- Data acquisition
- Modeling, simulation, and prototyping
- Data analysis, exploration, and visualization
- Scientific and engineering graphics
- Application development (including graphical user interface building)



MATLAB Working Environment

- MATLAB desktop
 - Command Window
 - Workspace Browser
 - Current Directory Window
 - Command History Window
 - Figure Window(s)
- MATLAB editor
- MATLAB help browser

MATLAB Desktop

The screenshot shows the MATLAB Desktop interface. The top menu bar includes Home, Plots, and Apps. The Command Window on the left shows the following code:

```

>> a=5;
>> b=4;
>> c=a+b;
c =
    9
  
```

The Workspace window on the right displays the following variables:

Name	Value	Min	Max
Index	[179,61,130,478]	62	478
IndexTemp	<1x500 double>	1	500
P1	<1x780 double>	0	0.9642
P2	<1x780 double>	0	0.9608
P_LR	<1x780 double>	0	1.8999
P_LR	<1x780 double>	0	1.9696
P_LR	<1x780 double>	0	1.8548
P_LR	<1x780 double>	0	1.8980
P_temp	<6x780 double>	0	0.9686
X	<1x252 double>	0	1
Y	<1x252 double>	0	1
a	5	5	5
ans	<1x2 double>	1	12
ans	370.0011	370.00...	370.00...
ans	366.0011	366.00...	366.00...
b	4	4	4
bad_chi	<500x12 double>	NaN	NaN

The Command History window shows the following commands:

```

test
-- 9/13/2013 9:08 AM --%
-- 9/18/2013 10:59 PM --%
Budget_Calculator
-- 8/21/13 1:07 PM --%
6277.83-2340-800-450-500
-- 9/20/2013 9:40 AM --%
ans=incread('baboon','left')
clc
ans
dependency_structures
clc
a=5;
b=4;
c=a+b
  
```

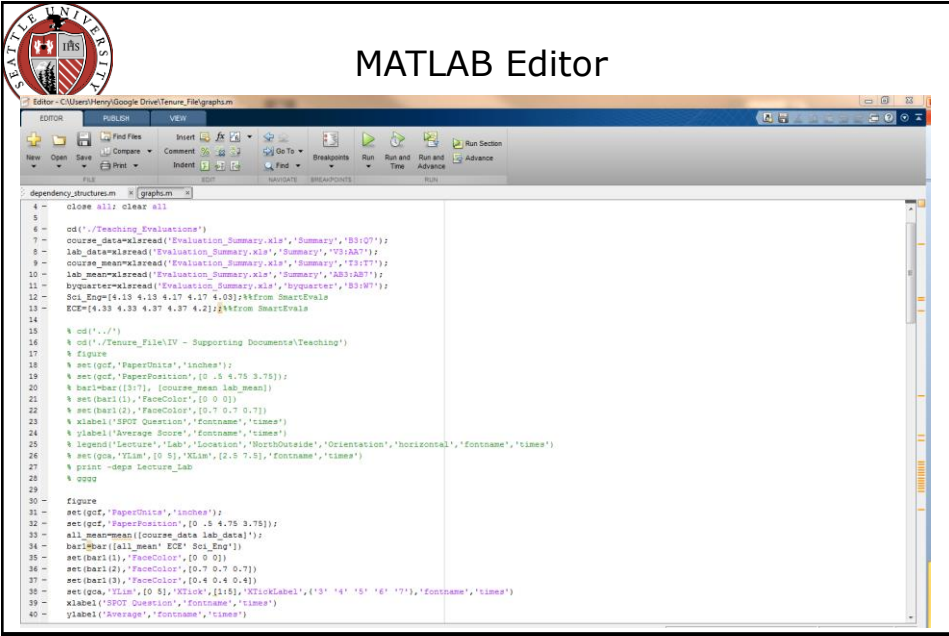
Figure 1 contains four subplots showing Power (p.u.) vs. Power (p.u.) for different time steps: A. t = 0.01, B. t = 0.25, C. t = 0.52, and D. t = 0.76.

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MATLAB Help

The screenshot shows the MATLAB Desktop interface, identical to the previous one, but with the Help menu in the top bar highlighted by a red circle.

