Introduction to MATLAB

for

Engineering Students

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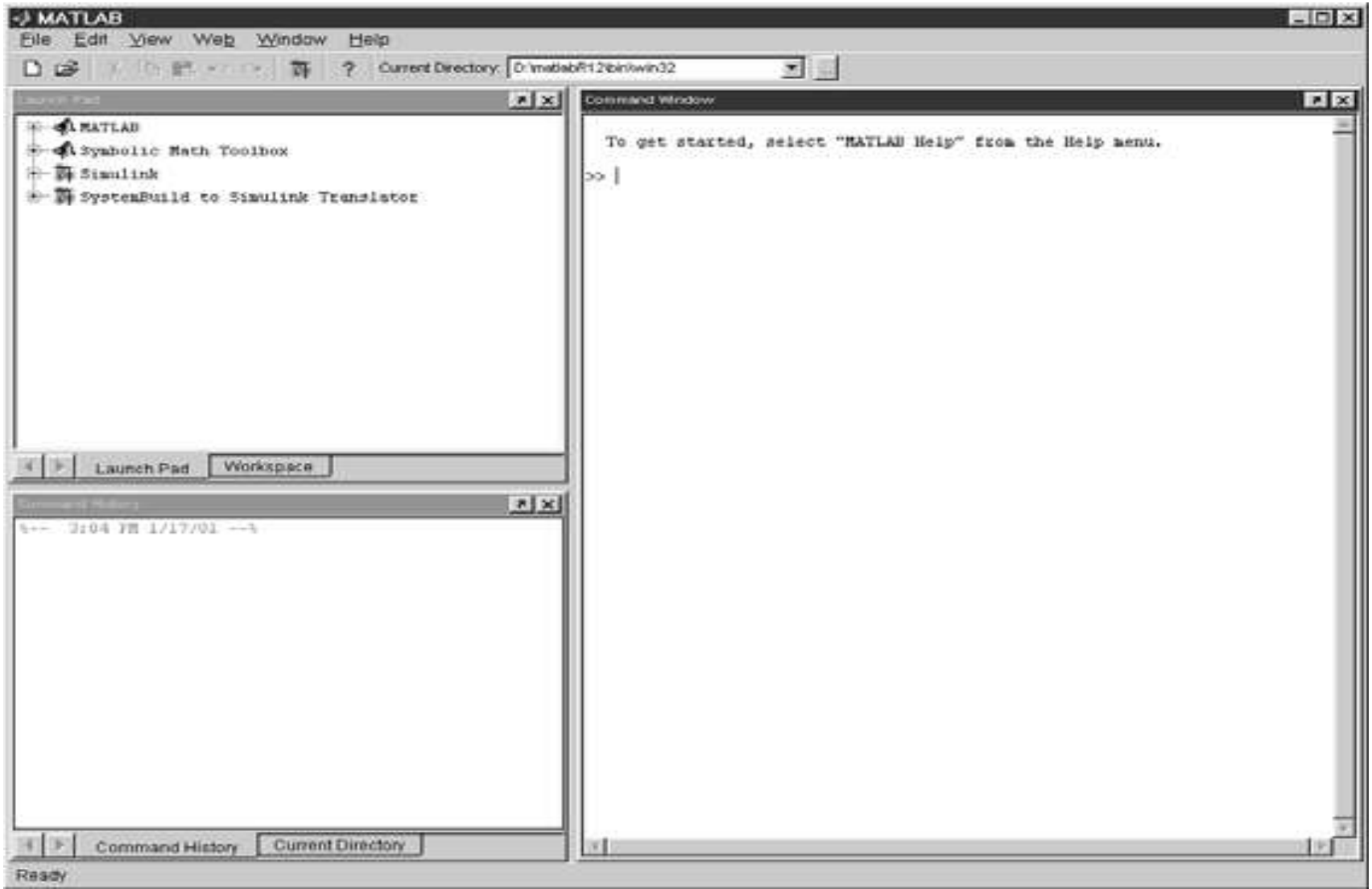
MATLAB as an Engineering Tool

- One of the important things for an engineer is to be able to calculate various problems or for solving various projects
- Especially in the world of 21st century, the complexity of the problems call for large calculations which require either programming knowledge or the help of calculation software such as MATLAB.

