Classes 1. Introduction to working in Matlab

1. Introduction to working in Matlab

Matlab is a high-level language and an interactive environment for numerical computation, visualization and programming[1].
The best way to learn to work with Matlab is "learning by doing"[2]. The following examples are intended to show Matlab's capabilities, but also encourage the reader to self-test the examples presented.
In this introduction, we will learn how to work with the Matlab environment.
On the website dedicated to Matlab: http://www.mathworks.com/products/matlab/
there are tutorials, video tutorials, code examples, and videos from the Matlab.

2. User's Guide

The environment itself provides a workbook. After the help command, a thematic list is displayed, which we can refer to for details on the selected topic, for example, when you enter the demo command the Matlab sample manual page is displayed. Depending on the installation, there are available video materials available for Matlab.

The help command can be used interchangeably with doc. To view information on the selected function, just put the help word before it, for example:

```
>> help max
max - Largest elements in array
```

This MATLAB function returns the largest element along different dimensions an array

```
C = max(A)
C = max(A,[],dim)
[C,I] = max(...)
C = max(A,B)
...
```

Quick access to the function of book is also possible. After selecting the fx badge in the bottom left of the console:

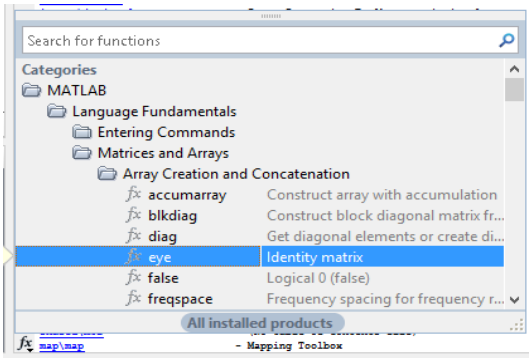

Fig.1 Quick access to the manual

[1]http://www.mathworks.com/products/matlab/
[2]David Houcque "INTRODUCTION TO MATLAB FOR ENGINEERING STUDENTS", Northwestern University, (version 1.2, August 2005), link:
https://www.mccormick.northwestern.edu/documents/students/undergraduate/introduction-to-matlab.pdf

The fundamental functions in Matlab include:

ans	Most recent answer
clc	Clear Command Window
diary	Save Command Window text to file
format	Set Command Window output display format
home	Send cursor home
iskeyword	Determine whether input is MATLAB keyword
more	Control paged output for Command Window

3. Data types

Among data types, we can distinguish fixed values, and scalar, vector, and matrix variables. Fixed values are shown in the table below:

i, j	imaginary unit $\sqrt{-1}$
pi	Number π
exp(1)	Euler's number
Inf	Infinity (∞)
NaN	Not-a-Number
eps	Floating-point relative accuracy
logical	Convert numeric values to logicals
true	Logical 1 (true)
false	Logical 0 (false)

Scalar expressions are real or complex values:

```
>> a=3.1415
a =
3.1415
>> b=1-i
b =
1.0000 - 1.0000i
```

The variables defined in this way can also be treated as primitive rows with one-piece components. Lists are sequences of ordered elements whose elements are identified by indexes. Lists can be created in different ways:

```
>> A = [1 1 2 3 5]
A =
1 1 2 3 5
>> B=1:0.5:4
B = 1.0000 1.5000 2.0000 2.5000 3.0000 3.5000 4.0000

>> C=[-i; 1; i]
C =
0.0000 - 1.0000i
```

```
1.0000 + 0.0000i
0.0000 + 1.0000i
```

We can create matrices:

```
>> D=[1 2 3;2 2 3;3 3 3]
D =
1 2 3
2 2 3
3 3 3
>> D(1,3)
ans =
3
```

where in the last command we display the array element from row 1 and column 3. This way you can refer to the individual elements of the matrix, and in particular the rows.

4. Basic operations in Matlab

The basic operations are shown in the table

plus	Addition
minus	Subtraction
times	Element-wise multiplication
rdivide	Right array division
ldivide	Left array division
power	Element-wise power
mtimes	Matrix Multiplication
mrdivide	Solve systems of linear equations xA = B for x
mldivide	Solve systems of linear equations Ax = B for x
mpower	Matrix power
diff	Differences and Approximate Derivatives
prod	Product of array elements
sum	Sum of array elements

The Matlab console can be used as a calculator for various mathematical calculations, e.g. to calculate the number of hours a week is:

```
>> (3+3+2+2)+(1+1)
ans =
       12
```

or to calculate the probability of passing a single-choice test of 10 questions with 3 responses per 100%:

```
>> (1/3)^10
ans =
       1.6935e-05
```

In addition to the operators described above, functional operators are also available, for example:

```
>> eq(2,2)
ans =
1
```
which is equivalent to the operator == or logical functions for true or false of p:

```
>> not(and(p,not(p)))
ans =
1
```

Table operators are mainly used for rows and arrays. With these operators it becomes possible to multiply corresponding indexes of matrix elements:

```
>> A=[1 -1; 8 0]
A =
1 -1
8 0
>> B=[2 4; 0.25 1]
B =
2.0000 4.0000
0.2500 1.0000
>> A.*B
ans =
2 -4
2  0
```

A comprehensive description of other operators can be found in the Matlab manual.

5. Selected functions

The set of selected mathematical functions is given in the table:

abs	Absolute value and complex magnitude
sin	Sine of argument in radians
asin	Inverse sine in radians
sinh	Hyperbolic sine of argument in radians
asinh	Inverse hyperbolic sine
cos	Cosine of argument in radians
acos	Inverse cosine in radians
cosh	Hyperbolic cosine
acosh	Inverse hyperbolic cosine

tan	Tangent of argument in radians
atan	Inverse tangent in radians
tanh	Hyperbolic tangent
cot	Cotangent of angle in radians
acot	Inverse cotangent in radians
coth	Hyperbolic cotangent
mod()	Remainder after division
exp	Exponential
log	Natural logarithm
log10	Common logarithm (base 10)
sqrt	Square root
erf	Error function
gamma	Gamma function

To determine the value of the function simply call the command function by adding the argument in parentheses:

```
>> abs(-105)
ans =
105
>> asin(0.5)
ans =
0.5236
>> log(1)
ans =
0
>> exp(0)
ans =
1
>> mod(17,4)
ans =
 1
```

6. Exercises

Exercise 6.1. Display the diary command in the console. Then turn on saving the working history in Matlab to the file name_surname.

Exercise 6.2. Display a list of all words from the Matlab syntax.

Exercise 6.3. Assign a variable a complex number (-1, π).

Exercise 6.4. Create list from the first 9 members of a Fibonacci sequence and designate row of squares of these members.

Exercise 6.5. Use Matlab to determine for what Boolean values p and q expressions:

a) $\sim p \vee q \equiv \sim (p \wedge \sim q)$;

b) $\sim p \vee p$;

c) $(p \rightarrow q) \wedge p$

are true.

Exercise 6.6. Calculate the value of the expression:

a) $2 \sin \frac{a+b}{2} \cos \frac{a-b}{2}$ dla $a = b = \pi$;

b) $\sin^2 a + \cos^2 a$ dla $a = 0.00001$;

c) $\ln ctg\ a$ dla $a = \pi/4$.