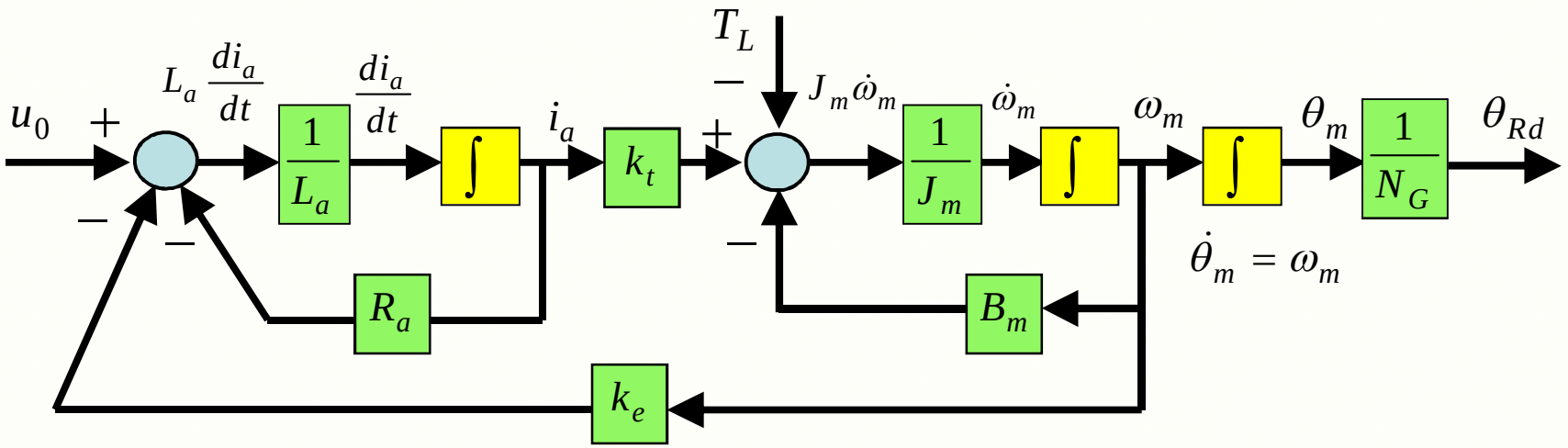
Engineering Softwares



Prof. Dr. İsmail H. Altaş

Karadeniz Teknik Üniversitesi
Elektrik-Elektronik Mühendisliği
61080 Trabzon

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Engineering Softwares

Chapter 1 – MATLAB Basics

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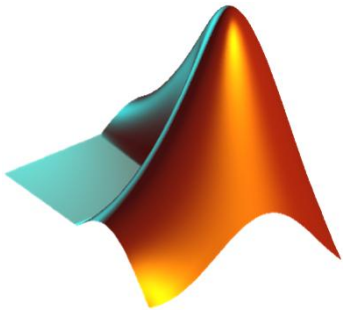
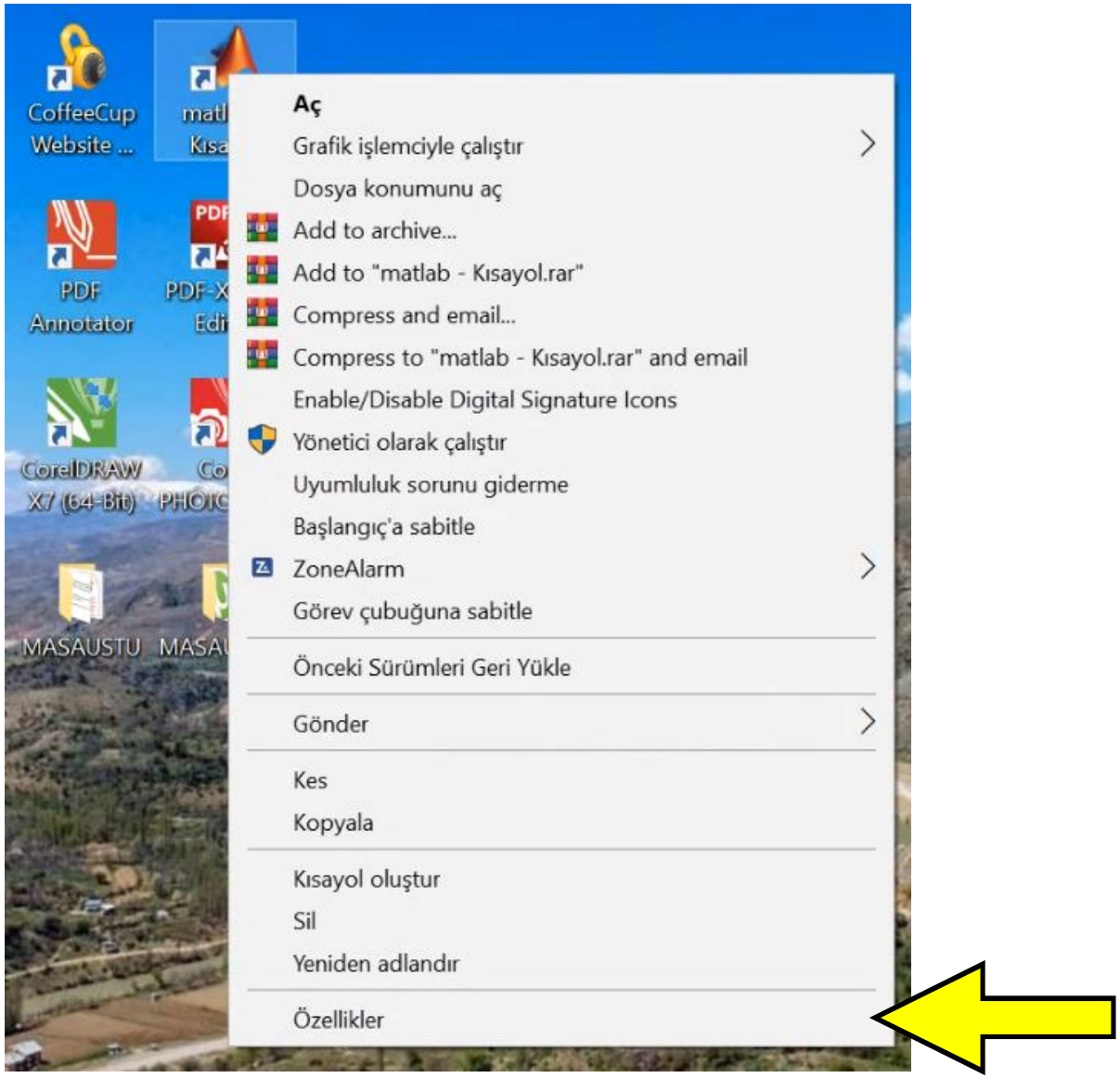


