FACULTY OF COMPUTING
& INFORMATION TECHNOLOGY

KING ABDULAZIZ UNIVERSITY

FCIT
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كلية الحاسبات
وتقنية المعلومات

جامعة الملك عبدالعزيز

# Chapter 0
# Introduction to Problem-Solving

CPIT 110 (Problem-Solving and Programming)

# Sections

- 0.1. Problem-Solving & Computer Science
- 0.2. Program Design & Problem-Solving Techniques
- 0.3. Steps in Program Development
- 0.4. Algorithms, Pseudocode, & Flowcharts
- 0.5. Decision Structures

# Examples

- Example 1: Road Example
- Example 2: Area of a Rectangle Calculator
- Example 3: Simple Calculator
- Example 4: Determining a Student’s Final Grade
- Example 5: Converting The Length
- Example 6: Area of a Rectangle Calculator
- Example 7: Determining The Largest Value

# Objectives

- To explain what problem solving is, and why it is important (0.1).
- To understand how to write algorithms (0.1–0.5).
- To describe how a program can be designed (0.2–0.3).
- To describe algorithms in different forms (0.4).
- To understand the difference between algorithms and pseudocode (0.4).
- To draw program flowcharts (0.4-0.5).
- To understand decision Structures (0.5).

# 0.1. Problem-Solving & Computer Science

- What is Computer Science?
- Example 1: Road Example
- Algorithms
- Example 2: Area of a Rectangle Calculator

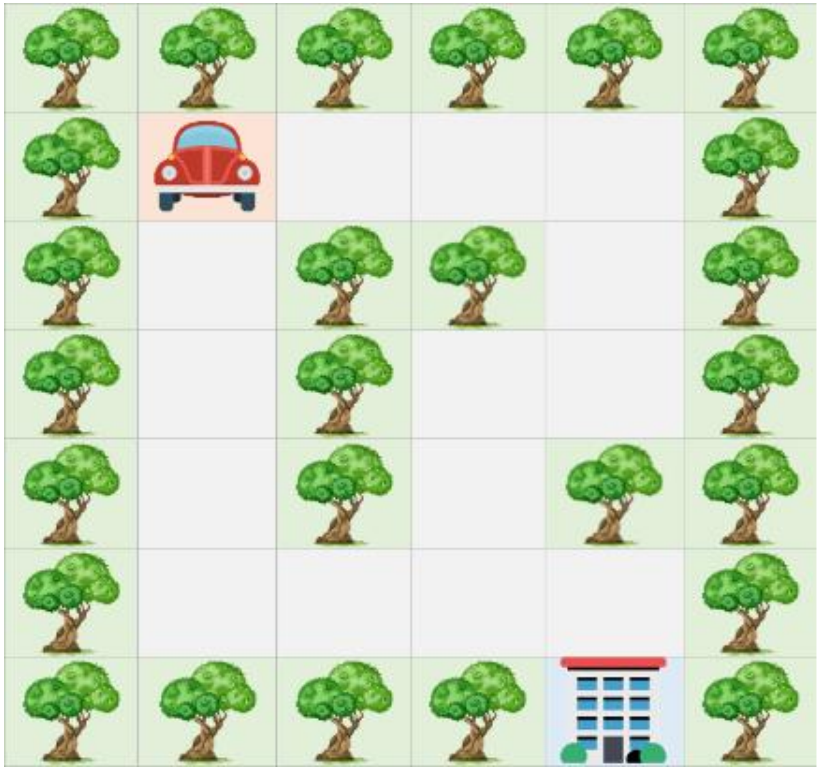
# What is Computer Science?

- Computer Science can be summarized with two simple words: problem solving.
- Computer Science is the study of problems, problem-solving, and the solutions that come out of this problem-solving process.
- Given a problem, the goal is to develop an algorithm to solve the problem.
- An algorithm is a step-by-step list of instructions to solve the problem.

# Road Example
## Example 1

Imagine that you have the following image, which is a map of a road leading to the building shown in the picture.

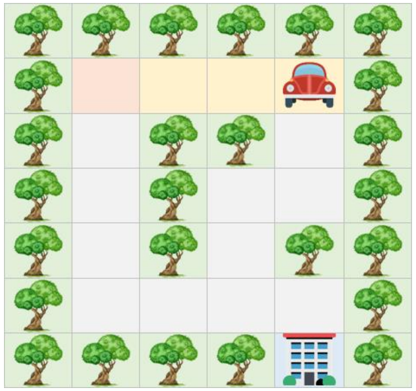
- There are a car and trees.
- The car cannot cross the trees.
- The road is divided into squares to calculate the steps of the car.
- Each square is considered as one step.



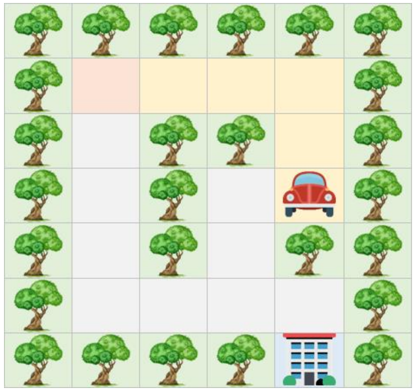
How can the car arrive at the building?

# Road Example
## Solution A

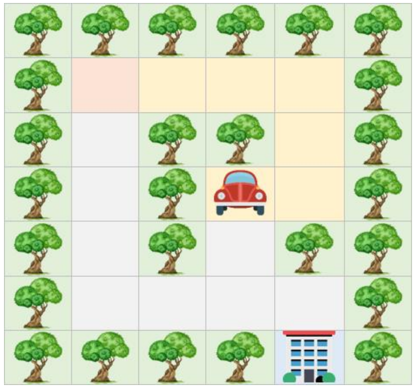
- Step 1: Move to the right three steps.
- Step 2: Move to down two steps.
- Step 3: Move to the left one step.
- Step 4: Move to down two steps.
- Step 5: Move to the right one step.
- Step 6: Move to down one step.



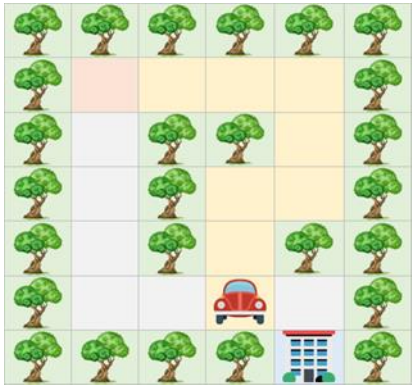
Step 1



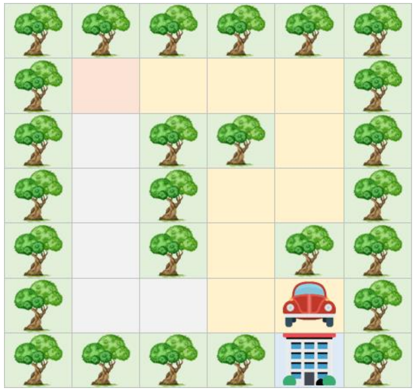
Step 2



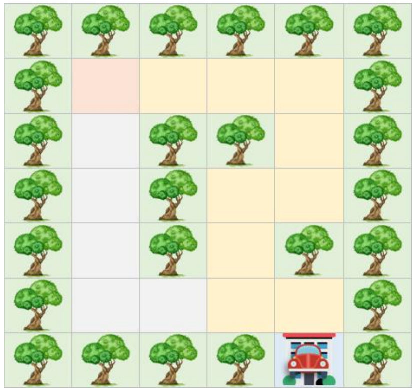
Step 3



Step 4



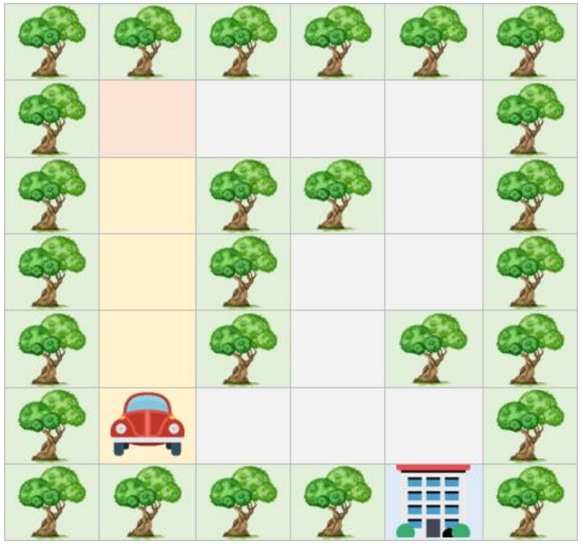
Step 5



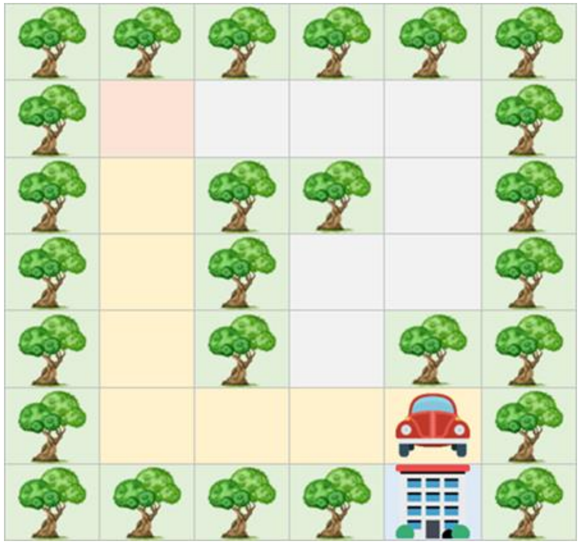
Step 6

# Road Example
## Solution B

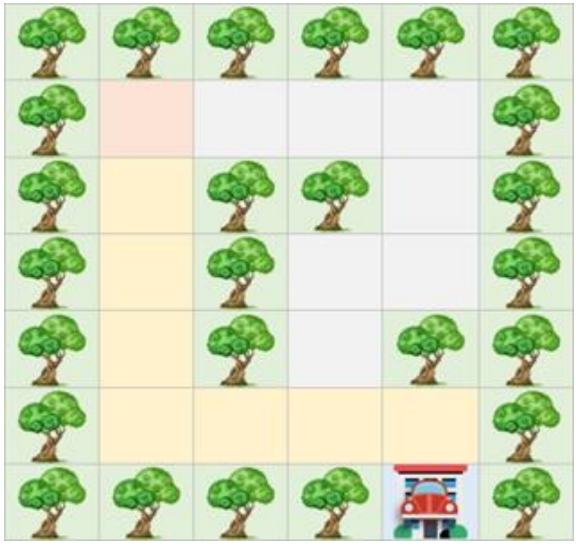
- Step 1: Move to down four steps.
- Step 2: Move to the right three steps.
- Step 3: Move to down one step.



Step 1



Step 2



Step 3

# Road Example
## Different Solutions

- As we can see that Solution A and Solution B are both correct solutions to the same problem, but there are differences in the complexity and efficiency of the solutions.
- The cost of Solution A is 10 steps while Solution B is 8 steps, so we consider Solution B as a better solution based on the number of steps.
- Reducing the number of steps in the previous example means reducing the amount of fuel needed by the vehicle and speeding up the arrival time.

# Algorithms

- An algorithm is a set of obvious, logical, and sequential steps that solve a specific problem.
- To put it simply, the algorithm is like a recipe for preparing a specific food.
- Following the steps of the algorithm will end up solving the problem.

# Area of a Rectangle Calculator
## Example 2

Write an algorithm that can calculate the area of a rectangle. The width and the height of the rectangle should be taken from the user.

Note:

Area = Width × Height

# Area of a Rectangle Calculator
## Solution A

**Solution A – Good:**

1. Ask the user to enter Width
2. Ask the user to enter Height
3. Set Area to (Width × Height)
4. Display Area for the user

- As you can see in this solution, we have described the steps that are going to solve the problem.
- You can describe the steps in your own way, but your description of the steps should be obvious, logical, and sequential.

# Area of a Rectangle Calculator
## Solution B

**Solution B - Bad:**

1. Ask the user to enter Width
2. Ask the user to enter Height
3. Calculate Area
4. Display Area for the user

The reason for considering Solution B as a bad solution:

- Step 3 is not clear because it does not explain how we can calculate Area.
- So, this algorithm is bad because its steps are not obvious.

# Area of a Rectangle Calculator
# Solution C

**Solution C - Bad:**

1. Set Area to (Width × Height)
2. Ask the user to enter Width
3. Ask the user to enter Height
4. Display Area for the user

<u>The reasons for considering Solution C as a bad solution:</u>

- We don't know what Width and Height at the Step 1 are. In other words, Width and Height have not been defined before Step 1, so we cannot use them because they do not exist yet.

- What about Step 2 and Step 3? Width and Height are defined there!. After Step 2, Width does exist, but Height does not. After Step 3, Height does exist. Both Width and Height are available to be used at or after step 4.

- So, this algorithm is bad because its steps are not correctly sequential.

# Area of a Rectangle Calculator
## Solution D

**Solution D - Bad:**

1. Set Area to (Width × Height)
2. Display Area for the user

The reasons for considering Solution D as a bad solution:

- Step 1 tells us to multiply Width and Height, but we don't know what Width and Height are. Even, they have not been defined in any steps of the algorithm.
- So, this algorithm is bad because of the illogical step, which is using unknown things (Width and Height).

# Area of a Rectangle Calculator
# Solution E

**Solution E - Bad:**

1. Ask the user to enter Width
2. Ask the user to enter Height
3. Set Area to (Width × Height × 2)
4. Display Area for the user

The reasons for considering Solution E as a bad solution:

- This algorithm will give us a wrong value of the Area. For example, suppose that the user entered **4** for Width and **5** for Height. The correct value of the Area should be **20**, but this algorithm will display **40** as the value of the Area.

- The reason for giving the wrong value is how Step 3 calculates the Area. Step 3 calculates the Area by the incorrect equation (Width × Height × 2) instead of (Width × Height).

- So, this algorithm is bad because it has a logical problem, which is producing incorrect output (the value of the Area).

# 0.2. Program Design & Problem-Solving Techniques

- How Do We Write a Program?
- Problem-Solving Phase
- Implementation Phase

# How Do We Write a Program?

- A Computer is not intelligent.
  - It cannot analyze a problem and come up with a solution.
  - A human (the programmer) must analyze the problem, develop the instructions for solving the problem, and then have the computer carry out the instructions.

- To write a program for a computer to follow, we must go through a two-phase process: problem solving and implementation.

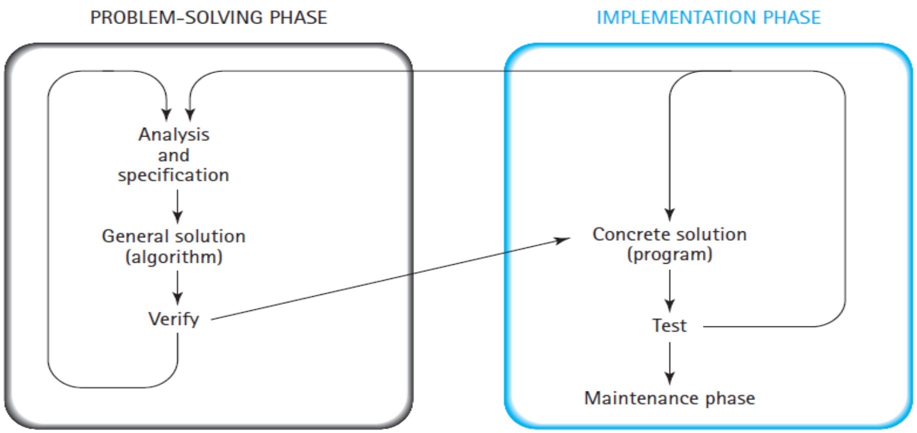

PROBLEM-SOLVING PHASE
IMPLEMENTATION PHASE
Analysis and specification
General solution (algorithm)
Verify
Concrete solution (program)
Test
Maintenance phase

Figure Programming process

# Problem-Solving Phase

1. **Analysis and Specification** - Understand (define) the problem and what the solution must do.

2. **General Solution (Algorithm)** - Specify the required data types and the logical sequences of steps that solve the problem.

3. **Verify** - Follow the steps exactly to see if the solution really does solve the problem.

# Implementation Phase

- **Concrete Solution (Program)** - Translate the algorithm (the general solution) into a programming language.
- **Test** - Have the computer follow the instructions.
  - Then manually check the results.
  - If you find errors, analyze the program and the algorithm to determine the source of the errors, and then make corrections.
- Once a program is tested, it enters into next phase (**Maintenance**).
- Maintenance requires modification of the program to meet changing requirements or to correct any errors that show up while using it.

# 0.3. Steps in Program Development

- Example 3: Simple Calculator

# Steps in Program Development

1. Define the problem into three separate components:
   - Inputs
   - Processing steps to produce required outputs.
   - Outputs

# Steps in Program Development

2. Outline the solution.
   - Decompose the problem to smaller steps.
   - Establish a solution outline.

3. Develop the outline into an algorithm.
   - The solution outline is now expanded into an algorithm.

# Steps in Program Development

4. Test the algorithm for correctness.
   - Very important in the development of a program, but often forgotten.
   - Major logic errors can be detected and corrected at an early stage.

5. Code the algorithm into a specific programming language.

# Steps in Program Development

6. Run the program on the computer.

- This step uses a program compiler or interpreter, and programmer-designed test data to machine-test the code for
  - Syntax errors
  - Runtime errors
  - Logic errors

7. Document and maintain the program.

# Simple Calculator
## Example 3

Suppose that you are asked to write a calculator program that can sum and subtract two integer numbers. Write the program requirements, specifications and algorithm.

# Simple Calculator
## The Requirements

Suppose that you are asked to write a calculator program that can sum and subtract two integer numbers. Write the program requirements, specifications and algorithm.

