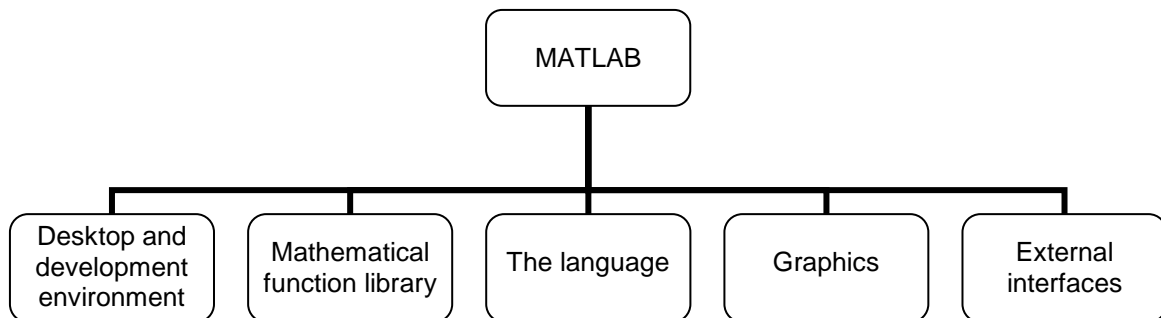


### What is MATLAB?

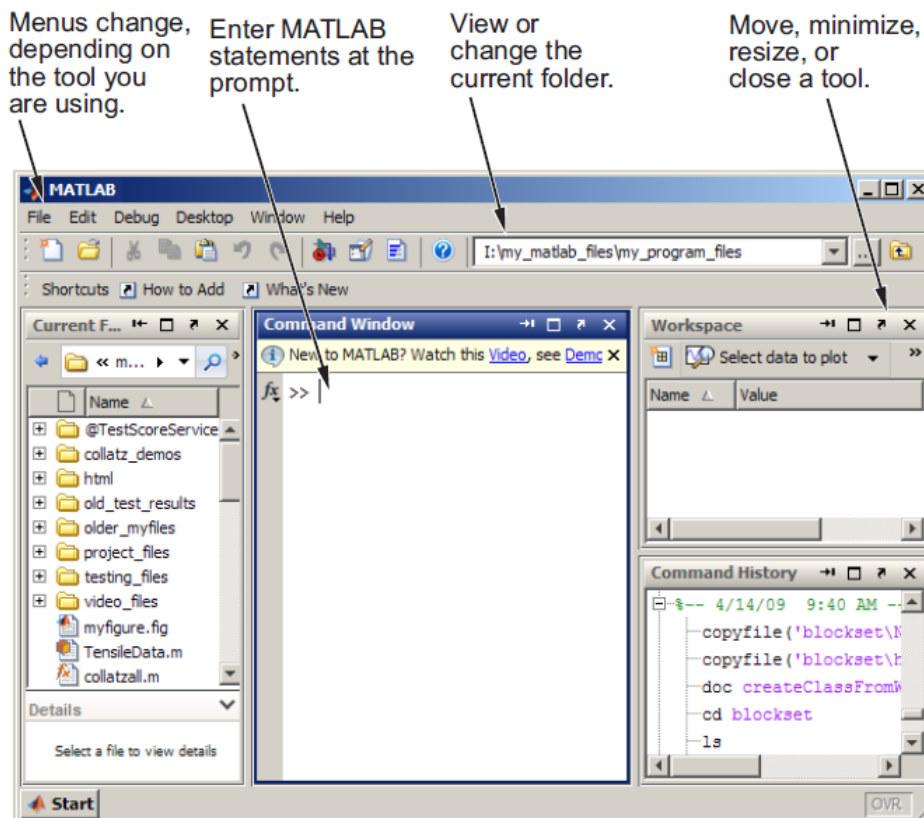
MATLAB (from MATrix LABoratory) is a high performance language for technical computing, which integrates computation, visualization, and programming in an easy to use environment, where problems and solutions are expressed in familiar mathematical notation.

The basic data element in MATLAB is the array (a collection of numbers arranged in a specific order). This allows you to solve many technical computing problems in a fraction of the time it would take to write a program in other languages.

### The MATLAB system



### MATLAB Desktop



## Command Window

The command window allow the user entering interactive commands at the prompt (`>>`) and they will executed directly after pressing the `<Enter>` key.

## The Prompt (`>>`)

MATLAB displays the prompt (`>>`) in command window to indicate that it is ready to receive instructions. Before giving instructions, be sure that the command window is active.

## Command History Window

This window shows the previous keystrokes you entered in the command window.

## Workspace

The area of computer memory used to store variables built up during a MATLAB session is called workspace.

## Current Folder

A directory (or folder) where MATLAB looks for your files.



- You can change the view of the default desktop layout from the MATLAB Desktop menu.
- To eliminate any window (e.g. history window), just click on its close button at its upper right corner.
- To separate any window and makes it float over the other windows (i.e. undocking), just click on the arrow button at its upper right corner.