MATLAB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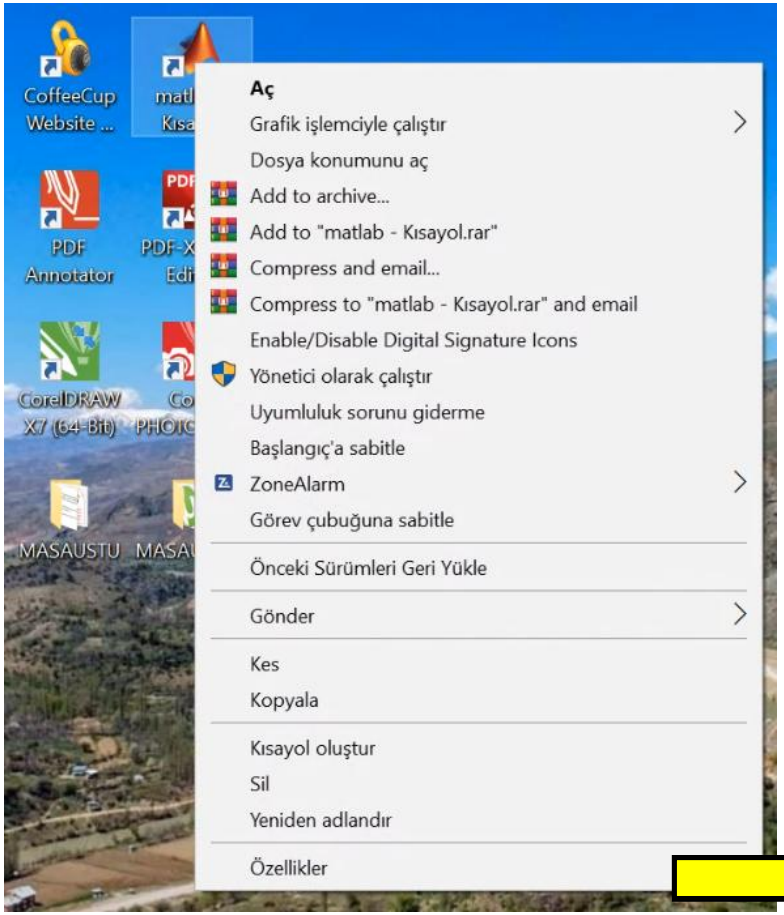
Özellikler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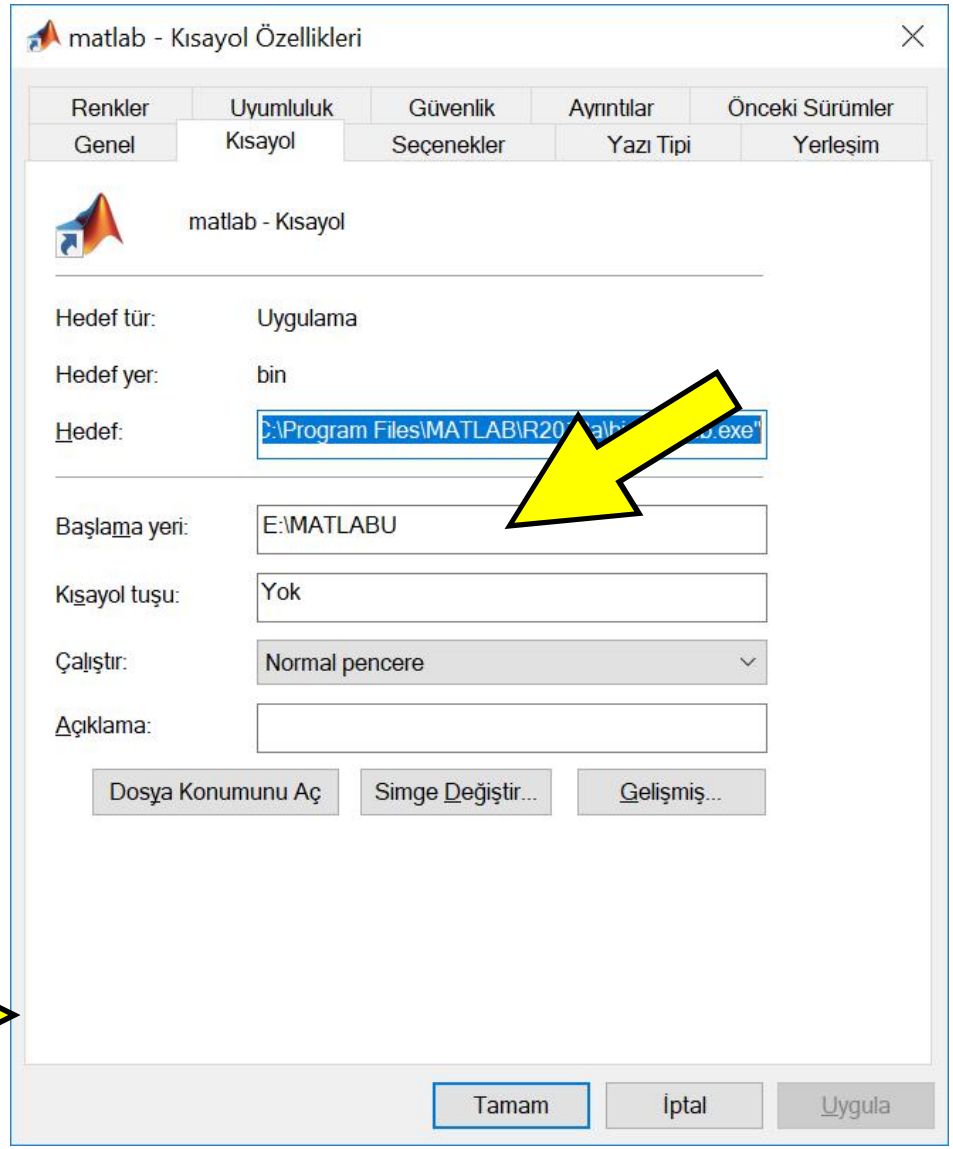
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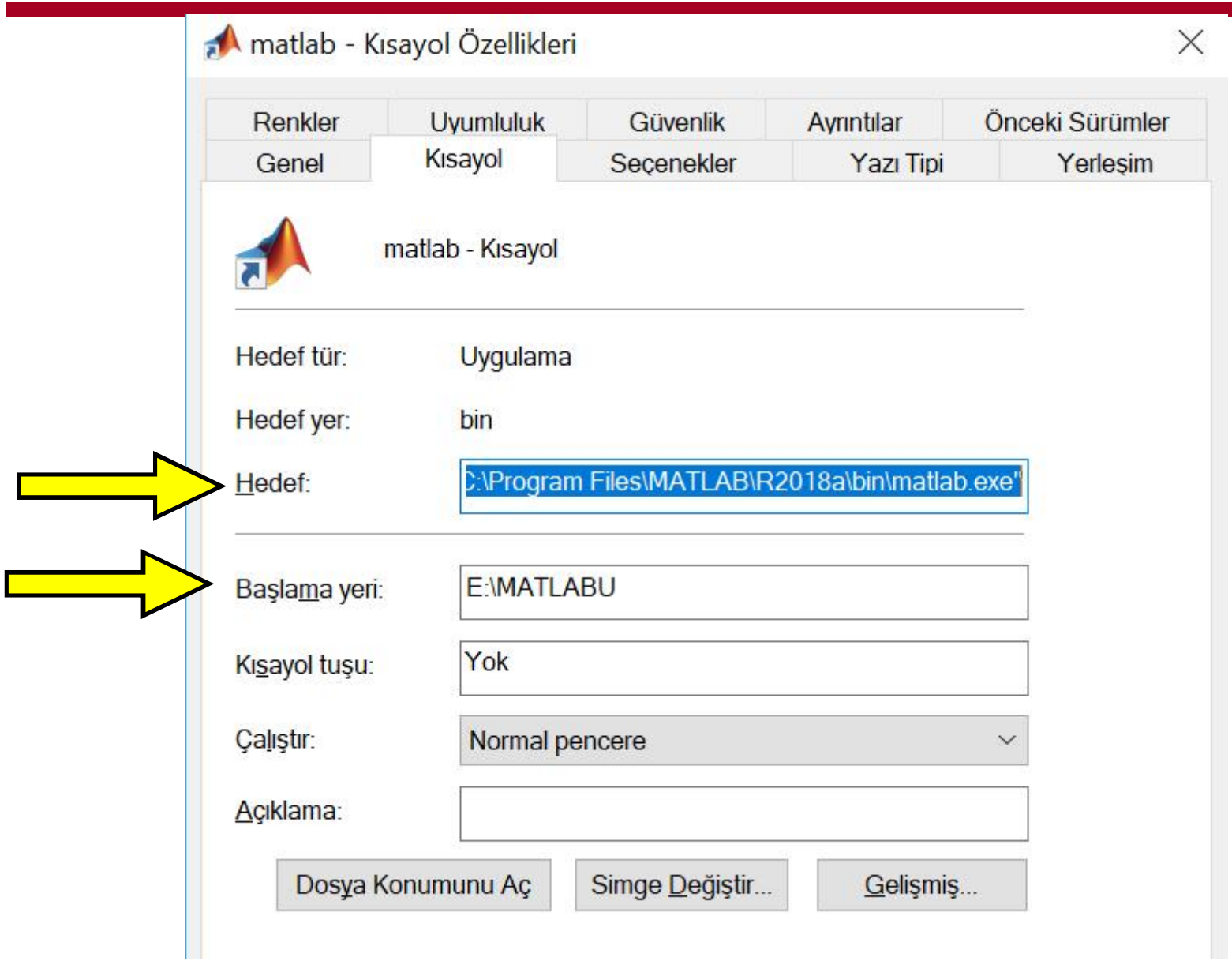
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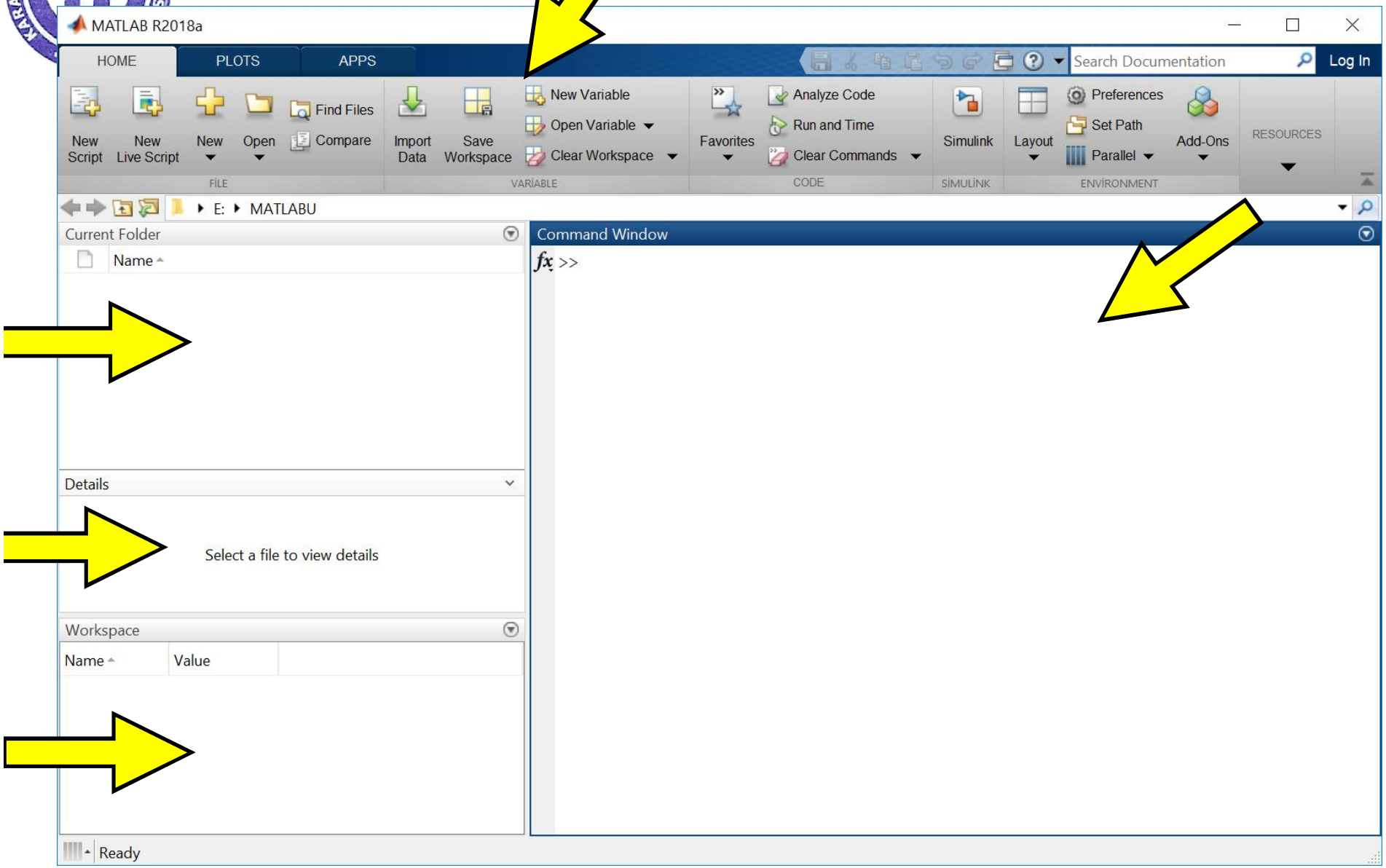
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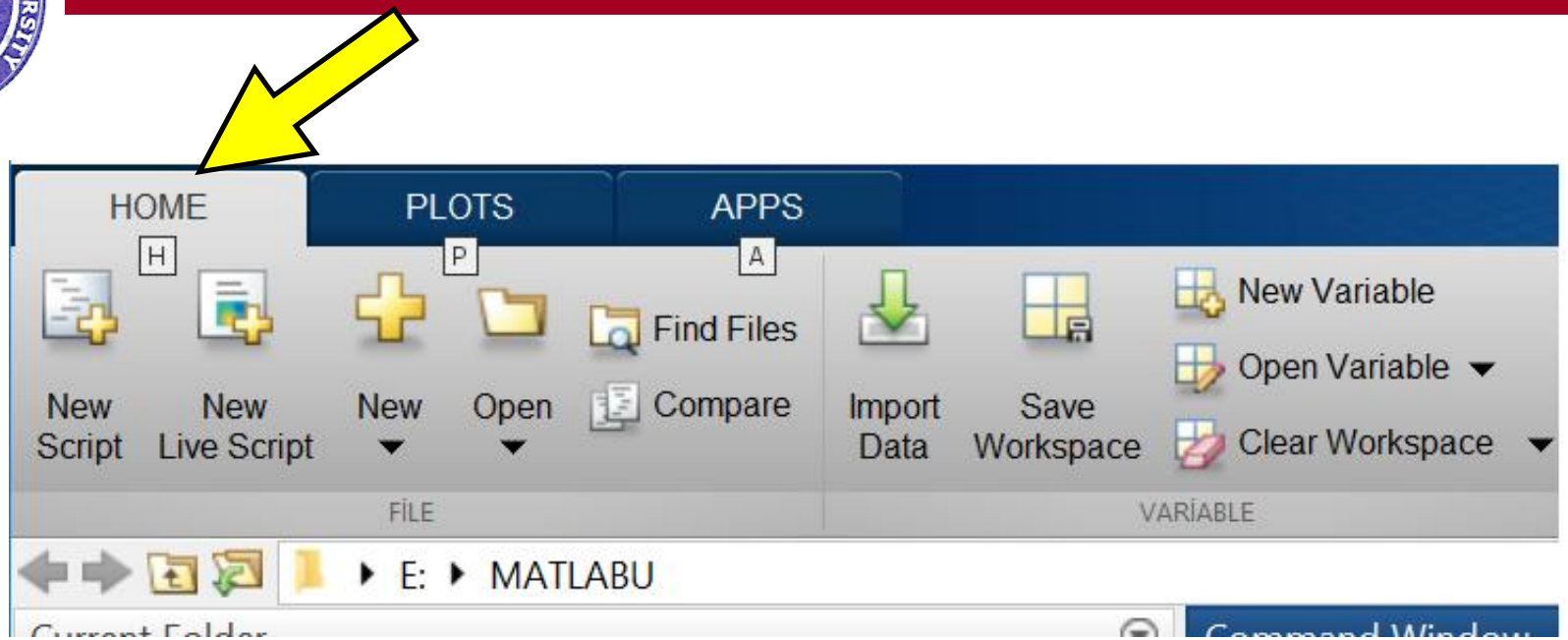
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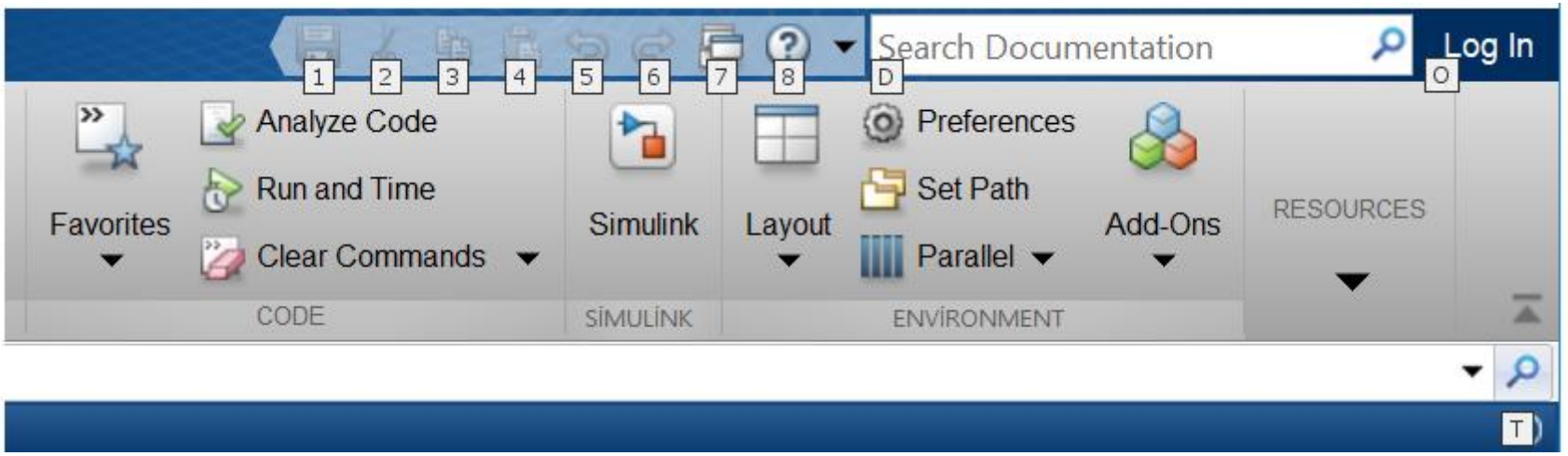