### The requirements:

- The user can enter an equation which consists of two numbers and a sign (- or +).
- The program should calculate the equation correctly and display the result for the user.
- The program can sum and subtract two integer numbers.

# Simple Calculator
## The Specifications

Suppose that you are asked to write a calculator program that can sum and subtract two integer numbers. Write the program requirements, specifications and algorithm.

### The specifications:

- When the program runs, it will display a welcome message that says, 'Welcome to our Calculator".
- The program will then ask the user to enter the first number.
- The program will then ask the user to enter the second number.
- The program will then ask the user to select the sign (calculation operators) from this set (-,+).
- The program will then display the correct result of the calculation on the screen and end.

# Simple Calculator
## Designing a Solution

- After the steps of identifying the problem (the requirements and specifications), we should have a clear idea about what is going exactly to be achieved and solved.
- In this step, we are going to describe how the specifications can be achieved.
- This means that we need to design an algorithm that fulfills the specifications.
- We can design the algorithm via written steps or visualized steps using, for example, flowcharts.
- In the written steps, we can use simple sentences in English or some special notations and structures in something called "Pseudocode".

# Simple Calculator
# The Algorithm

Suppose that you are asked to write a calculator program that can sum and subtract two integer numbers. Write the program requirements, specifications and algorithm.

## The algorithm:

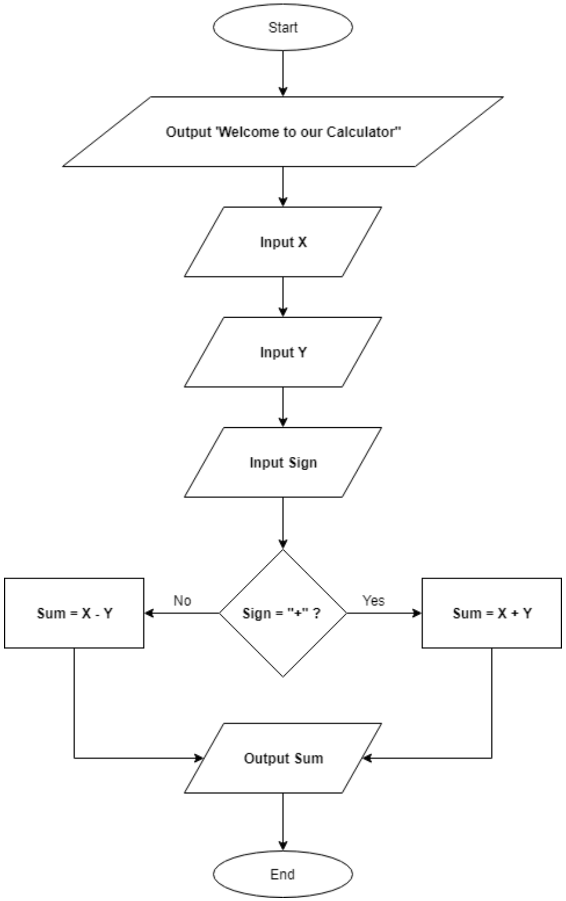
1. Display a welcome message that says, “Welcome to our Calculator".
2. Ask the user to enter the first number and save it to X.
3. Ask the user to enter the second number and save it to Y.
4. Ask the user to select the sign (-,+) and save it in Sign.
5. if Sign is equal to “+”, make Sum = X + Y
6. Otherwise, make Sum = X - Y
7. Display Sum

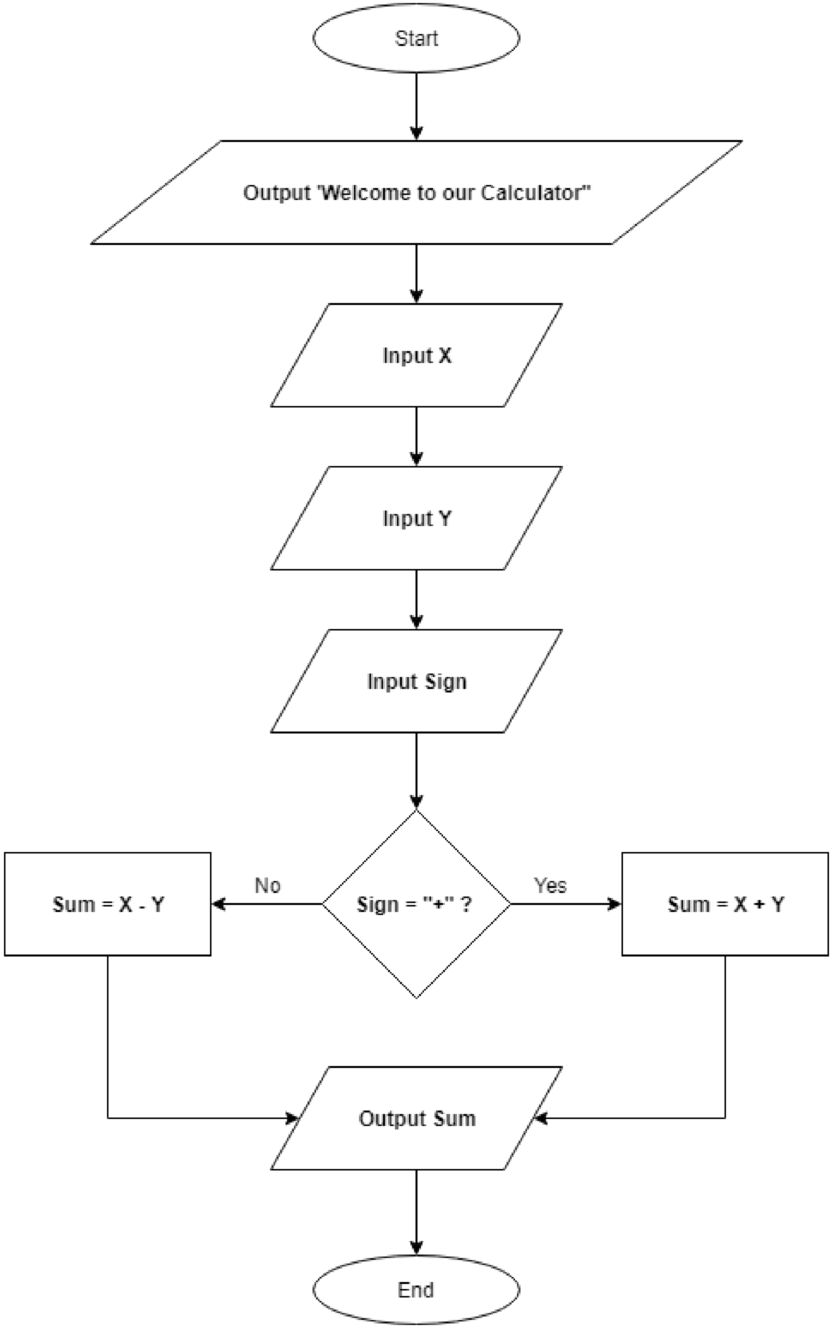
# Simple Calculator
## The Pseudocode and Flowchart

Suppose that you are asked to write a calculator program that can sum and subtract two integer numbers. Write the program requirements, specifications and algorithm.

### The algorithm (pseudocode and flowchart):

```
print “Welcome to our Calculator”
X = input “Enter the first number:“
Y = input “Enter the second number:”
Sign = input "Select – or +"
if Sign is equal to "+" then:
        Sum = X + Y
else:
        Sum = X – Y
End if
print Sum
```

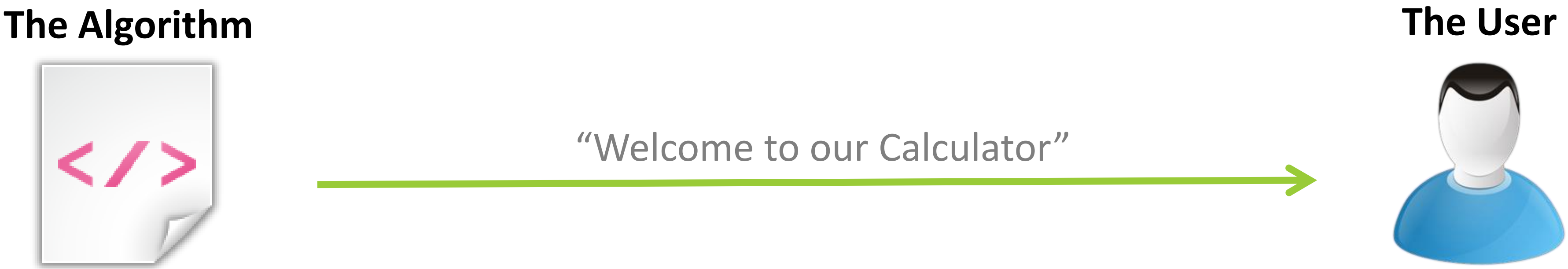



Start
Output 'Welcome to our Calculator"
Input X
Input Y
Input Sign
Sign = "+" ?
No
Yes
Sum = X - Y
Sum = X + Y
Output Sum
End

# Simple Calculator
## Verifying The Algorithm

1. Display a welcome message that says, “Welcome to our Calculator".
2. Ask the user to enter the first number and save it to X.
3. Ask the user to enter the second number and save it to Y.
4. Ask the user to select the sign (-,+) and save it in Sign.
5. if Sign is equal to “+”, make Sum = X + Y
6. Otherwise, make Sum = X - Y
7. Display Sum

**Test 1**



**The Algorithm**

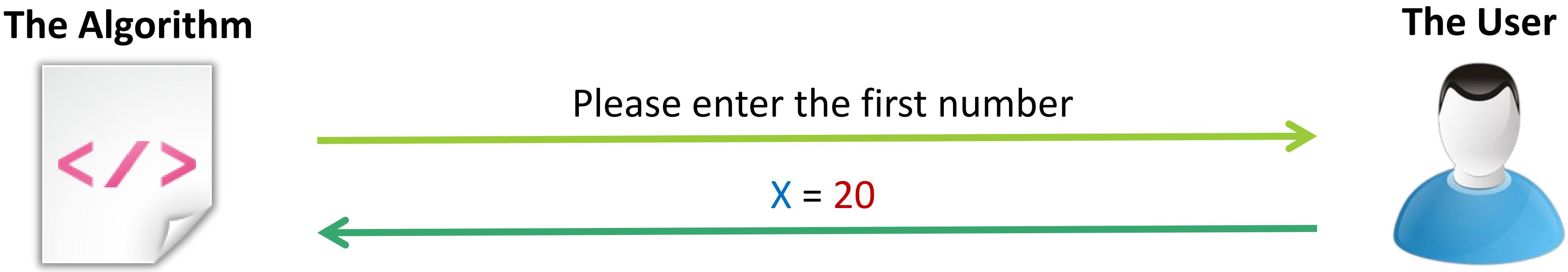
**The User**

“Welcome to our Calculator”

# Simple Calculator
## Verifying The Algorithm

1. Display a welcome message that says, “Welcome to our Calculator".
2. Ask the user to enter the first number and save it to X.
3. Ask the user to enter the second number and save it to Y.
4. Ask the user to select the sign (-,+) and save it in Sign.
5. if Sign is equal to “+”, make Sum = X + Y
6. Otherwise, make Sum = X - Y
7. Display Sum

**Test 1**



**The Algorithm**

**The User**

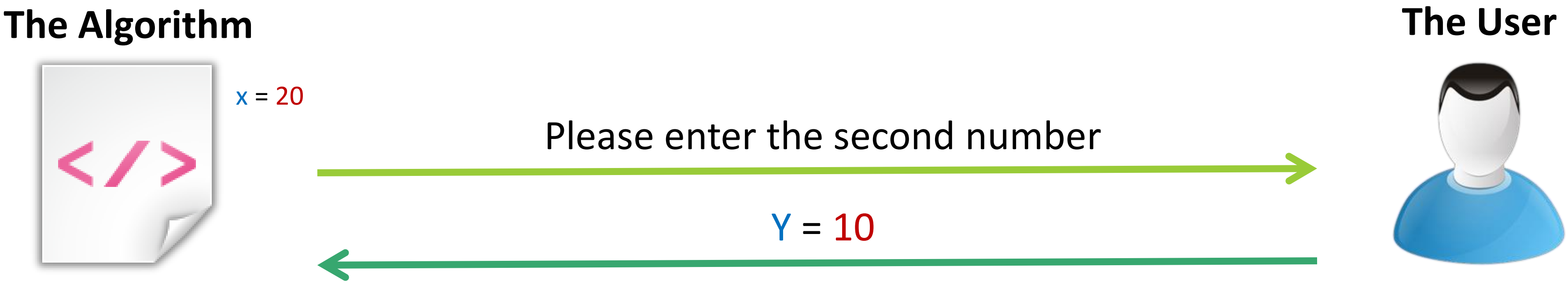
Please enter the first number

X = 20

# Simple Calculator
## Verifying The Algorithm

1. Display a welcome message that says, “Welcome to our Calculator".
2. Ask the user to enter the first number and save it to X.
3. Ask the user to enter the second number and save it to Y.
4. Ask the user to select the sign (-,+) and save it in Sign.
5. if Sign is equal to “+”, make Sum = X + Y
6. Otherwise, make Sum = X - Y
7. Display Sum

**Test 1**



**The Algorithm**

**The User**

x = 20

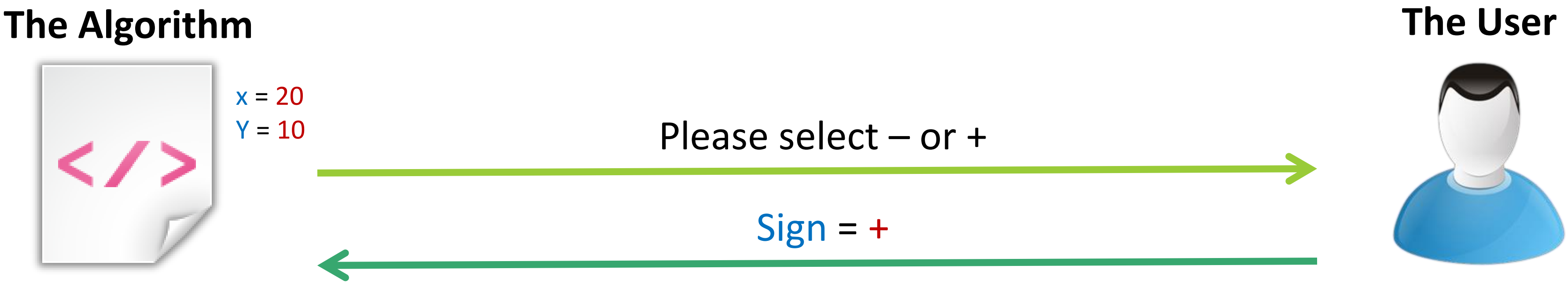
Please enter the second number

Y = 10

# Simple Calculator
## Verifying The Algorithm

1. Display a welcome message that says, “Welcome to our Calculator".
2. Ask the user to enter the first number and save it to X.
3. Ask the user to enter the second number and save it to Y.
4. Ask the user to select the sign (-,+) and save it in Sign.
5. if Sign is equal to “+”, make Sum = X + Y
6. Otherwise, make Sum = X - Y
7. Display Sum

**Test 1**



**The Algorithm**

x = 20
Y = 10

Please select – or +

Sign = +

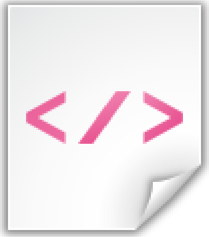
**The User**

# Simple Calculator
## Verifying The Algorithm

1. Display a welcome message that says, “Welcome to our Calculator".
2. Ask the user to enter the first number and save it to X.
3. Ask the user to enter the second number and save it to Y.
4. Ask the user to select the sign (-,+) and save it in Sign.
5. if Sign is equal to “+”, make Sum = X + Y
6. Otherwise, make Sum = X - Y
7. Display Sum

**Test 1**

**The Algorithm**



x = 20
Y = 10
Sign = +
Is Sign equal to “+”? **Yes**

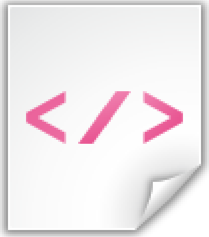
**The User**

# Simple Calculator
## Verifying The Algorithm

1. Display a welcome message that says, “Welcome to our Calculator".
2. Ask the user to enter the first number and save it to X.
3. Ask the user to enter the second number and save it to Y.
4. Ask the user to select the sign (-,+) and save it in Sign.
5. if Sign is equal to “+”, make Sum = X + Y
6. Otherwise, make Sum = X - Y
7. Display Sum

**Test 1**

**The Algorithm**



x = 20
Y = 10
Sign = +
Sum = X + Y = 20 + 10 = **30**

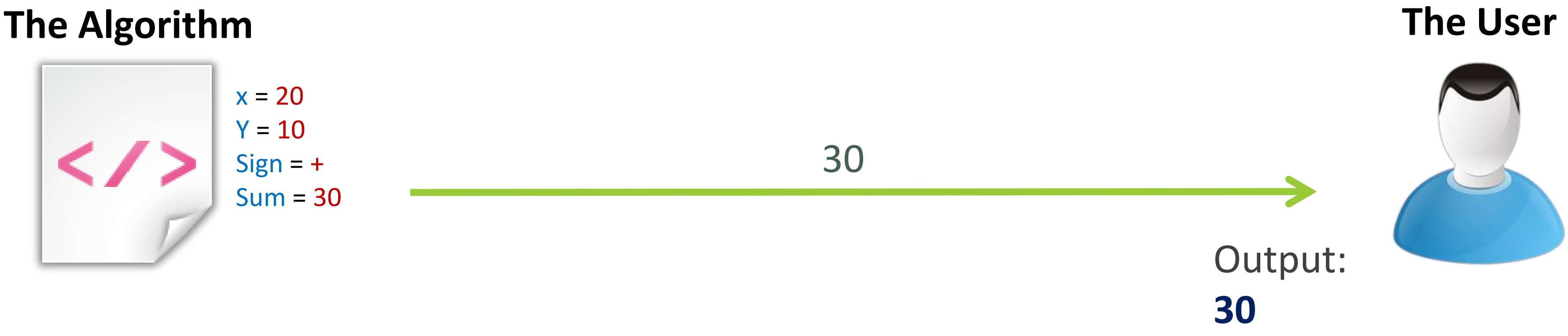
**The User**

# Simple Calculator

## Verifying The Algorithm

1. Display a welcome message that says, “Welcome to our Calculator".
2. Ask the user to enter the first number and save it to X.
3. Ask the user to enter the second number and save it to Y.
4. Ask the user to select the sign (-,+) and save it in Sign.
5. if Sign is equal to “+”, make Sum = X + Y
6. Otherwise, make Sum = X - Y
7. Display Sum