## **Entering commands and instructions**

Suppose that you want to find the result of the division of 7 by 2. Simply type `7/2` and press `<Enter>` key at the prompt of the command window:

```
>> 7/2
ans =
    3.5000
```



MATLAB will assign the answer to a variable called `ans` if you didn't give a variable name.

Example 1: Calculate the volume of a circular cylinder of height 15 m and radius of 8 m.

```
>> h=15
h =
    15
>> r=8
r =
     8
>> volume=3.14*r^2*h
volume =
    3.0144e+003
```

We call this interaction between MATLAB and you as a session.



To view the content of the workspace, select **Workspace** from the view menu in the MATLAB desktop, or type `workspace` at the command window prompt.



## Additional commands

<code>clc</code>	Clears the command window
<code>clear</code>	Removes all variables from memory
<code>clear var1 var2</code>	Removes the variables <code>var1</code> and <code>var2</code> from memory
<code>quit</code>	Stops MATLAB
<code>who</code>	Lists the variables currently in memory.
<code>whos</code>	Lists the current variables, sizes, and indicates if they have imaginary parts.

## Some MATLAB common mathematical functions

MATLAB function	Description	MATLAB function	Description
<code>abs(x)</code>	$ x $	<code>exp(x)</code>	$e^x$
<code>acos(x)</code>	$\cos^{-1} x$ (x in Radians)	<code>log(x)</code>	$\ln x$
<code>asin</code>	$\sin^{-1} x$	<code>log10(x)</code>	$\log_{10} x$
<code>atan</code>	$\tan^{-1} x$	<code>sin(x)</code>	$\sin x$
<code>atan2(y, x)</code>	$\tan^{-1} \frac{y}{x}$	<code>sqrt(x)</code>	$\sqrt{x}$
<code>cos(x)</code>	$\cos x$	<code>tan(x)</code>	$\tan x$

## PROBLEMS

1. What is the workspace? How can you determine what is stored in a MATLAB workspace?
2. How can you clear the contents of a workspace?
3. How can you clear the contents of the command window?
4. Use MATLAB to make the following calculations, using the values:  $x=10$ ,  $y=3$ . Check your calculations using a calculator.

a.  $u = x + y$     b.  $v = xy$     c.  $w = x/y$     d.  $z = \sin x$     e.  $r = 8 \sin y$     f.  $s = 5 \sin(2y)$

5. Suppose that  $x=3$  and  $y=4$ . Use MATLAB to compute the following:

a.  $\frac{yx^3}{x-y}$     b.  $\frac{3x}{2y}$     c.  $\frac{3}{2}xy$     d.  $\frac{x^5}{x^5-1}$     e.  $\left(1 - \frac{1}{x^5}\right)^{-1}$     f.  $3\pi x^2$

g.  $\frac{3y}{4x-8}$     h.  $\frac{4(y-5)}{2x-6}$     i.  $7xy^{1/3}$     j.  $2\frac{\sin x}{5}$     k.  $\sqrt{\frac{x}{y^2-1}}$     l.  $2 \ln \frac{x}{y}$

6. If  $a = 1.12$ ,  $b = 2.34$ ,  $c = 0.72$ ,  $d = 0.81$ , and  $f = 19.83$ . Write MATLAB statements to compute and display the following expressions:

a.  $x = 1 + \frac{a}{b} + \frac{c}{f^2}$     b.  $s = \frac{b-a}{d-c}$     c.  $r = \frac{1}{\frac{1}{a} + \frac{1}{b} + \frac{1}{c} + \frac{1}{d}}$     d.  $y = ab \frac{1}{c} \frac{f^2}{2}$

7. Calculate  $y_{\max}$  from the following equation if  $m=70$  kg,  $k=10$  N/m,  $g=9.8$  m/s<sup>2</sup>,  $L=10$  m, and  $D=5$  m.

$$y_{\max} = L + D + \frac{mg}{k} + \frac{1}{k} \sqrt{2m^2 g^2 + 2kmg(L + D)}$$

8. The volume of a sphere is given by  $V = 4\pi r^3 / 3$ , where  $r$  is the radius. Use MATLAB to compute the radius of a sphere having a volume of 30 percent greater than that of a sphere of radius 5 feet.

9. The ideal gas law is given by:

$$P = \frac{nRT}{V}$$

More accurate estimates can be made with van der Waals equation:

$$P = \frac{nRT}{V - nb} - \frac{an^2}{V^2}$$

For chlorine ( $\text{Cl}_2$ ),  $a=6.49$  and  $b=0.0562$ . compare the pressure estimates given by the ideal gas law and the van der Waals equation for 1 mol of gas in 22.41 liter at 273.2 K ( $R=0.08206$  liter atm/ mol K).

10. Consider the problem of estimating the height of a building, as illustrated in the given figure. If the observer is at a distance  $D$  from the building, the angle from the observer to the top of the building is  $\theta$ , and the height of the observer is  $h$ , what is the building height if  $h=1.7$  m,  $D=50$  m, and  $\theta=60$  degrees?