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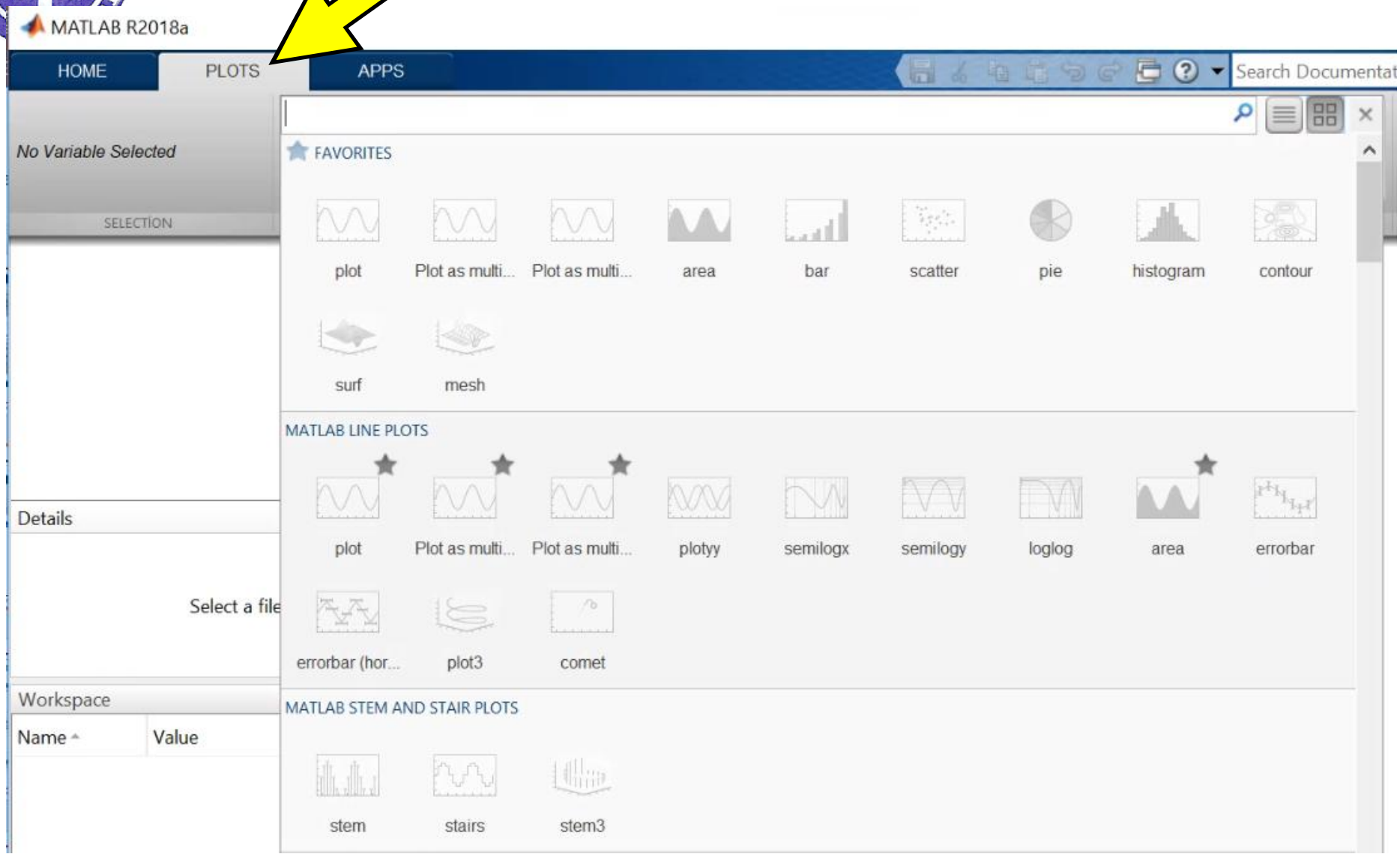
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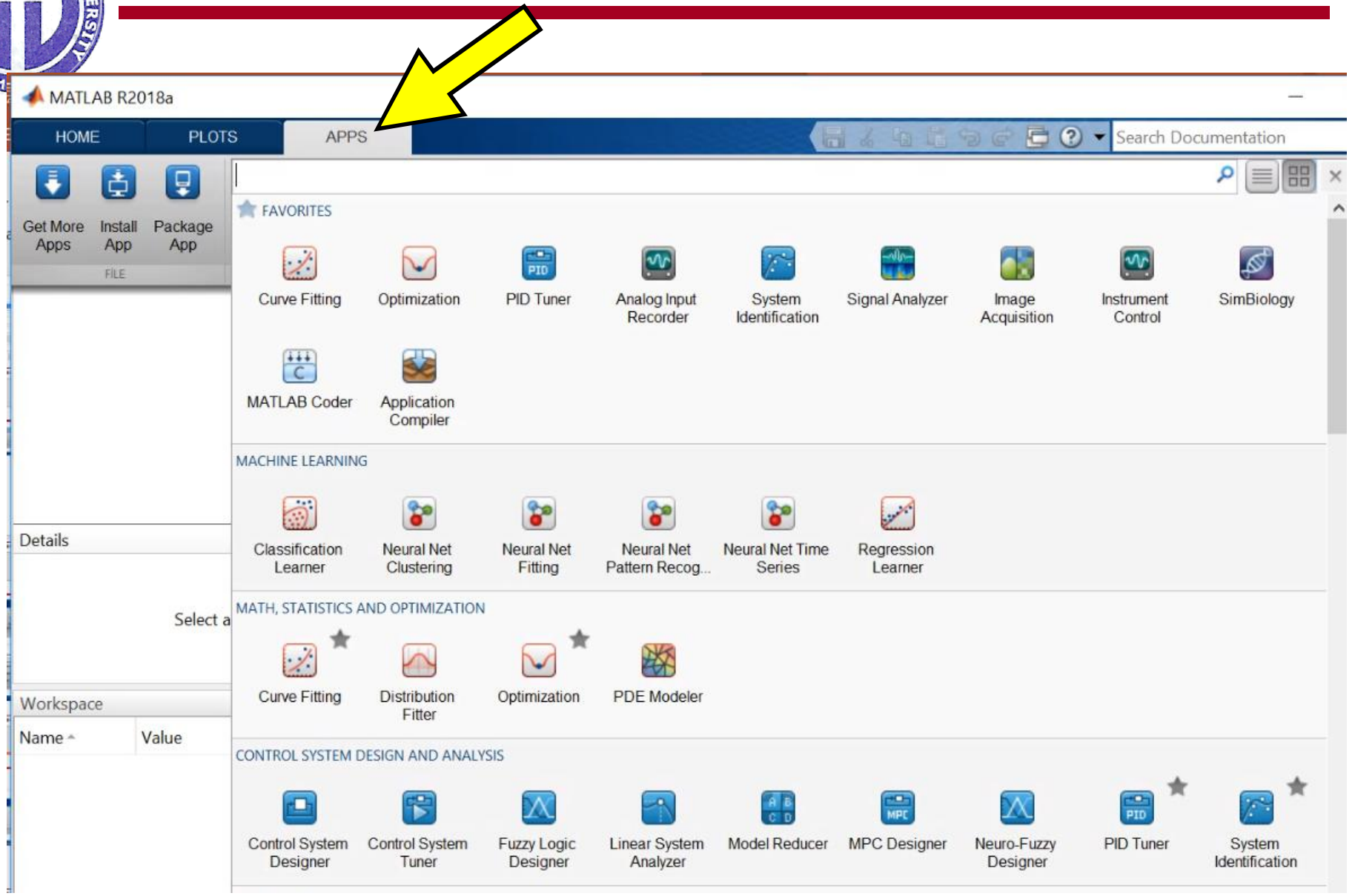
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Classification Learner
Neural Net Clustering
Neural Net Fitting
Neural Net Pattern Recog...
Neural Net Time Series
Regression Learner
MATH, STATISTICS AND OPTIMIZATION
Curve Fitting
Distribution Fitter
Optimization
PDE Modeler
CONTROL SYSTEM DESIGN AND ANALYSIS
Control System Designer
Control System Tuner
Fuzzy Logic Designer
Linear System Analyzer
Model Reducer
MPC Designer
