Chapter 2

Data types and script file

1. Introduction

MATLAB uses different types of data, called for simplicity classes, to store variables. For each variable, it associates a type for which the possible operations can be performed on are knowen. MATLAB users use command window to create and save variables. In addition to command window, MATLAB provides a space to create and combine instructions in a program, which we call script file.
In these pages, we will talk about different types of data adopted in MATLAB and the script file in which we can type our developed program.

2. Data types

MATLAB has different classes or data types that can be exploited, including numeric, character, logical, table, cell and structure types. Figure.1 shows the fundamental MATLAB classes:

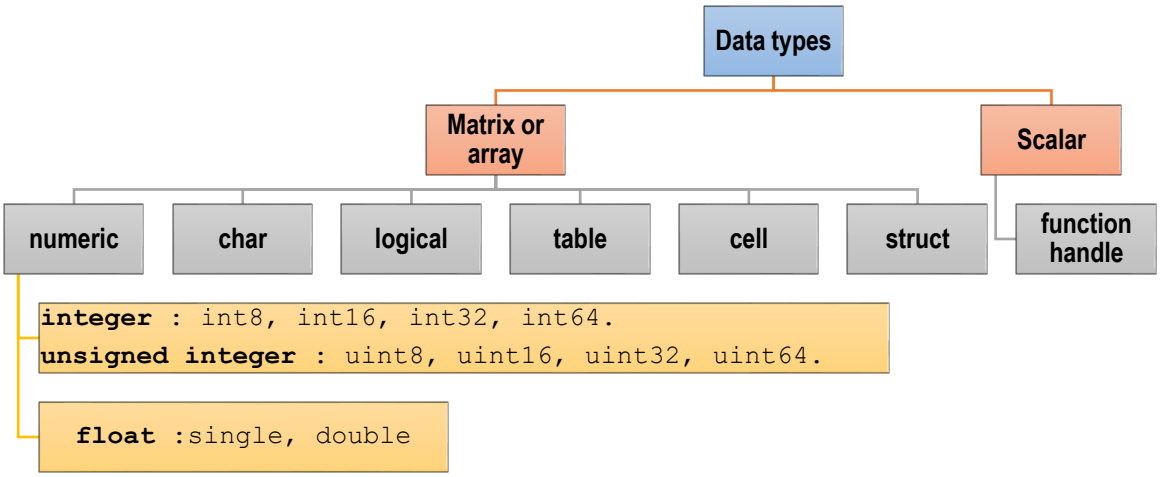


Figure.1 Fundamental MATLAB classes.

In MATLAB, the assigned data to a variable have different types. The main data types adopted in MATLAB are defined as indicated in what follows:

- **Numeric:** Numeric class includes **Integer** and **floating-point numbers.** Integer data type is saved as 8 bits, 10 bits, 32 bits, and 64 bits represented by int8, int16, int32, and int64 respectively. uint8, uint16, uint32, and uint64 denote the **unsigned integers** stored in 8, 16, 32 and 64 bits, respectively. Floating type is stored as single or double precision characterized by single and double respectively**.** MATLAB uses 4 bytes (32 bits) and 8 bytes (64 bits) to store single and double values. By default, the numeric values are stored as **double** precision in which we can change the numeric type to integer or single to offer memory space.
- **Characters and strings: char** and **string** are used to store the alphabetic characters (single character or character vectors) or text data respectively.
- **Logical data:** The logical data type is used to represent the Boolean value true or false using 1 and 0 respectively. The logical value can be used by Boolean operators (AND, OR …) or execute conditional code.

  Relational expressions: Relational or logical expressions are expressions that are conceptually either true or false. The main relational operators in MATLAB are : `>`, `<`, `>=`, `<=`, `==` (equality) and ~=(inequality). The logical operators: and: `&&`, or: `||` and not: `~`.
- **Tables:** They are used to package and store tabular data and used in general for data analysis.
- **Struct:** struct is used to store arrays of varying classes and sizes of data.
- **Cell:** Cells store varying classes of data in each cell, so they offer more flexibility to package data.
- **Function handle:** It is used to point and call a function.

