

Department of Electrical Engineering
University of Arkansas



A Tutorial on Matlab

Ch. 1 Introduction

Dr. Jingxian Wu
wuj@uark.edu

OUTLINE

- **Introduction: what is Matlab?**
- **Basics**
- **Simple Arithmetic**
- **Matlab workspace**
- **Getting help**
- **Exercises**

INTRODUCTION

- **What is Matlab**
 - **Matrix Laboratory**
 - A high level programming language for scientific and engineering computing
 - Developed by Mathworks Inc.

- **What can Matlab do?**
 - Scientific computations (a very powerful calculator)
 - Plotting data and functions
 - Implementation of algorithms
 - Simulating different systems
 - Interfacing with programs written in other languages (C, C++, Java, Fortran)

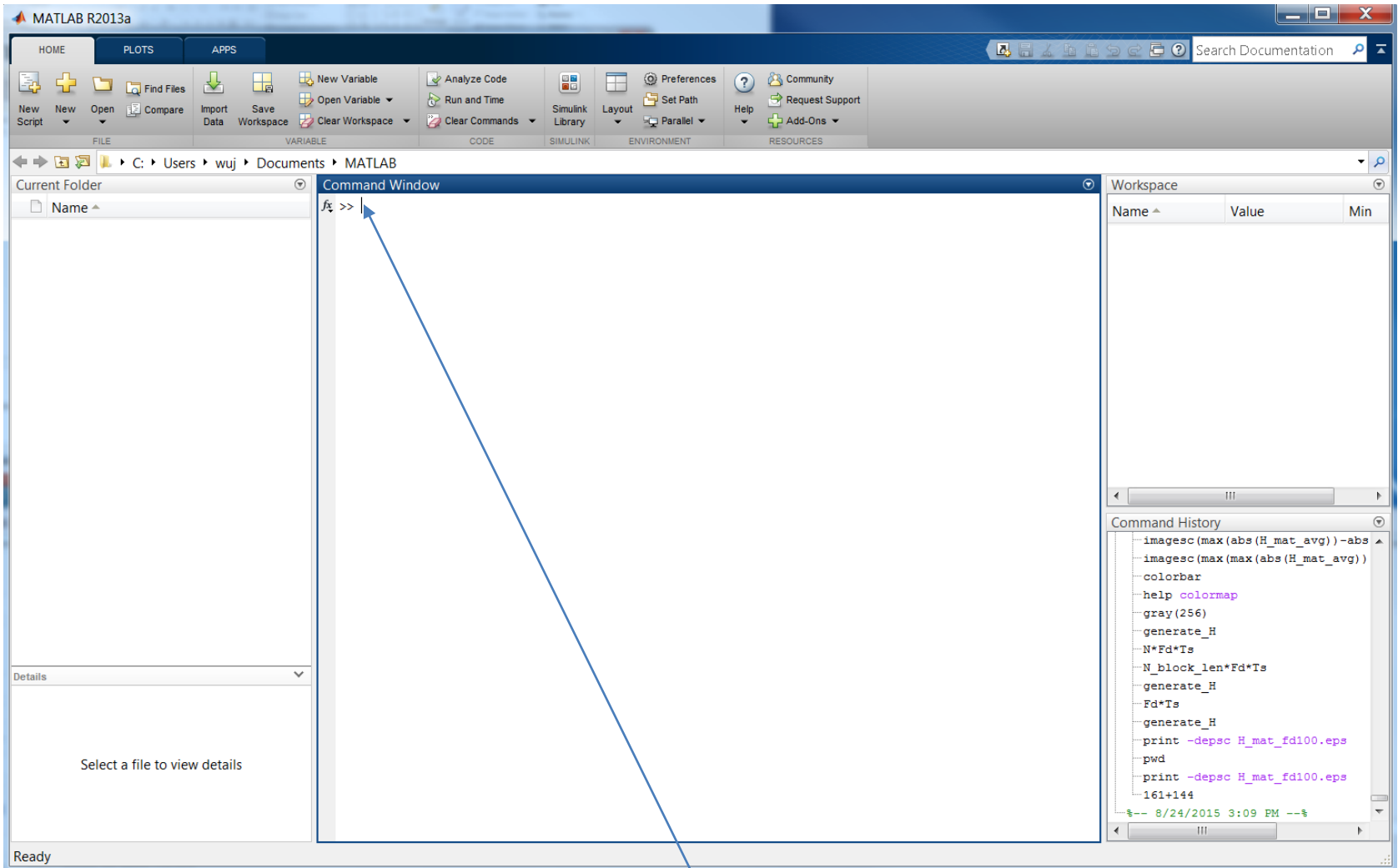
INTRODUCTION

- **Application areas**
 - Engineering
 - Science
 - Biomedical
 - Economics
 -

OUTLINE

- Introduction: what is Matlab?
- **Basics**
- Simple arithmetic
- Matlab workspace
- Getting help
- Exercises

BASICS



BASICS

- **Matlab command prompt:** `>>`
 - You can type Matlab commands after the prompter