Neuro-Fuzzy Designer
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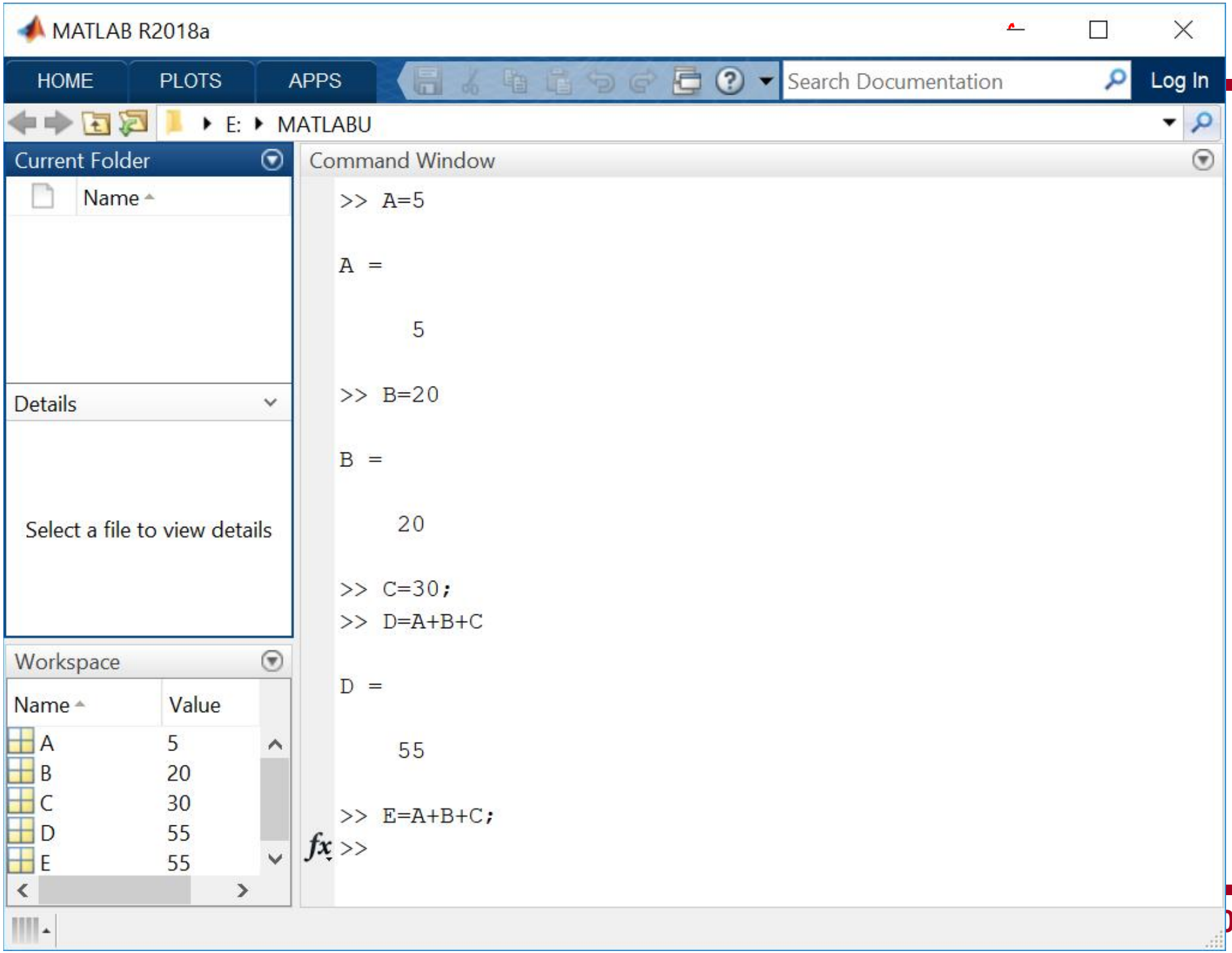
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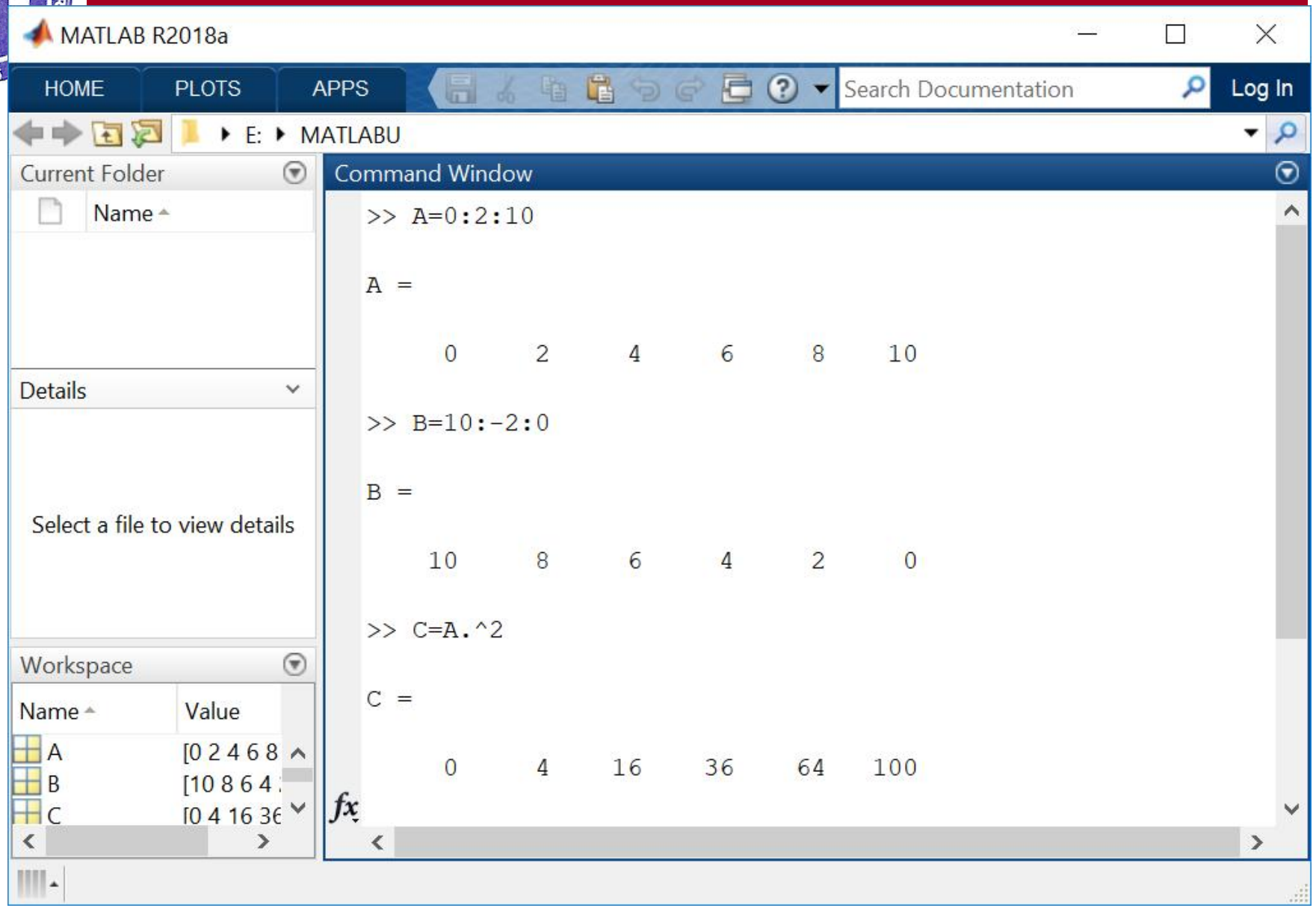
A 5
B 20
C 30
D 55
E 55
Command Window
>> A=5
A =
5
>> B=20
B =
20
>> C=30;
>> D=A+B+C
D =
55
>> E=A+B+C;
>>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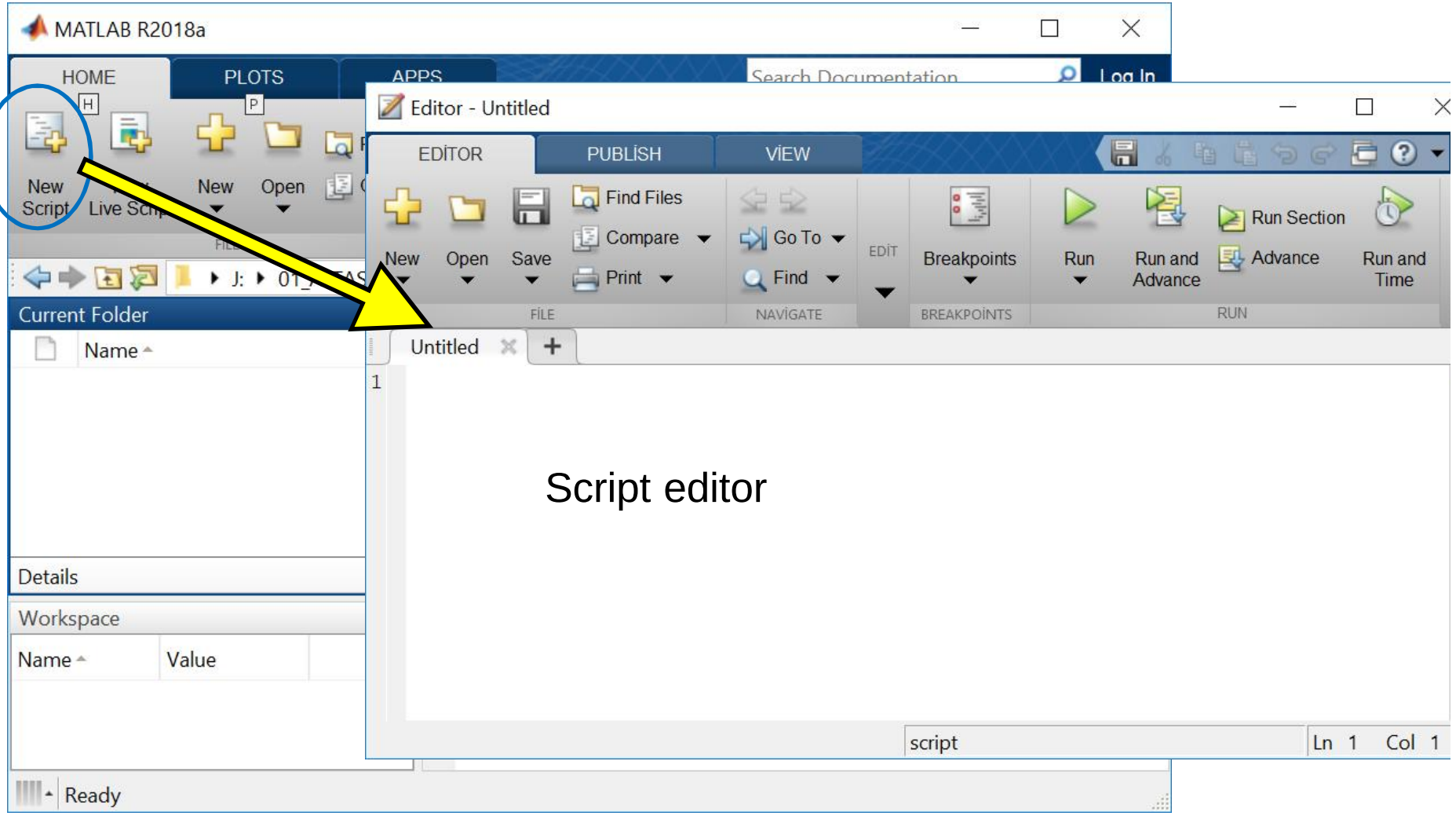
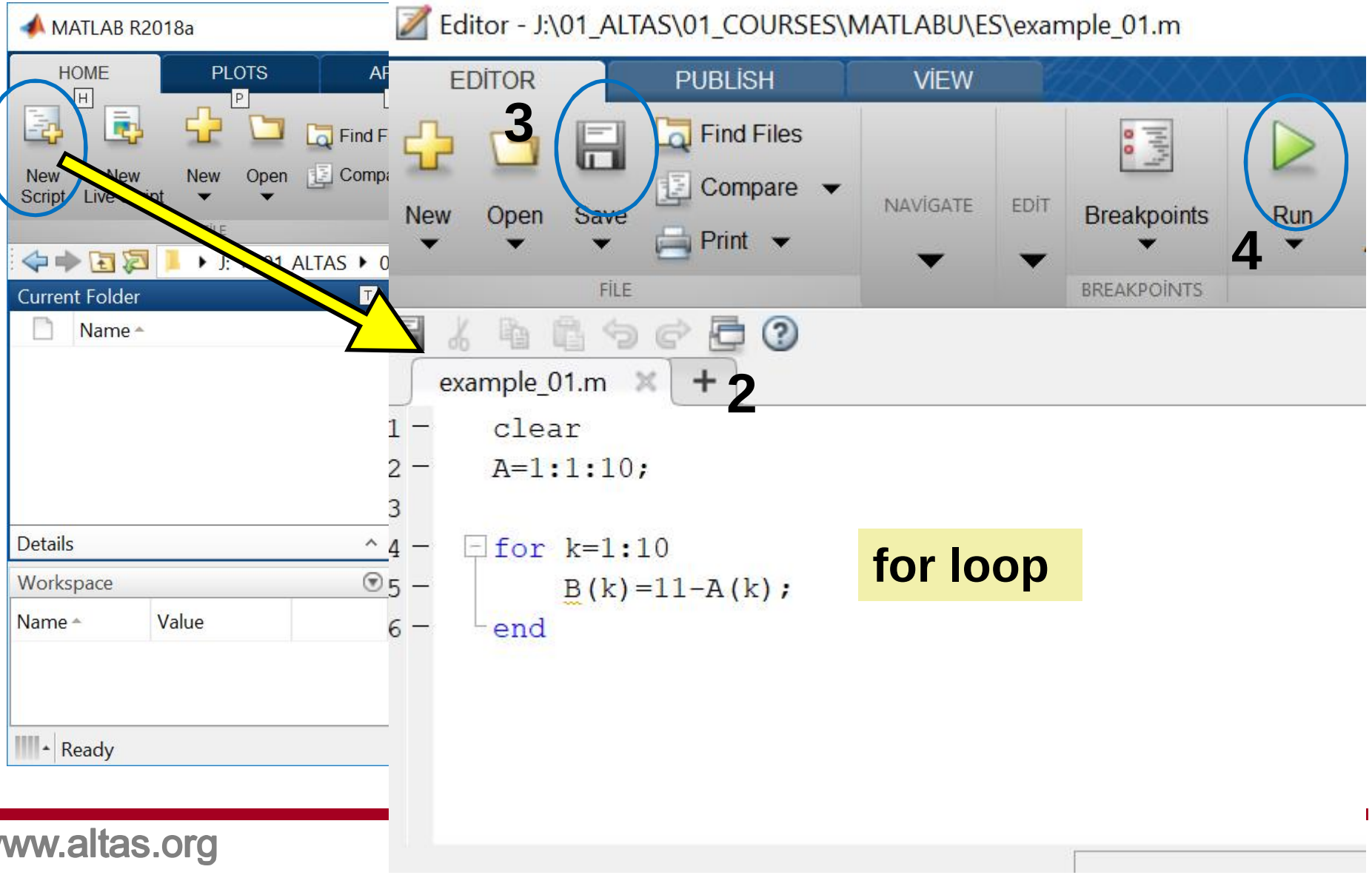
A
[0 2 4 6 8
B
[10 8 6 4
C
[0 4 16 36
Command Window
>> A=0:2:10
A =
0 2 4 6 8 10
>> B=10:-2:0
B =
10 8 6 4 2 0
>> C=A.^2
C =
0 4 16 36 64 100

