Middlesex University Dubai

MATLAB INTRODUCTION

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Learning outcomes

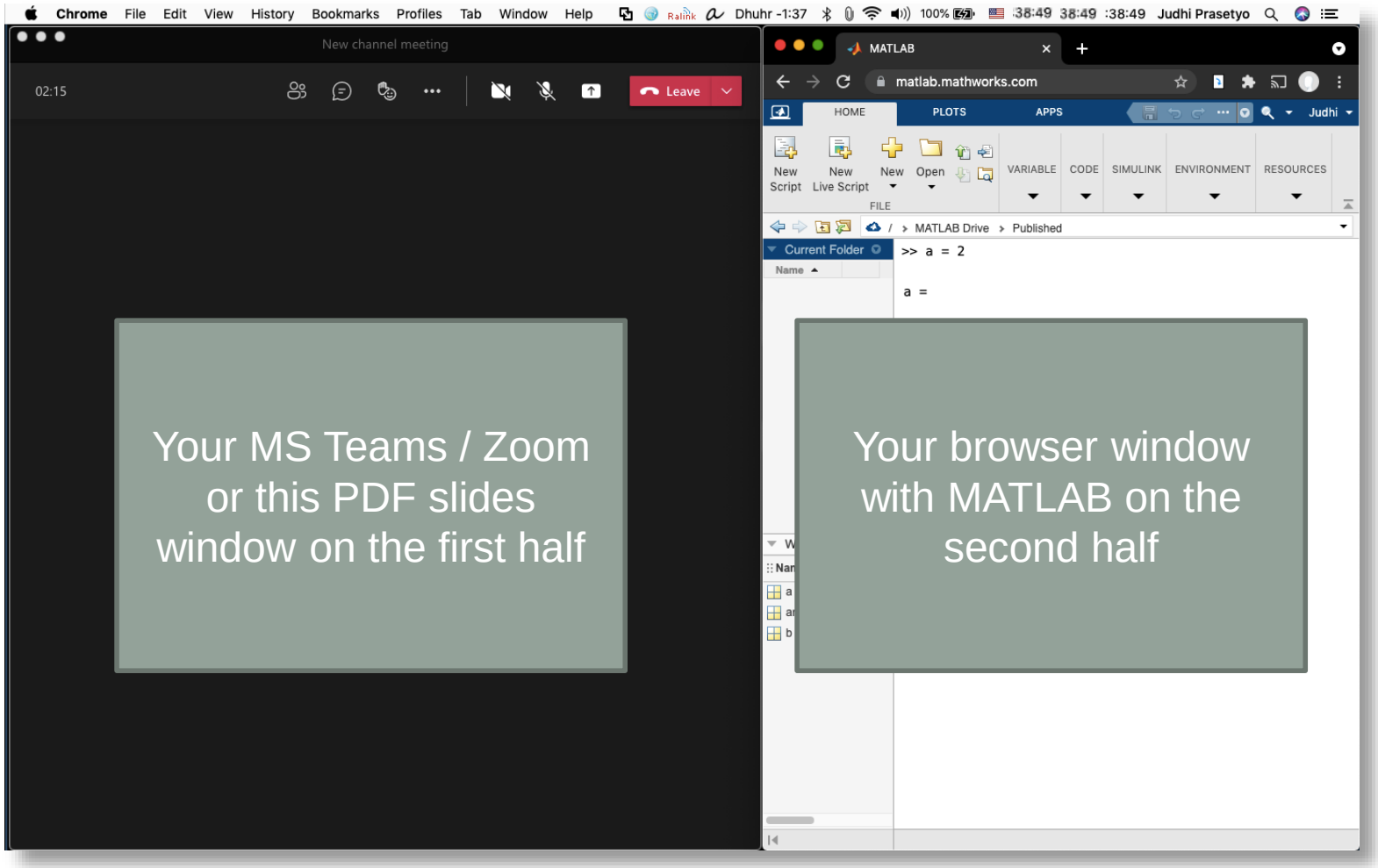
By the end of this session, you will be able to:

- describe the use and functionalities of Matlab
- use Matlab command window to solve simple mathematical problem
- understand various types of variable and operations in Matlab
- write short scripts in Matlab involves decision making and loops
- plot simple charts

Agenda

1. What is Matlab
2. Getting started
3. Matlab variables types
4. Operation & Functions
5. Plotting chart
6. Script
7. Summary

Recommended desktop arrangement for better learning



What is Matlab?