**Test 1**



**The Algorithm**

x = 20
Y = 10
Sign = +
Sum = 30

30

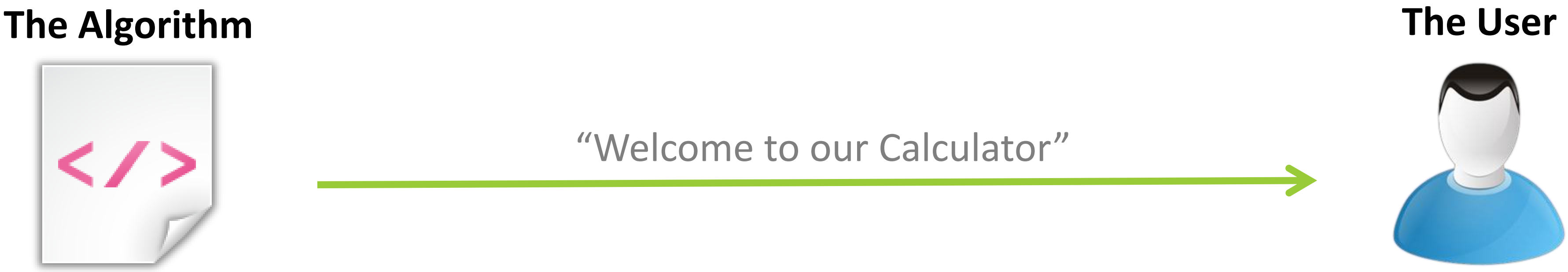
**The User**

Output:
**30**

# Simple Calculator
## Verifying The Algorithm

1. Display a welcome message that says, “Welcome to our Calculator".
2. Ask the user to enter the first number and save it to X.
3. Ask the user to enter the second number and save it to Y.
4. Ask the user to select the sign (-,+) and save it in Sign.
5. if Sign is equal to “+”, make Sum = X + Y
6. Otherwise, make Sum = X - Y
7. Display Sum

Test 2

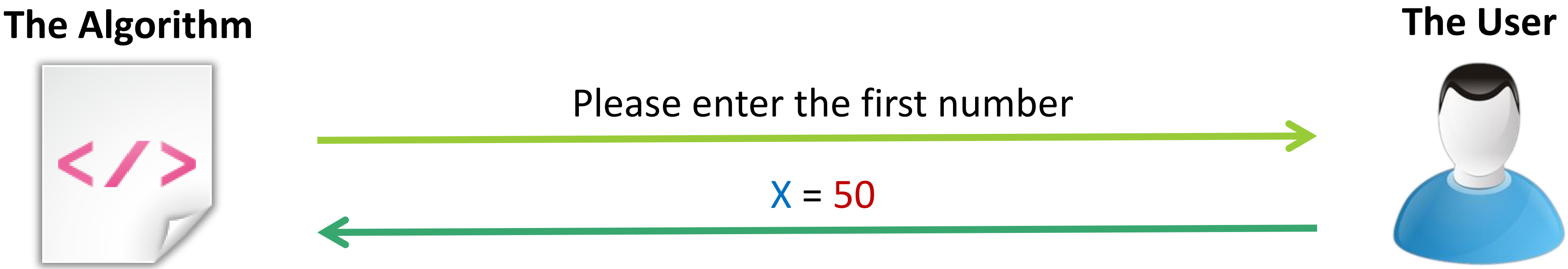


# Simple Calculator

## Verifying The Algorithm

1. Display a welcome message that says, “Welcome to our Calculator".
2. Ask the user to enter the first number and save it to X.
3. Ask the user to enter the second number and save it to Y.
4. Ask the user to select the sign (-,+) and save it in Sign.
5. if Sign is equal to “+”, make Sum = X + Y
6. Otherwise, make Sum = X - Y
7. Display Sum

**Test 2**



**The Algorithm**

**The User**

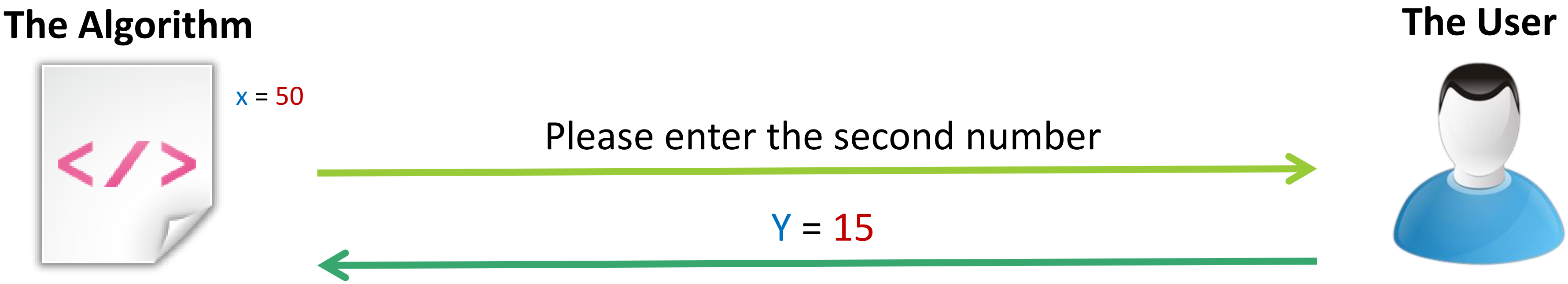
Please enter the first number

X = 50

# Simple Calculator
## Verifying The Algorithm

1. Display a welcome message that says, “Welcome to our Calculator".
2. Ask the user to enter the first number and save it to X.
3. Ask the user to enter the second number and save it to Y.
4. Ask the user to select the sign (-,+) and save it in Sign.
5. if Sign is equal to “+”, make Sum = X + Y
6. Otherwise, make Sum = X - Y
7. Display Sum

**Test 2**



**The Algorithm**

**The User**

x = 50

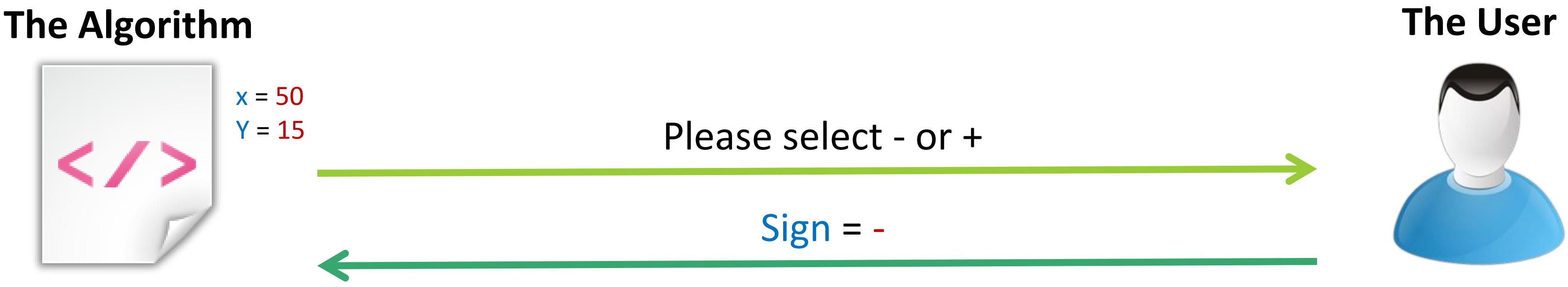
Please enter the second number

Y = 15

# Simple Calculator
## Verifying The Algorithm

1. Display a welcome message that says, “Welcome to our Calculator".
2. Ask the user to enter the first number and save it to X.
3. Ask the user to enter the second number and save it to Y.
4. Ask the user to select the sign (-,+) and save it in Sign.
5. if Sign is equal to “+”, make Sum = X + Y
6. Otherwise, make Sum = X - Y
7. Display Sum

**Test 2**

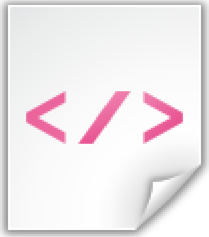


# Simple Calculator
## Verifying The Algorithm

1. Display a welcome message that says, “Welcome to our Calculator".
2. Ask the user to enter the first number and save it to X.
3. Ask the user to enter the second number and save it to Y.
4. Ask the user to select the sign (-,+) and save it in Sign.
5. if Sign is equal to “+”, make Sum = X + Y
6. Otherwise, make Sum = X - Y
7. Display Sum

**Test 2**

**The Algorithm**



x = 50
Y = 15
Sign = -
Is Sign equal to “+”? **No**

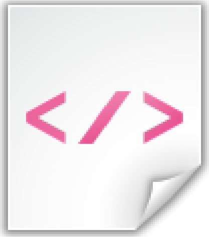
**The User**

# Simple Calculator
## Verifying The Algorithm

1. Display a welcome message that says, “Welcome to our Calculator".
2. Ask the user to enter the first number and save it to X.
3. Ask the user to enter the second number and save it to Y.
4. Ask the user to select the sign (-,+) and save it in Sign.
5. if Sign is equal to “+”, make Sum = X + Y
6. Otherwise, make Sum = X - Y
7. Display Sum

**Test 2**

**The Algorithm**



x = 50
Y = 15
Sign = -
Sum = X - Y = 50 - 15 = **35**

**The User**

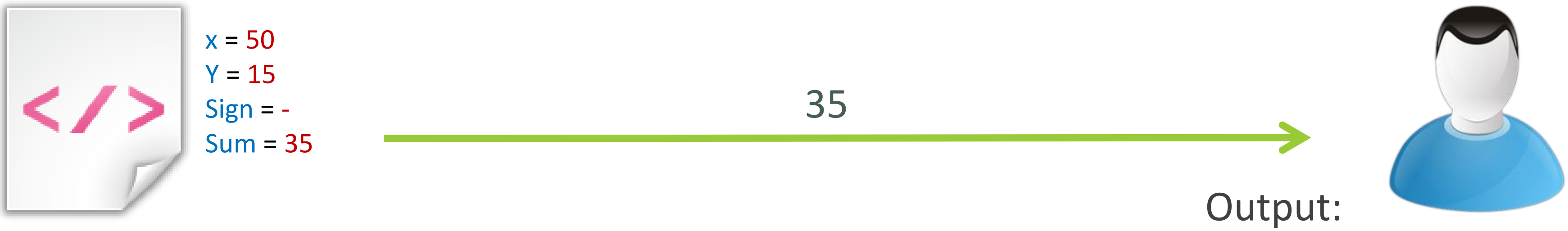
# Simple Calculator
## Verifying The Algorithm

1. Display a welcome message that says, “Welcome to our Calculator".
2. Ask the user to enter the first number and save it to X.
3. Ask the user to enter the second number and save it to Y.
4. Ask the user to select the sign (-,+) and save it in Sign.
5. if Sign is equal to “+”, make Sum = X + Y
6. Otherwise, make Sum = X - Y
7. Display Sum

**Test 2**

**The Algorithm**

**The User**



x = 50
Y = 15
Sign = -
Sum = 35

Output:
**35**

# 0.4. Algorithms, Pseudocode, & Flowcharts

- Example 4: Determining a Student’s Final Grade
- Flowcharts
- Flowchart Symbols
- Example 5: Converting The Length
- Example 6: Area of a Rectangle Calculator

# Algorithm, Pseudocode, & Flowcharts

- What is an algorithm?
  - A step-by-step series of instructions in order to perform a specific task.
  - An algorithm must:
    - Be lucid (clear), precise and unambiguous.
    - Give the correct solution in all cases, and eventually end.
- What is pseudocode?
  - It is English that looks similar to code
    - But it is not actual code (only looks a little similar) .
    - Think of pseudocode as a way of expressing your algorithm.
- What is a flowchart?
  - A graphical representation of the sequence of operations in an information system or program.

# Algorithm, Pseudocode, & Flowcharts

- For Clarity:
  - An algorithm is a series of steps you take to solve a problem, just like a recipe is a series of steps you take to make a food!
  - Now, we express our algorithms in many ways:
    - **Pseudocode**: this is not "real code", but a slightly more formal way of writing the algorithmic steps
      - As an example, maybe the programmer does not know the language he/she will use. Therefore, they just write pseudocode during Problem-Solving Phase.
    - **Flowchart**: this is a graphical representation of the algorithm
    - **Actual code**: this is during the Implementation Phase
      - Python, Java, C++, C, etc

# Determining a Student's Final Grade

## Example 4

Write an algorithm and pseudocode to determine a student's final grade and indicate whether it is passing or failing. The final grade is calculated as the average of four marks.

# Determining a Student’s Final Grade
## Algorithm

Write an algorithm and pseudocode to determine a student’s final grade and indicate whether it is passing or failing. The final grade is calculated as the average of four marks.

## Algorithm:

```
1.  Ask the user to enter 4 marks (Mark1, Mark2, Mark3, Mark4)
2.  Calculate the marks average (Avg) by summing marks and it dividing by 4
3.  If average (Avg) is greater than or equal 60
4.      Print “Pass”
5.  Else
6.      Print “Fail”
7.  End if
```

# Determining a Student’s Final Grade
## Pseudocode

Write an algorithm and pseudocode to determine a student’s final grade and indicate whether it is passing or failing. The final grade is calculated as the average of four marks.

Pseudocode:

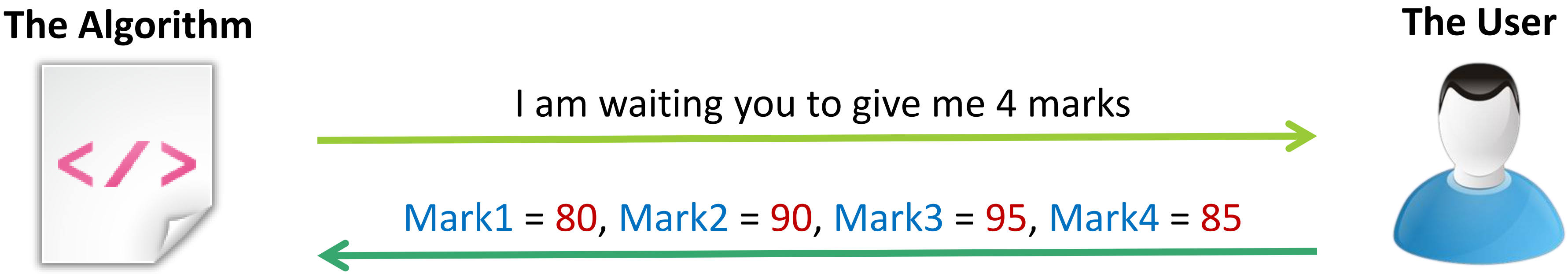
```
input Mark1, Mark2, Mark3, Mark4
Avg = (Mark1 + Mark2 + Mark3 + Mark4) / 4
if Avg >= 60:
    print “Pass”
else:
    print “Fail”
End if
```

# Determining a Student’s Final Grade

## Verifying The Algorithm

```
input Mark1, Mark2, Mark3, Mark4
Avg = (Mark1 + Mark2 + Mark3 + Mark4) / 4
if Avg >= 60:
        print “Pass”
else:
        print “Fail”
End if
```

**Test 1**



**The Algorithm**

**The User**

I am waiting you to give me 4 marks

Mark1 = 80, Mark2 = 90, Mark3 = 95, Mark4 = 85

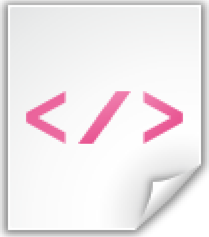
# Determining a Student’s Final Grade

## Verifying The Algorithm

```
input Mark1, Mark2, Mark3, Mark4
Avg = (Mark1 + Mark2 + Mark3 + Mark4) / 4
if Avg >= 60:
        print “Pass”
else:
        print “Fail”
End if
```

**Test 1**

**The Algorithm**



Mark1 = 80, Mark2 = 90, Mark3 = 95, Mark4 = 85

Avg = (80 + 90 + 95 + 85) / 4 = 350 / 4 = 87.5

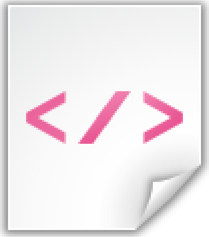
**The User**

# Determining a Student’s Final Grade
## Verifying The Algorithm

```
input Mark1, Mark2, Mark3, Mark4
Avg = (Mark1 + Mark2 + Mark3 + Mark4) / 4
if Avg >= 60:
        print “Pass”
else:
        print “Fail”
End if
```

