



ME 444

MATLAB® FOR ENGINEERS

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CHAPTER 5

PROGRAMMING IN MATLAB (m-files)

The following procedures are generally followed in the creation of computer software:

- Description of the problem (What-Why)
- Determination of solution method and steps (algorithm, flowcharts or pseudo-code)
- Coding (Translation to programming language)
- Test (Run the program)
- Update

Programming in MATLAB is most commonly done in two ways:

- In-line programming
- programming with m-files (script-files)

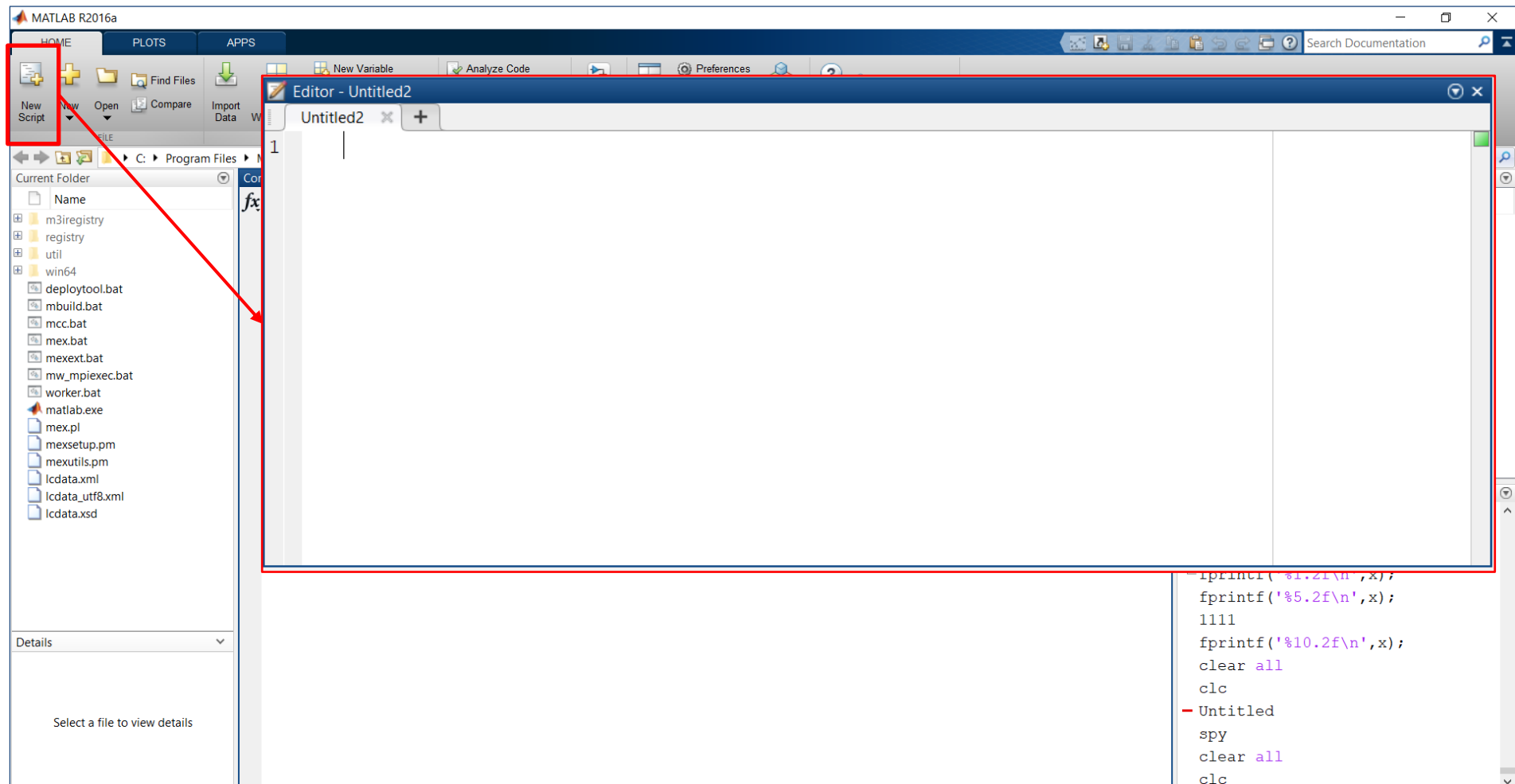
There are also two types of m-files:

- **Prose (script) m-files:** Script is the sum of commands MATLAB can execute in a row.
- **Function m-files:** These are new MATLAB functions specially produced for solving a specific problem. This topic will be covered in later lessons.