MATLAB® is a programming platform designed specifically for engineers and scientists to analyze and design systems and products that transform our world. The heart of MATLAB is the MATLAB language, a matrix-based language allowing the most natural expression of computational mathematics. [mathworks.com]

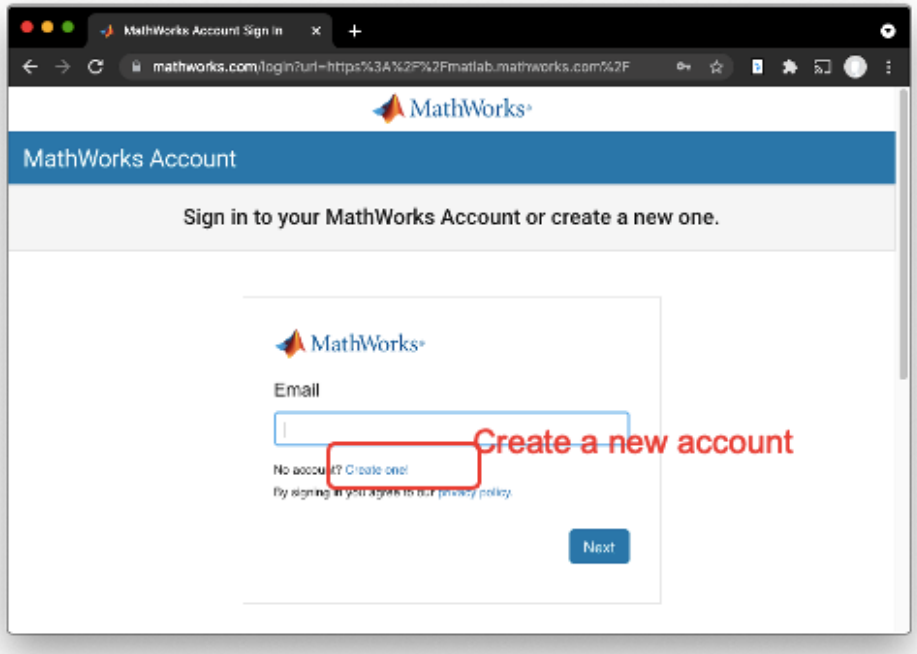
It is a big programmable calculator ☺
[judhi]

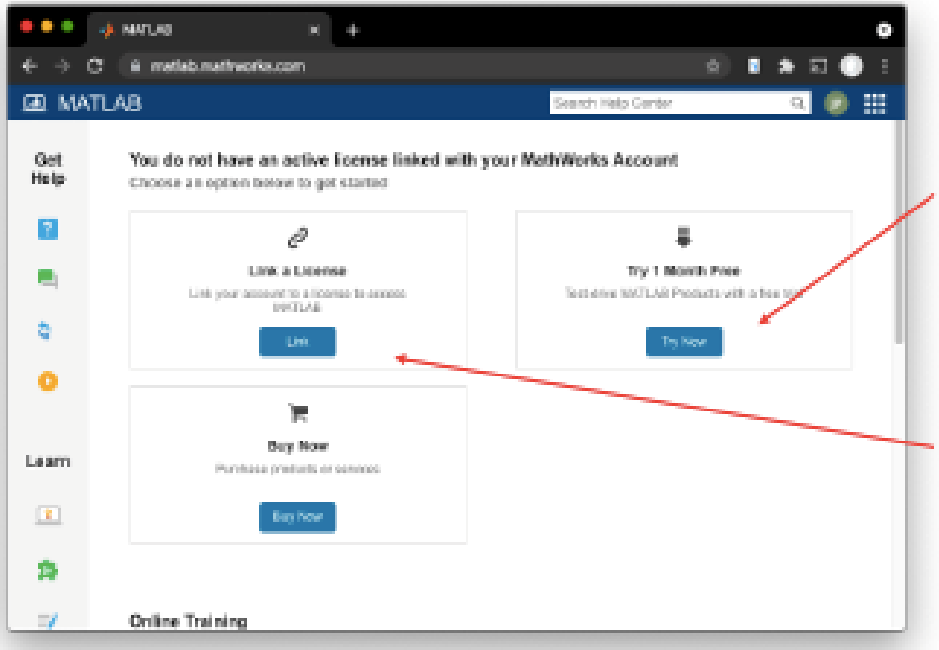
How to get Matlab?

