THE UNIVERSITY OF RHODE ISLAND

EGR 106
Foundations of Engineering II

Lecture 1 – Introduction to MATLAB

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THINK BIG WE DO℠

Introduction to MATLAB

- What is MATLAB?
  - Name is from matrix laboratory
- Powerful tool for
  - Computation and visualization for engineering, science and mathematics
  - Communication of ideas
  - Programming:
    - Built-in editor, debugger, and help
    - Many predefined functions
    - Interpreted or compiled programs

MATLAB Environment

Data represented in *arrays:*

- Organized by row and column indices
- Use variable names for them

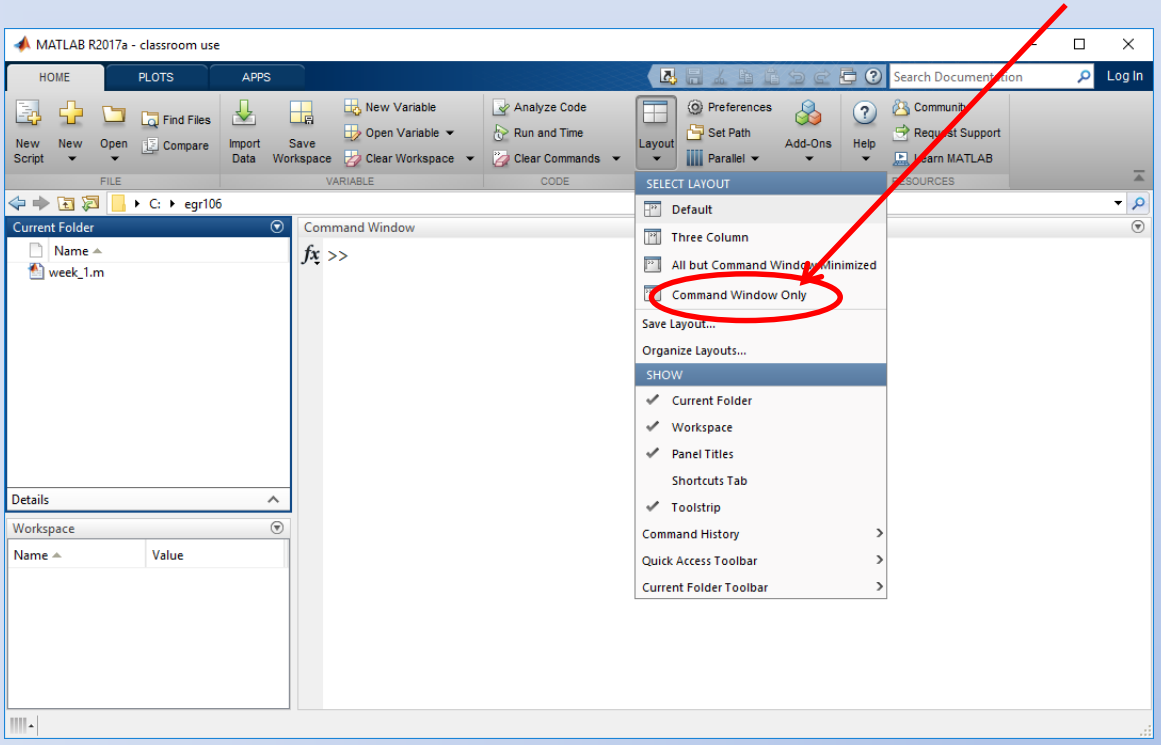
} *More next week*

User interface - multi-paned desktop:

- Command window
- Workspace browser
- Current directory
- Other windows: Figure, File Editor, Help, …..