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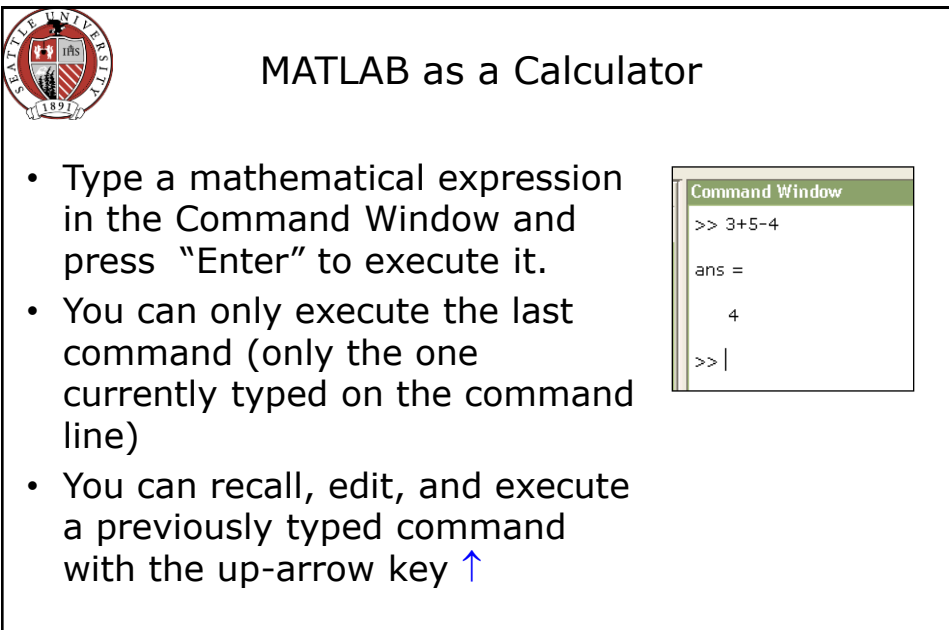
MATLAB Editor

```

4 - close all; clear all
5
6 - od('./Teaching_Evaluations')
7 - course_data=xlread('Evaluation_Summary.xls','Summary','B3:Q7');
8 - lab_data=xlread('Evaluation_Summary.xls','Summary','T3:R17');
9 - course_mean=xlread('Evaluation_Summary.xls','Summary','T3:T7');
10 - lab_mean=xlread('Evaluation_Summary.xls','Summary','AB3:AB7');
11 - byquarter=xlread('Evaluation_Summary.xls','byquarter','B3:B7');
12 - Sci_Eng=[4.19 4.19 4.27 4.37 4.03];%from SmartEval
13 - ECE=[4.33 4.33 4.37 4.37 4.2];%from SmartEval
14
15
16 - od('./')
17 - od('./Tenure_File\IV - Supporting Documents\Teaching')
18
19 - figure
20 - set(gcf,'PaperUnits','inches');
21 - set(gcf,'PaperPosition',[0.5 4.75 3.75]);
22 - bar=bar(3:7), [course_mean lab_mean];
23 - set(bar(1),'FaceColor',[0 0 0]);
24 - set(bar(2),'FaceColor',[0.7 0.7 0.7]);
25 - xlabel('SPOT Question','fontname','times');
26 - ylabel('Average Score','fontname','times');
27 - legend('Lecture','Lab','Location','NorthOutside','Orientation','horizontal','fontname','times');
28 - set(gca,'YLim',[0 5],'XLim',[0.5 0.5], 'fontname','times');
29 - print -deps Lecture_Lab
30
31 - figure
32 - set(gcf,'PaperUnits','inches');
33 - set(gcf,'PaperPosition',[0.5 4.75 3.75]);
34 - all_mean=mean([course_data lab_data]);
35 - bar=bar([all_mean ECE Sci_Eng]);
36 - set(bar(1),'FaceColor',[0 0 0]);
37 - set(bar(2),'FaceColor',[0.7 0.7 0.7]);
38 - set(bar(3),'FaceColor',[0.4 0.4 0.4]);
39 - set(gca,'YLim',[0 5],'Xtick',[1:3],'XtickLabel',{'3' '4' '5' '6' '7'}, 'fontname','times');
40 - xlabel('SPOT Question','fontname','times');
41 - ylabel('Average','fontname','times');

```

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MATLAB as a Calculator

- Type a mathematical expression in the Command Window and press “Enter” to execute it.
- You can only execute the last command (only the one currently typed on the command line)
- You can recall, edit, and execute a previously typed command with the up-arrow key ↑

Command Window

```

>> 3+5-4

ans =

    4

>> |

```

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MATLAB as a Calculator

- If a command is too long, press the Space key, type the ellipsis (three periods ...), press Enter and continue.
- To type a comment, use the percent symbol %.

```
>> 4^9+3-9/4+3*24 ...
+45/6
ans =
    2.6222e+005
>>
```

```
>> 3/7 % right division
ans =
    0.42857
>> 3\7 % left division
ans =
    2.3333
```



MATLAB as a Calculator

- Use the semicolon ; to suppress the output
- Use the `clc` command to clear the Command Window

```
>> 5^4+3
ans =
    628
```

```
>> 5^4+3;
>> |
```

Calculation performed,
output not displayed



Operations

Operators:

- + addition
- - subtraction
- * multiplication
- / right division
- \ left division
- ^ exponent



Order of Operations

1. Parenthesis (starting from the innermost)
 $4*(3-1) = 4*2 = 8$
2. Exponent
 $4*(3-1)^2 = 4*2^2 = 4*4 = 16$
3. Multiplication, division
 $4*2-3*2 = 8-6 = 2$
4. Addition, subtraction



Exercise

- Match the following MATLAB expressions with their results.