- Website: https://uk.mathworks.com/products/get-matlab.html
- Trial 30 days
- Campus license (use your email@live.mdx.ac.uk)
- Commercial license (standard, education, home, student)
- Online (with some limitations): https://matlab.mathworks.com/

Create MATLAB account & choose a license

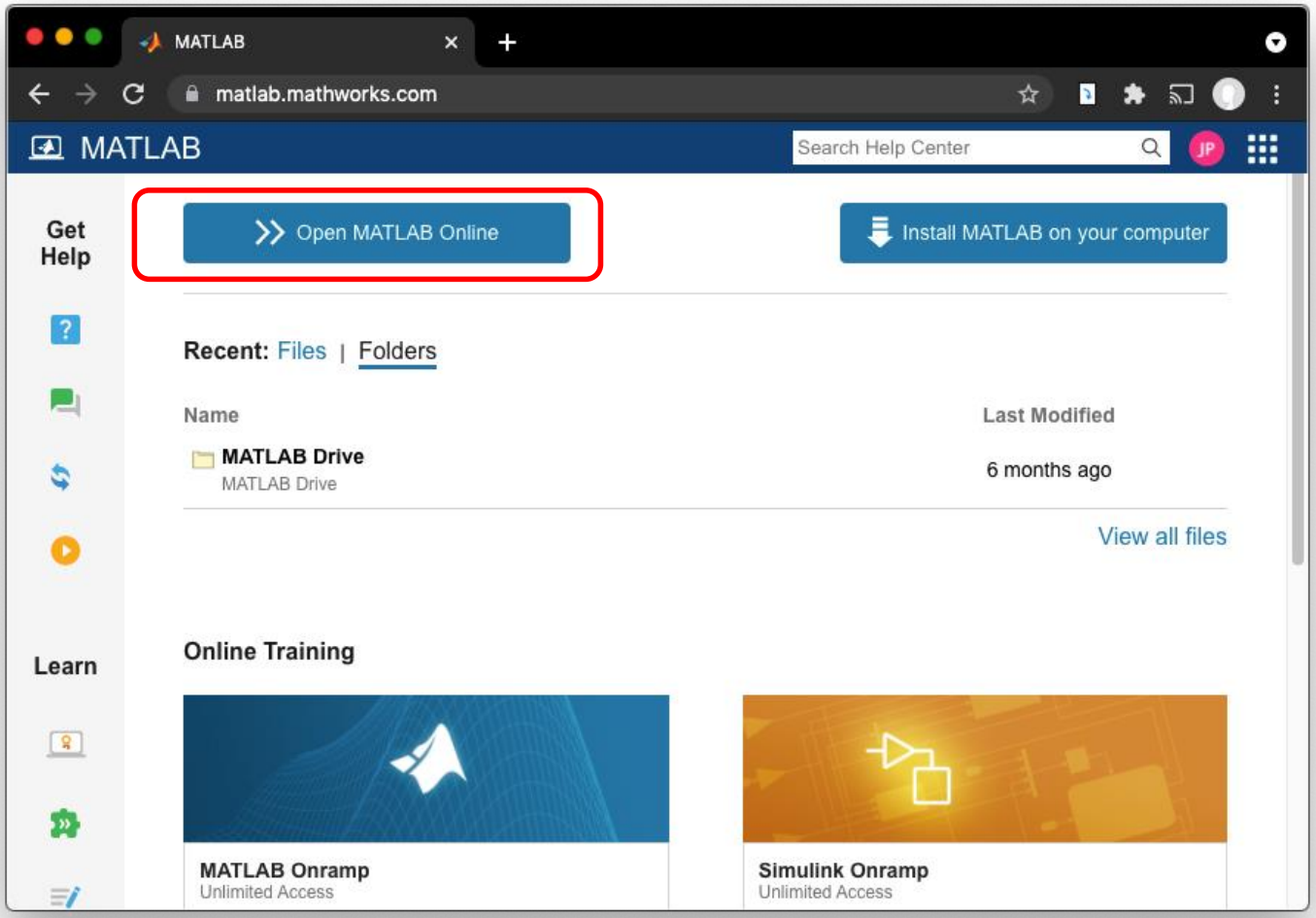
