

MATLAB Tutorial

Kun-Yen Chiu

The image shows the MATLAB R2019b interface. The top menu bar includes HOME, PLOTS, APPS, EDITOR, PUBLISH, and VIEW. The top toolbar contains icons for file operations (New, Open, Save, Compare, Print), navigation (Go To, Find), editing (Insert, Comment, Indent), breakpoints, and running (Run, Run and Advance, Run Section, Run and Time). The current folder is D:\Control_systems. The Editor window shows a new script 'test_file.m' with the following instructions:

1. Click "New" to add new script
2. Save it as any location you prefer

The Command Window shows the prompt `fx >>`. The Workspace window is empty. The Details pane shows "Select a file to view details".

Basic Operator

+	Plus; addition operator.
-	Minus; subtraction operator.
*	Scalar and matrix multiplication operator.
.*	Array multiplication operator.
^	Scalar and matrix exponentiation operator.
.^	Array exponentiation operator.
	Left-division operator.
/	Right-division operator.
.	Array left-division operator.
./	Array right-division operator.
:	Colon; generates regularly spaced elements and represents an entire row or column.

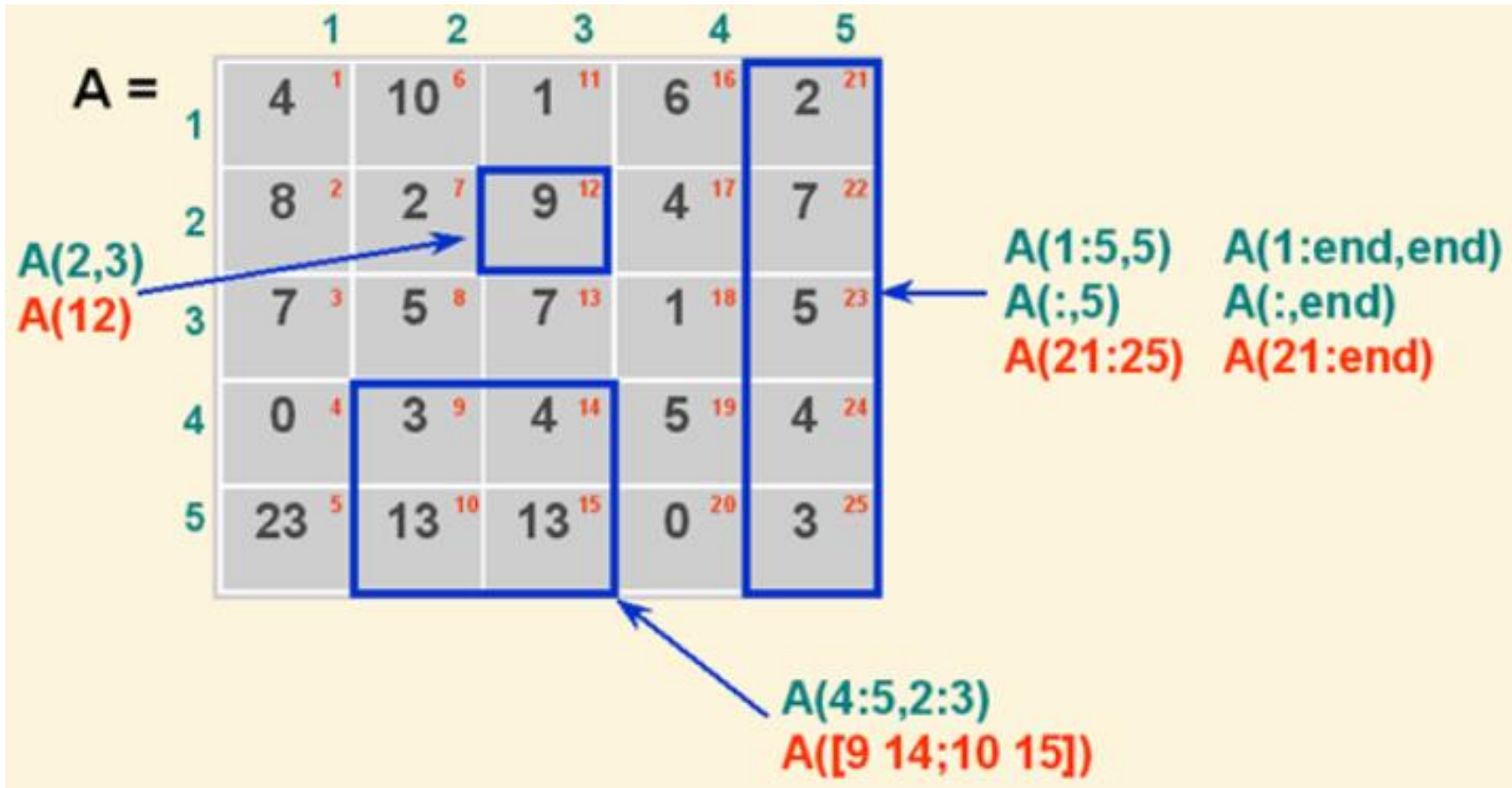
Exponential and Logarithmic Functions

<code>exp(x)</code>	Exponential; e^x .
<code>log(x)</code>	Natural logarithm; $\ln(x)$.
<code>log10(x)</code>	Common (base 10) logarithm; $\log(x) = \log_{10}(x)$.
<code>sqrt(x)</code>	Square root; \sqrt{x} .

Symbolic Linear Algebra Functions

<code>det</code>	Returns the determinant of a matrix.
<code>eig</code>	Returns the eigenvalues (characteristic roots) of a matrix.
<code>inv</code>	Returns the inverse of a matrix.
<code>poly</code>	Returns the characteristic polynomial of a matrix.

Matrix Representation



Noticed

A(## , ##)

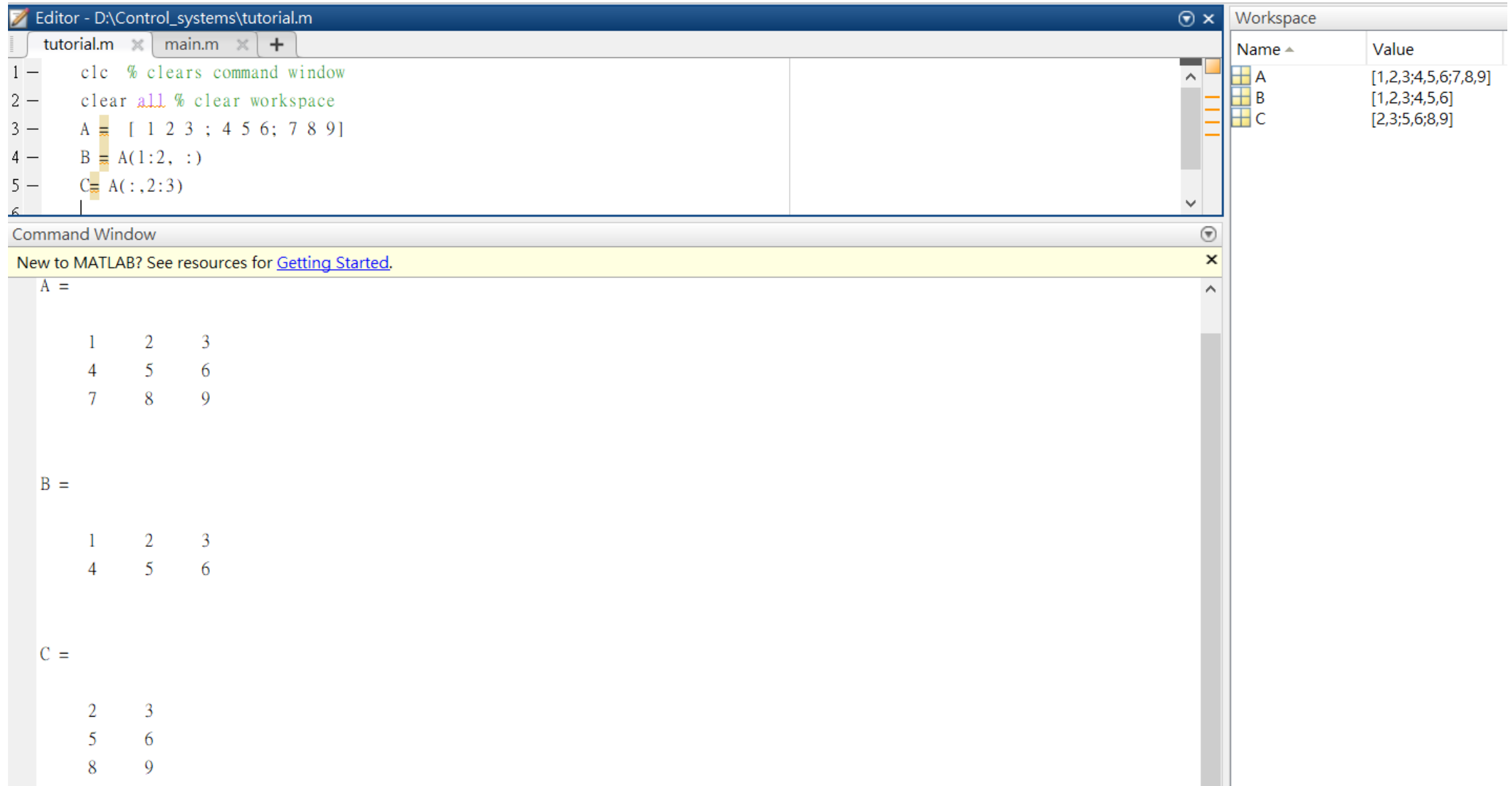
Column

(run vertical)

