



Procedures and Functions

1. Introduction

All MATLAB operations are implemented by means of functions. MATLAB provides a large number of standard elementary mathematical functions as well as many more advanced mathematical functions for performing numerical manipulations. For a list of the elementary and more advanced mathematical and matrix functions, type:

- >>help elfun Elementary mathematical functions.
- >>help specfun Specialized mathematical functions.
- >>help elmat Elementary matrices and matrix manipulation

2. Functions

Some of the functions, like `sqrt` and `sin`, are built-in. They are part of the MATLAB core so they are very efficient, but the computational details are not readily accessible. Other functions, like `gamma` and `sinh`, are implemented in M-files. You can see the code and even modify it if you want. You can also add functions of your own.

- **Core MATLAB (Built-in) Functions**
 - `sin`, `abs`, `exp`, ...
- **MATLAB-supplied M-file Functions**
 - `mean`, `stat`, ...
- **User-created M-file Functions**

Email: Feryal.ibrahim@uomus.edu.iq



- Differences between Script & Function M-files:
 - Structural Syntax
 - Function Workspaces, Inputs & Outputs

3. Script Functions

MATLAB allows you to define your own functions by putting them in text files. These text files must be accessible to MATLAB (i.e. in the same directory as you start MATLAB) and must end in .m. The function is called by typing its name (without the .m part).

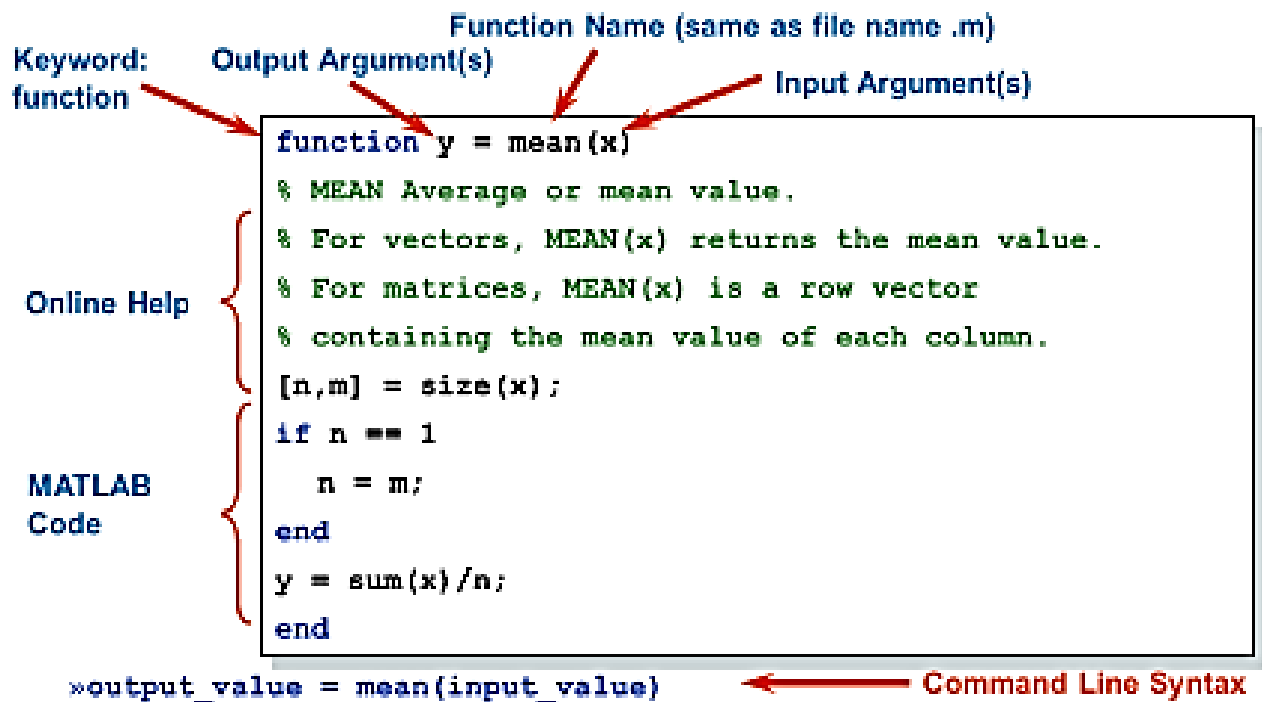
To create a function, you will write a text file with the following format:

```
function [OUT1, OUT2, ...] = FNAME(IN1, IN2, ...)
```