https://matlab.mathworks.com/



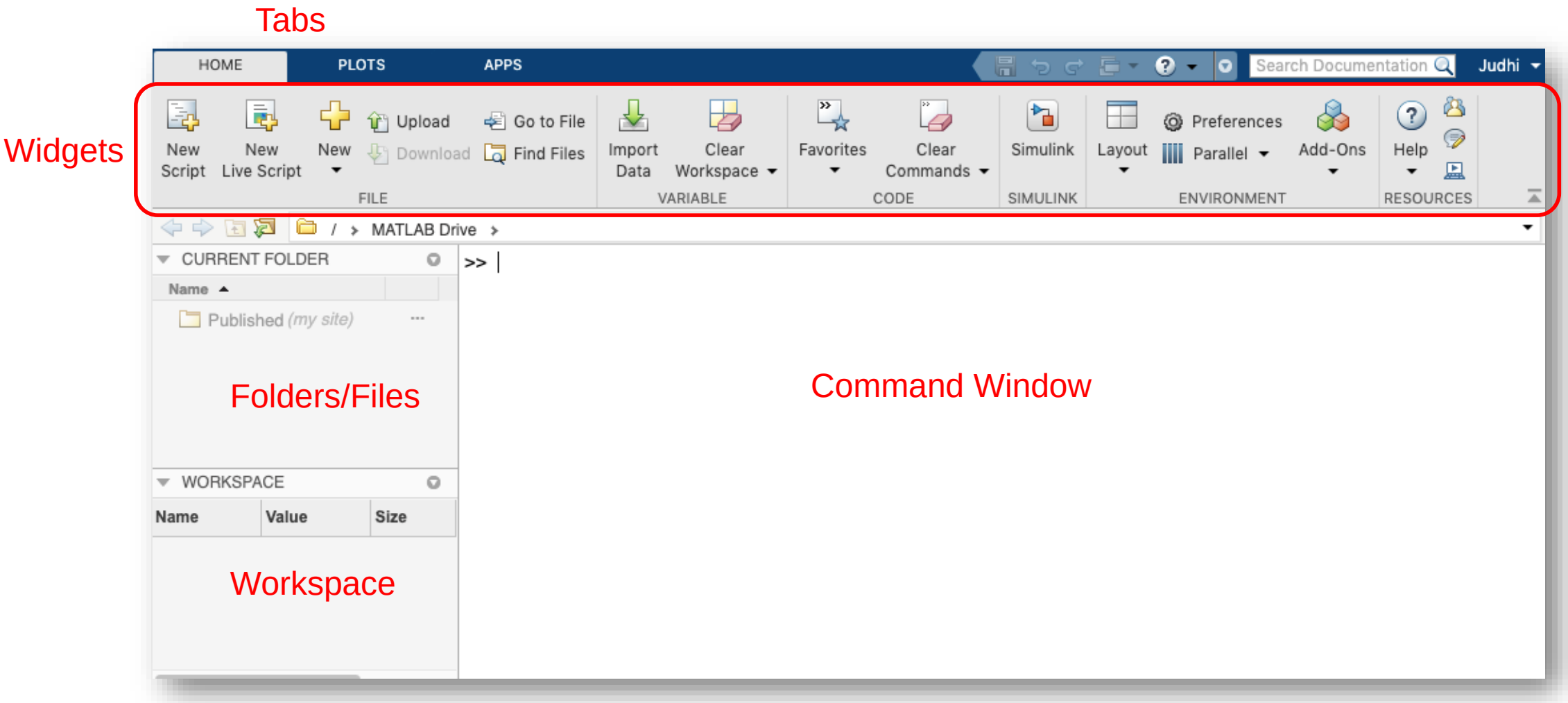


10 minutes

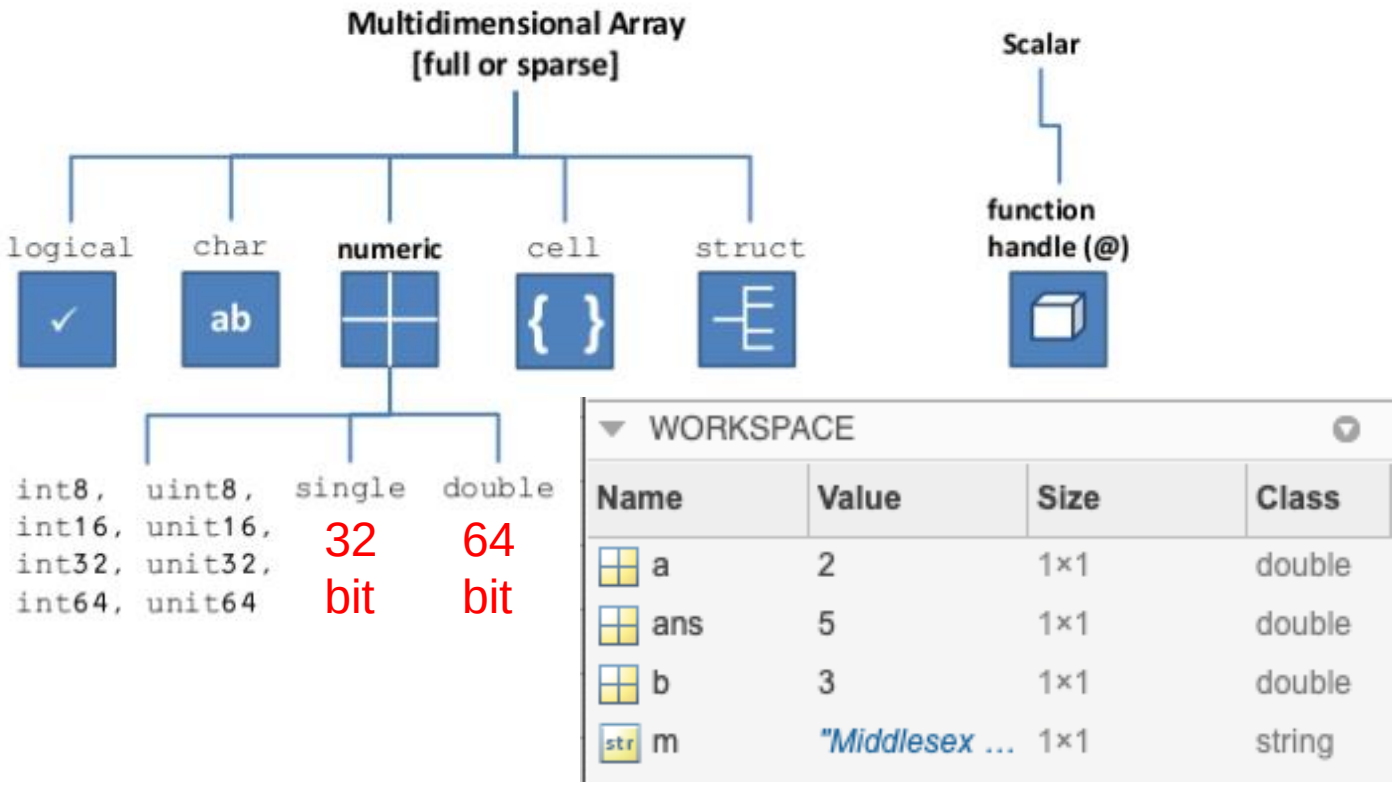
Start Using Matlab Online



Getting Started



Matlab Variable Types

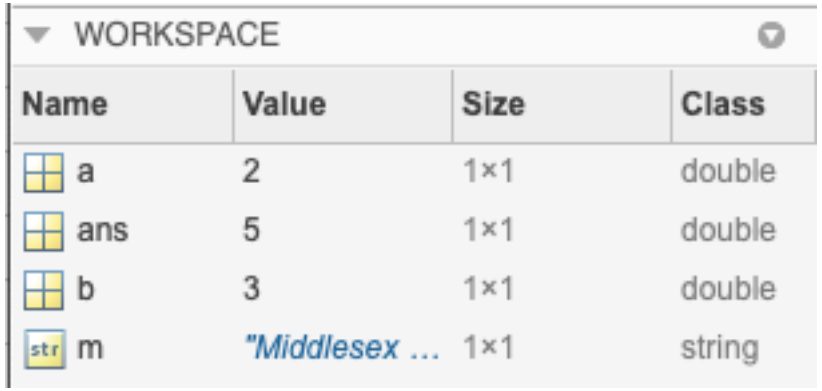


https://www.mathworks.com/help/matlab/matlab_prog/floating-point-numbers.html

Using Command Window

- Type the following lines on Command Window and observe as you type:

```
>> a = 3
>> b = 4
>> m = "Middlesex University"
>> a + b

ans =
     5
```



Now try to assign more numbers to different variables then do subtraction, multiplication, and division among them.