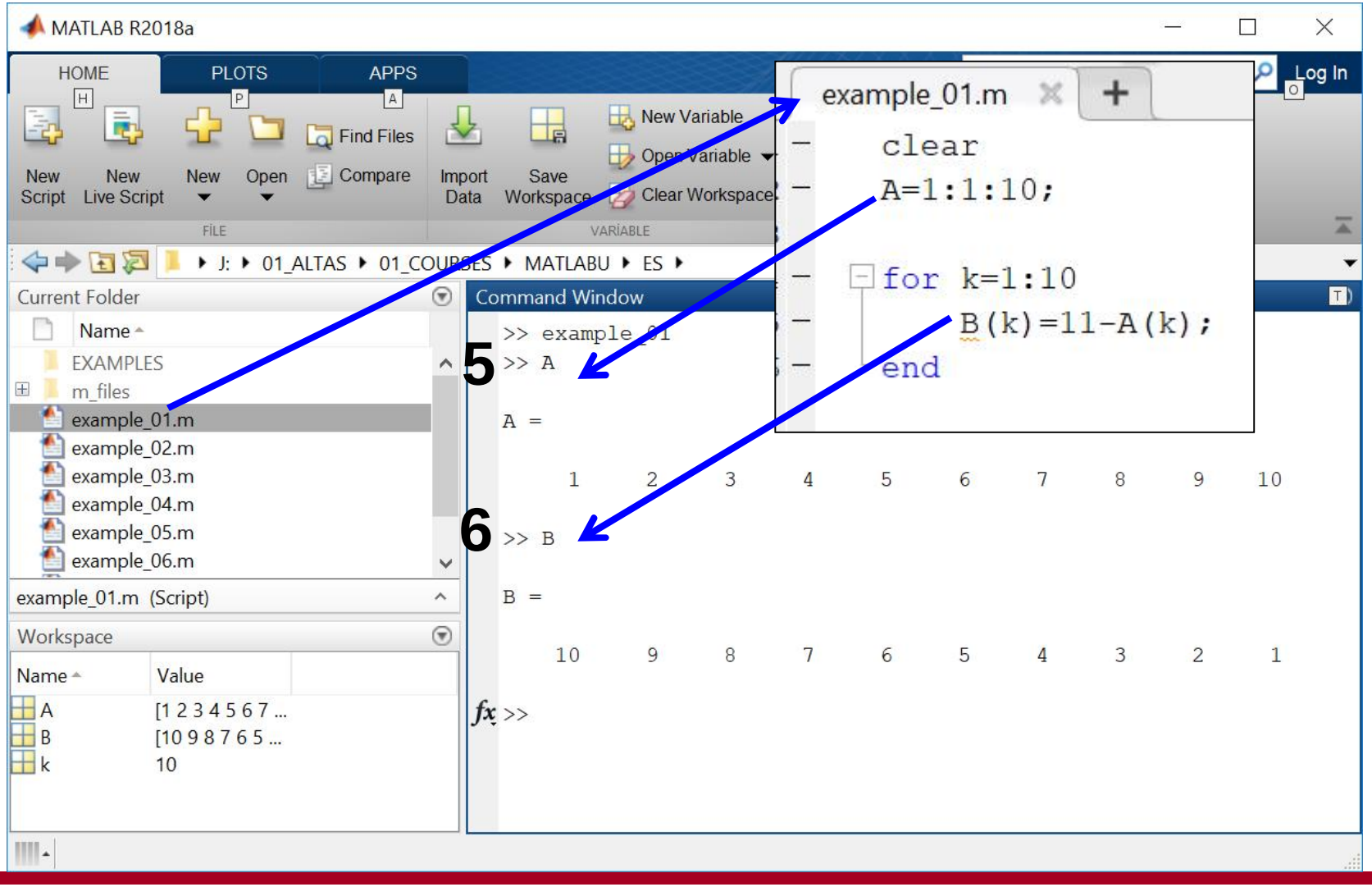
Writing codes with script editor



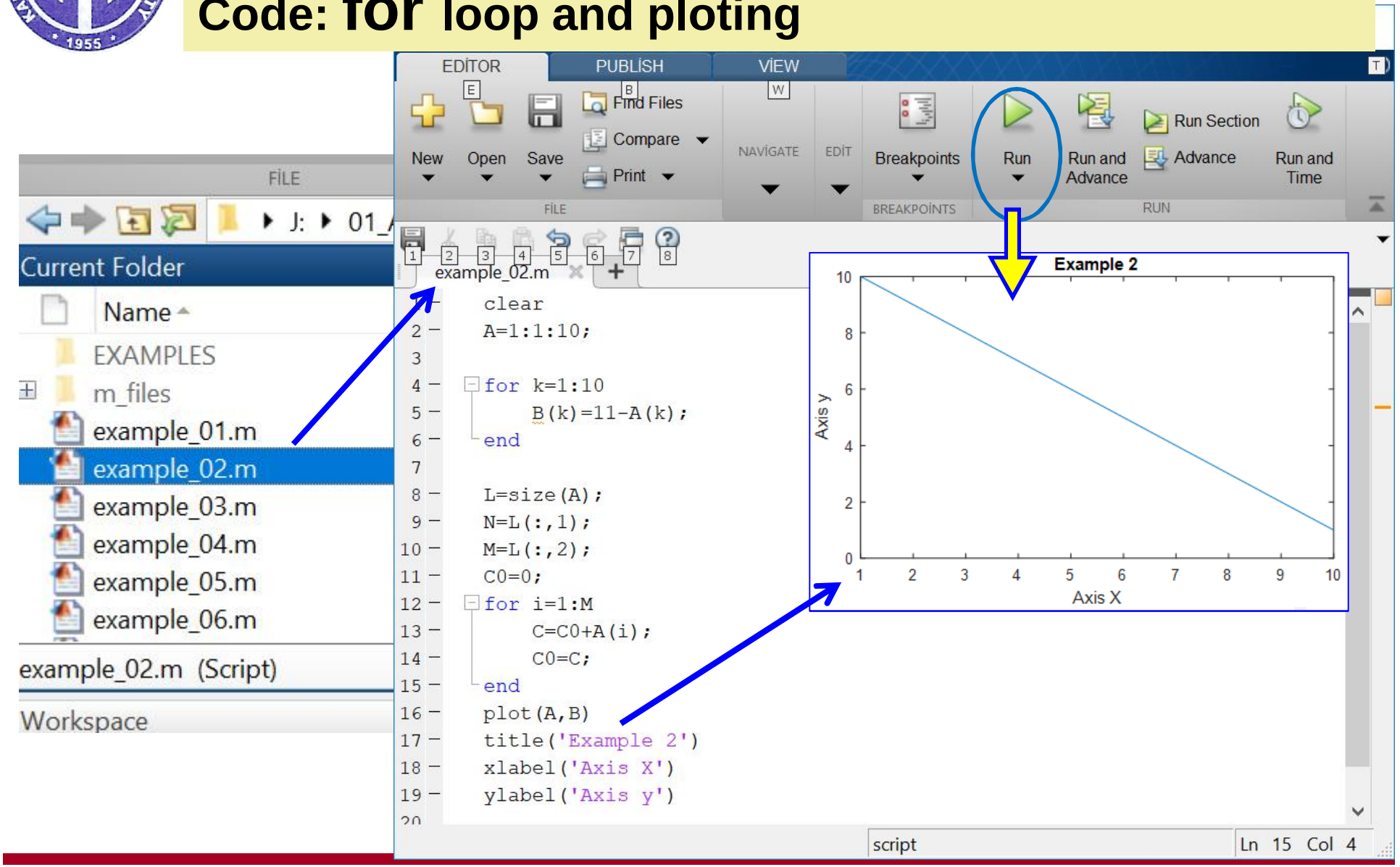
Code: for loop



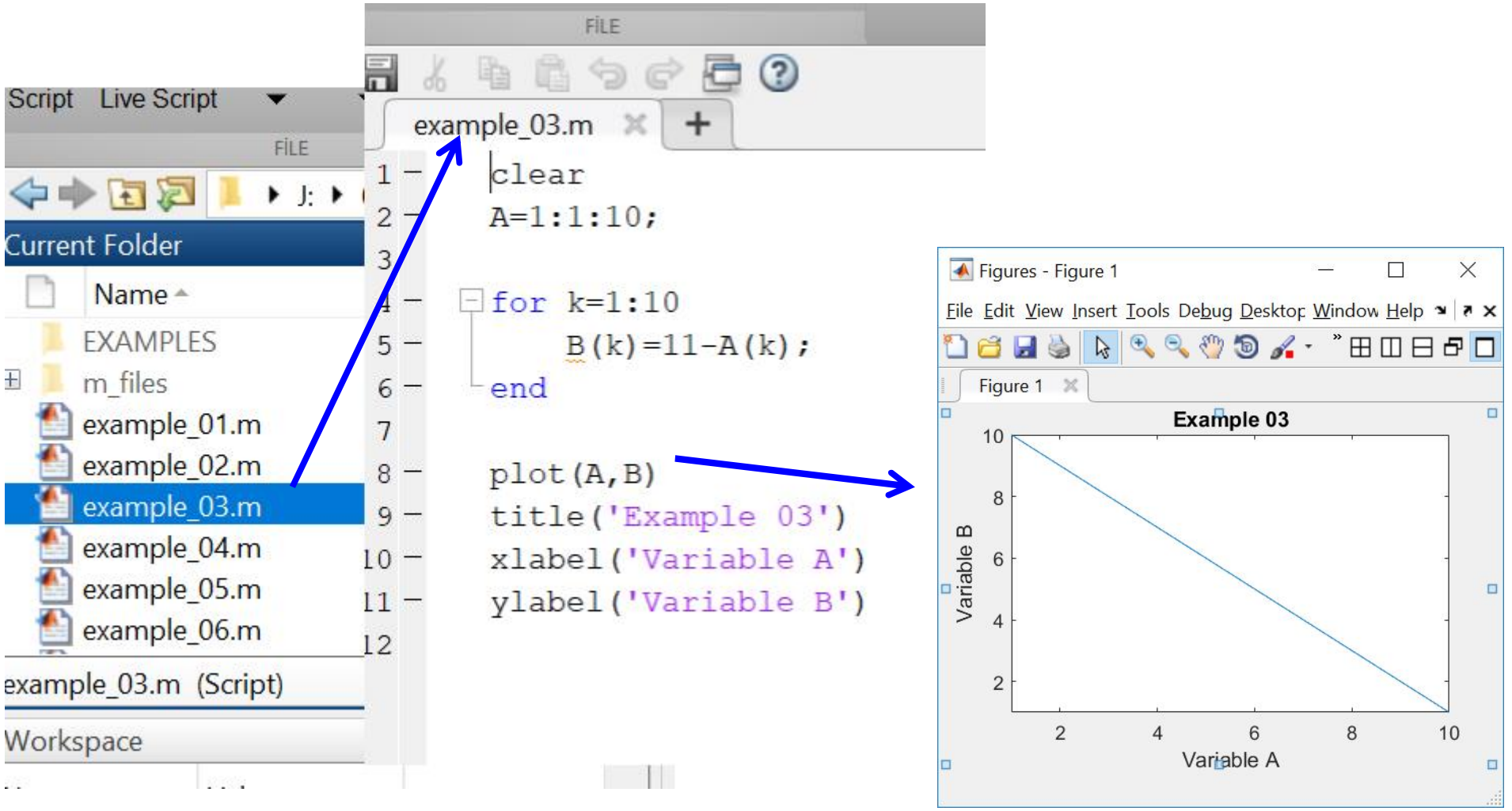
Code: for loop and data generation



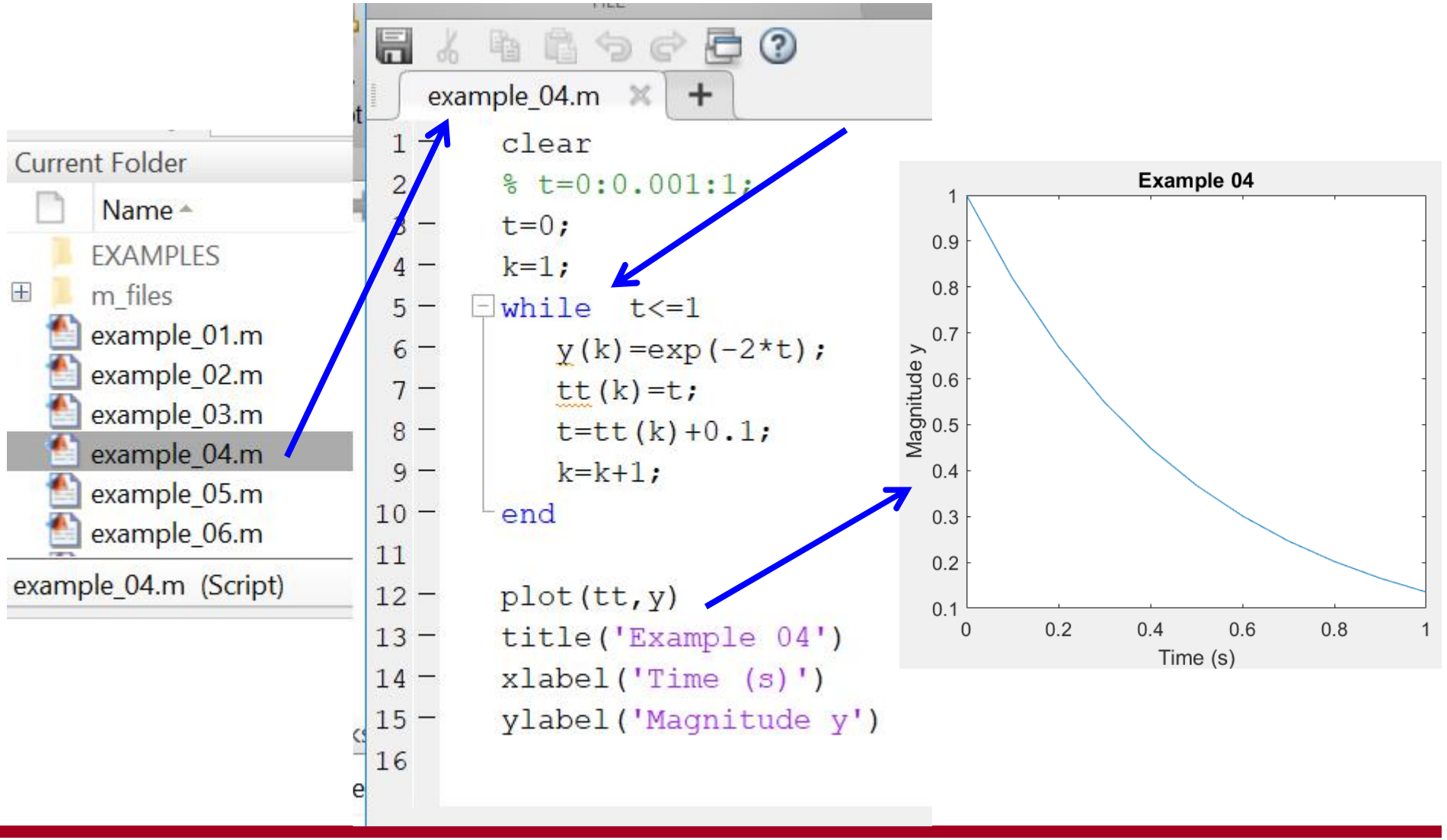
Code: for loop and ploting



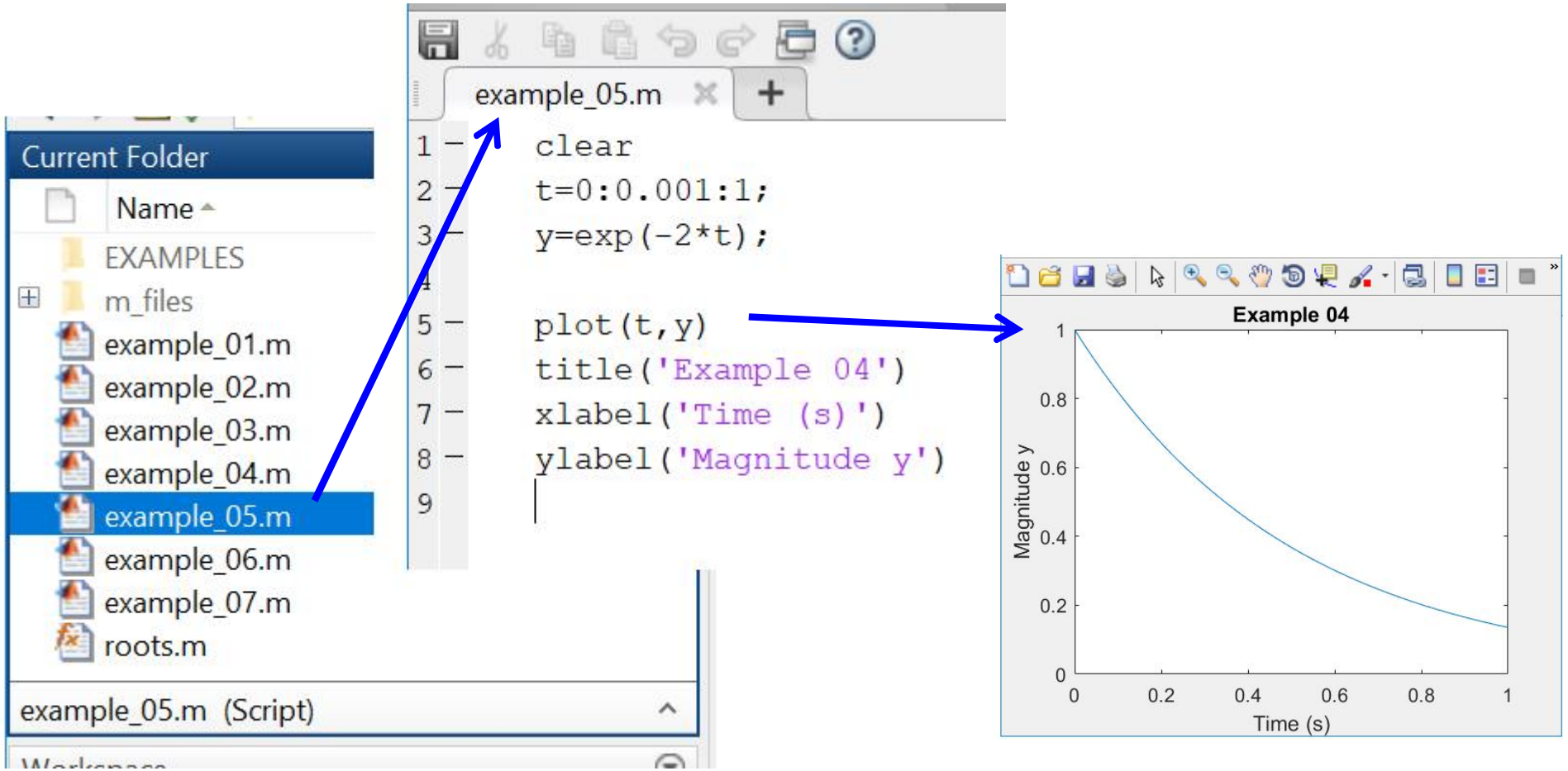
Code: for loop and ploting



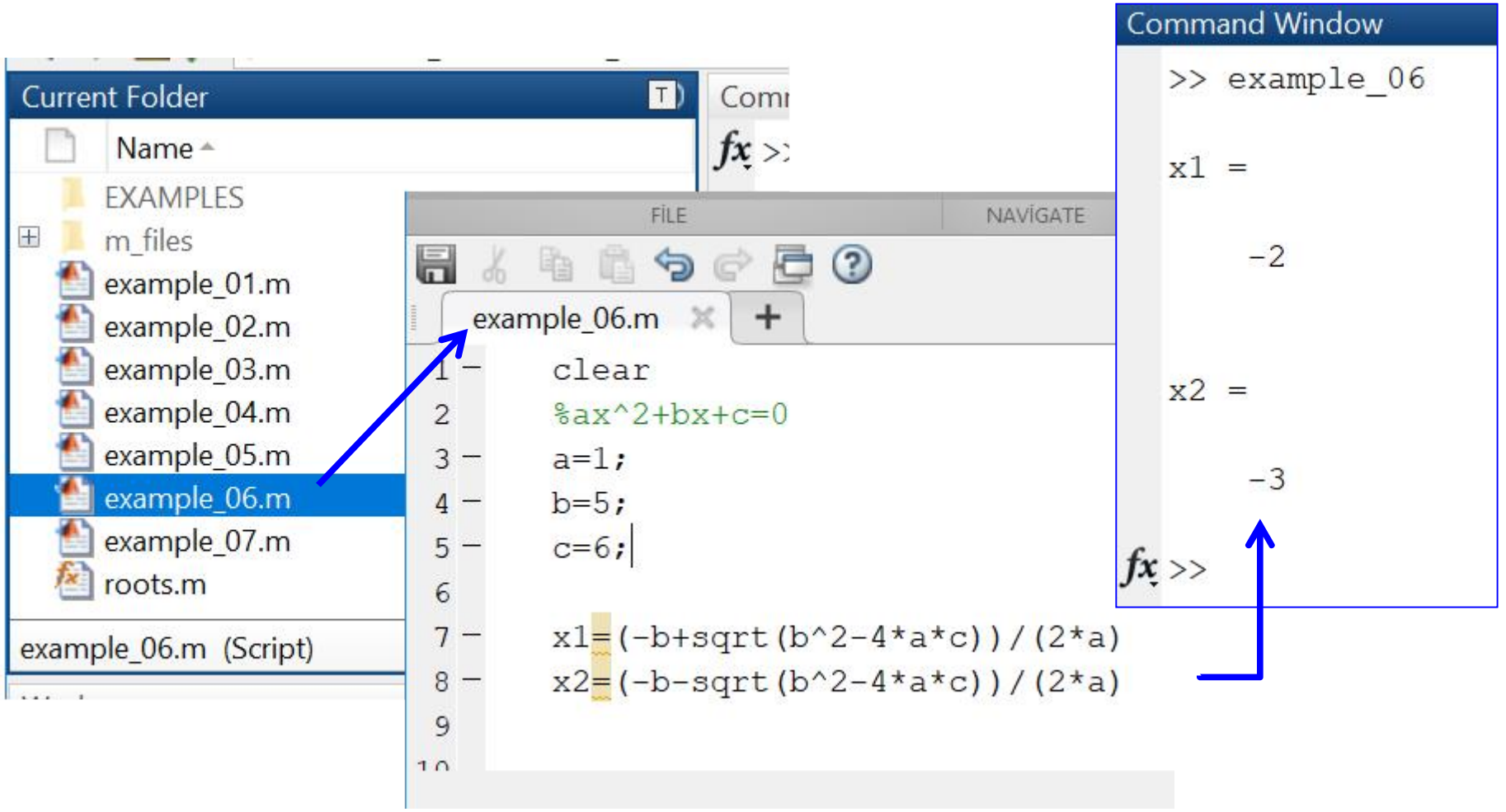
Code: while loop and ploting



Generating data without loops and ploting



Processing equations



Working with functions

roots.m

```
1   function X=roots(a,b,c)
2 -   x1=(-b+sqrt(b^2-4*a*c))/(2*a);
3 -   x2=(-b-sqrt(b^2-4*a*c))/(2*a);
4 -   X=[x1;x2]
5
```

Command Window

```
>> % 5X^2 +3X-7=0
>> X1X2=roots(5,3,-7)

X1X2 =

    0.9207
   -1.5207

>> % X^2 +10X+25=0
>> X1X2=roots(1,10,25)

X1X2 =

    -5
    -5

fx >>
```

Working with functions

Examples

Command Window

```
>> % X^2 +9X+20=0
>> X1X2=roots(1,9,20)

X1X2 =

    -4
    -5

fx >>
```

Command Window

```
>> % X^2 +6X+9=0
>> X1X2=roots(1,6,9)

X1X2 =

    -3
    -3
```

```
>> % X^2 +3X+9=0
>> X1X2=roots(1,3,9)