**Test 1**

**The Algorithm**



Mark1 = 80, Mark2 = 90, Mark3 = 95, Mark4 = 85

Avg = 87.5

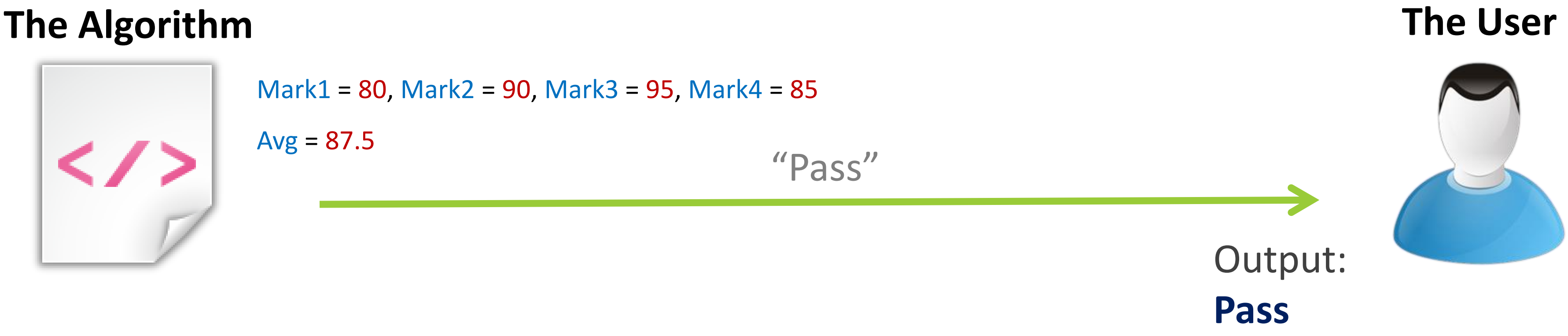
Avg >= 60 = 87.5 >= 60 = Yes

**The User**

# Determining a Student’s Final Grade
## Verifying The Algorithm

```
input Mark1, Mark2, Mark3, Mark4
Avg = (Mark1 + Mark2 + Mark3 + Mark4) / 4
if Avg >= 60:
        print “Pass”
else:
        print “Fail”
End if
```

**Test 1**



**The Algorithm**

Mark1 = 80, Mark2 = 90, Mark3 = 95, Mark4 = 85

Avg = 87.5

“Pass”

**The User**

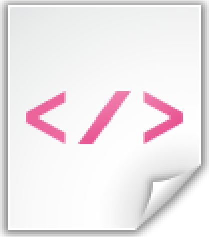
Output:
**Pass**

# Determining a Student’s Final Grade
## Verifying The Algorithm

```
input Mark1, Mark2, Mark3, Mark4
Avg = (Mark1 + Mark2 + Mark3 + Mark4) / 4
if Avg >= 60:
        print “Pass”
else:
        print “Fail”
End if
```

**Test 1**

**The Algorithm**



Mark1 = 80, Mark2 = 90, Mark3 = 95, Mark4 = 85

Avg = 87.5

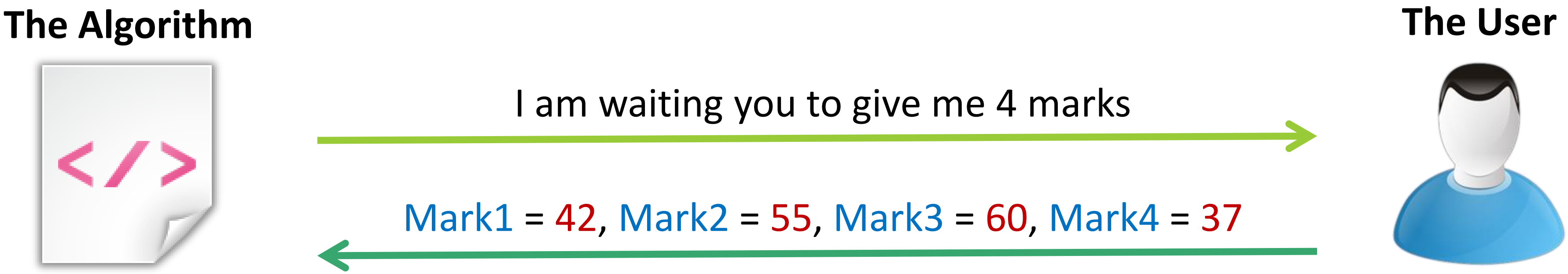
**The User**

Output:
Pass

# Determining a Student’s Final Grade
## Verifying The Algorithm

```
input Mark1, Mark2, Mark3, Mark4
Avg = (Mark1 + Mark2 + Mark3 + Mark4) / 4
if Avg >= 60:
        print “Pass”
else:
        print “Fail”
End if
```

**Test 2**



**The Algorithm**

**The User**

I am waiting you to give me 4 marks

Mark1 = 42, Mark2 = 55, Mark3 = 60, Mark4 = 37

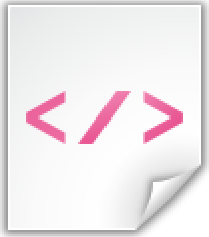
# Determining a Student’s Final Grade

## Verifying The Algorithm

```
input Mark1, Mark2, Mark3, Mark4
Avg = (Mark1 + Mark2 + Mark3 + Mark4) / 4
if Avg >= 60:
    print “Pass”
else:
    print “Fail”
End if
```

**Test 2**

**The Algorithm**



Mark1 = 42, Mark2 = 55, Mark3 = 60, Mark4 = 37

Avg = (42 + 55 + 60 + 37) / 4 = 194 / 4 = 48.5

**The User**

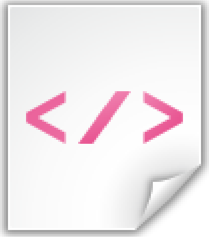
# Determining a Student’s Final Grade

## Verifying The Algorithm

```
input Mark1, Mark2, Mark3, Mark4
Avg = (Mark1 + Mark2 + Mark3 + Mark4) / 4
if Avg >= 60:
    print “Pass”
else:
    print “Fail”
End if
```

**Test 2**

**The Algorithm**



Mark1 = 42, Mark2 = 55, Mark3 = 60, Mark4 = 37

Avg = 48.5

Avg >= 60 = 48.5 >= 60 = No

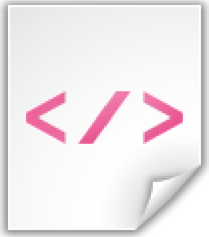
**The User**

# Determining a Student’s Final Grade
## Verifying The Algorithm

```
input Mark1, Mark2, Mark3, Mark4
Avg = (Mark1 + Mark2 + Mark3 + Mark4) / 4
if Avg >= 60:
        print “Pass”
else:
        print “Fail”
End if
```

**Test 2**

**The Algorithm**



Mark1 = 42, Mark2 = 55, Mark3 = 60, Mark4 = 37

Avg = 48.5

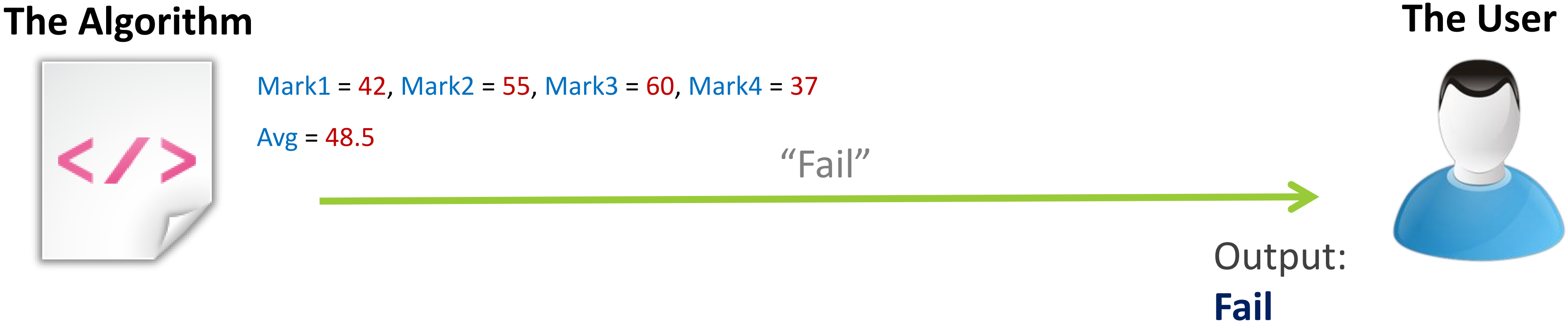
**The User**

# Determining a Student’s Final Grade

## Verifying The Algorithm

```
input Mark1, Mark2, Mark3, Mark4
Avg = (Mark1 + Mark2 + Mark3 + Mark4) / 4
if Avg >= 60:
        print “Pass”
else:
        print “Fail”
End if
```

**Test 2**



**The Algorithm**

**The User**

Mark1 = 42, Mark2 = 55, Mark3 = 60, Mark4 = 37

Avg = 48.5

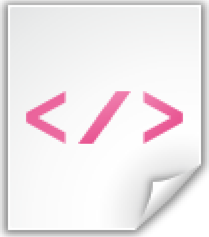
Output:
**Fail**

# Determining a Student’s Final Grade
## Verifying The Algorithm

```
input Mark1, Mark2, Mark3, Mark4
Avg = (Mark1 + Mark2 + Mark3 + Mark4) / 4
if Avg >= 60:
    print “Pass”
else:
    print “Fail”
End if
```

**Test 2**

**The Algorithm**



Mark1 = 42, Mark2 = 55, Mark3 = 60, Mark4 = 37

Avg = 48.5

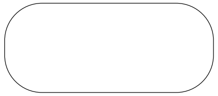
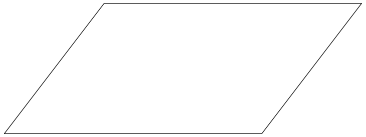
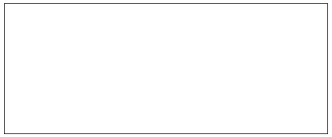
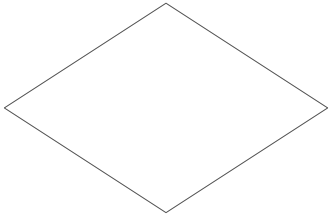
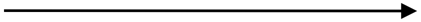
**The User**

Output:
Fail

# Flowchart

- A graphical representation of the sequence of operations in an information system or program.
- Program flowcharts show the sequence of instructions in a single program or subroutine.
  - show logic of an algorithm
  - emphasize individual steps and their interconnections
  - e.g. control flow from one action to the next
- Different symbols are used to draw each type of flowchart.

# Flowchart Symbols

| **Name** | **Symbol** | **Use in Flowchart** |
|---|---|---|
| Oval |  | Denotes the beginning or end of the program. |
| Parallelogram |  | Denotes an input / output operations. |
| Rectangle |  | Denotes a process to be carried out.<br>For example: addition, subtraction, and division. |
| Diamond |  | Denotes a decision or branch to be made The program should continue along one of two routes (Ex. If/Then/Else) |
| Flow line |  | Denotes the direction of logic flow in the program |

# Flowcharts

- Are flowcharts really necessary or helpful?
  - In the real world, programs are not only 1000 lines.
  - Programs are hundreds of thousands of lines of code.
    - Even Millions of lines of code.
  - Could you use only English to describe your program?
    - Sure you could, but you would end up with a book!
  - Therefore, think of flowcharts as an easier, clearer way to quickly understand what a program is doing.

# Flowcharts

- Are flowcharts really necessary or helpful?
  - So in summary, yes, they are helpful.

- That said, most of the programs we show you over the next few weeks are smaller programs.
  - Do you really need a flowchart for a small program?
  - Probably not.
  - However, students should get into the habit of making flowcharts with smaller, easier programs.
  - Then, it will be easy to do for larger programs.

# Converting The Length
## Example 5

Write an Algorithm, Pseudocode, and draw a flowchart to convert the length in feet to centimeter.

Algorithm:

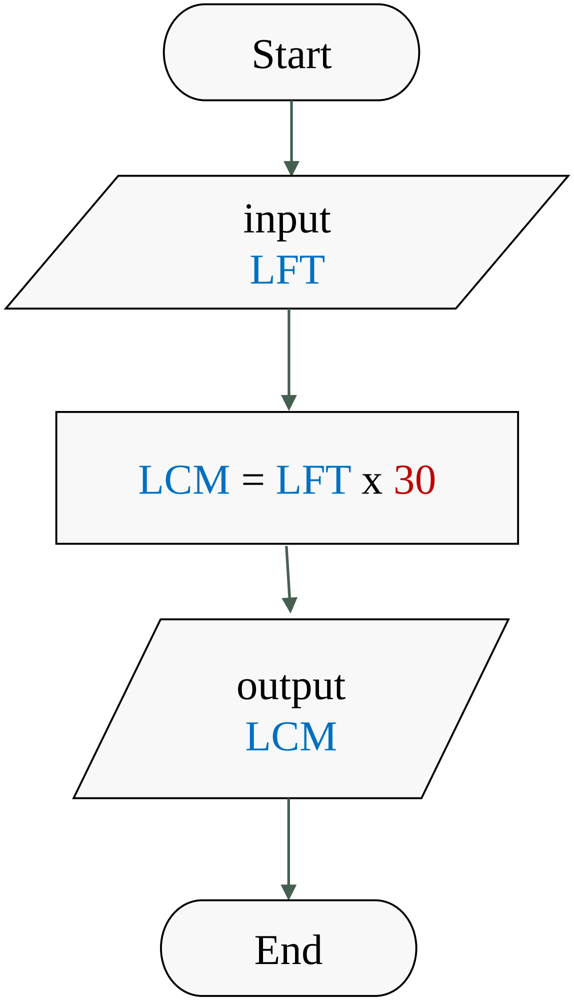
1. Input the length in feet (LFT)
2. Calculate the length in cm (LCM) by multiplying LFT with 30
3. Print length in cm (LCM)

# Converting The Length
## The Algorithm

Pseudocode:

```
1.  LFT  = input “Length in feet”
2.  LCM = LFT x 30
3.  print LCM
```

Flowchart:



Start

input
LFT

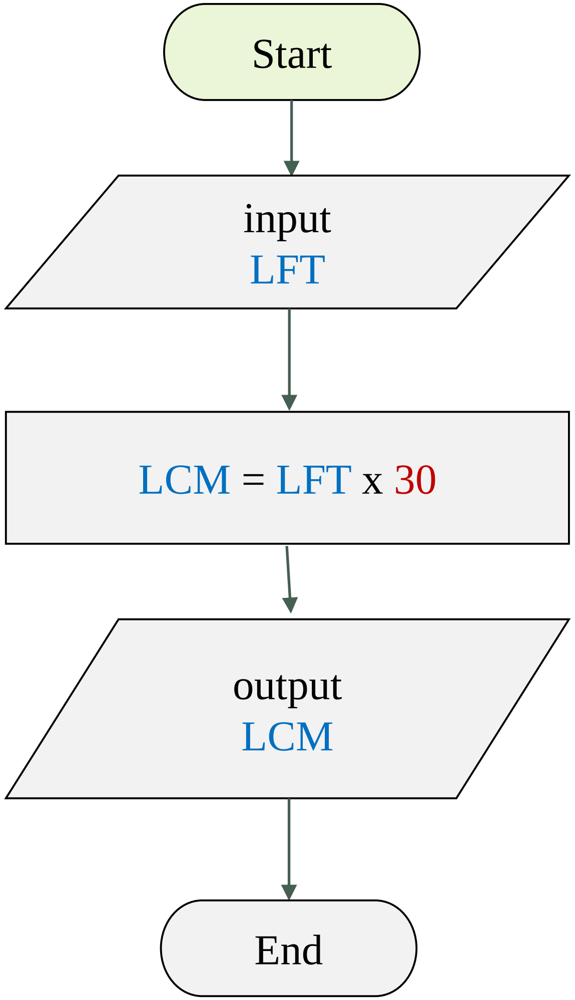
LCM = LFT x 30

output
LCM

End

# Converting The Length
## Verifying The Algorithm

**The Algorithm**


Start

input
LFT

LCM = LFT x 30

output
LCM

End

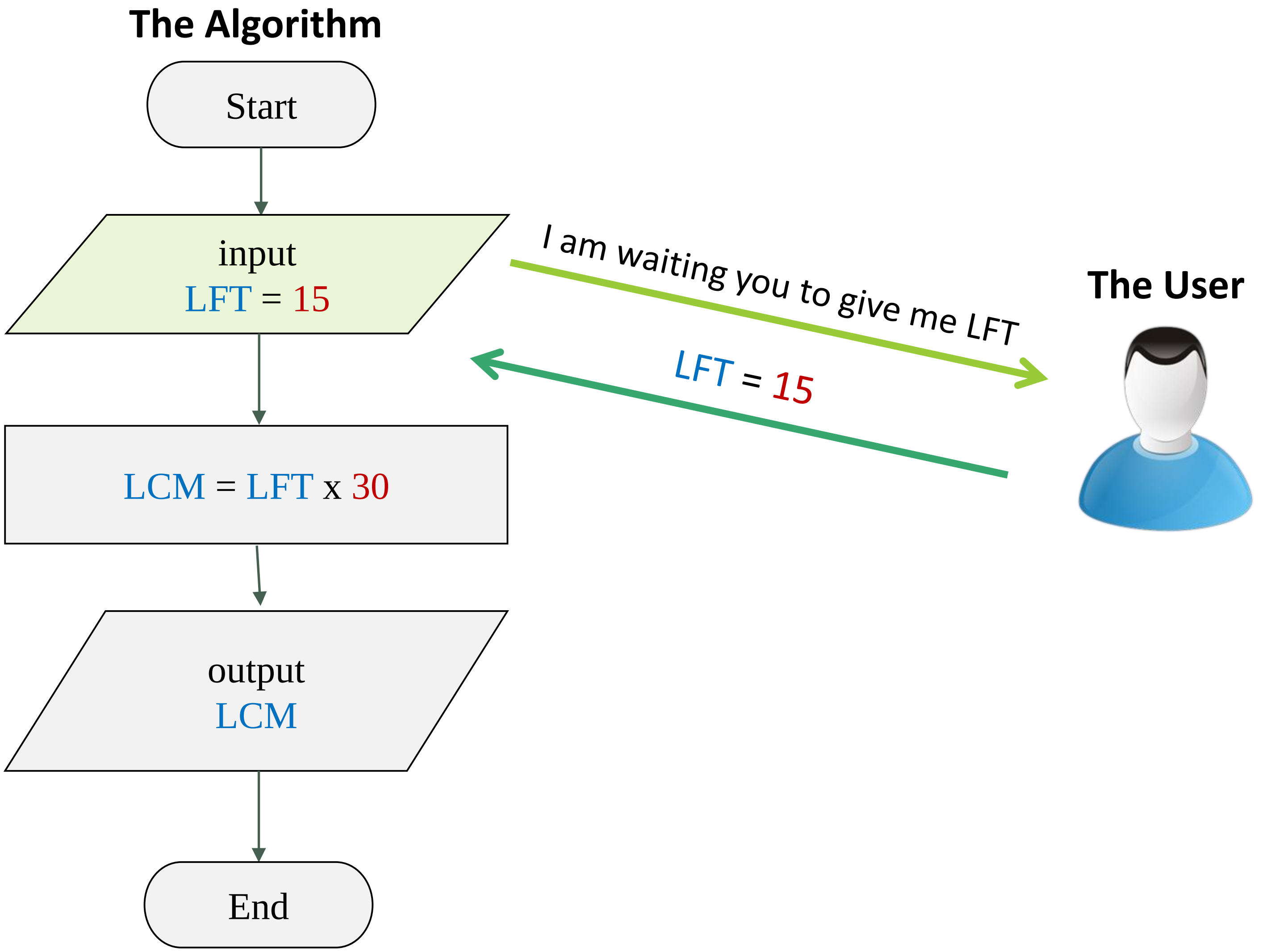
**Test 1**

**The User**

# Converting The Length

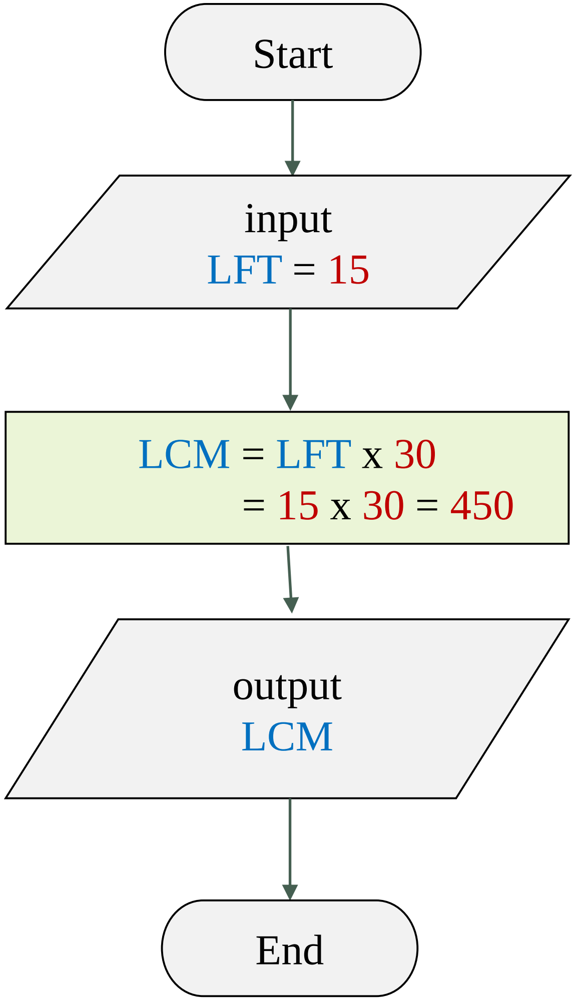
## Verifying The Algorithm

Test 1



# Converting The Length
## Verifying The Algorithm

**The Algorithm**

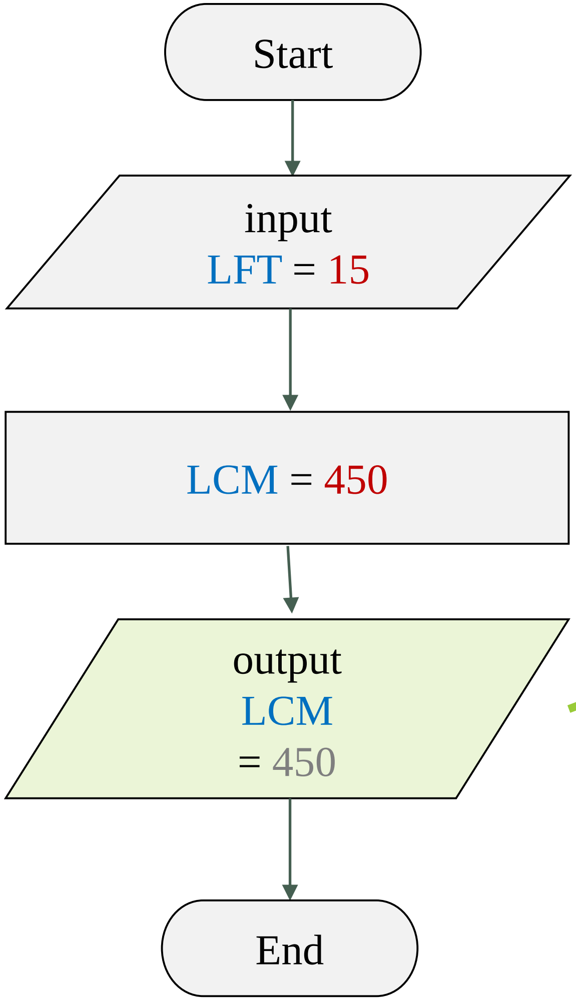


**Test 1**

**The User**

# Converting The Length
## Verifying The Algorithm

**The Algorithm**



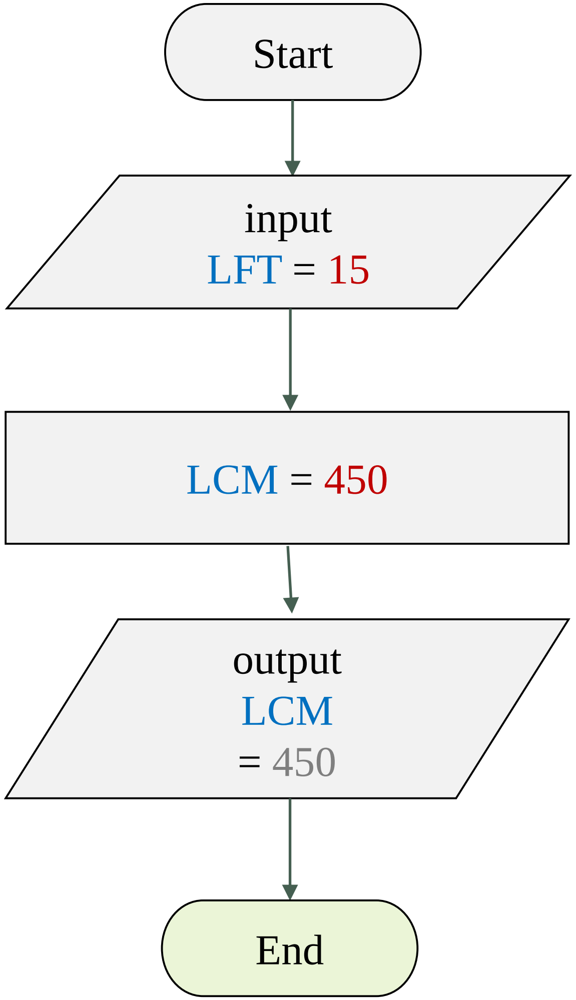
**Test 1**

**The User**

Output:
**450**

# Converting The Length
## Verifying The Algorithm

**The Algorithm**



**Test 1**

**The User**

Output:
450

# Area of a Rectangle Calculator
## Example 6

Write an Algorithm, Pseudocode, and draw a flowchart that will read the two sides of a rectangle and calculate its area.

Algorithm:

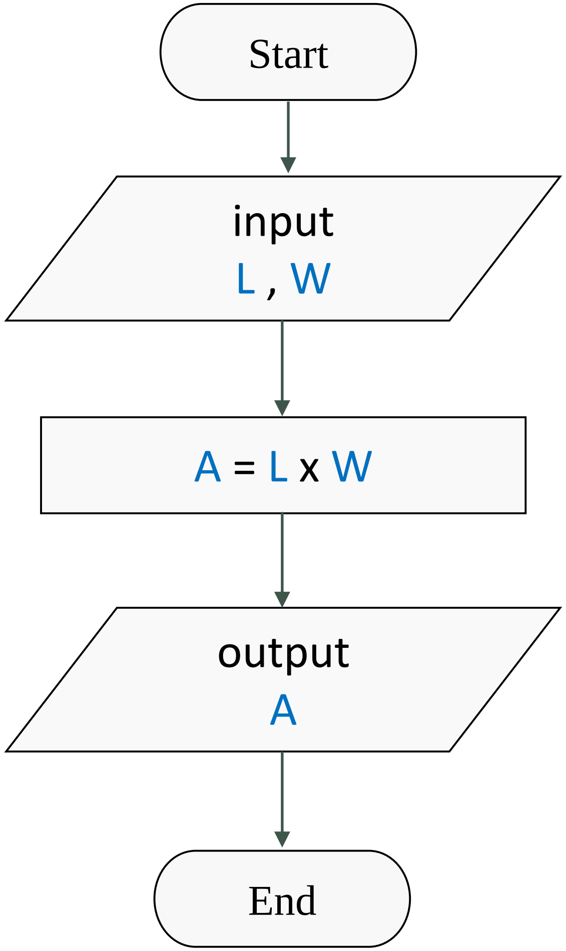
1. Input the Length (L) and width (W) of a rectangle
2. Calculate the area (A) by multiplying L with W
3. Print A

# Area of a Rectangle Calculator
## The Algorithm

Pseudocode:

```
1. input L, W
2. A = L x W
3. print A
```

Flowchart:



Start

input
L , W

A = L x W

output
A

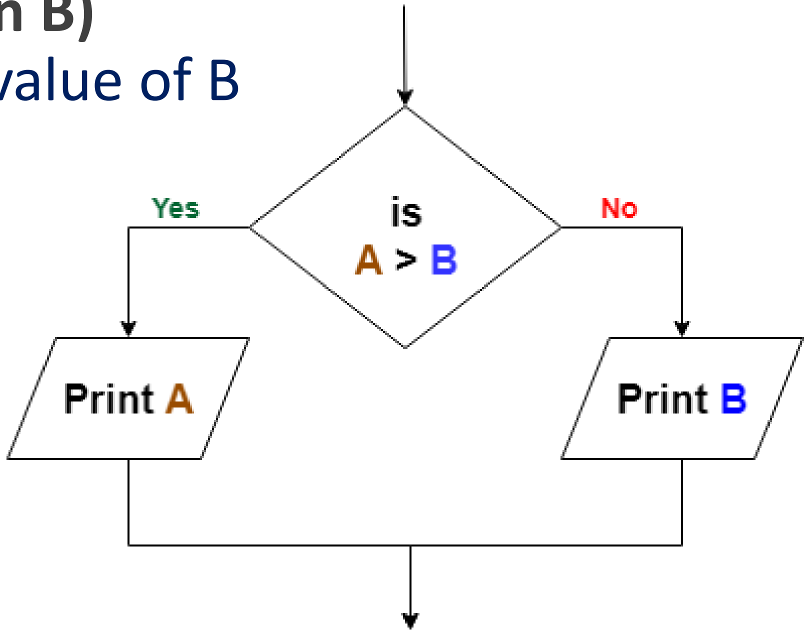
End

# 0.5. Decision Structures

- If–then–else Structure
- Relational Operators
- Example 7: Determining The Largest Value

# Decision Structures

- The expression A > B is a logical expression
- It describes a **condition** we want to test
- **if A > B is true (if A is greater than B)**
  we take the action on left: print the value of A
- **if A > B is false (if A is not greater than B)**
  we take the action on right: print the value of B
- Note: Print = Output



# If–then–else Structure

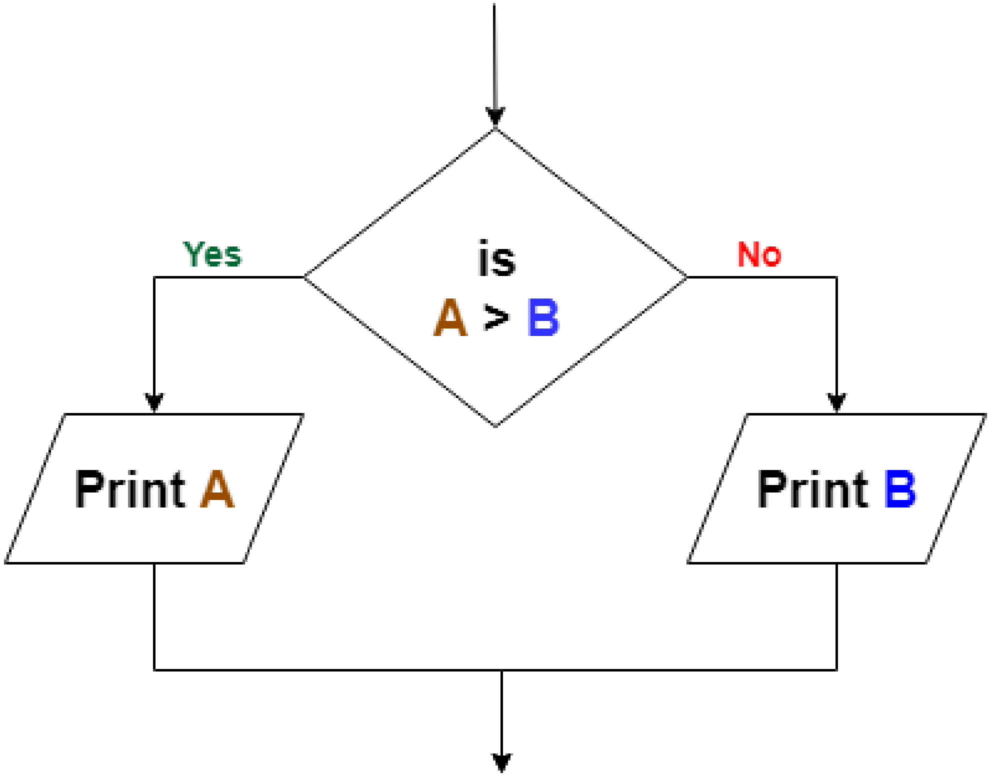
- The structure is as follows

```
if condition then
    true alternative
else
    false alternative
End if
```

# If–then–else Structure

- The algorithm for the flowchart is as follows:

```
if A > B then
        print A
else
        print B
End if
```



# Relational Operators

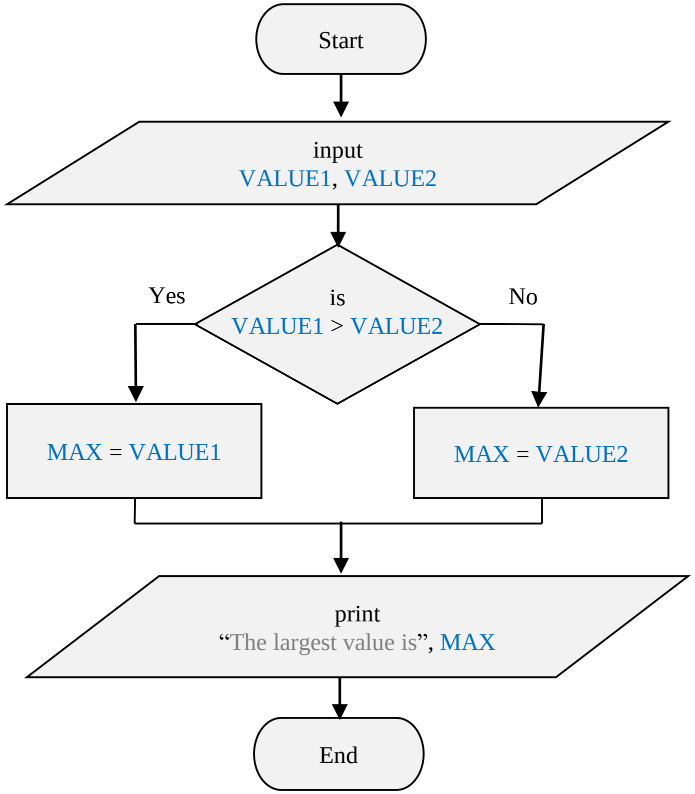
| Relational Operators | |
|---|---|
| **Operator** | **Description** |
| > | Greater than |
| < | Less than |
| == | Equal to |
| ≥ Or >= | Greater than or equal to |
| ≤ Or <= | Less than or equal to |
| ≠ Or != | Not equal to |

# Determining The Largest Value
## Example 7

Write a Pseudocode that reads two values, determines the largest value and prints the largest value with an identifying message.