Programming in MATLAB

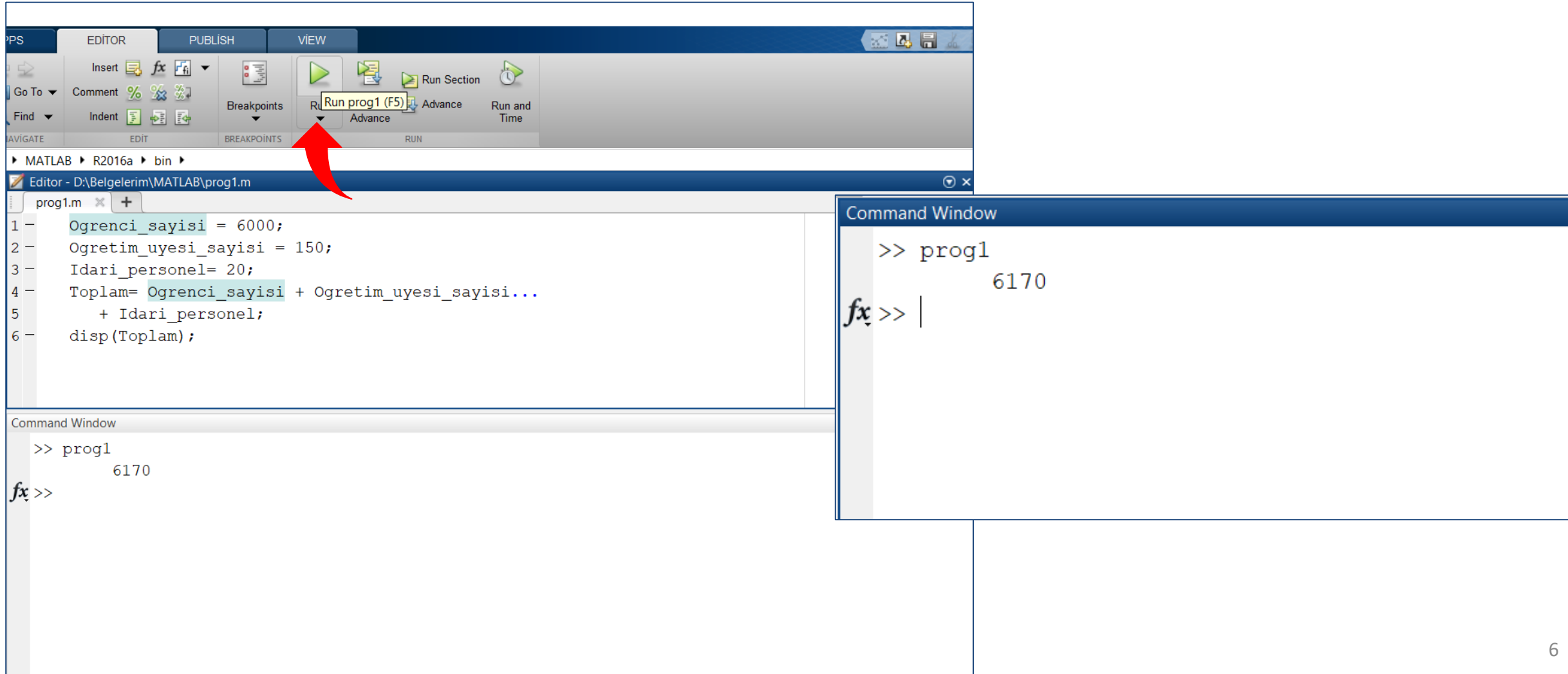


- A text editor is needed to create m files.
- m file is opened by clicking the New Script option from the File menu.