Row

(run horizontal)

Exercise 1 – Create Matrix



The image shows a MATLAB environment with the following components:

- Editor:** Contains a script named `tutorial.m` with the following code:

```
1 clc % clears command window
2 clear all % clear workspace
3 A = [ 1 2 3 ; 4 5 6; 7 8 9]
4 B = A(1:2, :)
5 C = A(:,2:3)
```
- Command Window:** Displays the output of the script:

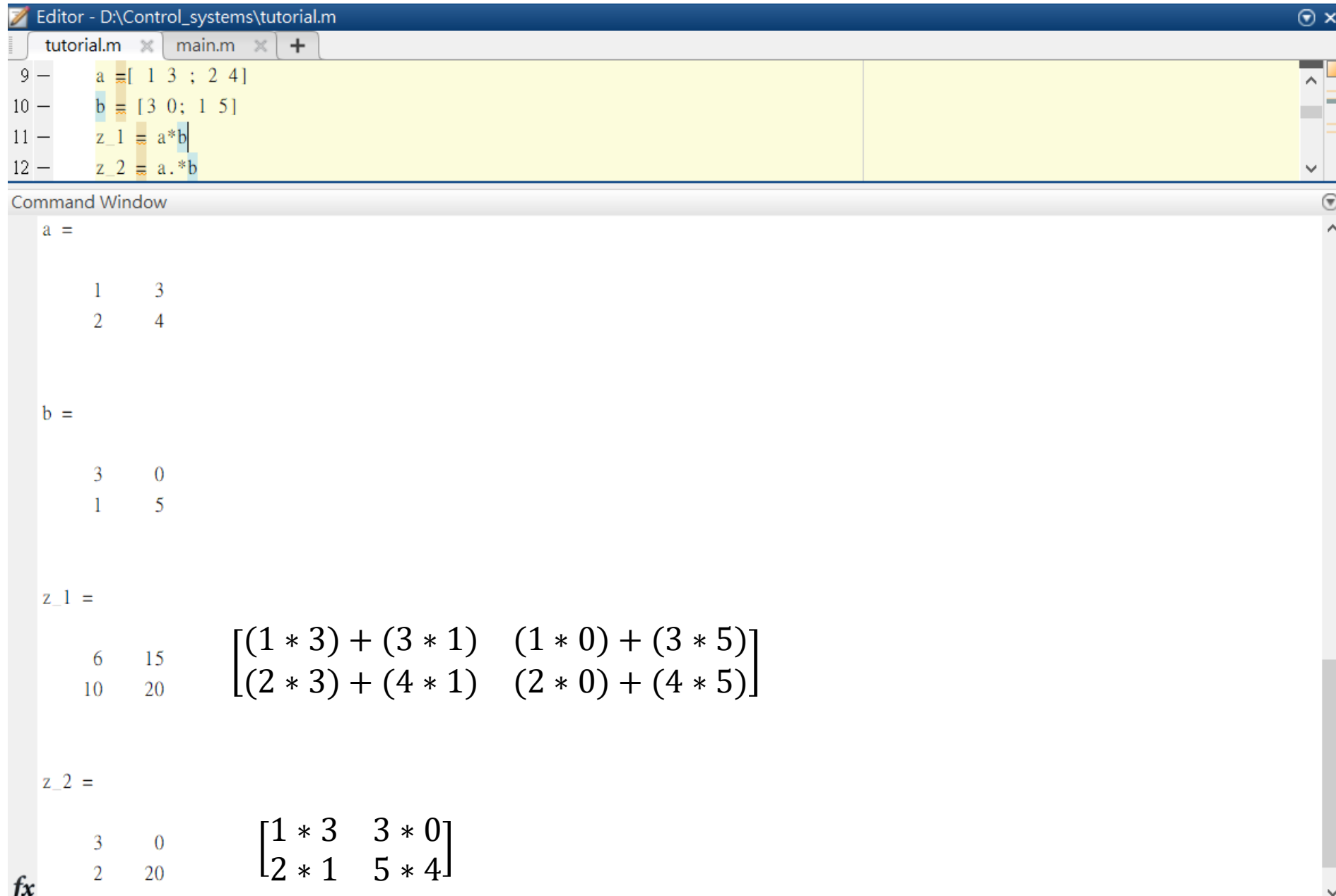
```
A =
     1     2     3
     4     5     6
     7     8     9

B =
     1     2     3
     4     5     6

C =
     2     3
     5     6
     8     9
```
- Workspace:** A table showing the variables created in the workspace:

Name	Value
A	[1,2,3;4,5,6;7,8,9]
B	[1,2,3;4,5,6]
C	[2,3;5,6;8,9]

Exercise 2 – Matrix Multiplication



The image shows a MATLAB Editor window with a script named 'tutorial.m' and a Command Window below it. The script defines two matrices, 'a' and 'b', and calculates their products 'z_1' and 'z_2'. The Command Window displays the resulting matrices and the calculation steps for 'z_1' and 'z_2'.

```
Editor - D:\Control_systems\tutorial.m
tutorial.m x main.m +
9 - a = [ 1 3 ; 2 4]
10 - b = [ 3 0; 1 5]
11 - z_1 = a*b
12 - z_2 = a.*b

Command Window
a =
     1     3
     2     4

b =
     3     0
     1     5

z_1 =
     6    15
    10    20
    [(1 * 3) + (3 * 1)  (1 * 0) + (3 * 5)]
    [(2 * 3) + (4 * 1)  (2 * 0) + (4 * 5)]

z_2 =
     3     0
     2    20
    [1 * 3  3 * 0]
    [2 * 1  5 * 4]
```

Exercise 3 – Solve Linear Equations

```
18 %A*X = B
19 y_1 = [2 4 ; 1 4] %y_1 = 2*x_1 + 4*x_2 = 16;    y_1 = 2x_1 + 4x_2 = 16
20 y_2 = [16; 14] %y_2 = 1*x_1 + 4*x_2 = 14;    y_2 = 1x_1 + 4x_2 = 14
21 x_value = y_1 \ y_2 %You can also do inv(y_1)*y_2
22
23
```