Observe the WORKSPACE as you do it.

String Operation

- Now type this and observe the results.

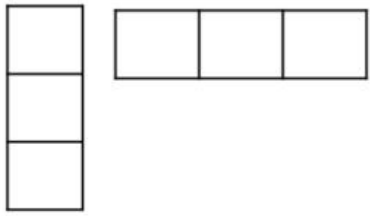
```
>> a = "2"
>> b = "3"
>> a + b
ans =
        "23"

>> m + 2020
ans =
        ”Middlesex University2020"
```

Array : scalar, vector, matrix

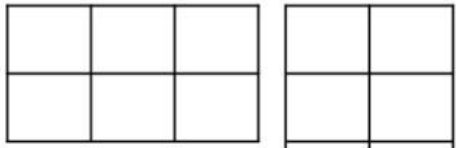
Array
Any size/dimension
Any value: Table, Characters, Words, Numbers

Scalar
Single Value
m = 1;

Vector
Row of Numbers
Column of Numbers
row = [1 2 3];
column = [1; 2; 3];



Matrix
Numeric 2D Array
m x n



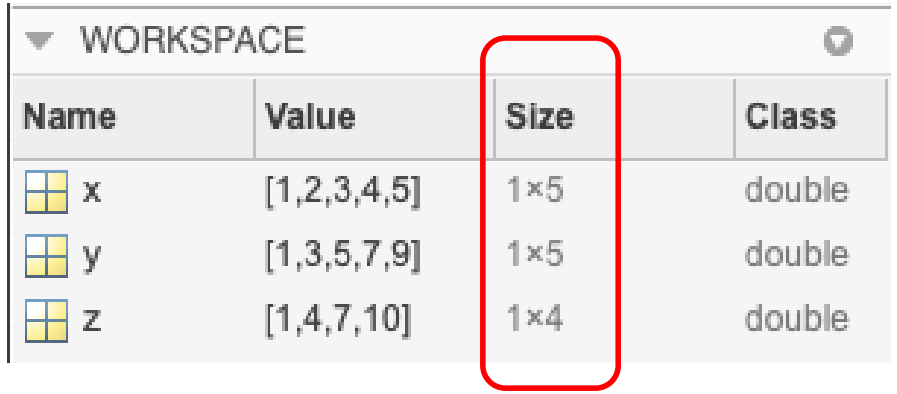
Array Creation & Access

Array Creation:

```
>> x = [1,2,3,4,5]
x =
        1 2 3 4 5


>> y = [1:2:10]
y =
        1 3 5 7 9


>> z = linspace(1,10,4)
z =
        1 4 7 10
```

Accessing Element:

```
>> x(1,3)
ans =
        3

>> y(1,2)
ans =
        3

>> x(1,3) + y(1,2)
ans =
        6
```



Array Creation - Matrix

```
>> x= [1,2,3;4,5,6]

x =
    1    2    3
    4    5    6

>> y = ["one", "two"; "three", "four"; "five", "six"]

y =
  3×2 string array

    "one"      "two"
    "three"    "four"
    "five"     "six"
```

Exercise - Array

From the values entered in the previous steps, find the result of:

a. x(1,2) * x(2,2)
b. y(1,1) + y(2,2) + y(3,2)
c. x(:,2) * 2
d. x(2,:) * 3
e. y(2:3,:) + "x”

Take a moment to understand Matlab’s ways of accessing the array elements.