Expressions:

a) $2^2/2+2*2-2$

b) $2^2/(2+2)*2-2$

c) $2^{(2/2+2)*2-2}$

d) $2^{(2/2+2*2)-2}$

e) $2^{(2/2)+2*2-2}$

f) $(2^2)/2+2*2-2$

Results:

30

14

4

0

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Exercise

Expressions:

a) $2^2/2+2*2-2$

b) $2^2/(2+2)*2-2$

c) $2^{(2/2+2)*2-2}$

d) $2^{(2/2+2*2)-2}$

e) $2^{(2/2)+2*2-2}$

f) $(2^2)/2+2*2-2$

Answers:

a) 4

b) 0

c) 14

d) 30

e) 4

f) 4

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Display Format

```
>> 100.11, 1001.1, 0.00010011
ans =
    100.1100

ans =
    1.0011e+003

ans =
    1.0011e-004
```

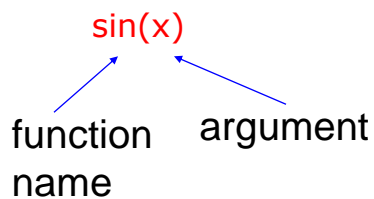
Can be changed with the **format** command:

- >> format long
(14 digits after the decimal)
- >> format bank
(“dollars and cents” format)
- >> format compact
(suppress extra line feeds)
- >> format loose
(restore extra line feeds)

Default:
format short



Built-In Functions



Examples:

sqrt(x), **cos(x)**, **tan(x)**,
log10(x), **exp(x)**, **abs(x)**,

Examples:

round(x) – round to the
nearest integer

fix(x) – round towards
zero

ceil(x) – round towards
infinity

floor(x) – round towards
minus infinity



Built-In Functions

- How do we find the right function?
 - Use the command **lookfor** or the search option in Help.

```
>> help inverse
inverse.m not found.
```

```
>> lookfor inverse
INVHILB Inverse Hilbert matrix.
IPERMUTE Inverse permute array dimensions.
ACOS Inverse cosine.
ACOSD Inverse cosine, result in degrees.
ACOSH Inverse hyperbolic cosine.
ACOT Inverse cotangent.
ACOTD Inverse cotangent, result in degrees.
ACOTH Inverse hyperbolic cotangent.
ACSC Inverse cosecant.
ACSCD Inverse cosecant, result in degrees.
ACSCH Inverse hyperbolic cosecant.
ASEC Inverse secant.
ASECD Inverse secant, result in degrees.
ASECH Inverse hyperbolic secant.
ASIN Inverse sine.
ASIND Inverse sine, result in degrees.
ASINH Inverse hyperbolic sine.
ATAN Inverse tangent.
ATAN2 Four quadrant inverse tangent.
ATAND Inverse tangent, result in degrees.
ATANH Inverse hyperbolic tangent.
ERFCINV Inverse complementary error function.
ERFINV Inverse error function.
INV Matrix inverse.
PINV Pseudoinverse.
IFFT Inverse discrete Fourier transform.
```



Exercise

Use the lookfor command to determine how to take the base-10 logarithm of a number in MATLAB.



Exercise

>> lookfor log
 PREFERENCES Bring up MATLAB user settable preferences dialog.
 and.m: %& Logical AND.
 not.m: %~ Logical NOT.
 or.m: %| Logical OR.
 XOR Logical EXCLUSIVE OR.
 LOGSPACE Logarithmically spaced vector.
 LOG Natural logarithm.
 LOG10 Common (base 10) logarithm.
 LOG1P Compute $\log(1+z)$ accurately.
 LOG2 Base 2 logarithm and dissect floating point number.
 REALLOG Real logarithm.
 ...



Exercise

Use the MATLAB Help Browser to find the command required to show MATLAB's current directory. What is the current directory when MATLAB starts up?



Exercise

>> help pwd

PWD Show (print) current working directory.

PWD displays the current working directory.

S = PWD returns the current directory in the string S.

See also cd.

Reference page in Help browser

doc pwd



Exercise

Get help on the MATLAB function "exp" using:

- a) the "help exp" command typed in the Command Window and
- b) the Help Browser.



Exercise

>> help exp

EXP Exponential.

EXP(X) is the exponential of the elements of X, e to the X.

For complex $Z=X+i*Y$, $EXP(Z) = EXP(X)*(COS(Y)+i*SIN(Y))$.

See also expm1, log, log10, expm, expint.

Reference page in Help browser: doc exp