Programming in MATLAB

Example: For a program that calculates and prints the total number of students, faculty and staff in a department:



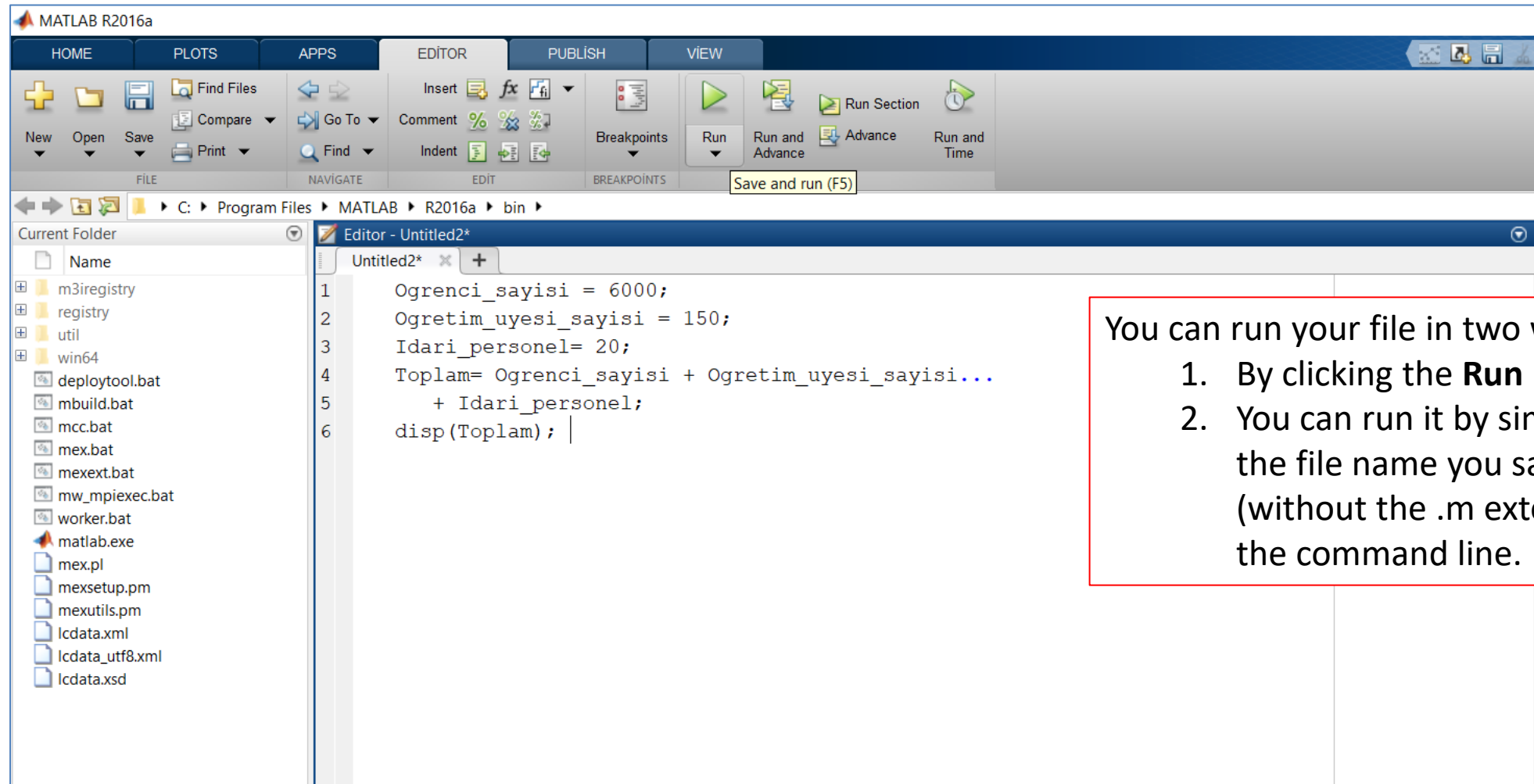
The image displays the MATLAB R2016a interface. The main window shows the Editor with a file named `prog1.m`. The code in the editor is as follows:

```
1 - Ogresci_sayisi = 6000;  
2 - Ogretim_uyesi_sayisi = 150;  
3 - Idari_personel= 20;  
4 - Toplam= Ogresci_sayisi + Ogretim_uyesi_sayisi...  
5   + Idari_personel;  
6 - disp(Toplam);
```

A red arrow points to the `Run` button (a green play icon) in the toolbar, which has a tooltip that reads `Run prog1 (F5)`. Below the editor, there are two Command Window panels. The bottom-left panel shows the command `>> prog1` and the output `6170`. The bottom-right panel, which is slightly offset and larger, shows the same command `>> prog1` and output `6170`, but with an additional prompt `fx >> |` on the line below.

