ENME 303 LAB

Week01: MATLAB Intro & Basic Syntax

Lab - 01

Welcome!

I. Lab schedule this semester
II. General lab structure (110 min)
    A. Small Lecture(10-20 min)
    B. Lab assignment (90-100 min)
    C. Attendance WILL be taken each class
        - You can leave after the lecture, but it's not recommended - we're here to help with the assignment!

I. Office hours/help beyond lab:

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Lab Schedule:

Week	Date	Topics
1	2/01	MATLAB Intro & Basic Syntax
2	2/08	Control Flow – I
3	2/15	Control Flow – II
4	2/22	Control Flow – III
5	3/01	Vectors
6	3/08	Matrix – I
7	3/15	Matrix – II
8	3/29	No Lab (Midterm Study Week)
9	4/05	Functions
10	4/12	2D Plotting
11	4/19	Image Processing Intro
12	4/26	Linear Transformation
13	5/03	Eigenvalue and eignevectors
14	5/10	Gauss-Seidel Method

*Class and lab schedule are subject to revision.

Week 1: MATLAB Intro & Basic Syntax

I. MATLAB Installation
II. MATLAB Interface
III. Variables and Basic Functions
IV. Basic Arithmetic Operations
V. Writing Code in your Editor
VI. Lab Etiquette

I. Getting MATLAB on your System

MATLAB (Full version!) is available to all UMBC students!

1. Head to MathWorks and create an account using your UMBC email address
    a. Already have one? That's ok. Just log in using your UMBC email address → My Account → Link a license (should automatically be available but if not)
2. Download R2023b for Windows or MAC and launch installer
3. MathWorks Product Installer will ask for UMBC credentials→ authorization→ licensing→ download location→ download!
    a. If you install on Local Disk (C:) (easy to locate and remember)
        i. Directory looks like: C:\Program Files\MATLAB\R2022a

I. Using MATLAB Web-based

An alternative to having to download and install MATLAB:

MATLAB Online

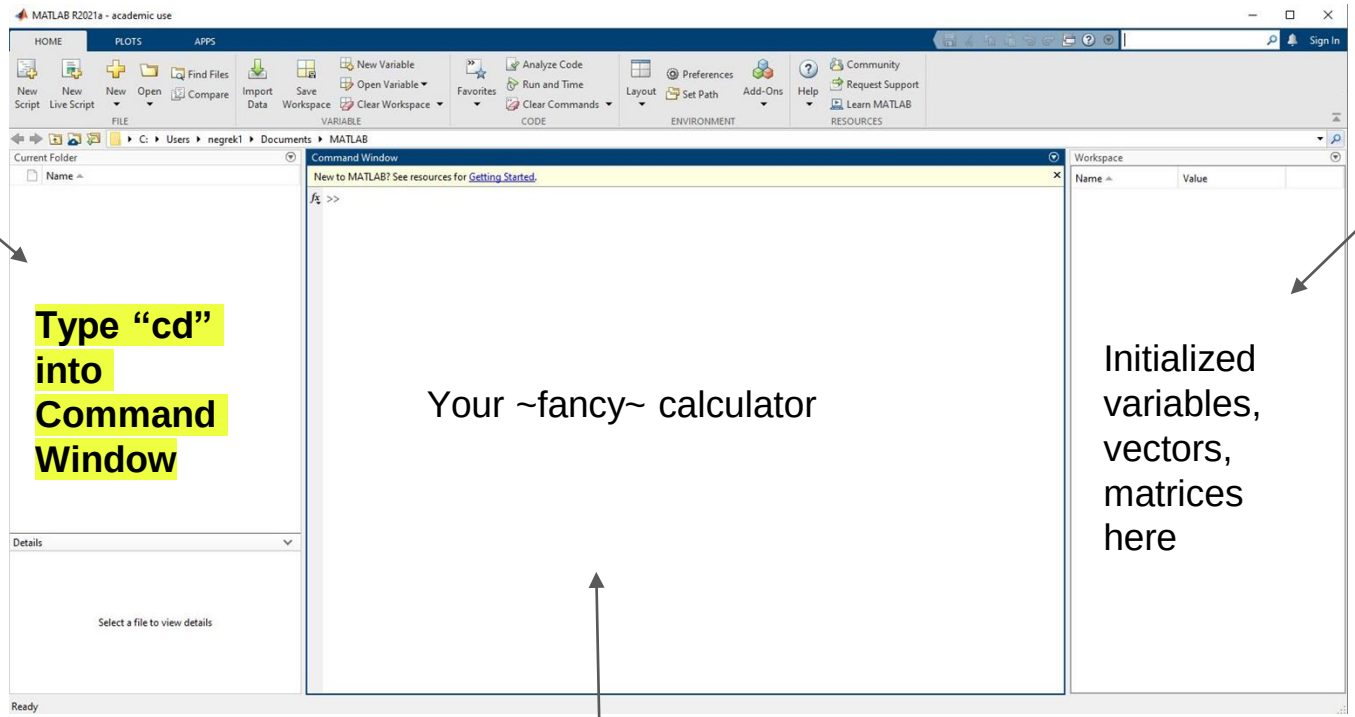
Files will be uploaded to a MATLAB drive in under your account information

