

CSE 1570 Interacting with MATLAB

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<http://www.cse.yorku.ca/course/1570>

1

Introduction

Outline

- Starting MATLAB
- MATLAB Windows
- Using the Command Window
 - Some useful commands
- Using MATLAB as a calculator
 - Arithmetic operations
 - Order of precedence
 - Elementary math built-in functions

2

Introduction

Outline (Cont'd)

- Variables
 - The assignment operator
 - Rules for variable names
 - Predefined variables
 - Useful commands for managing variables

3

Introduction

Starting MATLAB

On a campus machine, launch MATLAB through the “start” menu (clicking on the “start” button on the bottom left corner of the screen):

Start → All Programs → MATLAB → R2010a → MATLAB R2010a

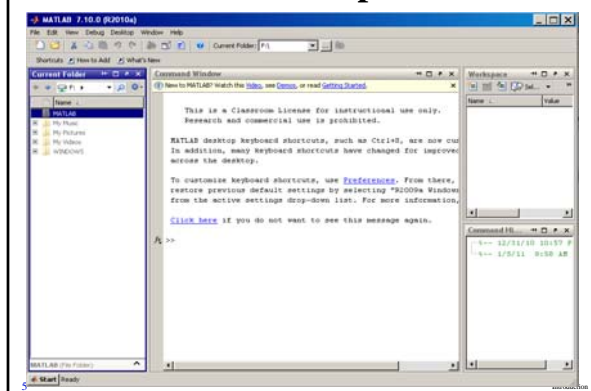
At home, launch MATLAB through WebFAS:

- Log into WebFAS at <http://webfas.yorku.ca> with your Passport York account
- Click on “Matlab R2012a”

4

Introduction

MATLAB Desktop Window



5

MATLAB Windows

Desktop window contains four smaller windows

- Command window
 - Most important window
 - for issuing commands and displaying the results
- Current Folder window (called “Current Directory” in some previous versions)
 - Lists the files and sub-folders contained in the current folder
 - The current folder is by default
 - your personal desktop folder (My Documents), or
 - F drive (your FAS home directory) when using WebFAS
 - You can change the current folder (will learn later)

6

Introduction

MATLAB Windows (Cont'd)

- Workspace window
 - Lists the variables currently active
- Command History window
 - Lists the commands that you have entered in the Command window.

You can close and re-open any window

- Click on **x** at the top right corner of the window
- Open by selecting the window name from the **Desktop** menu

Get back to default layout of the Desktop:

- **Desktop** → **Desktop Layout** → **Default**

7

Introduction

MATLAB Windows (Cont'd)

Three other important windows:

- Help window
 - Provides help information
 - Can be opened from the **Help** menu or by typing the **doc** command in the Command window
- Editor window (will study later)
 - For writing and editing MATLAB programs and functions.
 - Can be opened from the **File** menu or by typing **edit** on command window
- Figure window (will study later)
 - Opens automatically when graphics commands are executed
 - Contains graphs created by these commands

8

Introduction

Using the Command Window

You can type MATLAB command after **>>** prompt

Practice the following commands

- **date** ---- show the current date
- **calendar** ---- show a month's calendar (default: current month)
- **clc** ---- clear command window
- **pwd** ---- show the current folder name
- **ls** ---- list the content of current folder
- up arrow (↑) ---- brings back the last command(s)
- **help** (also try **help command/function_name**)
- **doc** (also try **doc command/function_name**)

9

Introduction

Using MATLAB as a Calculator

Type a math expression in the command line and press the **Enter** key

Practice the following math expressions:

- **3+5**
- **6*38**
- **125/5**
- **3+6/3**
- **(3+6)/3**
- **3+7/2+3**
- **(3+7)/(2+3)**

10

Introduction

Using MATLAB as a Calculator

Arithmetic operators:

Operation	Symbol	Example
Addition	+	5+3
Subtraction	-	5-3
Multiplication	*	5*3
Division	/	5/3
Exponentiation	^	5^3 (means 5 ³ =125)

Practice the following:

- **6*8-6^2**
- **5^3-25**

11

Introduction

Using MATLAB as a Calculator

Order of Precedence:

Precedence	Math Operations
First	Parentheses. For nested parentheses, the innermost are executed first.
Second	Exponentiation (^)
Third	Multiplication (*), division (/) (equal precedence)
Fourth	Addition (+), subtraction (-) (equal precedence)
From left to right	for operations with the same precedence

What is the result of each of these expressions:

- **2*3^2**
- **(2*3)^2**
- **6*(8-6)/(2*3)**
- **6*(8-6)/2*3**
- **5^(5-4+1)/((2+3)*2)**
- **5^(5-4+1)/(2+3*2)**

12

Introduction

Using MATLAB as a Calculator

Express the following using MATLAB:

$$\left(\frac{18}{3}\right)^2 - 10$$

Expression:

```
(18/3)^2-10
```

Result:

```
ans =
```

26

13

Introduction

Using MATLAB as a Calculator

Express the following using MATLAB:

$$\left(\frac{18-3}{3}\right)^2 - 10$$

Expression:

```
((18-3)/3)^2-10
```

Result:

```
ans =
```

15

14

Introduction

Using MATLAB as a Calculator

Express the following using MATLAB:

$$\left(\frac{7}{3}\right)^2 \times 4^3 \times 12 - \frac{6^7}{9^3 - 652}$$

Expression:

```
(7/3)^2*4^3*12-6^7/(9^3-652)
```

Result:

```
ans =
```

545.8009

15

Introduction

Scientific Notation of Numbers

Like in most of scientific calculator, you can express very large or very small values in *scientific notation*:

```
>> 1.637e7 ← means 1.637×107
```

```
ans =  
16370000
```

This is same as typing:

```
>> 163.7*100000 or >> 1.637*10^7
```

```
>> 58e-4 ← means 58×10-4
```

```
ans =  
0.0058
```

Here **e** represents “times ten raised to the power of”

16

Introduction

Scientific Notation of Numbers

You can use scientific notations in math expressions

```
>> 1.637e7 + 15/5
```

```
ans =  
16370003
```

```
>> 58e-4 * 100
```

```
ans =  
0.5800
```

17

Introduction

Built-in Math Functions

Expressions in MATLAB can include *functions*

A built-in function

- is a sub-program provided in MATLAB, which performs a task
- has a name
- accepts one or more values as input (called *input arguments*)
- returns a value as output



MATLAB provides many built-in functions, such as `sqrt(x)`, `sin(x)`, `cos(x)`, `exp(x)`, `log(x)`, ...

18

Introduction

An Example of Built-in Functions

function name
↓
`sqrt(x)`
↑
argument

Task: function `sqrt(x)` computes the square root of `x`

Try the following on the command window:

- `sqrt(9)`
- `sqrt(64)`
- `sqrt(253)`

19

Introduction

Elementary Math Built-in Functions

Some elementary math functions

Function	Description	Example
<code>sqrt(x)</code>	Square root of <code>x</code>	<code>sqrt(81)</code>
<code>nthroot(x,n)</code>	<code>n</code> th root of <code>x</code>	<code>nthroot(27,3)</code>
<code>abs(x)</code>	Absolute value of <code>x</code>	<code>abs(-28)</code>
<code>exp(x)</code>	Exponential (e^x)	<code>exp(5)</code>
<code>log(x)</code>	Natural logarithm (Base e logarithm) of <code>x</code>	<code>log(1000)</code>
<code>log10(x)</code>	Base 10 logarithm of <code>x</code>	<code>log10(1000)</code>
<code>factorial(x)</code>	The factorial of <code>x</code>	<code>factorial(5)</code>
<code>rem(x,y)</code>	The remainder after <code>x</code> is divided by <code>y</code>	<code>rem(13,5)</code>

20

Introduction

Exercise

Express the following using MATLAB:

$$28.5 \times 3^3 - \sqrt{1500}$$

Expression:

`28.5*3^3-sqrt(1500)`

Result:

`ans =`

730.7702

21

Introduction

Exercise

Express the following using MATLAB:

$$e^4 - \frac{\ln 200}{1.5}$$

Expression:

`exp(4)-log(200)/1.5`

Result:

`ans =`

51.0659

22

Introduction

Variables

A *variable*

- is a name (usually made of a letter or several letters and digits) of a piece of memory space used to store a value. The value can be changed from time to time.
- can be assigned a numerical value by

`variable_name = a numerical value or a computable expression`

where "=" is called *assignment operator*

For example,

`>> x = 5`

- can be used in math expressions, in functions and any MATLAB statements and commands.