Programming in MATLAB

Example: For a program that calculates and prints the total number of students, faculty and staff in a department:



You can run your file in two ways:

1. By clicking the **Run** button.
2. You can run it by simply typing the file name you saved (without the .m extension) on the command line.

INPUT-OUTPUT FUNCTIONS - *Input Function*

Input Function:

- Input functions are used to read data from a default or standard input device. On most systems, the default input device is the keyboard, so the input expression reads values entered from the keyboard by the user or the person running the script.
- In order for the user to know what to enter, the input function must first indicate the desired values to the user with a message (prompt).
- The simplest input function in MATLAB is the *input* function.

```
variable_name=input('message to user_prompt')
```

INPUT-OUTPUT FUNCTIONS - *Input Function*

Example:

```
>> x=input('Vize Notunu Giriniz: ')\nVize Notunu Giriniz: 5\nx =\n    5\n>> x=input('Vize Notunu Giriniz: \\n')\nVize Notunu Giriniz:\n5\nx =\n    5
```

```
>> isim=input('Öğrenci İsmi: ','s')\nÖğrenci İsmi: NEVA\nisim =\nNEVA\n>> isim=input('Öğrenci İsmi: ')\nÖğrenci İsmi: 'NEVA'\nisim =\nNEVA
```

- If character or string input is desired, 's' should be added after the message.
- On the other hand, it is possible to input strings without adding 's'. If the word is written in a single quote (') while entering, the string will still be entered. But doing it the first way would be more correct in terms of programming logic.

INPUT-OUTPUT FUNCTIONS - *Input Function*

Example:

```
>> x=input('Vize Notunu Giriniz: \n')
Vize Notunu Giriniz:
a
Error using input
Undefined function or variable 'a'.
Vize Notunu Giriniz:
85
x =
    85
```

```
>> t=55;
>> x=input('Vize Notunu Giriniz: \n')
Vize Notunu Giriniz:
55
x =
    55
```

- Note, MATLAB warns when the user is prompted to enter a numeric value, but when the user enters an alphanumeric character.
- On the other hand, if the entered alphanumeric character is a variable and has a numeric value, the input function will still work correctly.

INPUT-OUTPUT FUNCTIONS - *Input Function*

Practice:

Write a command line asking the user first the air temperature, then whether the value entered is C (celsius) or F (fahrenheit)? When it works it should look like this:

```
Sıcaklık değerini girin: 21  
C mi, F mi? C  
|
```

INPUT-OUTPUT FUNCTIONS – Output Functions

`disp` and `fprintf` Functions:

- Output expressions display strings and the results of expressions and may allow formatting or customizing how they are displayed.
- The simplest output function in MATLAB is `disp` which is used for display only.
- However, the `disp` function does not allow formatting. For example;

```
>> disp('Hello world');  
Hello world
```

```
>> disp(variable_name);
```

```
>> disp(4^3)  
64
```

```
>> disp('4^3')  
4^3
```

INPUT-OUTPUT FUNCTIONS – Output Functions

`disp` and `fprintf` Functions:

- Formatted outputs can be printed using the `fprintf` function.

```
>> fprintf('Result is %d Newton. \n',4^3);  
Result is 64 Newton.
```

- When using the `fprintf` function, a string (format string) is entered first, containing the text to be printed and formatting information for the expressions to be printed.
- In this example, `%d` is an example of format information. `%d` is sometimes named as a placeholder, Specifies where to print the value of the expression after the string. The character in the placeholder is called the transform character and specifies the type of value being printed.