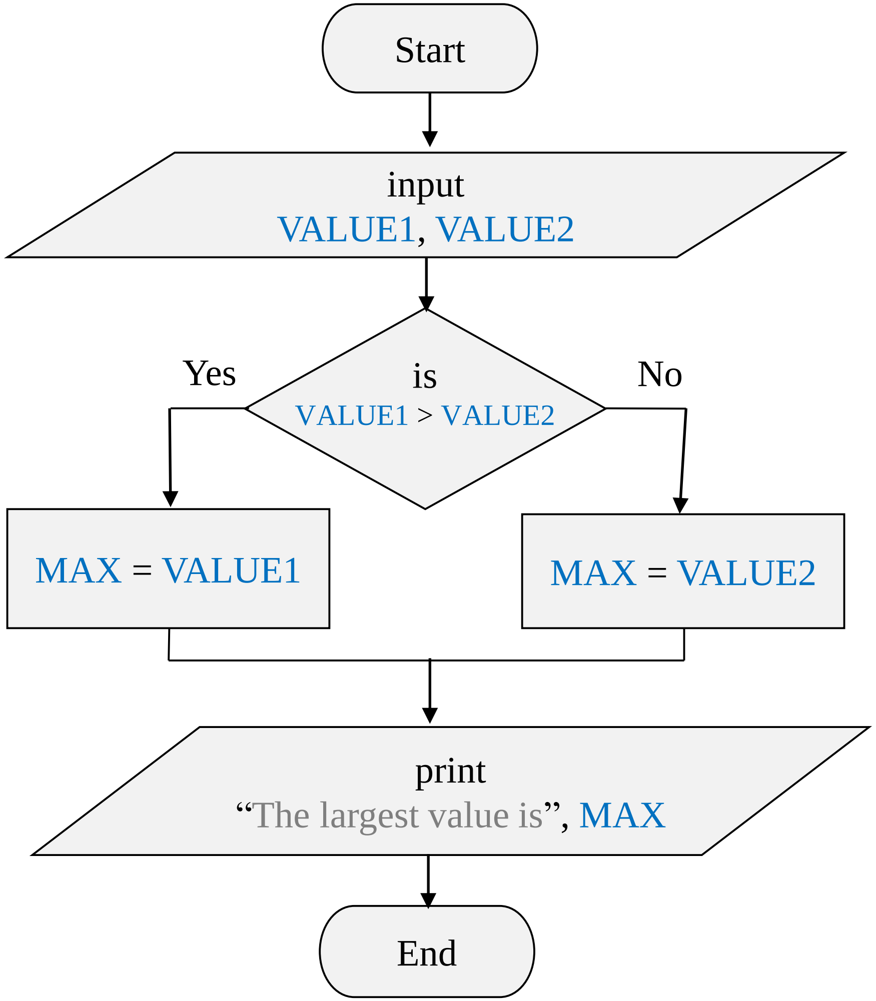
Pseudocode:

```
1. Input VALUE1, VALUE2
2. if (VALUE1 > VALUE2) then
3.         MAX = VALUE1
4. else
5.         MAX = VALUE2
6. endif
7. print “The largest value is”, MAX
```