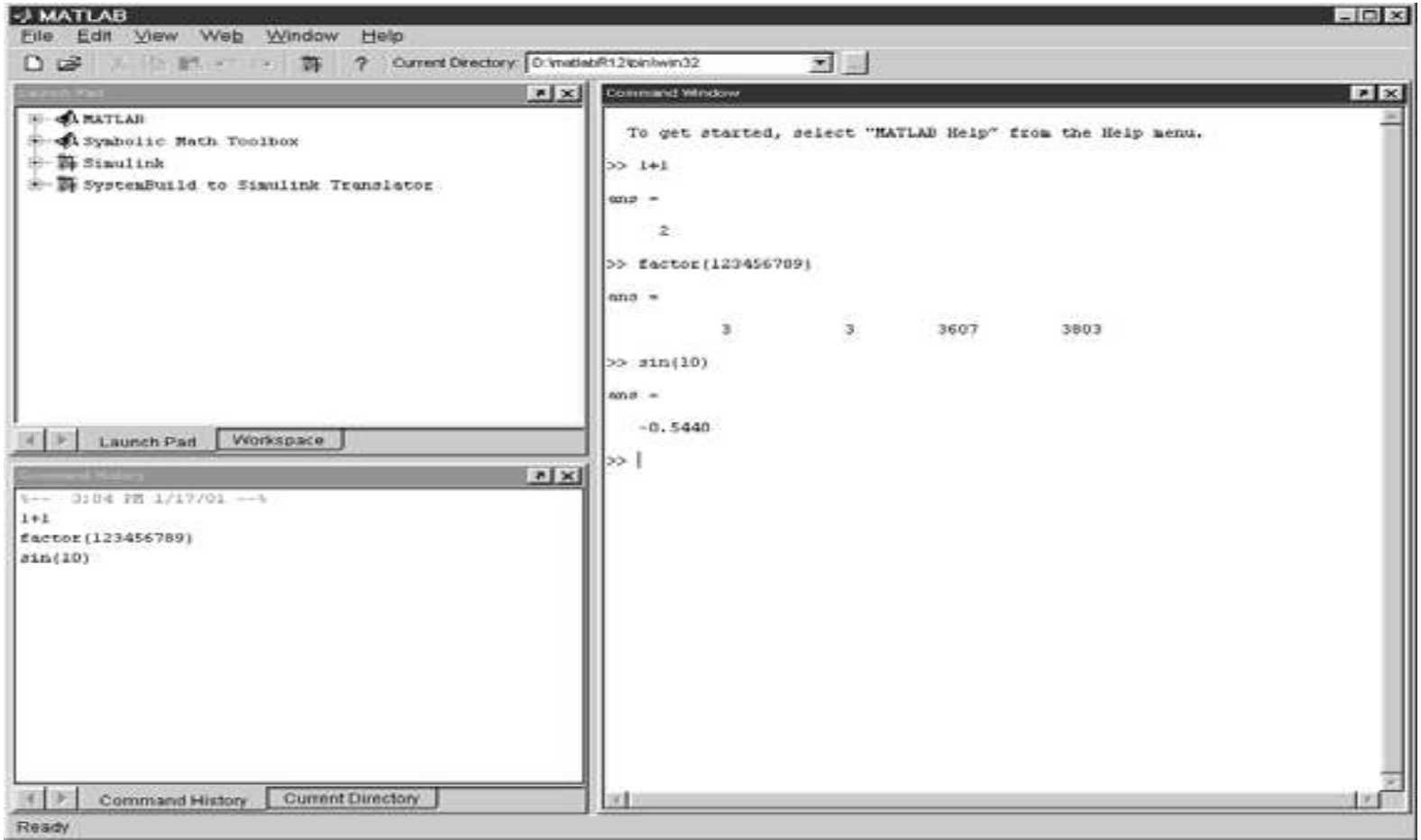
MATLAB Desktop

- This is what a basic MATLAB Desktop looks like



MATLAB as a Calculator

- The most basic function of MATLAB is as a scientific calculator. Here is the basic command window for calculation operations.



MATLAB Fundamentals

- >> is the command prompt. Matlab will try to calculate anything after this prompt.
- In Matlab, you usually don't need to declare variables as Matlab will assign types automatically
- Dimensioning is automatic in MATLAB as arrays and vectors are given dimensions automatically
- MATLAB is case sensitive. Hence, a and A are different variables
- Output of every MATLAB command is displayed directly on the screen. If a semicolon is present, the output is suppressed.

General MATLAB Commands

- **help** = lists help topics
- **helpwin** = opens interactive help window
- **help topic** = lists help on the particular topic
- **who** = lists variables currently in the workspace
- **clear** = clears workspace, removes variables
- **clear x y z** = clears only variables x,y,z
- **clc** = clears command window
- **clf** = clears figure window

MATLAB Operations Order

- First brackets
- Exponents
- Multiplication and Division Left to Right
- Addition and Subtraction Left to Right

MATLAB Formatting

Command	Example of Output
>>format short	31.4162(4–decimal places)
>>format short e	3.1416e+01
>>format long e	3.141592653589793e+01
>>format short	31.4162(4–decimal places)
>>format bank	31.42(2–decimal places)

```
format compact
```

is also useful in that it suppresses blank lines in the output thus allowing more information to be displayed.