Up to 5 GB storage space, which you can access anywhere anytime.

II. MATLAB Interface: Keys windows

Current folder

The folder MATLAB is working in. Your default. MATLAB can execute files in this folder



Type "cd" into Command Window

Your ~fancy~ calculator

Workspace

Initialized variables, vectors, matrices here

Command Window or Command Prompt or CP

II. MATLAB Interface: Exercises

1. Type “1”. Enter. Check your command window and workspace. What happens?
2. Type “1+1”. Enter. Check your command window and workspace. What happens?
3. It's not all numbers - we can chat too. Type “Hello World”. Try now, fprintf(“Hello World”). What happens?

III. Variables and Basic Functions

Variables are just a vessel for your data or expression.

They're created with the assignment statement:

Variable name = a value (or expression)

For example,

- X = 10
- Candy = true (Boolean in MATLAB returns 1 for true and 0 for false)
- My_Var = x^2 + x - cos(x) (requires Symbolic Toolbox, which we will download and use later in the semester)
- KarsMatrix = [1 2 3 4]
- MyName = 'Riyaz'

Data Type:

- Numeric (Single, Double, etc) (use whos command)
- Characters (Strings, char)

III. Variables and Basic Functions

Variable naming convention is straightforward once you know some rules

1. MATLAB variables are case sensitive. “UMBC” and “umbc” are different variables
2. Underscores and numbers are fair game (“UMBC_21” is ok)
3. Some names are reserved for special constants, (e.g. pi, alpha, etc.)
4. Variable contents can be replaced
5. Be smart with variables, consider length/purpose + be consistent

Always refer back to workspace to manage your variables!

III. Variables and Basic Functions

Your general purpose commands

Commands for Managing a Session	
`clc`	Clears Command window.
`clear`	Removes variables from memory.
`exist`	Checks for existence of file or variable.
`global`	Declares variables to be global.
`help`	Searches for a help topic.
`lookfor`	Searches help entries for a keyword.
`quit`	Stops MATLAB.
`who`	Lists current variables.
`whos`	Lists current variables (long display).

Operators and Special Characters	
+	Plus; addition operator.
−	Minus; subtraction operator.
*	Scalar and matrix multiplication operator.
.*	Array multiplication operator.
^	Scalar and matrix exponentiation operator.
.^	Array exponentiation operator.
\	Left-division operator.
/	Right-division operator.
.\	Array left-division operator.
./	Array right-division operator.
:	Colon; generates regularly spaced elements and represents an entire row or column.
( )	Parentheses; encloses function arguments and array indices; overrides precedence.
[ ]	Brackets; enclosures array elements.
.	Decimal point.
...	Ellipsis; line-continuation operator.
,	Comma; separates statements and elements in a row.
;	Semicolon; separates columns and suppresses display.
%	Percent sign; designates a comment and specifies formatting.
_	Quote sign and transpose operator.
._	Nonconjugated transpose operator.
=	Assignment (replacement) operator.

III. Variables and Basic Functions

Some more helpful commands:

Operator	Description
>	Greater than
<	Less than
>=	Greater than or equal to
<=	Less than or equal to
==	Equal to
~=	Not equal to
&	AND operator
|	OR operator
~	NOT operator

System and File Commands

`cd`	Changes current directory.
`date`	Displays current date.
`delete`	Deletes a file.
`diary`	Switches on/off diary file recording.
`dir`	Lists all files in current directory.
`load`	Loads workspace variables from a file.
`path`	Displays search path.
`pwd`	Displays current directory.
`save`	Saves workspace variables in a file.
`type`	Displays contents of a file.
`what`	Lists all MATLAB files in the current directory.
`wklread`	Reads .wk1 spreadsheet file.

Special Variables and Constants

`ans`	Most recent answer.
`eps`	Accuracy of floating-point precision.
`i,j`	The imaginary unit $\sqrt{-1}$.
`Inf`	Infinity.
`NaN`	Undefined numerical result (not a number).
`pi`	The number π.