X1X2 =

  -1.5000 + 2.5981i
  -1.5000 - 2.5981i
```

EXAMPLE

Write a Matlab function to calculate equavalent value of **parallel** connected resistances.
PS: Resistance values will be entered as avector as below
R=[R1 R2 R3 …….. Rn]

```
function RT = paralelnr(R)
% R: paralel baðlý direnç deðerlerinden oluþan vektör
%    Bu vektörün sayýsal olarak önceden oluþturulmasý
%    gerekir
n=length(R);
RTOP1=0;
for i=1:n
   RTOP1=RTOP1+(1/R(i));
end
RT=1/RTOP1;
```

EXAMPLE

Write a Matlab function to calculate equavalent value of **series** connected resistances.
PS: Resistance values will be entered as avector as below
R=[R1 R2 R3 …….. Rn]

```
function RT = serinr(R)
% R: Seri baðlý direnç deðerlerinden oluþan vektör
%    Bu vektörün sayýsal olarak önceden oluþturulmasý
%    gerekir
n=length(R);
RT1=0;
for i=1:n
   RT1=RT1+R(i);
end
RT=RT1;
```

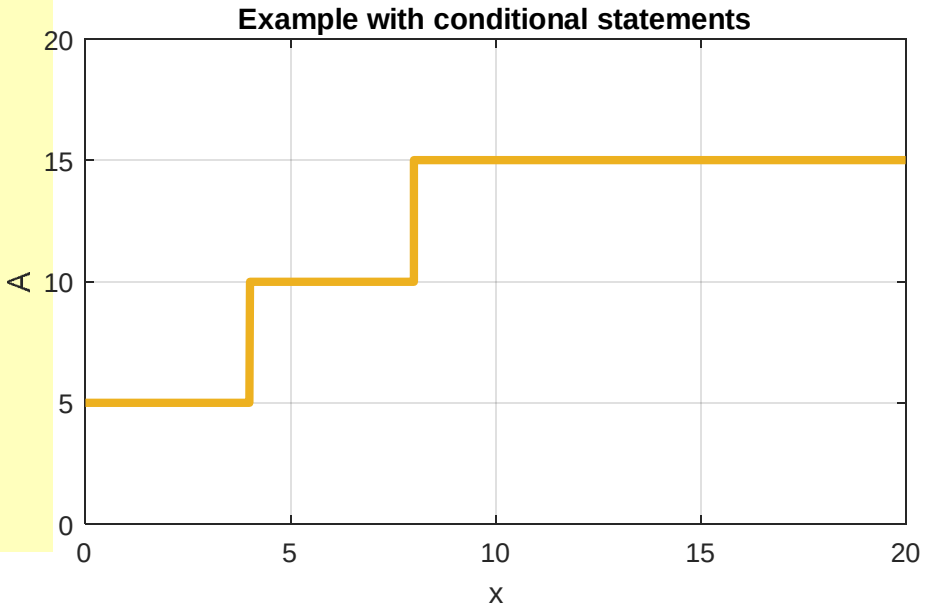
Conditional Statments

```
x=input('Enter x value ==>')

x1=4; x2=8; x3=12;

if x <= x1
       A=5
    elseif x<=x2
        A=10
    elseif x <= x3
        A=20
    else
        A =100
end
```