The "e" notation is used for very large or very small numbers:

-1.3412e+03 $= -1.3412 \times 10^{3} = -1341.2$

-1.3412e-01 $= -1.3412 \times 10^{-1} = -0.13412$

Ans Variable in MATLAB

- Whenever you calculate something in MATLAB, the value is stored in Ans. You can always use this value for further calculations.

```
>>  3-2^4

ans  =

    -13

>>  ans*5

ans  =

    -65
```

Variables in MATLAB

- In mathematics, it is very important to store values in variables which can be used repeatedly with changing dynamic values. In MATLAB, you can equate something directly to a variable.

```
>> x = 3-2^4
x =
    -13
>> y = x*5
y =
    -65
```

Legal names consist of any combination of letters and digits, starting with a letter. These are allowable:

```
NetCost, Left2Pay, x3, X3, z25c5
```

These are **not** allowable:

```
Net-Cost, 2pay, %x, @sign
```

Simple MATLAB Calculations

- >> 2 + 2

  ans = 4

>> x = 2 + 2

  x= 4

>> y= x + 2

  y = 6

>> z= y + x

  z = 10

Functions in MATLAB

- There are many built in functions in MATLAB which help you to calculate real life functions

`sin, cos, tan`
and their arguments should be in radians.

The inverse trig functions are called `asin, acos, atan` (as opposed to the usual arcsin or $\sin^{-1}$ etc.). The result is in radians.

These include `sqrt, exp, log, log10`

Function Examples in MATLAB

```
>> x = 9;
>> sqrt(x),exp(x),log(sqrt(x)),log10(x^2+6)
ans =
     3
ans =
   8.1031e+03
ans =
    1.0986
ans =
    1.9395
```

exp(x) denotes the exponential function $\exp(x) = e^x$ and the inverse function is log:

e.g. to work out the coordinates of a point on a circle of radius 5 centred at the origin and having an elevation $30^\circ = \pi/6$ radians:

```
>> x = 5*cos(pi/6), y = 5*sin(pi/6)
x =
    4.3301
y =
    2.5000
```

MATLAB Examples

$$\frac{2^5}{2^5-1} = 2\,\wedge\,5\,/\,(2\,\wedge\,5-1) = 1.0323$$

$$e^3 = \exp(3) = 20.0855$$

$$\ln(e^3) = \log(\exp(3)) = 3$$

$$\log_{10}(e^3) = \log 10(\exp(3)) = 1.3029$$

$$\sin\frac{\pi}{6} = \sin(pi\,/\,6) = 0.5$$

$$\sin^2\frac{\pi}{6} + \cos^2\frac{\pi}{6} = (\sin(pi\,/\,6))\,\wedge\,2 + (\cos(pi\,/\,6))\,\wedge\,2$$

$$\frac{1+3i}{1-3i} = (1+3i)\,/\,(1-3i) = -0.8+0.6i$$

Vectoral Operations in MATLAB

- >> x = [1 2 3]

  x = 1 2 3

  >> y = [2; 1 ;5]

  y = 2

  1

  5

  >> z = [2 1 0]

  >> a = x + z

  a = 3 3 3

  >> b = 2* a

  b = 6 6 6

  >> t = 1:10

  t = 1 2 3 4 5 6 7 8 9 10

Example: Equation of a Straight Line

- The equation of a straight line is **y = mx + c** where m and c are constants. Compute the y coordinates of a line with slope m = 0.5 and intercept c= -2 at the following x coordinates where x = 0, 1.5, 3, 4, 5, 7, 9 and 10

- x = [0 1.5 3 4 5 7 9 10];

  y = 0.5*x-2

  Ans. y =-2 -1.25 -0.5 0 0.5 1.5 2.5 3

Creating a Plot Graph of a Line

- Lets plot the graph of the line equation given in the previous example y= 0.5x -2
- >> x = [0 1.5 3 4 5 7 9 10];

  >> y = 0.5*x-2

- >> plot (x, y)

  (The Matlab will plot the line at this point. However, the axis will be mismatched. We need to set them equal to each other

  >> axis ('equal') ! Sets the axis lengths equal

  >> xlabel ('x') ! Labels the x axis

  >> ylabel ('y') ! Labels the y axis

  >> title('Graph of a Line')

Creating a Plot of a Circle

- Lets draw a unit circle using 100 points from the equations x = cos Θ, y= sin Θ, where Θ is between 0 and 2pi
- >> theta = linspace(0,2*pi,100)

  >> x = cos(theta)

  >> y = sin(theta)

  >> plot (x,y)

  >> axis('equal')

  >> xlabel('x)

  >> ylabel ('y)

  >> title('Circle of unit radius')

Creating a Trigonometric Plot

- Plot y = sinx with x changing between 0 and 2pi taking 100 linearly spaced points

- x = linspace(0,2*pi,100)

  plot (x,sin(x))

  xlabel (‘x’)

  ylabel(‘sin(x)’)