III. Variables and Basic Functions: Exercises

1. Try “x=1+1”. Enter. What happens?
2. Now, try “a=3”. Enter. “b=a”. What happens?
3. Ok now, “a=3”. Enter. “a=a+1”. Enter. “a”. What happens?
4. Type “a=3;”. Enter. “b=5;”. Enter. “c=a+b”. What is c? What is the purpose of the semicolon?
5. Let's clear a variable: “c1=3” enter “c2= c1+5;” enter “clear c1” enter “c1” What happened?
6. Lastly, type “clc”. Enter. What happens?

IV. Basic Arithmetic Operations

Basic Arithmetic Operations in MATLAB→ Math functions are BUILT IN!

See complete list by typing into CW:

"help elfun" (elementary functions)

"help specfun" (~special~ functions)

Table 1.1: Basic arithmetic operators

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

You can also find information about any function by typing help and the name of that function

Some favorites→

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

IV. Basic Arithmetic Operations

Beware of the hierarchy of arithmetic operations in MATLAB

Table 1.2: Hierarchy of arithmetic operations

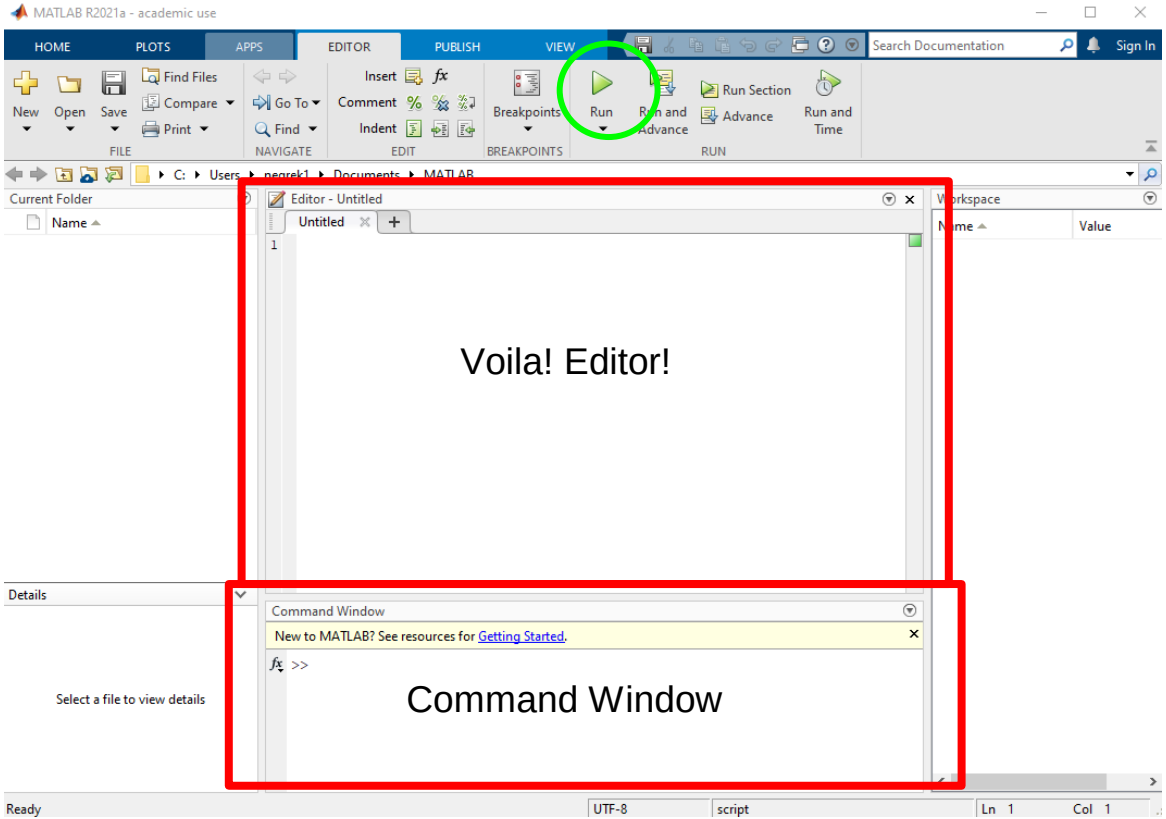
PRECEDENCE	MATHEMATICAL OPERATIONS
First	The contents of all parentheses are evaluated first, starting from the innermost parentheses and working outward.
Second	All exponentials are evaluated, working from left to right
Third	All multiplications and divisions are evaluated, working from left to right
Fourth	All additions and subtractions are evaluated, starting from left to right

It's PEMDAS

IV. Basic Arithmetic Operations: Exercises

1. 234+4567=?
2. 104-753=?
3. 47*90=?
4. 5^4= ?
5. (1+2)*3=? versus 1+2 *3=?. Does MATLAB use PEMDAS?
6. Use command to verify inequalities. Type “4>5”. Enter. Then “5>4”. Enter. What are the results of each and what do they mean?
7. Try, “x=pi”, “y=sin(pi/2)”, and “z= exp(-sin(pi/2))”.