<code>%d</code>	decimal integer
<code>%f</code>	float
<code>%g</code>	Compact format
<code>%c</code>	character
<code>%s</code>	string

INPUT-OUTPUT FUNCTIONS – Output Functions

`disp` and `fprintf` Functions:

- The `\n` command added to the end of the text to be printed in the `fprintf` function means a new line and the expression from the position it is used appears on the new line.
- In the previous example, let's see what would have happened if the `\n` command was not typed:

```
>> fprintf('Result is %d Newton. ', 4^3);  
Result is 64 Newton. >> |
```

- By using the `\n` command, any number of spaces can be left between the lines.

```
>> fprintf('The value is %d, \n\nOK!\n', 4^3)  
The value is 64,  
  
OK!
```

INPUT-OUTPUT FUNCTIONS – Output Functions

disp and fprintf Functions:

- The field width can also be included in the placeholder in fprintf; this specifies how many characters to use in total.
- For example, %5d specifies a field width of 5 to print an integer (decimal integer), and %10s specifies a field width of 10 for a string.
- For decimals (floats), the number of decimal places can also be specified; for example, %6.2f means 6 field widths (including whole number and decimal places) with two decimal places.
- Also, for decimals, only the number of decimal places can be specified; for example, %.3f shows three decimal places.



```
>> fprintf('The int is %3d and the float is %6.2f\n',5,4.9)
The int is __5 and the float is __4.90
```

- If the field width is larger than required, leading spaces are printed, and if more decimal places than required are specified, trailing zeros are printed.

INPUT-OUTPUT FUNCTIONS – Output Functions

disp and **fprintf** Functions:

QUESTION: What do you think will happen if you try to print the number 1234.5678 using 2 decimal places and 3 field widths? For example, if you type `>> fprintf('%3.2f\n', 1234.5678)`

ANSWER: Prints all 1234 but rounds decimals to two digits,

```
1234.57
```

If the field width is not large enough to print the number, the field width is increased. Basically, truncating the number gives a misleading result, but rounding the decimal places doesn't change the number much.

INPUT-OUTPUT FUNCTIONS – Output Functions

disp and **fprintf** Functions:

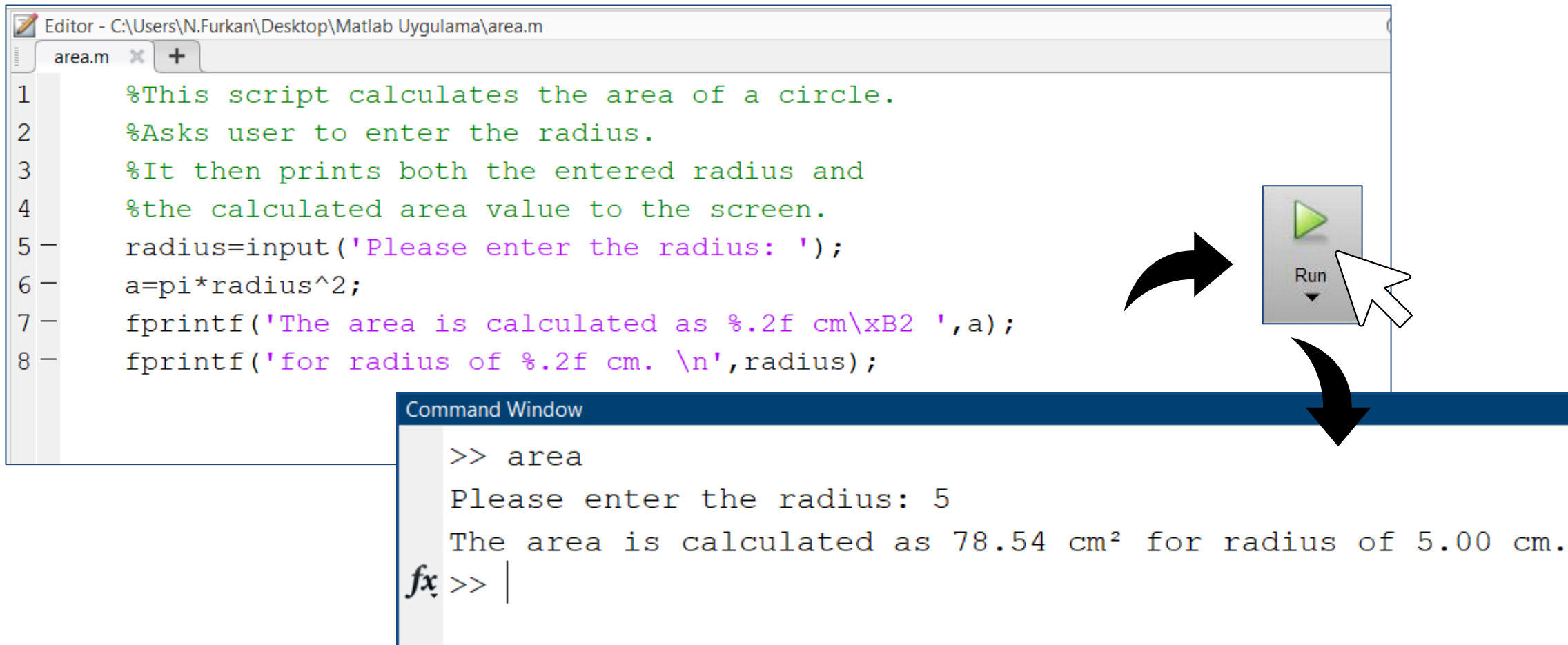
QUESTION: What happens if you use the %d command for a decimal number? For example:
for the command `>> fprintf('%d\n',1234567.89)`