An example of some popular data types are presented in the following command window

```
>> a = 5; b = int8(5); c = int16(5); d = single(5);
>> e = '5'; f = "abcd"; g = true;
>> whos
  Name      Size            Bytes  Class      Attributes

  a         1x1                 8  double
  b         1x1                 1  int8
  c         1x1                 2  int16
  d         1x1                 4  single
  e         1x1                 2  char
  f         1x1               150  string
  g         1x1                 1  logical
```

Next lines denote some relational expressions.

```
>> 5 < 8

ans =

  logical

   1

>> (5 >= 8) && (5 ~= 4)

ans =

  logical

   0

>> 5 == 5

ans =
```

```
  logical

    1


>> 5 = 5
 5 = 5
    ↑
Incorrect use of '=' operator. Assign a value to a
variable using '=' and compare values for equality
using '=='.
```

The workspace window can show the name, the value and the type of the variables created in the command window. In addition, user can specify the type of attributes to be displayed by clicking on the right down arrow.

3. MATLAB Scripts

A script is an external file with .m extension, which contains a sequence of MATLAB instructions and commands. The script file can be edited, saved and executed. To run the script we enter the file name in the command window and type Enter. Figure.2 illustrates how to create a new script.

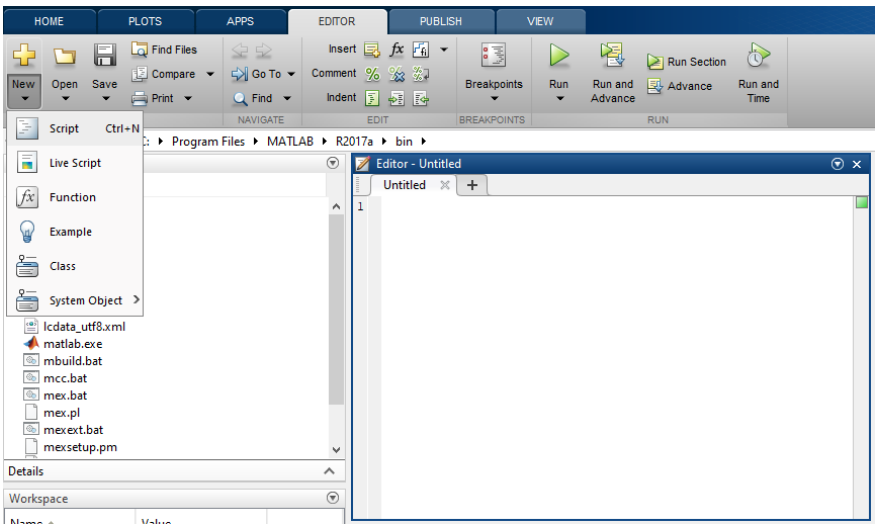


Figure.2 Creation of a new script.

We can edit, save and run the script file in the command window using the following commands: `editscriptName`, `save scriptName` and `scriptName` respectively, where `scriptName` indicates the name of our script.

4. First example

In our first script, we create a program to calculate the area of a rectangle given by:

$$my\_area = length * width$$

where, my_*area* represents the rectangle area variable and *length* and *width* refers to rectangle length and width respectively. To execute a script file, we simply enter its name in the command window without the .m extension. Figure.3 depicts our first script file that calculates the rectangle area and its execution in the command window:

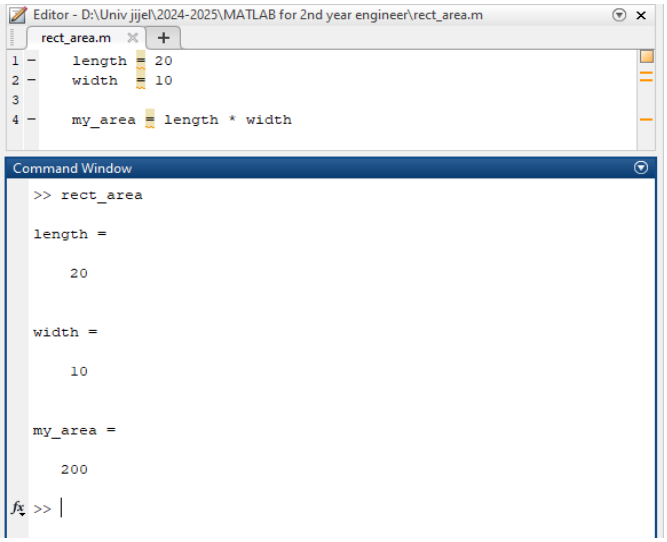


Figure.3 First script: Calculation of the rectangle area.