V. Writing Code in Your Editor



Difference between Editor and Command window:

Command window = fancy, immediate calculator. Executes code instantly!

Editor: Allows you to write as much code as you want and only executes when you hit **RUN (Ctrl+F5)**

V. Writing Code in Your Editor

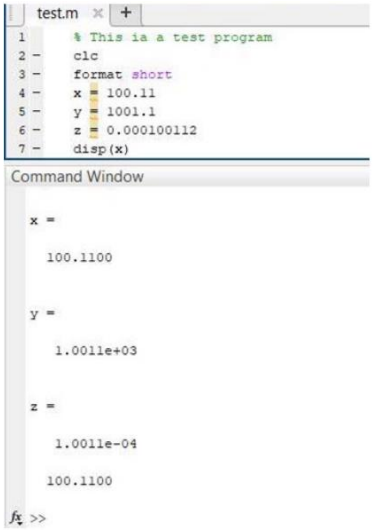
Once familiar with your Command Window, you'll notice that you can't save any of your commands or execute more than one command at a time => Editor time

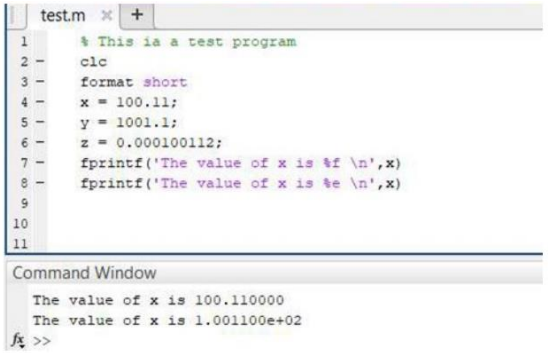
1. To open editor, click 

to open a new script
2. Check your current folder directory by typing "cd" into your command window
3. 'Save as' your blank script file (.m files)
    a. It will open to the directory you saw above. Open the MATLAB folder.
    b. Create a new folder for each week of lab. This week => Week 1
    c. Save your blank script into Week 1 folder
4. Make sure current folder in the Current Folder has the correct directory for you script file-> Double click on the folder. To check run "cd" in command.

V. Displaying Output Data

1. semicolon off
2. disp("_")
3. fprintf("....format", data)





Format String	Results
%d	Display value as an integer.
%e	Display value in exponential format.
%f	Display value in floating-point format.
%g	Display value in either floating-point or exponential format, whichever is shorter.
\n	Skip to a new line.

VI. Lab Etiquette

```
%--------------------------------
%Author:Karla Negrete
%UMBC ID: MQ31578
%Course: ENME 303, Lab Week 1
%Description: Lab Assignment 1
%--------------------------------
```

- Add your credentials to the top of your script:
- All assignments must be submitted to Blackboard (no exceptions, even late assignments). Each assignment allows 2 submissions. Double check your script file before submitting
- Add sections between each exercise using "%% " (**include the space**) and comment all logic in your code.
- Use Semicolon to repress unwanted outputs.

*You WILL lose points for not including credentials, sections, and comments

V. Writing Code in Your Editor

Let's create one together really fast!

1. Open new script. Save it to Week 1 folder as 'Cake.m'
2. We want to write a script that calculates the amount of frosting on our cake (pictured above).
3. Our script must ask the chef the dimensions, calculate the surface area of the cake, and tell the chef.

Try it out!

Note: we are neglecting the thickness of the frosting

Resources

You will have to use these sites sometimes!

Go here before you ask us!!!

MathWorks MATLAB Documentation

MATLAB Commands and Functions

MATLAB WikiBooks

Acknowledgement

The lab slides you see are not made by one person. All the TA/TFs served for this course have contributed their effort and time to the slides. Below are the leading TFs for each semester:

- 2021 FA - Karla Negrete (GTA)
- 2022 SP - Justin Grahovac
- 2022 FA - Kelli Boyer and Yisrael Wealcatch
- 2023 SP - Mahamoudou Bah and Matt Moeller
- 2024 SP - Mohammad Riyaz Ur Rehman and Michael Mullaney