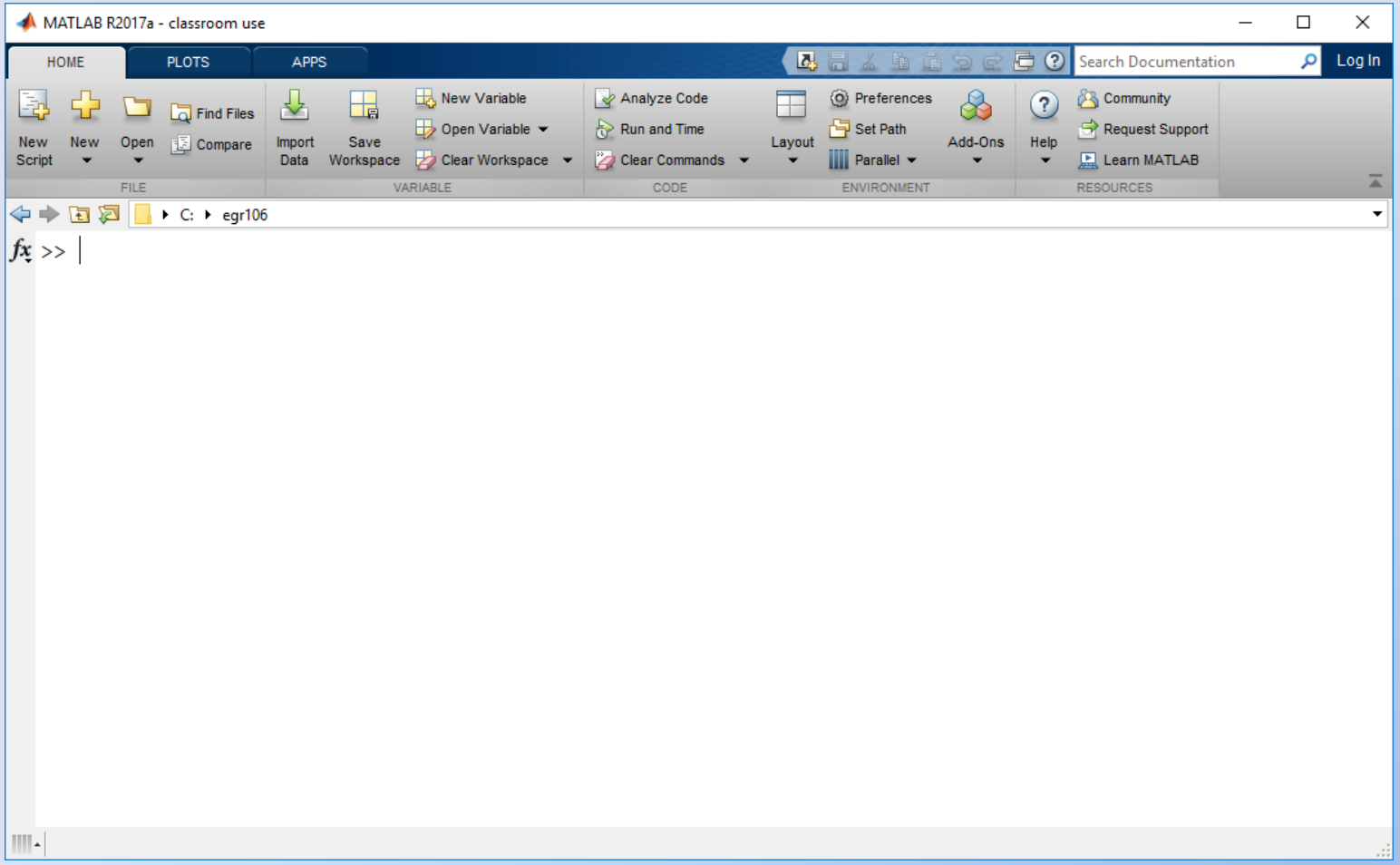
MATLAB Graphical User Interface (GUI)

Default layout:



For now, turn off everything but Command window
(Layout => Command Window Only)

Command Window Only



Command Window Operations

Command prompt >>

Basic math operations are available:

addition + subtraction – division /

multiplication * exponentiation ^

"enter" key "executes" or "runs" or "invokes" the operation

Operator precedence: PEMDAS

5 – 4 + 3 ^ 4 / (3 – 1) **= 41.5**

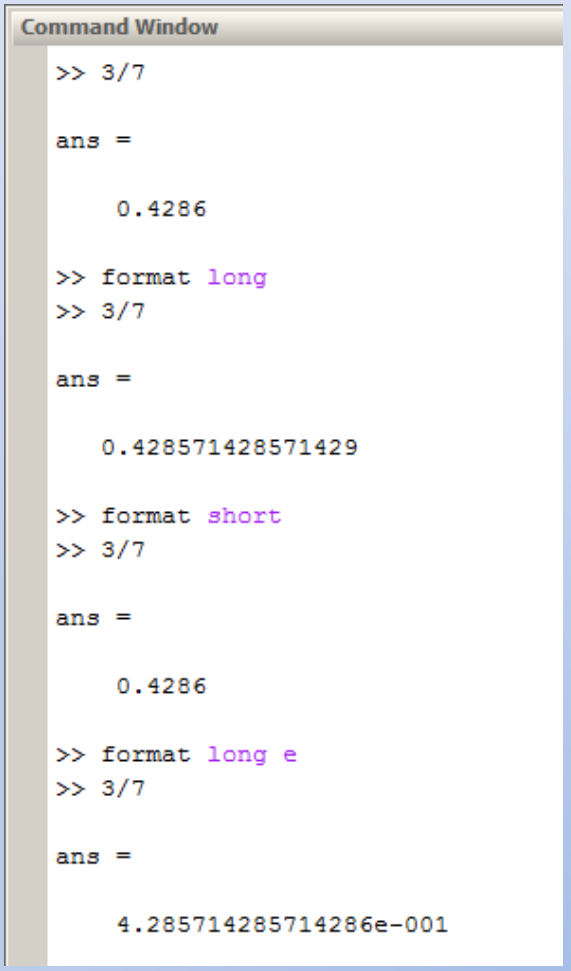
Examples

```
Command Window
>> 2+4

ans =

     6

>> 3*7

ans =

    21

>> 4/3

ans =

    1.3333

fx >>
```

```
Command Window
>> 2^4

ans =

    16

>> 7/0

ans =

   Inf

>> 0/0

ans =

   NaN

>> 3+4*2-5

ans =

     6
```