ANSWER: MATLAB will display the result using exponential (e+001 / exponential) notation:

```
1.234568e+06
```

Script Programs Using Input-output Functions

- Putting all this together, we can program an exemplary algorithm from this point forward.
- The script below calculates and prints the area of a circle.
- It first asks the user for a radius, reads the radius, and then calculates and prints the area of the circle based on that radius.



The image shows a MATLAB script in the Editor window and its execution in the Command Window. The script, named 'area.m', prompts the user for a radius, calculates the area, and prints the result. The Command Window shows the script being run, the prompt for the radius, and the calculated area.

```
Editor - C:\Users\N.Furkan\Desktop\Matlab Uygulama\area.m
area.m x +
1 %This script calculates the area of a circle.
2 %Asks user to enter the radius.
3 %It then prints both the entered radius and
4 %the calculated area value to the screen.
5 radius=input('Please enter the radius: ');
6 a=pi*radius^2;
7 fprintf('The area is calculated as %.2f cm\xB2 ',a);
8 fprintf('for radius of %.2f cm. \n',radius);

Run

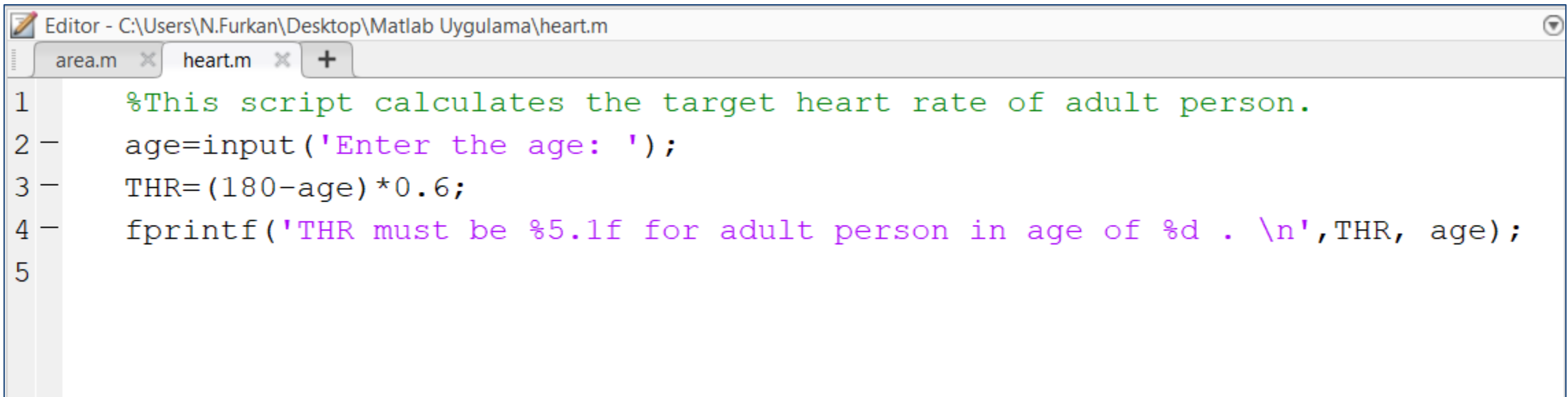
Command Window
>> area
Please enter the radius: 5
The area is calculated as 78.54 cm2 for radius of 5.00 cm.
fx >> |
```