Command Window Useful Tips

Command	Outcome
`clear`	Clears the workspace, all variables are removed from the memory
`clear x y z`	Clears only variables x, y, and z
`clear all`	Clears all variables and functions from workspace
`who`	Lists variables currently in the workspace
`whos`	Lists variables currently in the workspace with their sizes together with information about their bytes and class

To get help on certain statement or function, type help followed the function name

Example:

```
>> help clear
```

Matlab Operations & Functions

- Matlab has various built-in Operations and Functions
- Full list of operations, functions and data types: https://uk.mathworks.com/help/matlab/referencelist.html?type=function
- Matlab will give you syntax suggestions as you type the function
- Example:

```
>> a = "2"
>> 5 * a
>> "The answer is " + 5 * double(a)

>> m = "Middlesex University"
>> contains(m, "ex")
>> count(m, "i")
```

Operations	Operators	Examples
Addition	+	>> 5 + 3
Subtraction	−	>> 5 − 3
Multiplication	*	>> 5 * 3
Right Division	/	>> 5/3
Left Division	\	>> 5\3 = 3/5
Exponentiation	^	>> 5^3 (means $5^3 = 125$)

Precedence Order	Operators
1	Parentheses ( ). For nested parentheses, the innermost are executed first.
2	Exponentiation, ^
3	Multiplication, *; Division, /,\
4	Addition, +; Subtraction, -

Exercise: Operations & Functions

```
>> pi
>> round(pi)
>> round(pi,2)
>> floor(pi)
>> floor(3.89)
>> rand(1)
>> rand(3)
>> rand(1,3)
>> rand(3,1)
>> mod(10,3)
>> mod(10,4)
```

Exercise: Operations & Functions

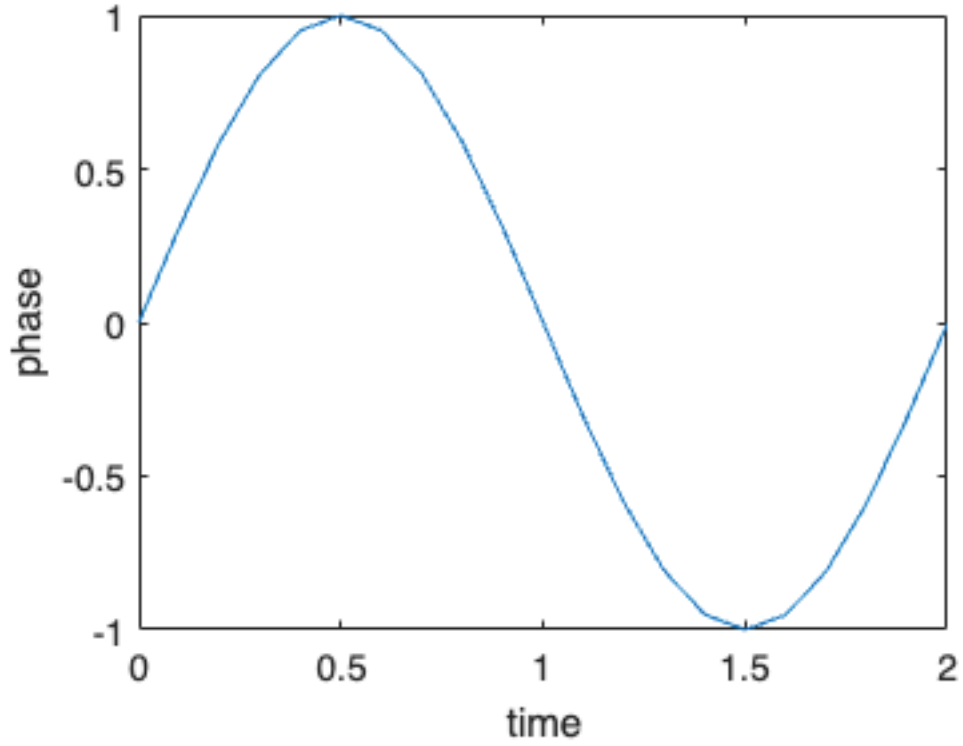
Find the Matlab function to perform the following:

a. Check if a variable contains a numeric value
b. Convert “Middlesex” to “MIDDLESEX”
c. Convert “Middlesex” to “ex”
d. Split ”Middlesex University Dubai” into three strings: “Middlesex”, “University”, and “Dubai”
e. Show today’s date and time in the following format ‘02-Jul-2020 17:20:00’
f. Show sine of 90-degree angle