Conditional Statments

```
x1=4; x2=8; x3=12;
x=0; k=1;
while x <=20
    if x <= x1
       A(k)=5;
    elseif x <= x2
        A(k)=10;
     else
        A(k) =20;
    end
    xx(k)=x;
    x=x+0.01;
    k=k+1;
end
```

```
plot(0,25,xx,A)
title('Example with conditional
statements')
xlabel('x');  ylabel('A'); grid
```



Conditional Statments

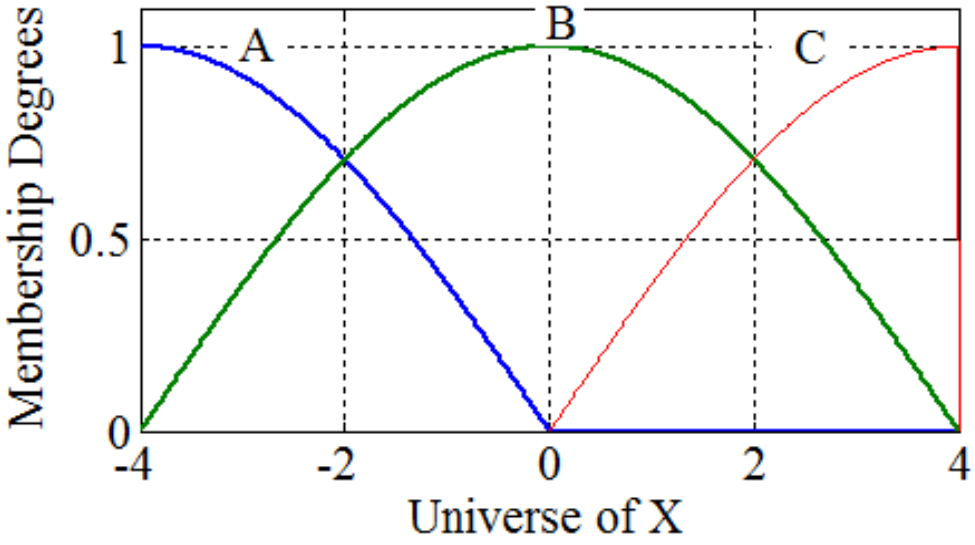
```
%   Inputs  X, n and  x1, x2 and x
clear;  clc;   clf
n=3; x1=-4; x2=-x1; X=x2-x1;
a=X/(n-1); b=(X/2)-a;
for m=1:n
   XP(m)=x1+a*(m-1);
end
XPA=XP(1); XPB=XP(2); XPC=XP(3);
A1=(b*pi)/(2*a);  A2=A1+(pi/2);
k=1;
```

```
function mu=sinus01m(a,A,t)
        T=4*a;
        w1=(2*pi/T);
        mu=abs(sin(w1*t+A));
```

```
for x=x1:0.01:x2;
   if x<XPA
      SA(k)=0; SB(k)=0; SC(k)=0;
    elseif x<XPB
       SA(k)=sinus01m(a,A1,x);
       SB(k)=sinus01m(a,A2,x);
       SC(k)=0;
    elseif x<XPC
       SA(k)=0;
       SB(k)=sinus01m(a,A2,x);
       SC(k)=sinus01m(a,A1,x);
    else
       SA(k)=0; SB(k)=0; SC(k)=0;
    end
    X(k)=x;  k=k+1;
end
```

Conditional Statments

```
plot(X,SA,X,SB,X,SC);
xlabel('Universe of X');
ylabel('Membership Degrees');
grid
```



Matrices and Arrays

Array Creation

To create an array with four elements in a single row, separate the elements with either a comma (,) or a space.

```
a = [1 2 3 4]
```

```
a =
1 2 3 4
```

This type of array is a *row vector*.

Matrices and Arrays

Array Creation

To create a matrix that has multiple rows, separate the rows with semicolons.

```
a = [1 2 3; 4 5 6; 7 8 10]
```

```
a =
1     2     3
4     5     6
7     8    10
```

```
b = 10+a
```

```
b=
11    12    13
14    15    16
17    18    20
```

Another way to create a matrix is to use a function, such as ones, zeros, or rand. For example, create a 5-by-1 column vector of zeros.

```
z = zeros(4,1)
```

```
z =
0
0
0
0
```

Matrices and Arrays

To **transpose** a matrix, use a single quote (’):

```
a =
     1     2     3
     4     5     6
     7     8    10
```

```
c = a’
```

```
>> c
ans =
     1     4     7
     2     5     8
     3     6    10
```

Inverse of a matrix

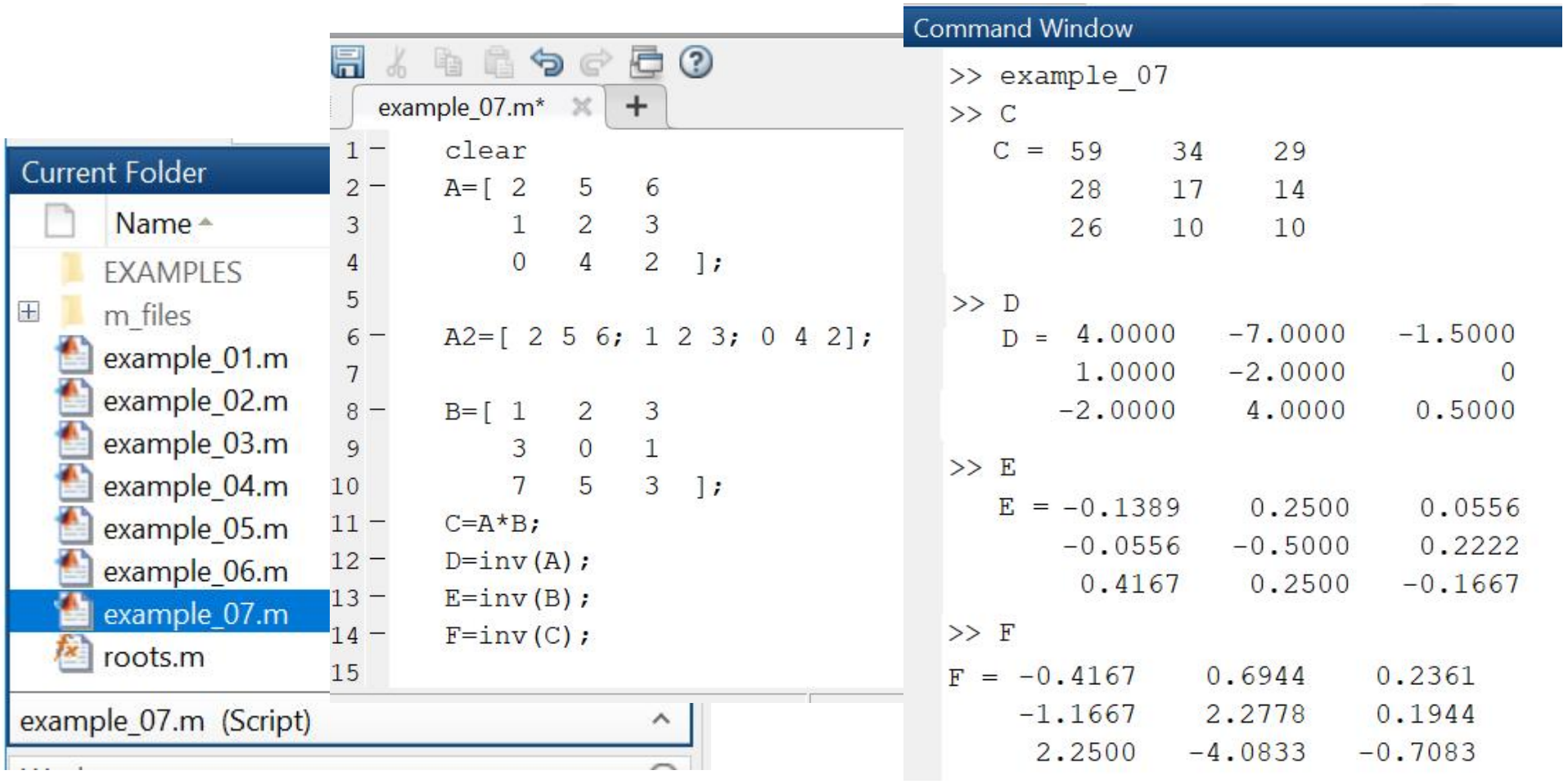
```
d= inv(a)
```

```
d =

   -0.6667   -1.3333    1.0000
   -0.6667    3.6667   -2.0000
    1.0000   -2.0000    1.0000
```

```
E= a*inv(a)
```

```
E =

    1.0000   -0.0000   -0.0000
    0.0000    1.0000   -0.0000
    0.0000   -0.0000    1.0000
```

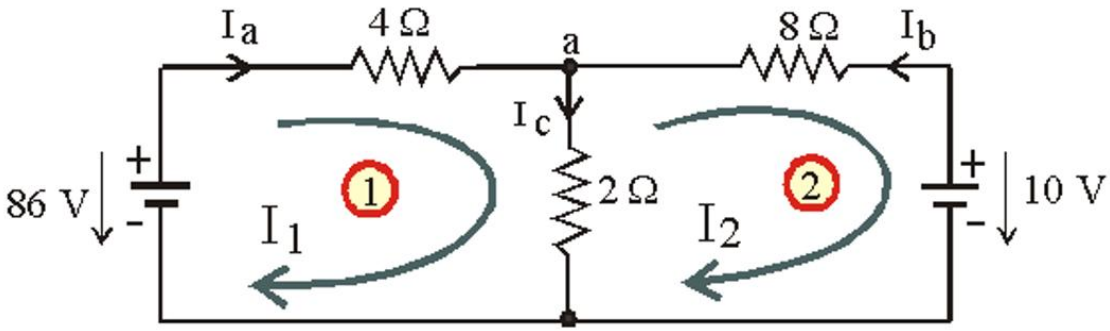
Matrices and Arrays



Matrices and Arrays

EXAMPLE

Use matrix operations in Matlab and dbtain the loop currents in circuit given below



Prepare the formulas from figure

$$\begin{bmatrix} -86 \\ 10 \end{bmatrix} + \begin{bmatrix} 4+2 & -2 \\ -2 & 8+2 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = 0$$

$$\begin{bmatrix} 86 \\ -10 \end{bmatrix} = \begin{bmatrix} 4+2 & -2 \\ -2 & 8+2 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

$$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 4+2 & -2 \\ -2 & 8+2 \end{bmatrix}^{-1} \begin{bmatrix} 86 \\ -10 \end{bmatrix}$$

```
E=[86; -10];
R=[6  -2; 2  10];
I=inv(R)*E

I=
15.0000
2.0000
```

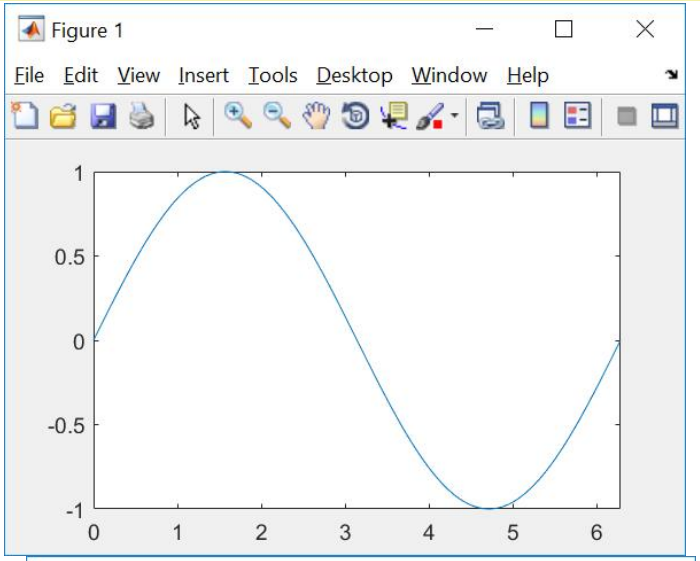
Command Window

```
>> E=[86; -10];
R=[6  -2; 2  10];
I=inv(R)*E

I =

   13.1250
   -3.6250

fx >>
```