Command Window

y_1 =

2 4
1 4

$$y_1 = \begin{bmatrix} 2 & 4 \\ 1 & 4 \end{bmatrix}$$

y_2 =

16
14

$$y_2 = \begin{bmatrix} 16 \\ 14 \end{bmatrix}$$

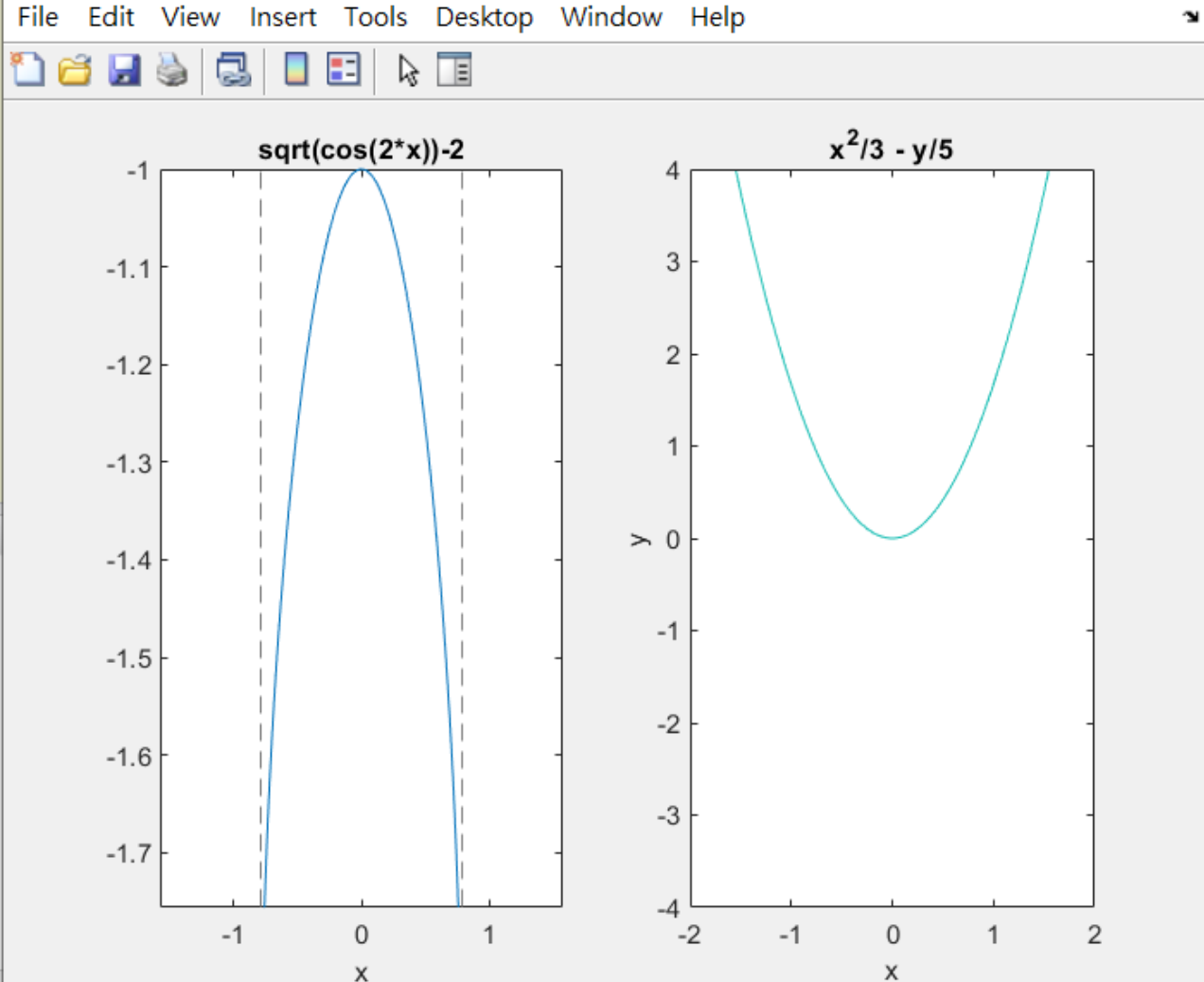
x_value =

2
3

$$x_value = \begin{bmatrix} 2 \\ 3 \end{bmatrix} \Rightarrow x_1 = 2, x_2 = 3$$

Exercise 4 – Plot equations

```
%%  
%plot equations  
subplot(1,2,1) % column:1 /row:2 /figure location: 1  
fplot(@(x) sqrt(cos(2*x))-2,[-pi/2, pi/2]) %ezplot(fun2,[xmin,xymax])  
title('sqrt(cos(2*x))-2');  
xlabel('x');  
  
subplot(1,2,2) % column:1 /row:2 /figure location: 2  
syms x y  
ezplot((x.^2/3) - (y./5), [-2, 2, -4, 4]) %ezplot(fun,[xmin,xmax,ymin,ymax])
```

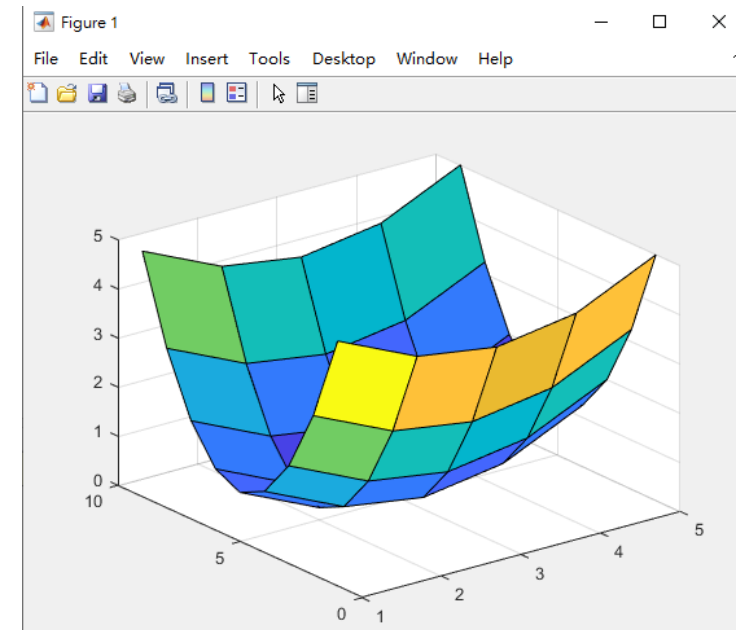


Eq1: $y = \sqrt{\cos(2x)} - 2, x \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

Eq2: $f(x, y) = \frac{x^2}{3} - \frac{y}{5}, (-2 \leq x \leq 2, -4 \leq y \leq 4)$

Plot $f(x,y)$

- `x = [-2:2]` % value x range
- `y = [-4:4]` % value y range
- `[xm ym] = meshgrid(x,y)` % meshgrid: 2-D and 3-D grids
- `fx = (xm.^2)/4 + ((ym.^2)/4)` % Your Function $fx = f(x,y)$
- `surf(fx)` % surf : Surface plot



Reference

- <https://www.tutorialspoint.com/matlab/index.htm>