Examples (cont.)

Format command – controls display output format



Display Formats
(source: Gilat's text)

Table 1-2: Display formats

Command	Description	Example

`format short`	Fixed-point with 4 decimal digits for: $0.001 \le number \le 1000$ Otherwise display format `short e`.	`>> 290/7`
		`ans =`
		`41.4286`

`format long`	Fixed-point with 15 decimal digits for: $0.001 \le number \le 100$ Otherwise display format `long e`.	`>> 290/7`
		`ans =`
		`41.428571428571431`

`format short e`	Scientific notation with 4 decimal digits.	`>> 290/7`
		`ans =`
		`4.1429e+001`

`format long e`	Scientific notation with 15 decimal digits.	`>> 290/7`
		`ans =`
		`4.142857142857143e+001`

`format short g`	Best of 5-digit fixed or floating point.	`>> 290/7`
		`ans =`
		`41.429`

`format long g`	Best of 15-digit fixed or floating point.	`>> 290/7`
		`ans =`
		`41.4285714285714`

`format bank`	Two decimal digits.	`>> 290/7`
		`ans =`
		`41.43`

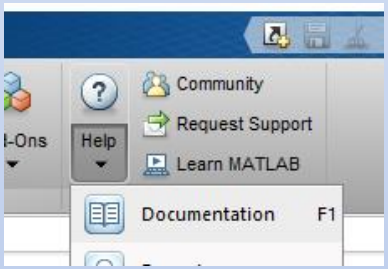
`format compact`	Eliminates empty lines to allow more lines with information displayed on the screen.	
`format loose`	Adds empty lines (opposite of `compact`).	

Options for Getting Help

Built in help command:

```
>> help format
```

Built in documentation (F1):