Plotting Chart

- Example: type in the following commands on Command Window

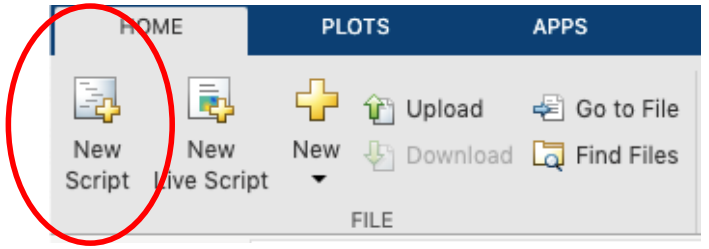
```
>> x = [0:0.1:2]
>> y = sin(x*3.14)
>> plot(x,y)
>> xlabel('time’)
>> ylabel('phase')
```



Can you try plotting other functions?

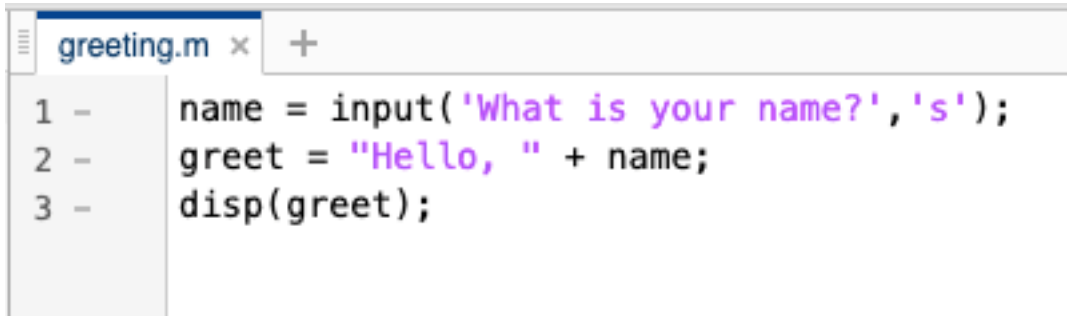
Script

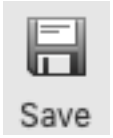
- Script is an external file that contains a sequence of Matlab statements. Matlab scripts have a filename extension of .m
- To create a new script, click on the New Script widget
- A script editor will appear

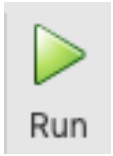


Script – your first Matlab script

- Open a new script and type in the statements below. Mind the semicolon (;) at the end of each line



- Click Save 

, and name the file as **greeting.m** and continue saving
- Run the file by clicking Run 

- Interact with the script by typing on the Command Window

Script - Decision Making

- Continue your script with the following statements and run it

```
4 -  age = input('How old are you?');
5 -  if (age >= 18)
6 -      disp('You are a grown up')
7 -  else
8 -      disp('You are underaged')
9 -  end
```

- Or try this variant

```
4 -  age = input('How old are you?');
5 -  if (age >= 18)
6 -      disp('You are a grown up')
7 -  end
8 -  if (age > 12 && age < 18)
9 -      disp('You are a teenager')
10 - end
11 - if (age <= 12)
12 -     disp('You are a kid')
13 - end
```

Script - Loops

- “For” is used when the number of iteration is known
- “While” is used when the loop shall be terminated based on condition

loops.m

```
disp('For loop')
for x = 1:2:10
    disp(x);
end

disp('While loop')
y = 1;
while y < 10
    disp(y^2);
    y = y + 2;
end
```

Challenge

- Create a script to plot equation $y = x^2 + 2x – 5$
- Create a script to print a list of all leap years from 1980 to 2022
- Create a game of number guessing, the computer will choose a random number from 0 to 9, user must try to guess the number. Users will win if they can guess the number in maximum than 3 tries.

HAVE FUN!

Summary

- Matlab is a powerful tool to do computation and visualization of data.
- There are various ways to get Matlab on our computer and even mobile devices.
- Matlab can be used by entering line by line statements in Command Window or a sequence of statements saved as script files.
- Matlab stores variables as arrays in the form of scalar (1x1), vector (1 x n) or (n x 1), or matrix (n x n x n).
- We just learnt the basic of Matlab, there is a lot more that Matlab can do with Add-ons (apps, toolboxes, support packages, etc.)