23

Introduction

Examples of Variables

Type the following in the command line:

`x=5`

which assigns value 5 to variable `x`.

Output from MATLAB:

`x=`

5

Can use `x` in expressions:

`y=x^2+x+3`

- It first calculates `5^2+5+3` and
- then assigns the result to variable `y`.

24

Introduction

Examples of Variables

What is the value in **z** after executing the following commands?

```
x=5
y=3
z=x*y
```

Output: (>> is the prompt; what's after it is the command you input)

```
>> x=5          >> z=x+y
x =              z =
     5              15
>> y=3
y =
     3
```

25

Introduction

Examples of Variables

What does the following do?

```
x=5
x=x+2
```

The second line first takes the current value of **x**, adds 2 to it and assigns the result back to **x**.

Output: (>> is the prompt; what's after it is the command you input)

```
>> x=5
x =
     5
>> x=x+2
x =
     7
```

26

Introduction

Suppressing the Output

You can use “**;**” at the end of a command to suppress the output of the command:

```
x=5;
```

which will prevent the output from being displayed.

Thus,

```
x=5;
y=x^2+x+3
```

will only output **y** value:

```
y=
    33
```

27

Introduction

Exercise

Define variables **x** and **y** as **x=5.3** and **y=7.8**, then calculate:

$$\frac{xy}{(x-y)^2}$$

Expression and result:

```
>> x=5.3; y=7.8;
>> x*y/(x-y)^2
```

```
ans =
    6.6144
```

← can put more than one assignment in one line. A comma or semicolon can be used as a separator. Semicolon suppresses the output, while comma does not. Try it.

28

Introduction

Rules About Variable Names

- Must begin with a letter
- Can contain letters, digits and the underscore character. For example, `A1`, `xy3`, `First_name`, `firstName`, `c23D`
- Cannot contain special characters (`$`, `%`, `&`, `@`
- MATLAB is case sensitive, meaning
 - `A` and `a` are names of different variables.
- No space is allowed between characters
 - Use underscore where a space is desired.
- Avoid using the names of build-in functions (e.g., `sqrt`, `exp`, `log`, `sin`, `cos`,...)
- Avoid using keywords reserved by MATLAB (`for`, `if`, `else`, `while`,...)

29

Introduction

Predefined Variables in MATLAB

ans – hold the value of the last expression if it was not assigned to another variable.

pi – the number π (3.1416)

eps – a very small number. Equal to 2^{-52} .

inf – a very big number. Used for infinity.

NaN – stand for Not-a-Number. Used when MATLAB cannot determine a valid value, such as $0/0$.

i and **j** – defined as $\sqrt{-1}$

If you assign a value to a pre-defined variable, the pre-defined value is overwritten.

30

Introduction

Useful Commands for Managing Variables

who – Display a list of the variables currently in the memory.

whos – Display a list of the variables currently in the memory and their size and other related information.

clear – Removes all variables from the memory.

clear x, y, z – Removes only variables **x**, **y**, and **z** from the memory.

31

Introduction

Exiting MATLAB

You can exit MATLAB in one of the following ways:

- Type one of the following commands in the Command window:
 - **exit**
 - **quit**
- Choose “**Exit MATLAB**” from the **File** menu
- Click **x** at the top right corner of the MATLAB Desktop window.

32

Introduction

Home Exercise

Express the following using MATLAB:

$$\frac{3^5 - \sqrt{125}}{6 + \log_{10} 256}$$

Assign 6 to variable **n** and calculate the factorial of **n**.

Assign 281 to **N** and 5 to **a**. Then calculate $\log_a N$

33

Introduction

Next Class

Creating vectors and matrices

Location: TEL 2027&2032

34

Introduction