- **Example: Matlab as a calculator**

```
>> 3+2*5
```

```
ans =
```

```
13
```

```
>> sqrt(1+6*8)-3^2
```

```
ans =
```

```
-2
```

```
>> 48/(6+2)
```

```
ans =
```

```
6
```

```
>>
```

SYMBOL	OPERATION	EXAMPLE
+	Addition	$2 + 3$
-	Subtraction	$2 - 3$
*	Multiplication	$2 * 3$
/	Division	$2/3$

BASICS

- **Variables**
 - We can assign values to variables
 - Examples

```
>> x = 3
```

```
x =
```

```
3
```

```
>> y = 5
```

```
y =
```

```
5
```

```
>> x+y*2
```

```
ans =
```

```
13
```

```
>>
```


BASICS

- **Semicolon**

- Add semicolon at the end of an expression can suppress displaying the output
- Example:

```
>> x = 3;
```

```
>> y = 2;
```

```
>> z = (x^2-1)/y;
```

```
>> z
```

```
z =
```

```
4
```

```
>>
```

BSAICS

- **The “ans” variable**

- If we do not assign the result of an expression to a variable, it will be stored in the “ans” variable by default.

- Example:

```
>> (12/(4+2)+5)*2
```

```
ans =
```

```
14
```

```
>> ans*2
```

```
ans =
```

```
28
```

```
>>
```

OUTLINE

- Introduction: what is Matlab?
- Basics
- **Simple arithmetic**
- Matlab workspace
- Getting help
- Exercises

SIMPLE ARITHMETIC

- **Matlab supports a long list of basic mathematical functions**
 - Elementary Matlab functions:

<code>cos(x)</code>	Cosine	<code>abs(x)</code>	Absolute value
<code>sin(x)</code>	Sine	<code>sign(x)</code>	Signum function
<code>tan(x)</code>	Tangent	<code>max(x)</code>	Maximum value
<code>acos(x)</code>	Arc cosine	<code>min(x)</code>	Minimum value
<code>asin(x)</code>	Arc sine	<code>ceil(x)</code>	Round towards $+\infty$
<code>atan(x)</code>	Arc tangent	<code>floor(x)</code>	Round towards $-\infty$
<code>exp(x)</code>	Exponential	<code>round(x)</code>	Round to nearest integer
<code>sqrt(x)</code>	Square root	<code>rem(x)</code>	Remainder after division
<code>log(x)</code>	Natural logarithm	<code>angle(x)</code>	Phase angle
<code>log10(x)</code>	Common logarithm	<code>conj(x)</code>	Complex conjugate

- You can use “**help command**” to get more detailed information about each function

SIMPLE ARITHMETIC

- **Constants**

- Predefined constants

pi	The π number, $\pi = 3.14159\dots$
i, j	The imaginary unit i , $\sqrt{-1}$
Inf	The infinity, ∞
NaN	Not a number

- Avoid using **i** or **j** as your variables

- Example:

```
>> clear all
```

```
>> (3*i)^2
```

```
ans =
```

```
-9
```

Avoid doing this because i is a reserved constant!

```
>> i = 2;
```

```
>> (3*i)^2
```

```
ans =
```

```
36
```

```
>>
```

SIMPLE ARITHMETIC

- **Example:**
 - Use Matlab to evaluate the expression:
 - $y = \exp(-a) + \cos(b) \log(c)$
 - where $a = -2 + 3i, b = \frac{3\pi}{5}, c = 10$

OUTLINE

- Introduction: what is Matlab?
- Basics
- Simple Arithmetic
- **Matlab workspace**
- Getting help
- Exercises

MATLAB WORKSPACE

- **Matlab workspace**

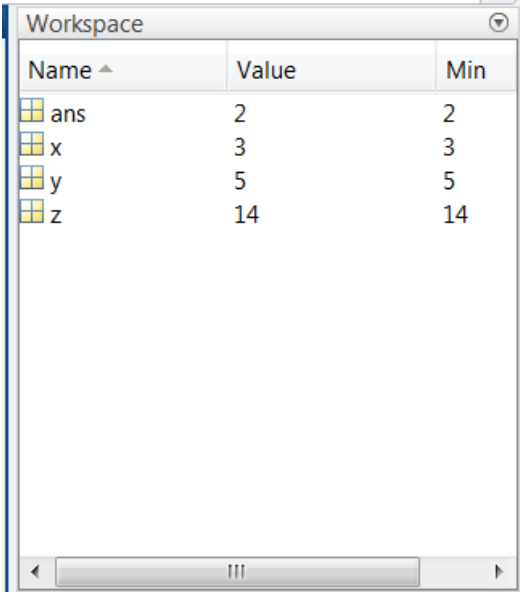
- The collection of variables that have been defined.
- We can use the **who** command to display all available variables.
- Example:

```
>> x = 3;  
>> y = 5;  
>> z = x^2 + y;  
>> sqrt(16)/2;  
>> who
```

Your variables are:

```
ans  x  y  z
```

```
>>
```



The screenshot shows the MATLAB Workspace window with a table of variables. The table has three columns: Name, Value, and Min. The variables listed are ans, x, y, and z.