Line Plots

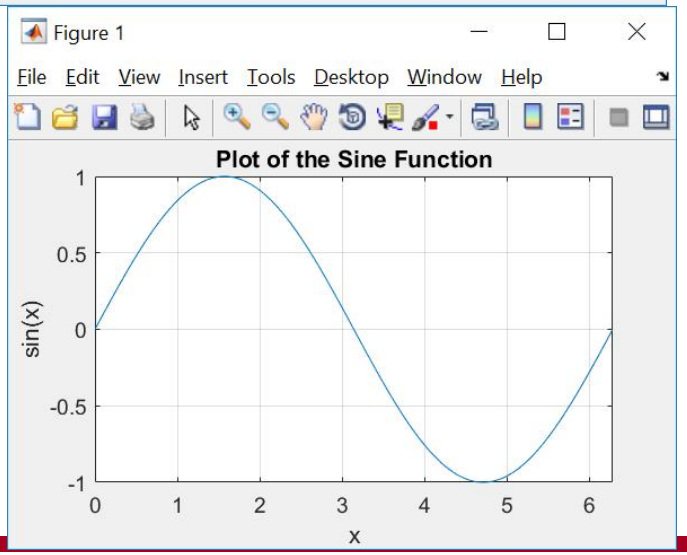
To create two-dimensional line plots, use the plot function. For example, plot the value of the sine function from 0 to 2π:

```
x = 0:pi/100:2*pi;
y = sin(x);
plot(x,y)
```



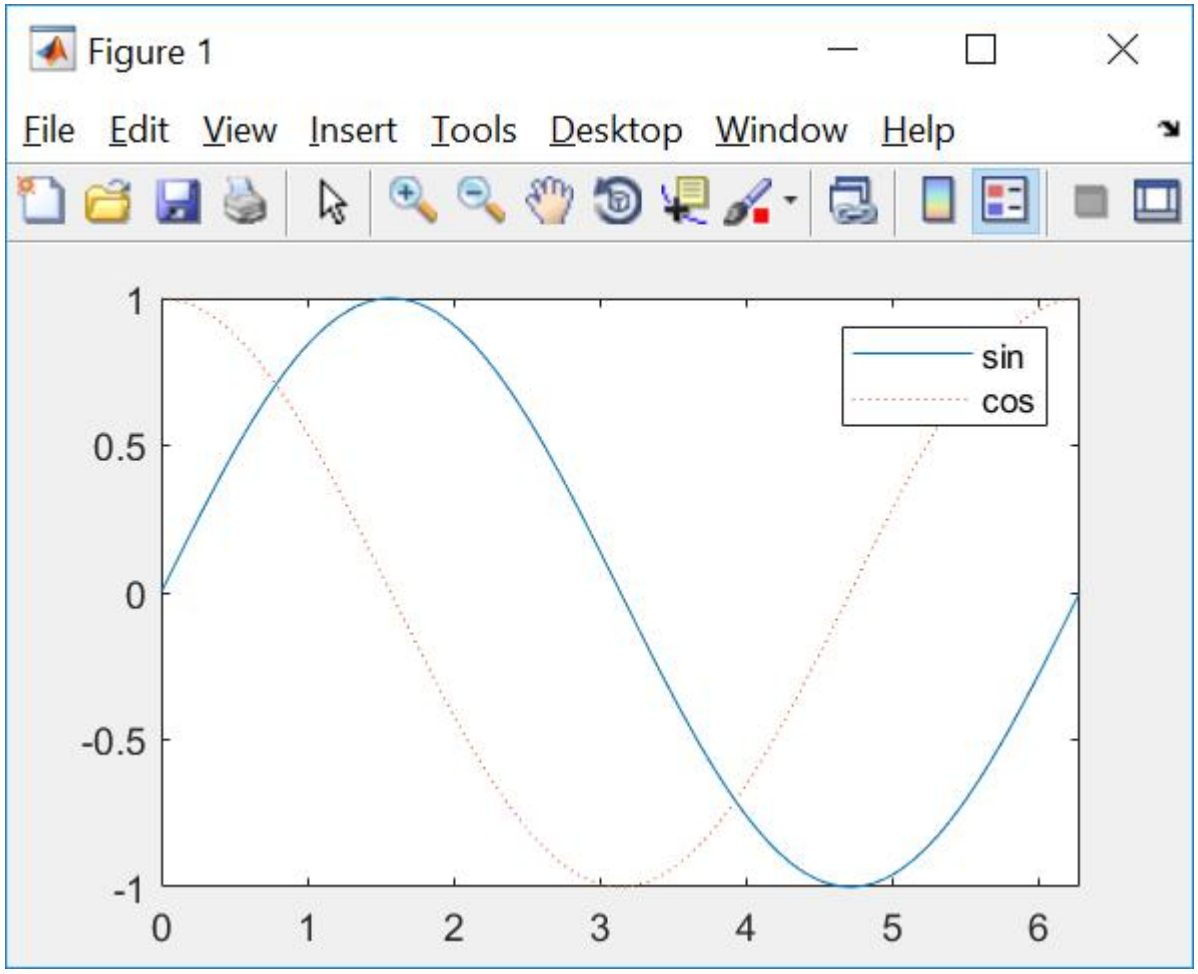
You can label the axes and add a title.

```
xlabel('x')
ylabel('sin(x)')
title('Plot of the Sine Function')
grid
```



Line Plots - Examples

```
x = 0:pi/100:2*pi;
y = sin(x); plot(x,y)

hold on
y2 = cos(x);
plot(x,y2,':')
legend('sin','cos')
hold off
```



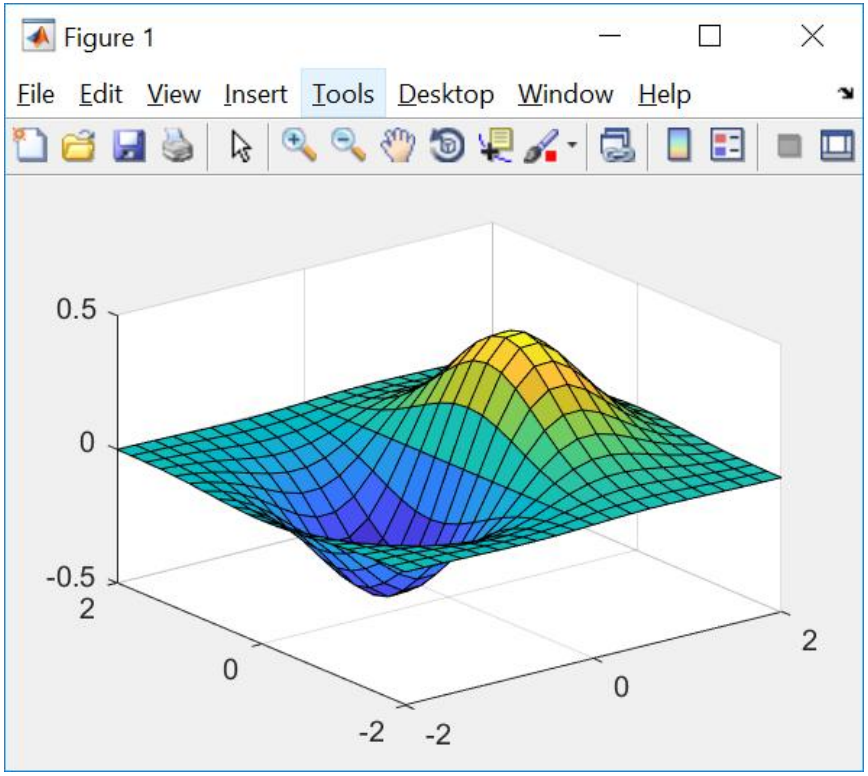
3-D Plots

Three-dimensional plots typically display a surface defined by a function in two variables, ***z = f(x,y)*** .

To evaluate *z*, first create a set of (*x*,*y*) points over the domain of the function using **meshgrid**.

```
[X,Y] = meshgrid(-2:.2:2);
Z = X .* exp(-X.^2 - Y.^2);
```

```
surf(X,Y,Z)
```



Subplots

You can display multiple plots in different subregions of the same window using the subplot function.

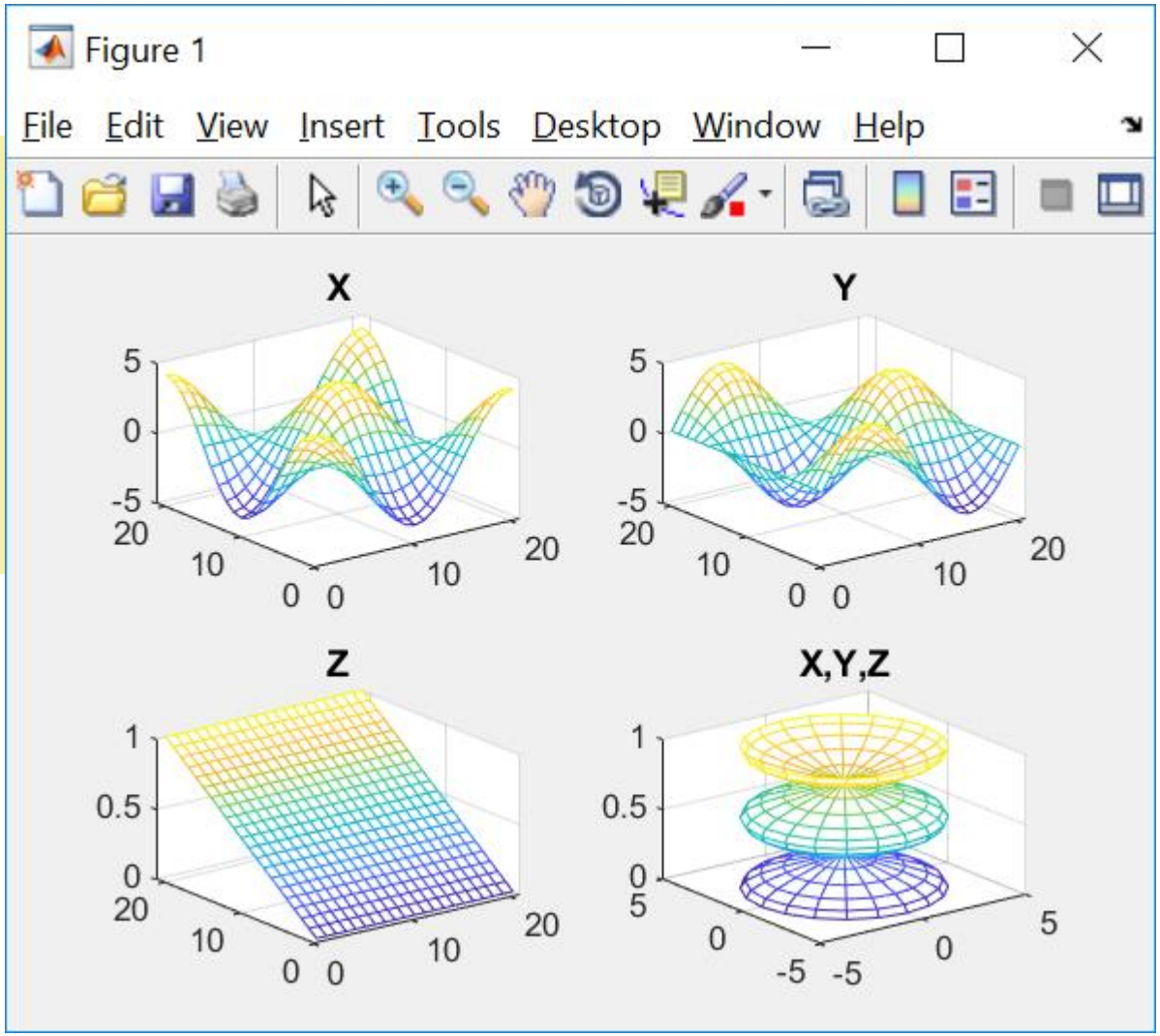
The first two inputs to subplot indicate the number of plots in each row and column. The third input specifies which plot is active. For example, create four plots in a 2-by-2 grid within a figure window.

```
t = 0:pi/10:2*pi;
[X,Y,Z] = cylinder(4*cos(t));

subplot(2,2,1);   mesh(X);          title('X');
subplot(2,2,2);   mesh(Y);          title('Y');
subplot(2,2,3);   mesh(Z);          title('Z');
subplot(2,2,4);    mesh(X,Y,Z);   title('X,Y,Z');
```

Subplots

```
t = 0:pi/10:2*pi;
[X,Y,Z] = cylinder(4*cos(t));

subplot(2,2,1);   mesh(X);
subplot(2,2,2);   mesh(Y);
subplot(2,2,3);   mesh(Z);
subplot(2,2,4);    mesh(X,Y,Z);
```

2,2,1	2,2,2
2,2,3	2,2,4



NEXT
Simulink Basics