# Determining The Largest Value

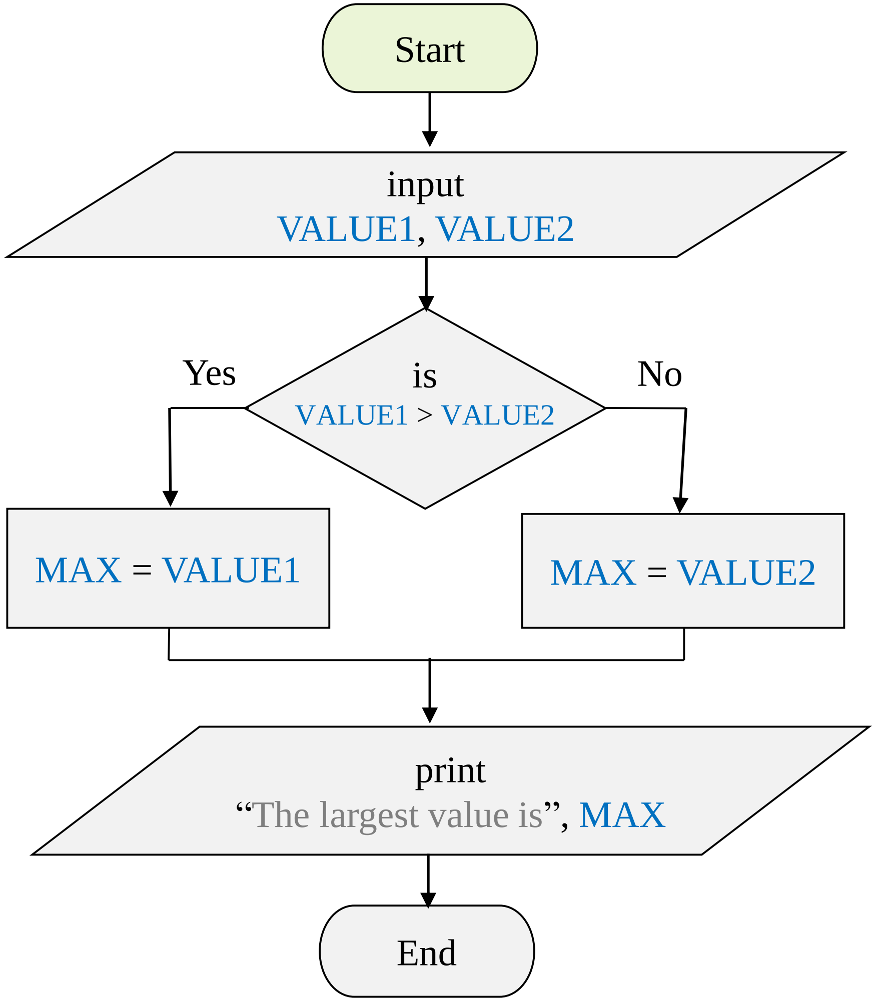
## The Algorithm



# Determining The Largest Value

## Verifying The Algorithm

**The Algorithm**



**Test 1**

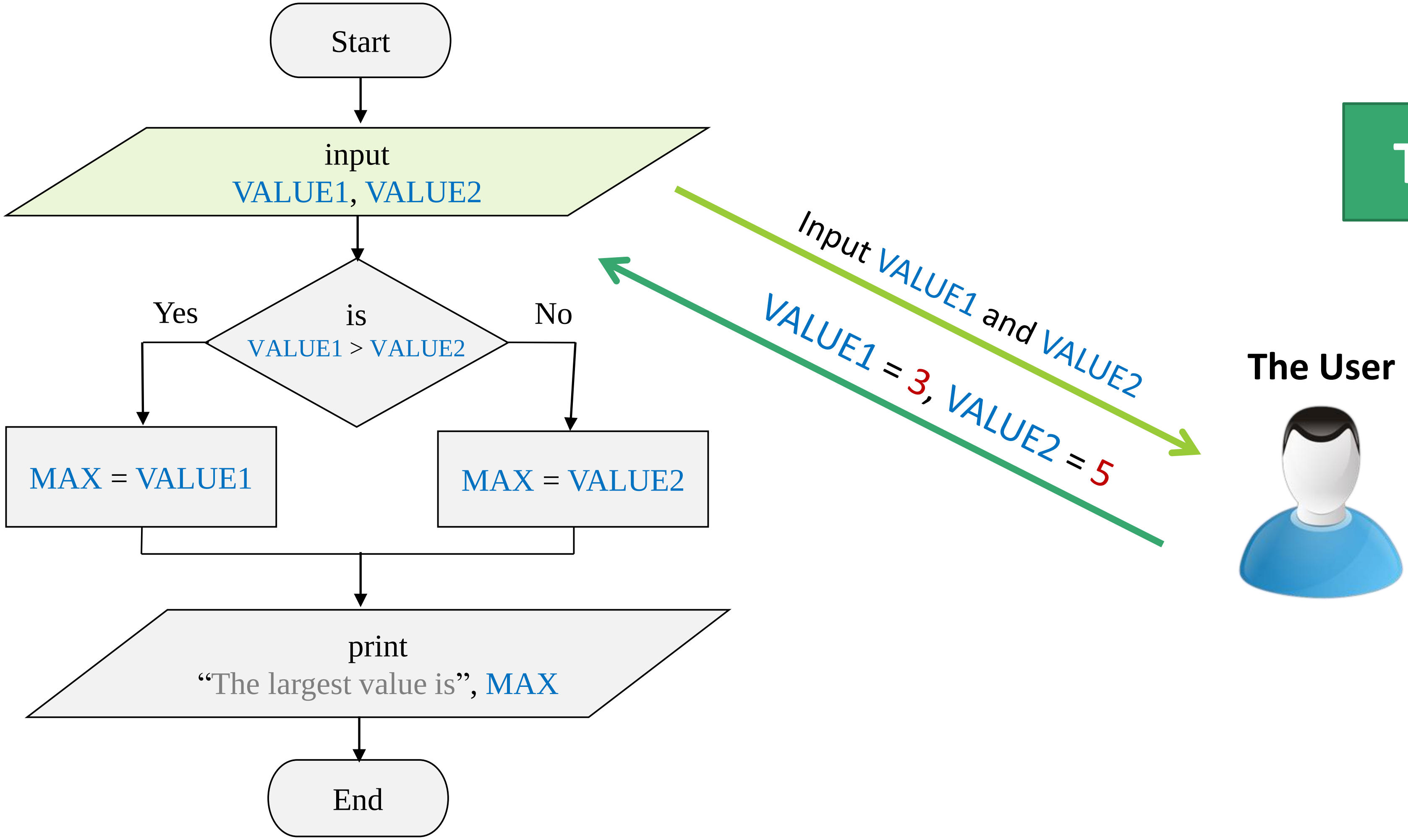
**The User**

# Determining The Largest Value

## Verifying The Algorithm

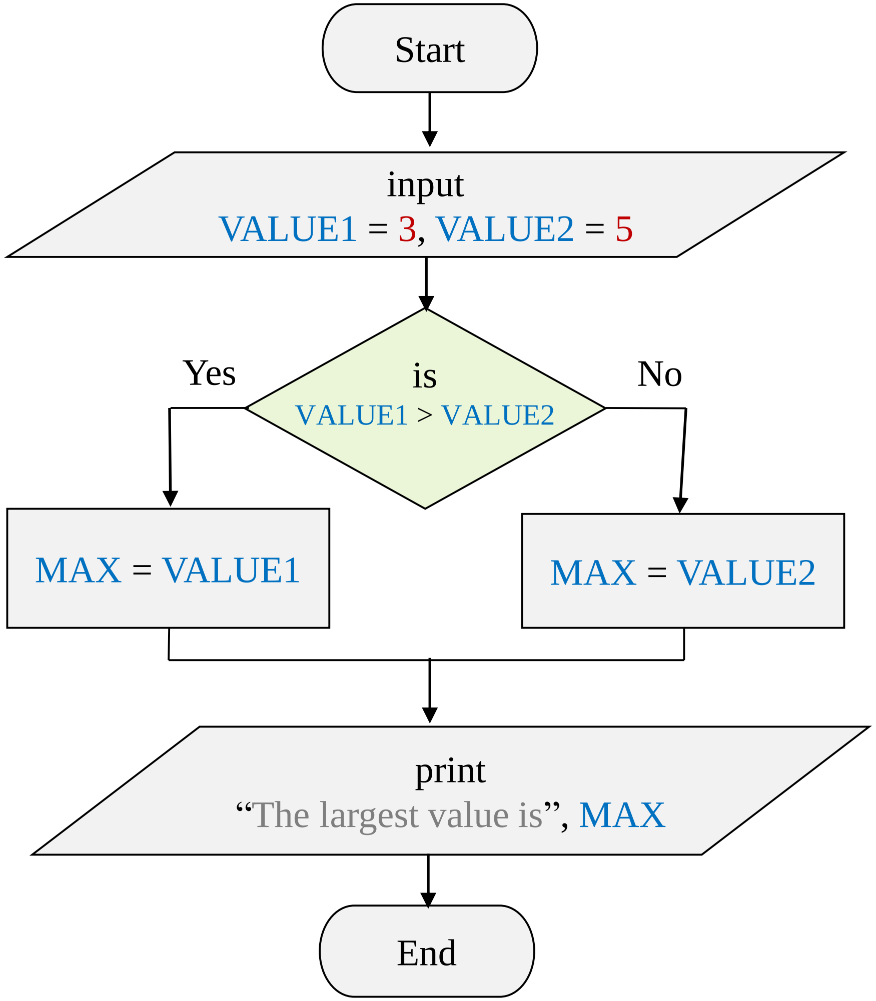
**The Algorithm**

**Test 1**



# Determining The Largest Value
## Verifying The Algorithm

**The Algorithm**

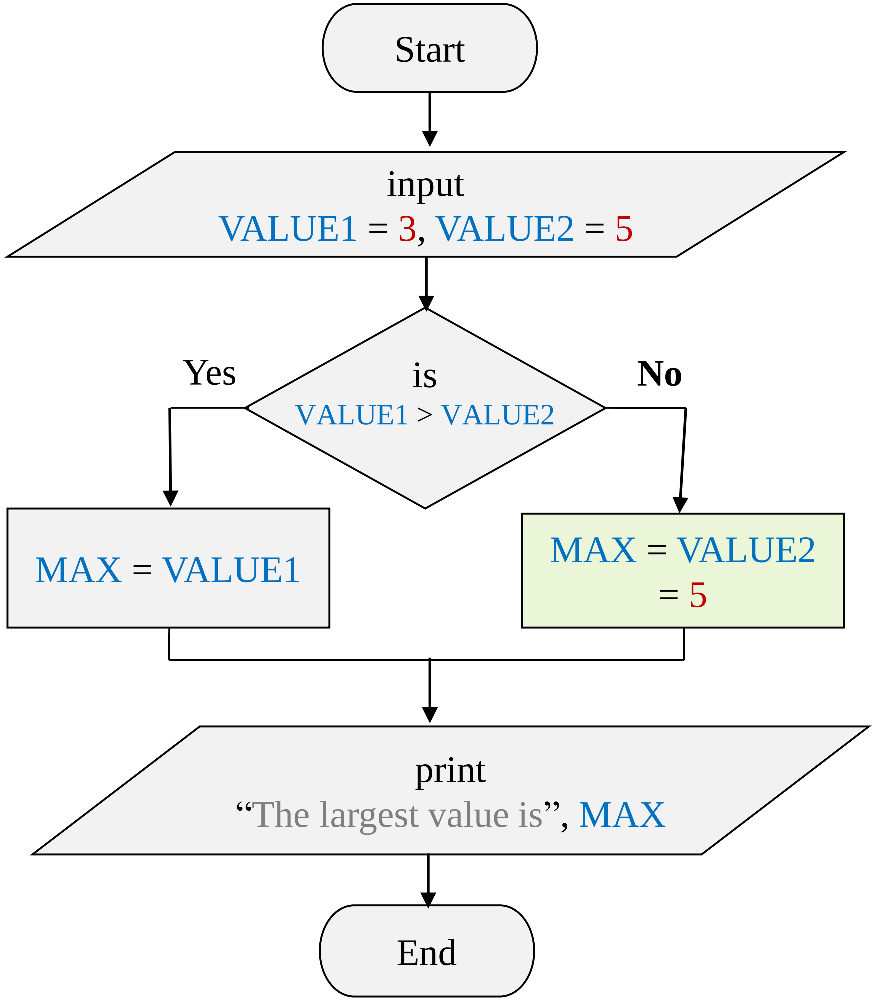


**Test 1**

**The User**

# Determining The Largest Value
## Verifying The Algorithm

**The Algorithm**



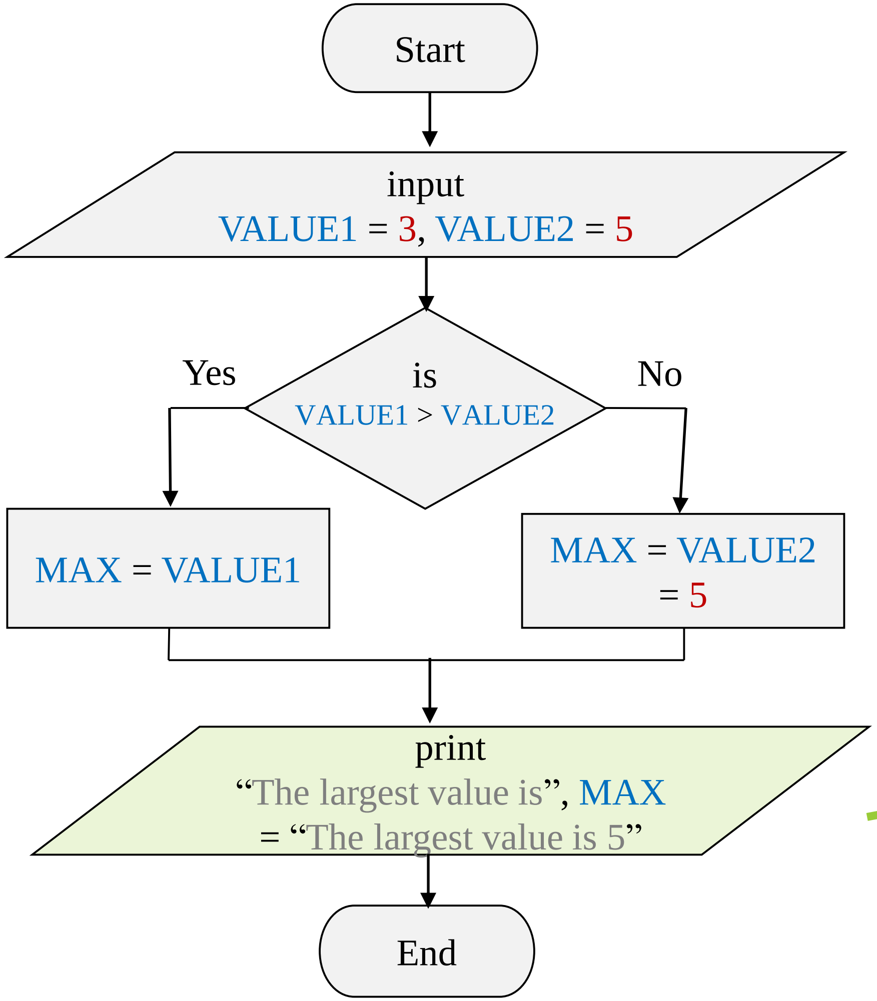
**Test 1**

**The User**

# Determining The Largest Value

## Verifying The Algorithm

**The Algorithm**



**Test 1**

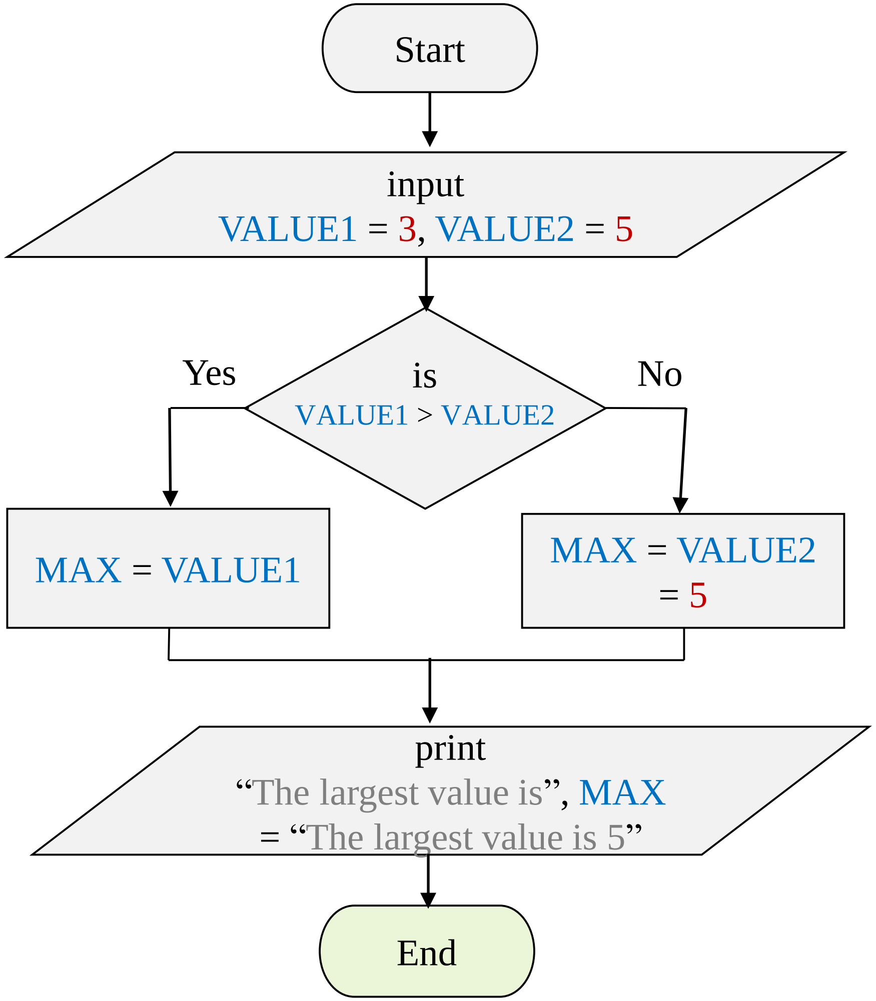
**The User**

Output:

**The largest value is 5**

# Determining The Largest Value
## Verifying The Algorithm

**The Algorithm**



Start

input
VALUE1 = 3, VALUE2 = 5

is
VALUE1 > VALUE2

Yes

No

MAX = VALUE1

MAX = VALUE2
= 5

print
“The largest value is”, MAX
= “The largest value is 5”

End

**Test 1**

**The User**

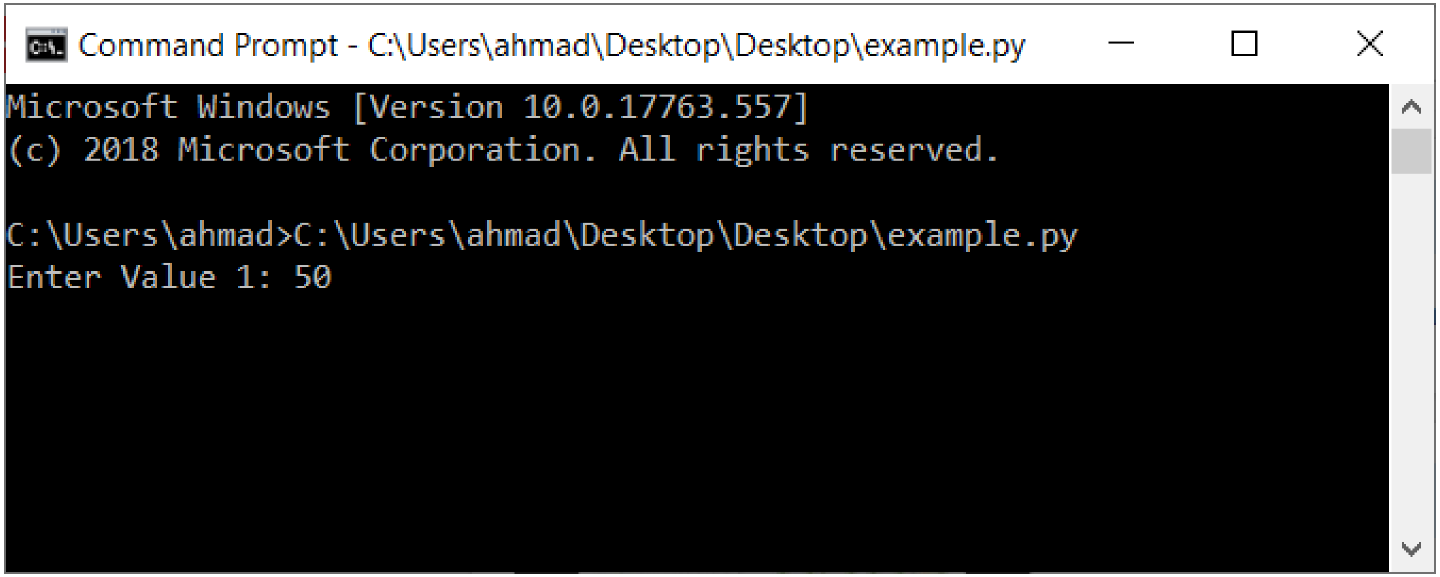
Output:
The largest value is 5

# Determining The Largest Value

## Verifying The Algorithm

```
Input VALUE1, VALUE2
if (VALUE1 > VALUE2) then
    MAX = VALUE1
else
    MAX = VALUE2
endif
print "The largest value is", MAX
```

**Test 2**

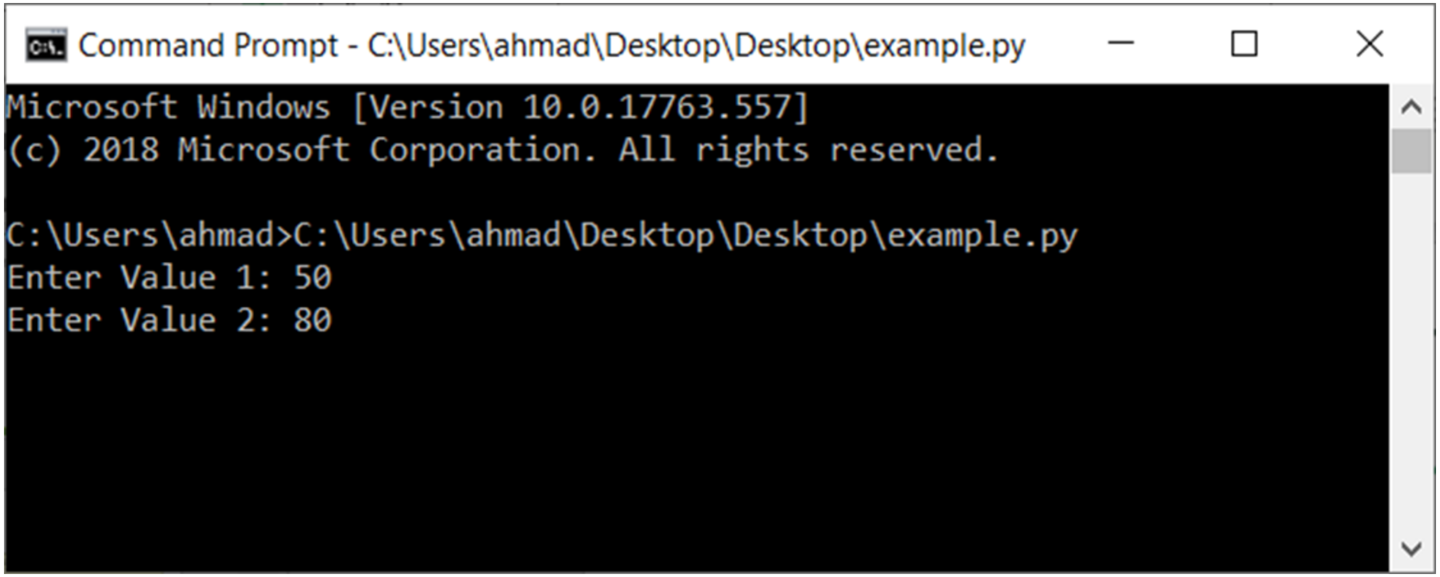


```
Microsoft Windows [Version 10.0.17763.557]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\ahmad>C:\Users\ahmad\Desktop\Desktop\example.py
Enter Value 1: 50
```

# Determining The Largest Value
## Verifying The Algorithm

```
Input VALUE1, VALUE2
if (VALUE1 > VALUE2) then
    MAX = VALUE1
else
    MAX = VALUE2
endif
print "The largest value is", MAX
```

**Test 2**

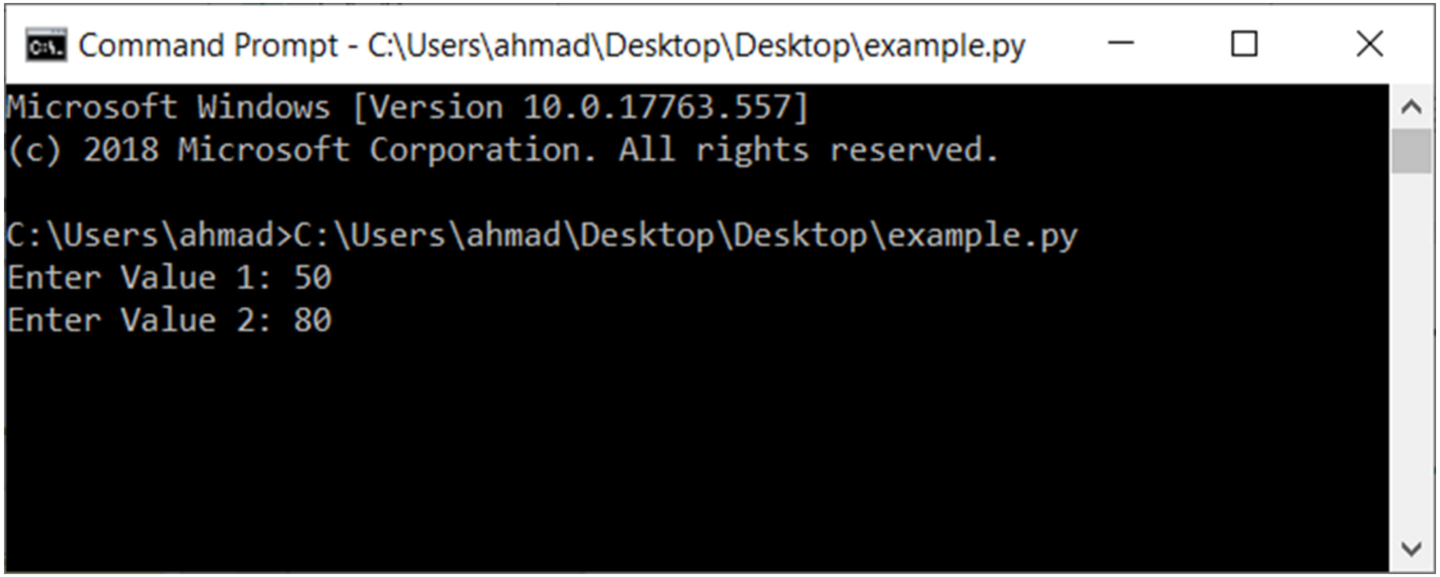


```
Microsoft Windows [Version 10.0.17763.557]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\ahmad>C:\Users\ahmad\Desktop\Desktop\example.py
Enter Value 1: 50
Enter Value 2: 80
```

# Determining The Largest Value
## Verifying The Algorithm

```
Input VALUE1, VALUE2
if (VALUE1 > VALUE2) then
        MAX = VALUE1
else
        MAX = VALUE2
endif
print "The largest value is", MAX
```

**Test 2**



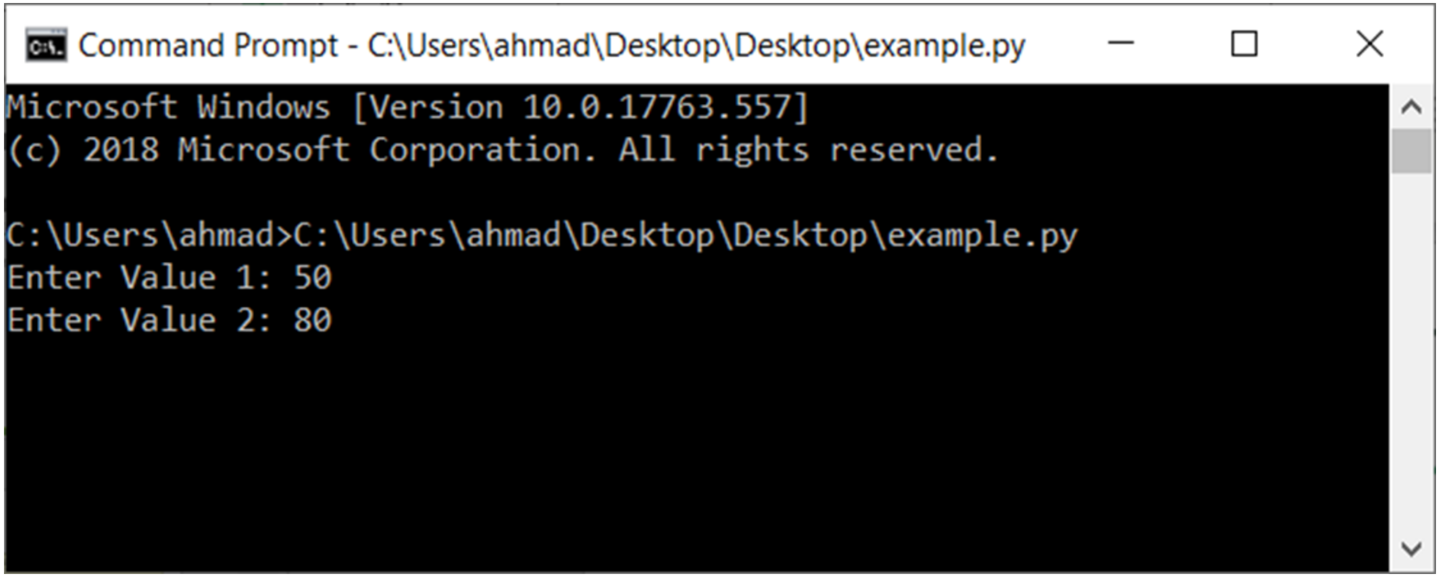
```
Microsoft Windows [Version 10.0.17763.557]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\ahmad>C:\Users\ahmad\Desktop\Desktop\example.py
Enter Value 1: 50
Enter Value 2: 80
```

# Determining The Largest Value

## Verifying The Algorithm

```
1. Input VALUE1, VALUE2
2. if (VALUE1 > VALUE2) then
3.         MAX = VALUE1
4. else
5.         MAX = VALUE2
6. endif
7. print "The largest value is", MAX
```

**Test 2**



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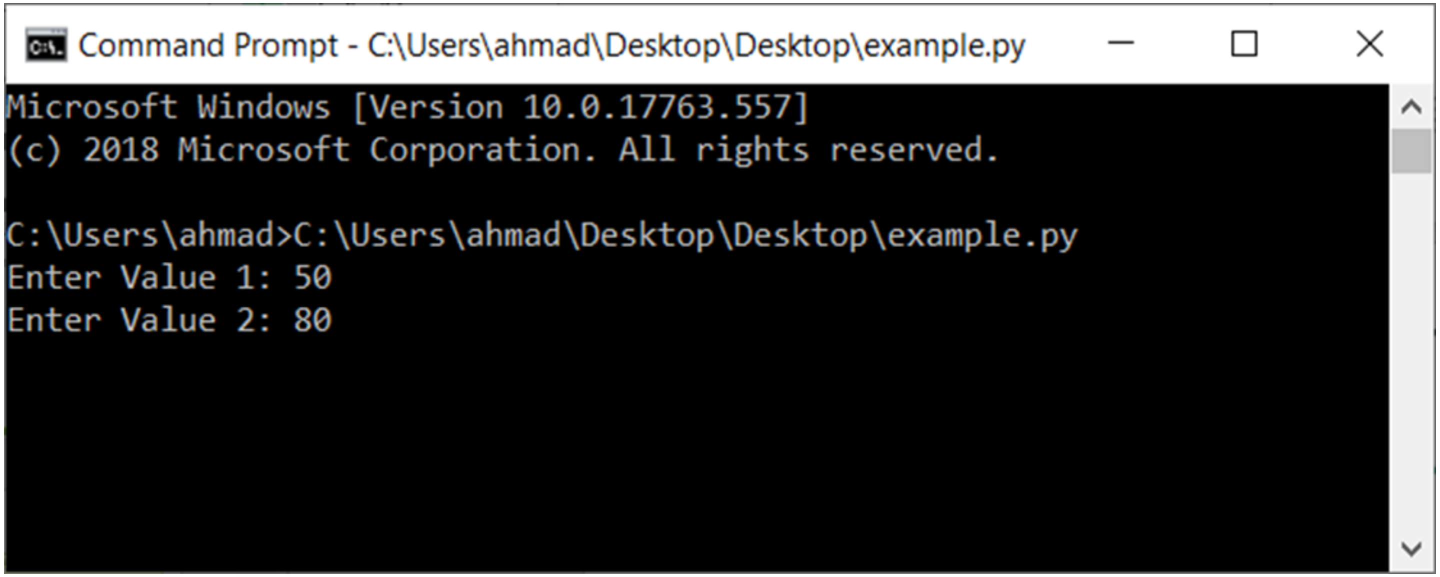