Name ^	Value	Min
ans	2	2
x	3	3
y	5	5
z	14	14

MATLAB WORKSPACE

- **Matlab workspace**

- Use the **clear** command to clear the part or the entirety of the workspace
- Example:

```
>> x = 3;  
>> y = 5;  
>> z = x^2 + y;  
>> who
```

Your variables are:

```
x y z
```

```
>> clear x  
>> who
```

Your variables are:

```
ans y z
```

```
>> clear  
>> who  
>> y+1
```

Undefined function or variable 'y'.

Error message

MATLAB WORKSPACE

- **Command history**
 - At the command prompt, you can use the “up arrow” key and “down arrow” key on your keyboard to recall to previously typed command.
 - Once a previous command is recalled, you can use the “left arrow” and “right arrow” keys to edit the command.
 - Demo:

MATLAB WORKSPACE

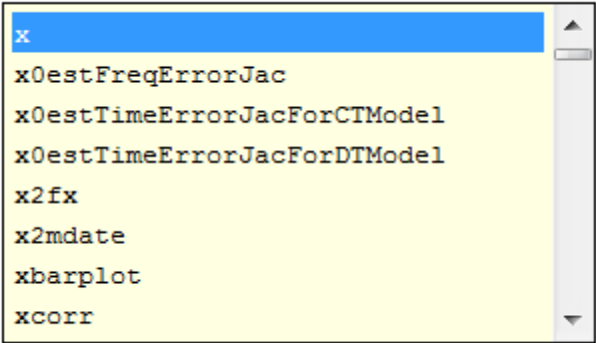
- **Command assistance**

- After typing a few letters (e.g. xyz), you can use the “tab” key on your keyboard to prompt you with all available commands and variables that start with “xyz”

- Example:

I typed “x” at the command prompt, then hit the “tab” key. Matlab pops a small window displaying all variables and commands starting with “x”

```
>>
>> x
>> x0estFreqErrorJac
>> x0estTimeErrorJacForCTModel
>> x0estTimeErrorJacForDTModel
>> x2fx
>> x2mdate
>> xbarplot
>> xcorr
>> x
```

A screenshot of the MATLAB command window. The user has typed 'x' at the prompt. A dropdown menu is displayed, listing several variables and functions that start with 'x'. The first item, 'x', is highlighted in blue. The other items are: 'x0estFreqErrorJac', 'x0estTimeErrorJacForCTModel', 'x0estTimeErrorJacForDTModel', 'x2fx', 'x2mdate', 'xbarplot', and 'xcorr'. The list is contained within a yellow rectangular box with a scroll bar on the right side.

OUTLINE

- Introduction: what is Matlab?
- Basics
- Simple Arithmetic
- Matlab workspace
- **Getting help**
- Exercises

GETTING HELP

- **To get more information about a Matlab command**

- Use `help command_name`
- The `help` command is your best friend!
- When not sure about a command, always use `help`!
- Example

```
>> help sqrt
```

```
sqrt Square root.
```

```
sqrt(X) is the square root of the elements of X. Complex results are produced if X is not positive.
```

See also `sqrtm`, `realsqrt`, `hypot`.

Overloaded methods:

```
codistributed/sqrt
```

```
gpuArray/sqrt
```

Reference page in Help browser

```
doc sqrt
```

GETTING HELP

- **Find a command for a certain operation**

- Use the **lookfor keyword** command
- The command returns a list of Matlab functions that has keyword in the first section of the help file.
- Example:

- I want to find a command that can play audio files. The lookfor command

```
>> lookfor audio
```

```
audioplayer          - Audio player object.  
audiorecorder        - Audio recorder object.  
audiodevinfo         - Audio device information.  
audioinfo            - Information about an audio file.  
audioplayerreg       -  
audioread             - Read audio files  
audiorecorderreg     - AUDIOPLAYERREG  
audiouniquename      - Assign unique variable name in workspace.  
audiowrite           - write audio files  
avgate
```

```
...
```

OUTLINE

- Introduction: what is Matlab?
- Basics
- Matlab workspace
- Getting help
- Exercises

EXERCISES

– 1. Use Matlab to calculate the following expressions

- (1) $x = \frac{1}{\sqrt{21}} + \frac{12^2-2}{36+\log(5)}$
- (2) $y = 2$
- (3) $z = \frac{x}{y} + \log(x) \log_{10}(y) + x^y$
- (4) $\frac{x}{0}$
- (5) $x = \sqrt{-9}$

– 2. In the Matlab command window, use the “upper arrow” key on your keyboard to recall the command corresponding to the command for Ex. 1(1). Then use the “left arrow” and “right arrow” key to edit the command such that you can calculate

$$x = \frac{1}{\sqrt{22}} + \frac{12^2-2}{36+\log(7)}$$

EXERCISES

- 3. Calculate $x + z$. Then use the `clear` command to clear the variables x and z , and try $x + z$ again.
- 4. Use the `lookfor` command to find out the command corresponding to the $\log_2(x)$ function, then use the `help` command to obtain detailed information about the function.