5. Comments

When writing a script it is meaningful to introduce some comments that clarify how the task is accomplished and give the user some insights regarding the developed algorithm. The simple way to document the script is to use the MATLAB comment lines defined by using the '%' character before the comment line. The comments are ignored when executing the script. Figure.4 illustrates our first script with useful lines of comments.

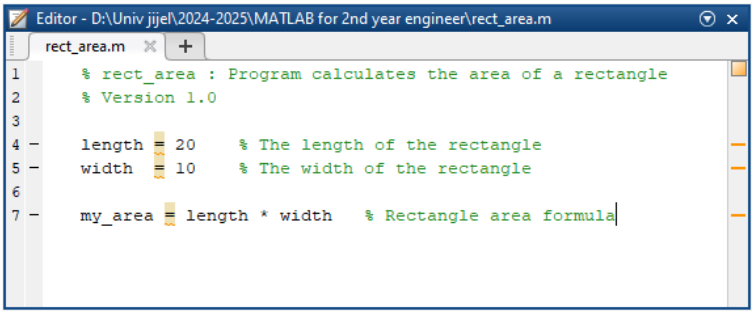


Figure.4 First script with useful lines of comments.

Comments are used to describe different parts of the script, in which the first comments introduced at the beginning of the script are reserved to denote a description of the script task. In addition, we can use the MATLAB help command with scripts to display the first lines of comments as a script help as indicated in Figure.5.

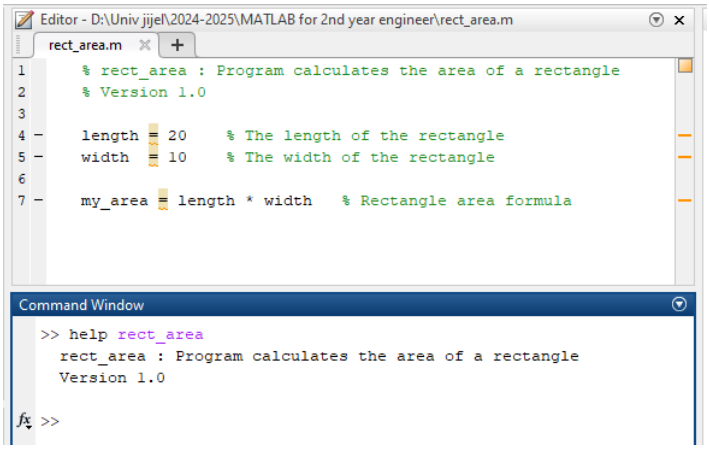
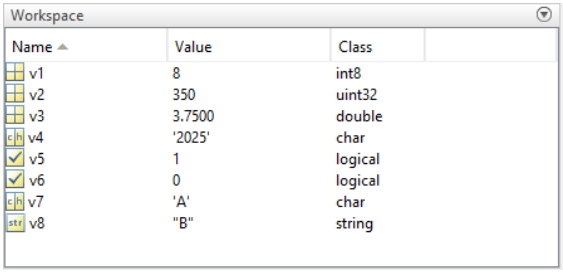


Figure.5 Script useful comments and help.

6. Practical work 2

Data types

1. Determine by your intuition the value, the type and the size on bytes of the following variables:
   a = 8; b = 2.3; c = a+b; d = a<b; e = int16 (8); f = a+e; g = 'a+b'.
2. Check your response using the command and the workspace windows.
3. Based on the above workspace window, create the indicated variables.



Script file

4. Given a triangle formula, write a script (using comments) to calculate the area of a triangle.

$$Triangle\ area = \frac{1}{2}\ (base\ \times perpendicular\ heights)$$

5. Write a simple script to calculate the surface of a cylinder given by:

$$Cylinder\ surface = 2\pi r^2 + 2\pi rh$$

where *r* and *h* are the radius and the height of the cylinder respectively.

6. Include in your script a detailed help and valuable comments