where OUTn are the out variables and INn are the input variables.



4. Structure of a Function M-file



The figure above summarizes of the structural syntax available for defining functions:

Required:

- Keyword: `function`
- Function name (should be the same as the file name -file has `.m` extension)

Optional:

- Input / Output Argument(s) - These define the internal variable names
- Online help - Comment lines following immediately after the function definition line.



(NOTE: The first line in the Online Help is referred to as the “H1” line. The LOOKFOR command uses the H1 lines for its string search.)

- MATLAB Code - Contains the MATLAB expressions to be executed as part of function.

Command Line Syntax:

- When calling a function from the command line, MATLAB searches the path for an M-file with the specified name (does not search for the function name in the file’s text).

NOTE:

- Input name(s) defined in the first line of the function are used in the function code.

The results produced by the function code must be stored in variable(s) with the same name as the output arguments(s).

5. Multiple Input & Output Arguments

```
function r = ourrank(X,tol)
% OURRANK Rank of a matrix
s = svd(X);
if ( nargin == 1)
    tol =
    max(size(X))*s(1)*eps;
end
r = sum(s > tol);
end
```

```
>>RANK = ourrank(rand(5),0.1);
>>[MEAN,STDEV] = ourstat(1:99);
```

Multiple Input
Arguments (,)

Multiple Output
Arguments [.]

```
function [mean,stdev] = ourstat(x)
% OURSTAT Mean & std. deviation
[m,n] = size(x);
if m == 1
    m = n;
end
mean = sum(x)/m;
stdev = sqrt(sum(x.^2)/m - mean.^2);
end
```



Example 1

Create a function file, named *Nmax* should be written in a file named *Nmax.m*. It takes three numbers as argument and returns the maximum of the numbers.

```
function max=Nmax(a,b,c)
% this function calculates the maximum of the
% three numbers as input
if (a>b) & (a>c)
    max=a;
elseif (b>c)
    max=b;
else
    max=c;
end
end
```

➤ How do I Save a MATLAB function?

This is done in the same way you save a file in any other application:

☐ Type in the name that you want to use

1. it is best to always use the “function name” as the “file name”
2. you don't need to explicitly specify the file type as *.m.

➤ Where to Save an M-File?

Click on FILE, click on SET PATH, click on BROWSE, navigate to the folder you want as present working directory and click on it, and then click save.

6. Calling Functions



Calling a function, also referred to as invoking a function, is used to pass the control of the program to the required function, which in turn performs defined tasks and returns the control of the program back to the main program if the return statement of this function is executed or if the function-ending brace is encountered. A function is called by simply passing the required arguments or parameters into the name of the function.

Example 2

After saved the functions that create an Example 1, then calling a function in script for testing:

```
1. clc
2. Clear
3. a = 12;
4. b = 35;
5. c = 1;
6. x = Nmax(a,b,c) ;
```

```
>> x=Nmax(12, 35, 1)
x =
    35
>> x=Nmax(12, -35, 1)
x =
    12
>> x=Nmax(-12, -35, 1)
x =
     1
```

H.W 6

1. Write a function named *quadratic* that would *calculates the roots* of a *quadratic equation*.
2. Write a script that *transposes* a matrix *A*. Check its correctness with the MATLAB operation: A' .

Email: Feryal.ibrabim@uomus.edu.iq