Script Programs Using Input-output Functions

Example: The target heart rate (THR) for an active person is defined by the equation $THR = (180 - \text{age}) * 0.6$. We want a script that will ask for age, then calculate and print THR. When the script is executed it will look like this:

```
Enter the age: 45
THR must be 81.0 for adult person in age of 45 .
```

Solution example:



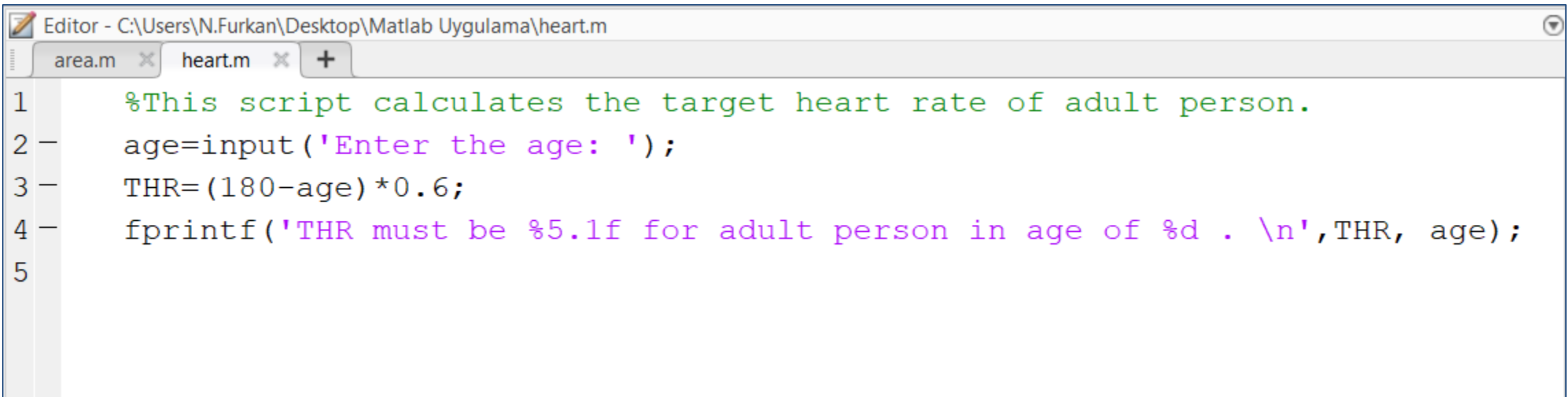
```
Editor - C:\Users\N.Furkan\Desktop\Matlab Uygulama\heart.m
area.m x heart.m x +
1 %This script calculates the target heart rate of adult person.
2 age=input('Enter the age: ');
3 THR=(180-age)*0.6;
4 fprintf('THR must be %5.1f for adult person in age of %d . \n',THR, age);
5
```

Script Programs Using Input-output Functions

Example: The target heart rate (THR) for an active person is defined by the equation $THR = (180 - \text{age}) * 0.6$. We want a script that will ask for age, then calculate and print THR. When the script is executed it will look like this:

```
Enter the age: 45
THR must be 81.0 for adult person in age of 45 .
```

Solution example:

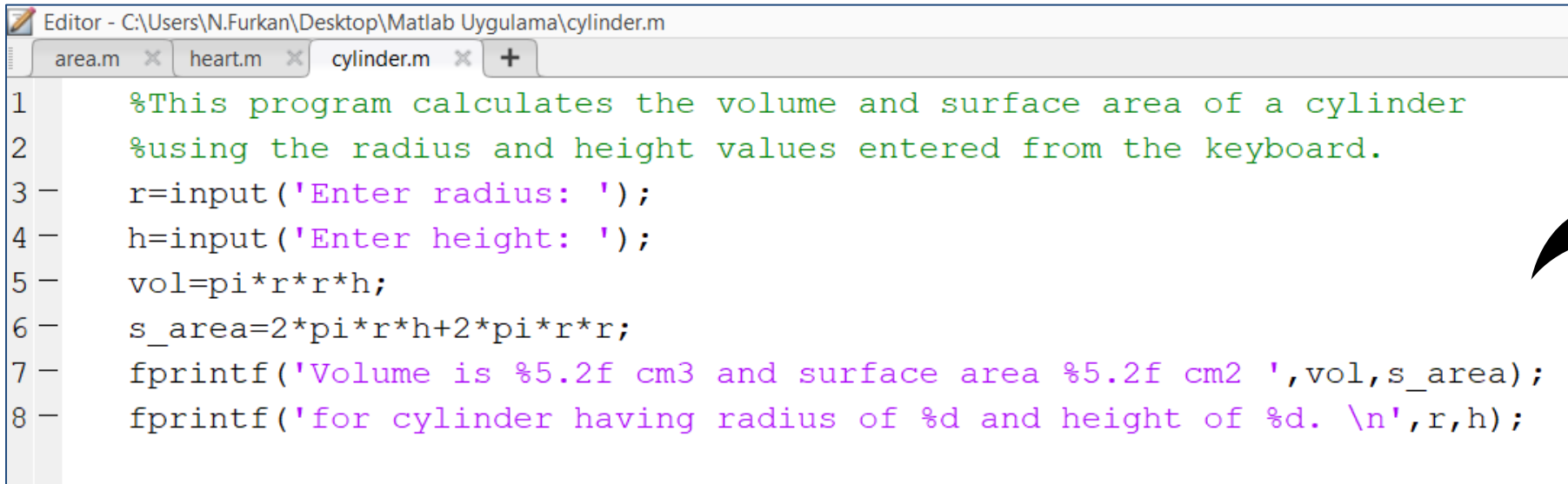


```
Editor - C:\Users\N.Furkan\Desktop\Matlab Uygulama\heart.m
area.m x heart.m x +
1 %This script calculates the target heart rate of adult person.
2 age=input('Enter the age: ');
3 THR=(180-age)*0.6;
4 fprintf('THR must be %5.1f for adult person in age of %d . \n',THR, age);
5
```

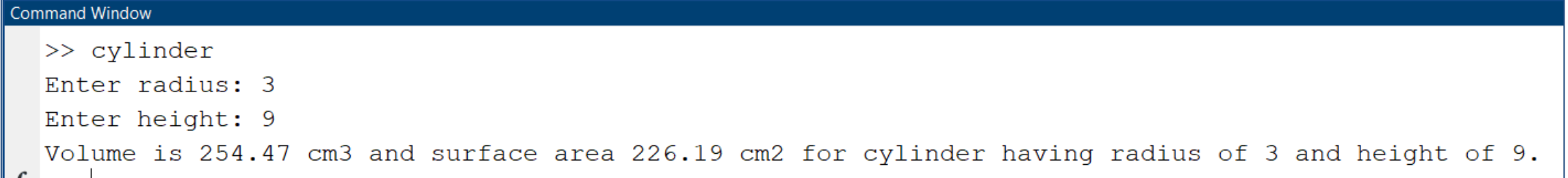
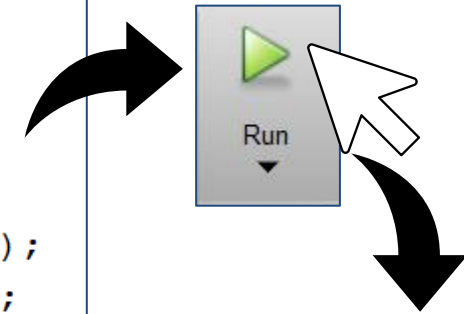
Script Programs Using Input-output Functions

Example: Write a MATLAB program that calculates and prints the volume and surface area of a cylinder. Ask the user to enter the radius and height of the cylinder from the keyboard.

Solution example:



```
Editor - C:\Users\N.Furkan\Desktop\Matlab Uygulama\cylinder.m
area.m x heart.m x cylinder.m x +
1 %This program calculates the volume and surface area of a cylinder
2 %using the radius and height values entered from the keyboard.
3 r=input('Enter radius: ');
4 h=input('Enter height: ');
5 vol=pi*r*r*h;
6 s_area=2*pi*r*h+2*pi*r*r;
7 fprintf('Volume is %5.2f cm3 and surface area %5.2f cm2 ',vol,s_area);
8 fprintf('for cylinder having radius of %d and height of %d. \n',r,h);
```



```
Command Window
>> cylinder
Enter radius: 3
Enter height: 9
Volume is 254.47 cm3 and surface area 226.19 cm2 for cylinder having radius of 3 and height of 9.
```

Next week

Chapter 5

**Programming in MATLAB-2
(User defined functions)**