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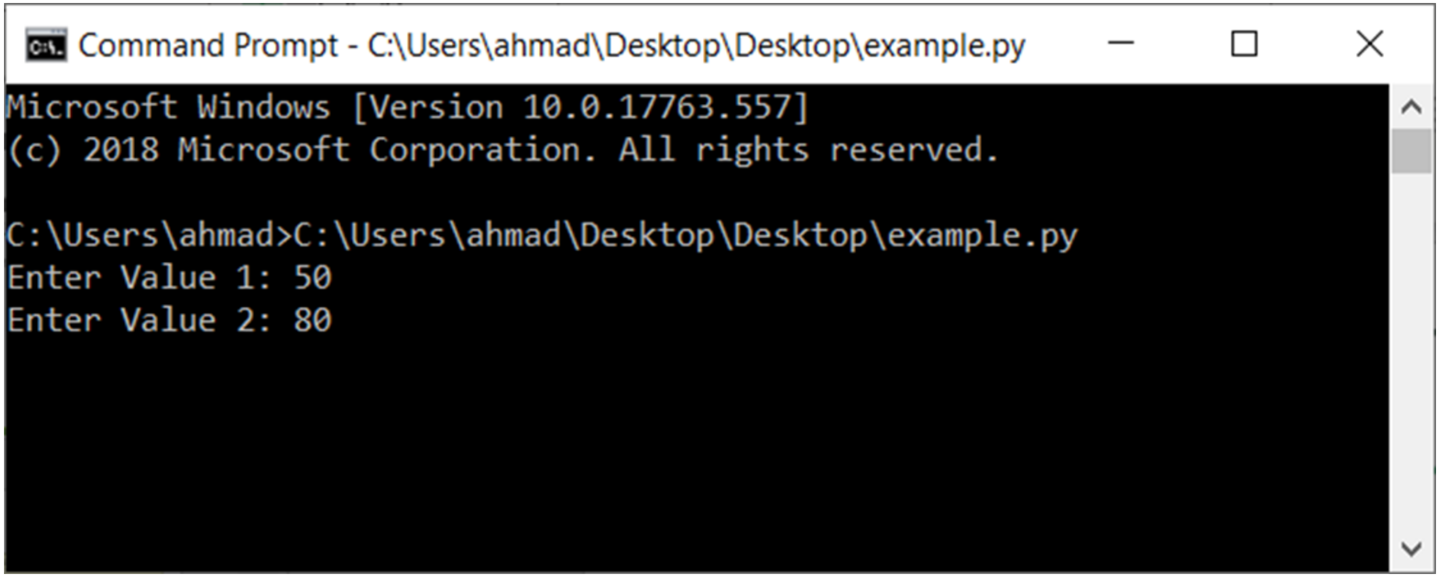

```
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C:\Users\ahmad>C:\Users\ahmad\Desktop\Desktop\example.py
Enter Value 1: 50
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```
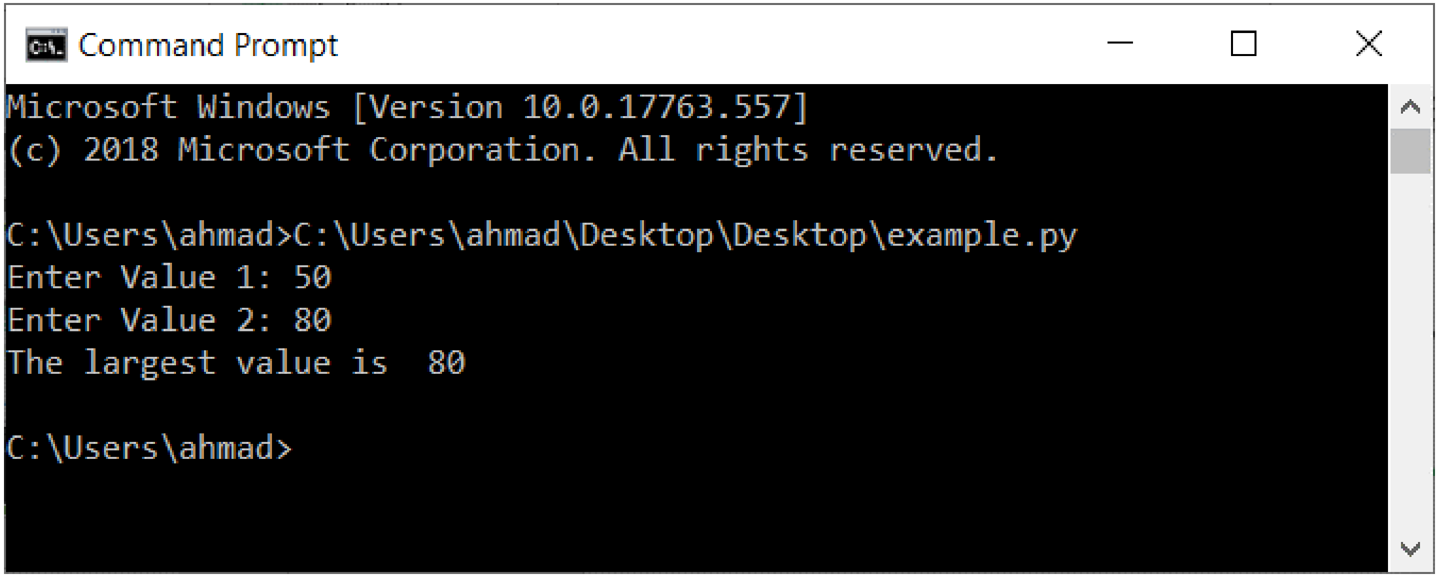

# Determining The Largest Value
## Verifying The Algorithm

```
Input VALUE1, VALUE2
if (VALUE1 > VALUE2) then
    MAX = VALUE1
else
    MAX = VALUE2
endif
print “The largest value is”, MAX
```

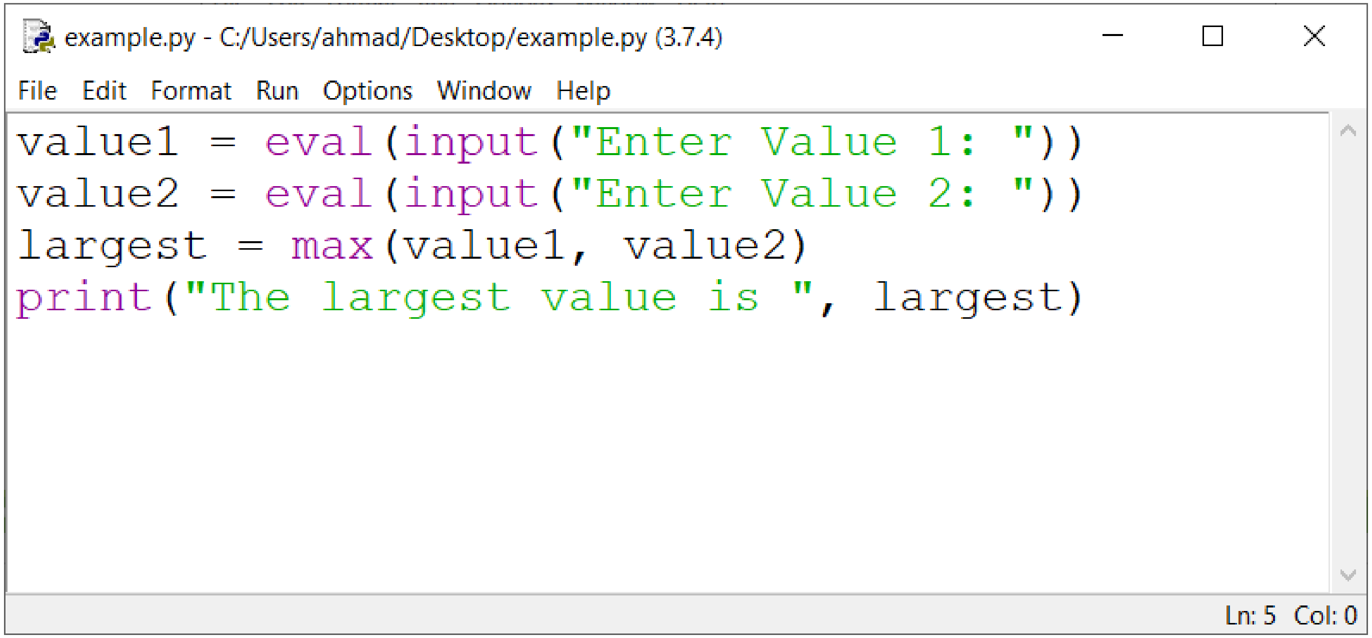
**Test 2**



```
Microsoft Windows [Version 10.0.17763.557]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\ahmad>C:\Users\ahmad\Desktop\Desktop\example.py
Enter Value 1: 50
Enter Value 2: 80
The largest value is  80

C:\Users\ahmad>
```

# Determining The Largest Value
## Python Code

```python
value1 = eval(input("Enter Value 1: "))
value2 = eval(input("Enter Value 2: "))
largest = max(value1, value2)
print("The largest value is ", largest)
```


example.py - C:/Users/ahmad/Desktop/example.py (3.7.4)
File Edit Format Run Options Window Help
Ln: 5 Col: 0

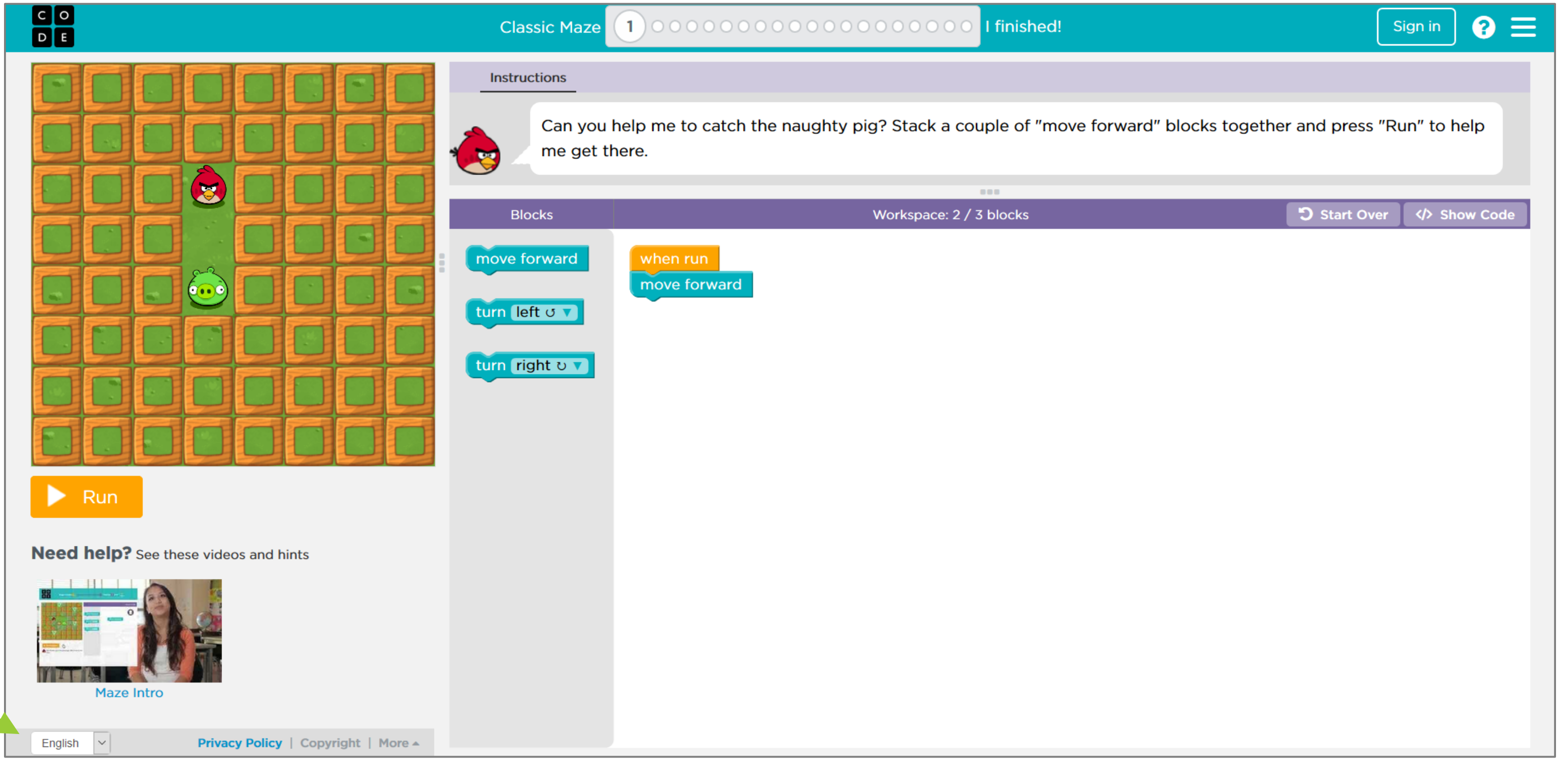
```python
value1 = eval(input("Enter Value 1: "))
value2 = eval(input("Enter Value 2: "))
largest = max(value1, value2)
print("The largest value is ", largest)
```

# End

- Play & Learn

# Play & Learn

- Be familiar with basic logic and problem-solving techniques through practicing at Code.org.
- Visit https://studio.code.org/hoc/1 and play.

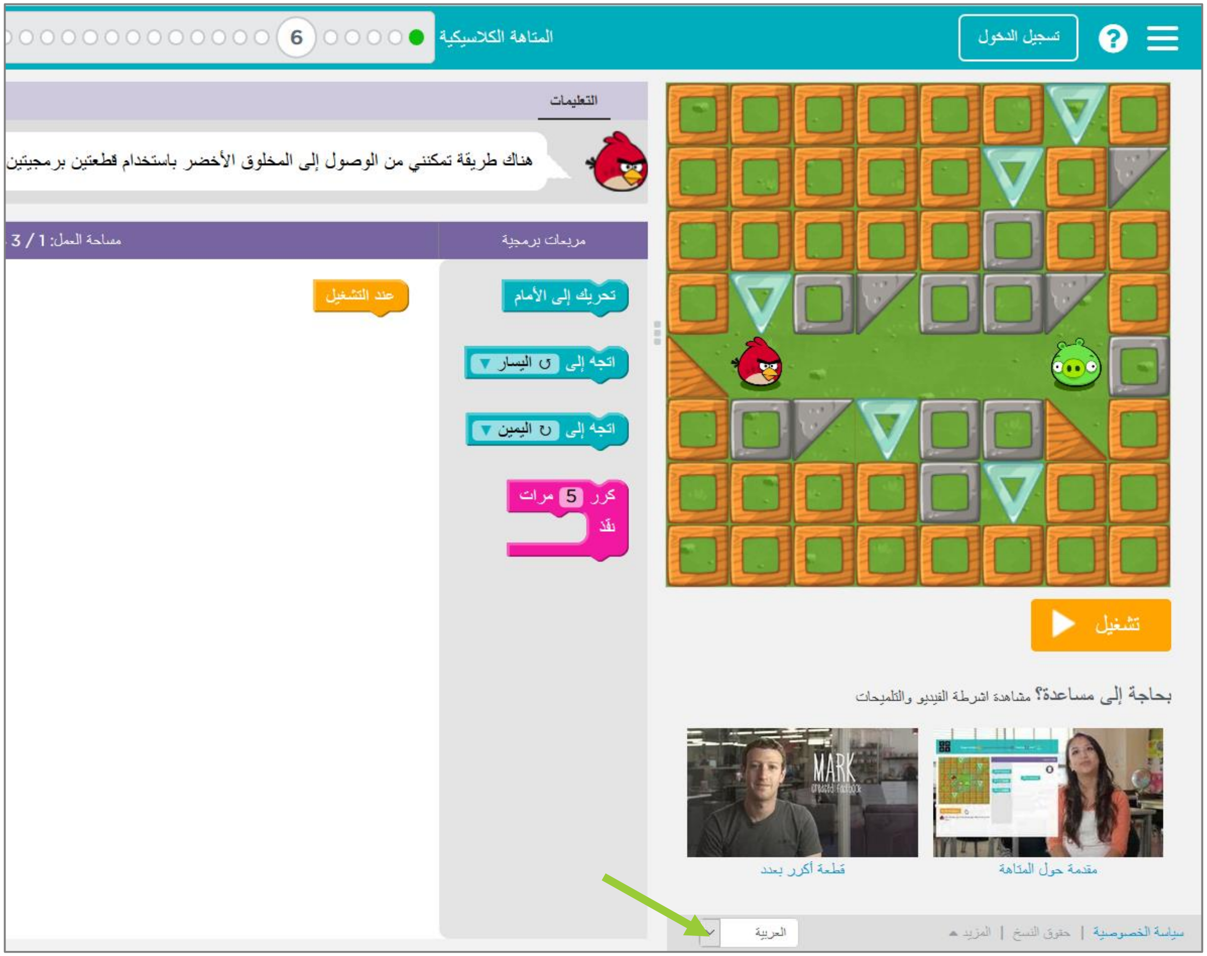


Can you help me to catch the naughty pig? Stack a couple of "move forward" blocks together and press "Run" to help me get there.

**Need help?** See these videos and hints

# Play & Learn

- Note: You can select “Arabic” from the menu at the bottom.



هناك طريقة تمكنني من الوصول إلى المخلوق الأخضر باستخدام قطعتين برمجيتين

بحاجة إلى مساعدة؟ مشاهدة اشرطة الفيديو والتلميحات