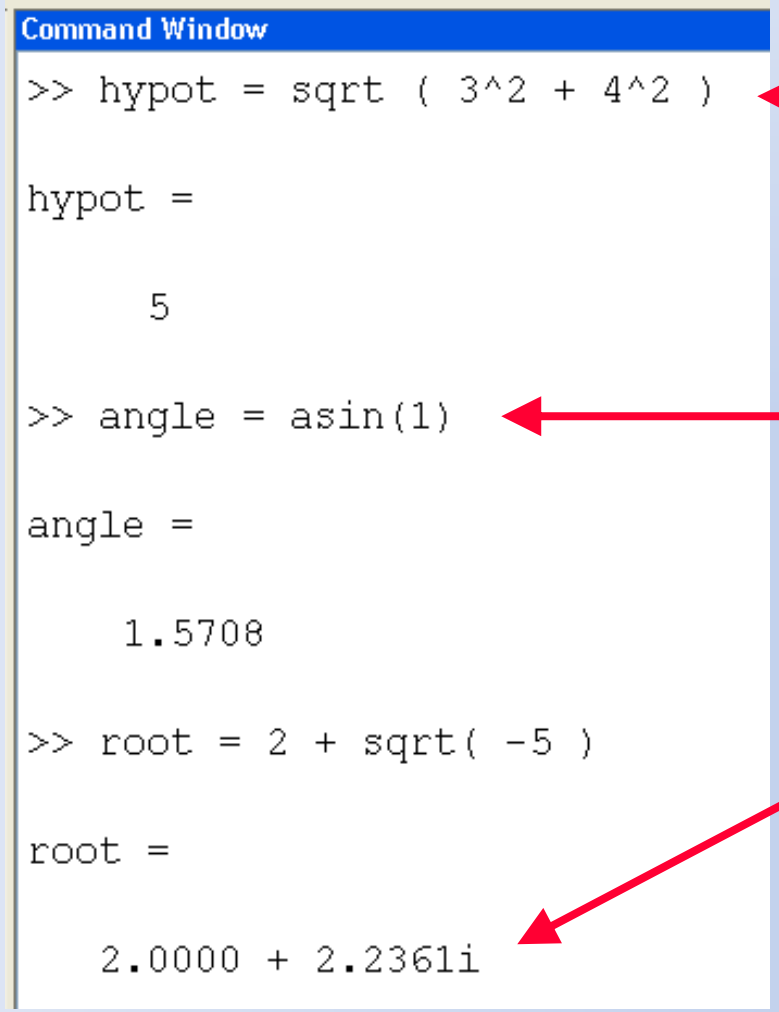


Mathworks web site:

https://www.mathworks.com/help/

Google:

More Examples



Square roots

Note that trig functions generally work in radians, not degrees

In general, all variables are complex numbers

Assigning Variables

The equal sign is an *assignment* operator

c = 7.5 bob3 = 3.7789

There are naming restrictions:

- Connected symbols, starting with a letter
- Make them unique
- Some are predefined for special values or uses:

pi inf i j ans

(note: if you assign a new value,
the predefined value is lost)

Built in Functions

Matlab has a large library of built-in functions:

abs(x)	ceil(x)	exp(x)	fix(x)
sign(x)	floor(x)	log(x)	round(x)
sqrt(x)	conj(x)	log10(x)	rem(x,y)
sin(x)	sinh(x)	tan(x)	atan2(x,y)
asin(x)	acosh(x)	atan(x)	sec(x)
sind(x)	and many more !!		

Elementary Math Functions

Function	Description	Example

`sqrt(x)`	Square root.	`>> sqrt(81)`
		`ans =`
		`9`

`nthroot(x,n)`	Real *n*th root of a real number *x*. (If *x* is negative *n* must be an odd integer.)	`>> nthroot(80,5)`
		`ans =`
		`2.4022`

`exp(x)`	Exponential (e^x).	`>> exp(5)`
		`ans =`
		`148.4132`

`abs(x)`	Absolute value.	`>> abs(-24)`
		`ans =`
		`24`

`log(x)`	Natural logarithm.
	Base *e* logarithm (ln).
		`>> log(1000)`
		`ans =`
		`6.9078`

`log10(x)`	Base 10 logarithm.	`>> log10(1000)`
		`ans =`
		`3.0000`

Trigonometric Functions

Function	Description	Example

`sin(x)`
`sind(x)`
	Sine of angle x (x in radians).
	Sine of angle x (x in degrees).
		`>> sin(pi/6)`
		`ans =`
		`0.5000`

`cos(x)`
`cosd(x)`
	Cosine of angle x (x in radians).
	Cosine of angle x (x in degrees).
		`>> cosd(30)`
		`ans =`
		`0.8660`

`tan(x)`
`tand(x)`
	Tangent of angle x (x in radians).
	Tangent of angle x (x in degrees).
		`>> tan(pi/6)`
		`ans =`
		`0.5774`

`cot(x)`
`cotd(x)`
	Cotangent of angle x (x in radians).
	Cotangent of angle x (x in degrees).
		`>> cotd(30)`
		`ans =`
		`1.7321`

Rounding Functions

Function	Description	Example

`round(x)`	Round to the nearest integer.	`>> round(17/5)`
		`ans =`
		`3`

`fix(x)`	Round toward zero.	`>> fix(13/5)`
		`ans =`
		`2`

`ceil(x)`	Round toward infinity.	`>> ceil(11/5)`
		`ans =`
		`3`

`floor(x)`	Round toward minus infinity.	`>> floor(-9/4)`
		`ans =`
		`-3`

`rem(x,y)`	Returns the remainder after x is divided by y.	`>> rem(13,5)`
		`ans =`
		`3`

`sign(x)`	Signum function. Returns 1 if $x > 0$, -1 if $x < 0$, and 0 if $x = 0$.	`>> sign(5)`
		`ans =`
		`1`

Misc. Commands and Features

Other useful system commands:

clear, clc	diary
help, lookfor	who, whos

Semicolon (;) suppresses the *displaying* of the result of a computation

Arrow keys allow for editing of prior commands

Introduction to Plotting (more later)

Figure window commands:

figure, figure(3), clf, close

plot(x,y) in which x and y are “arrays”

Annotation commands:

```
title('the title goes here')
xlabel('the x axis label goes here')
ylabel('the y axis label goes here')
```