# Beginner Programming Fundamentals With Python

## Module 2

## Input, Processing and Output

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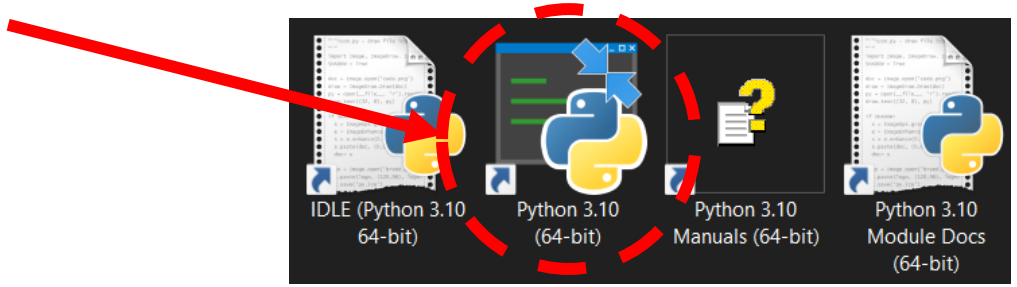
Jan 2022

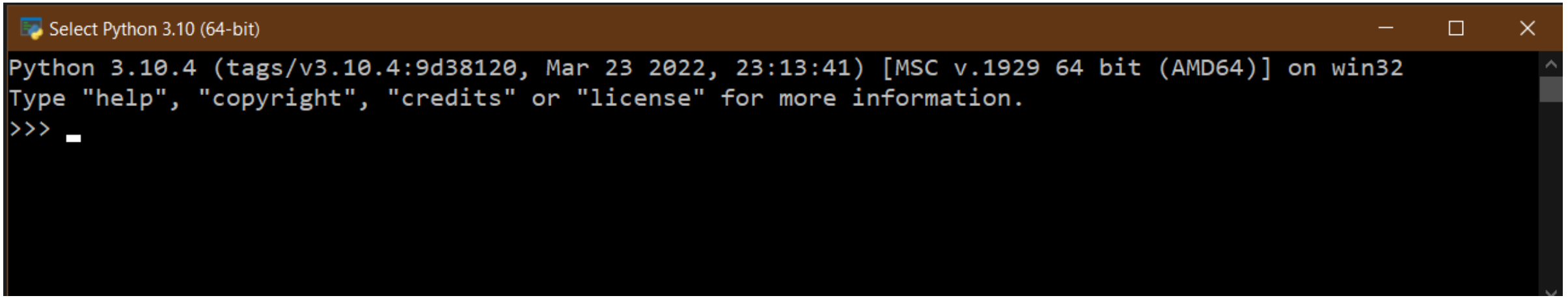
# Module Roadmap

1. Using Python
2. Designing a Program & Problem Solving
3. Input, Processing and Output
4. Variables & Data Types
5. Working with Inputs & Performing Calculation
6. Working with Numbers & Strings

# Interactive Mode (REPL)

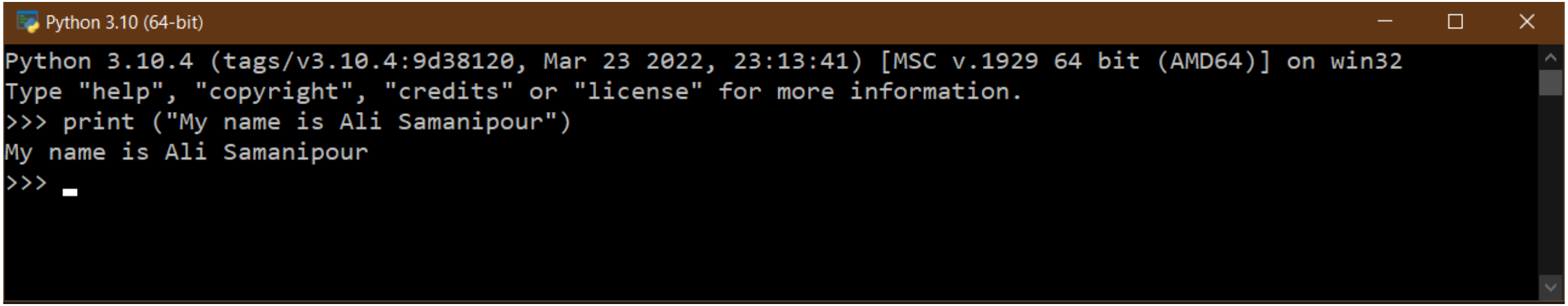
When the Python interpreter is running in interactive mode, it is commonly called the ***Python shell*** or ***REPL***. (useful for testing)



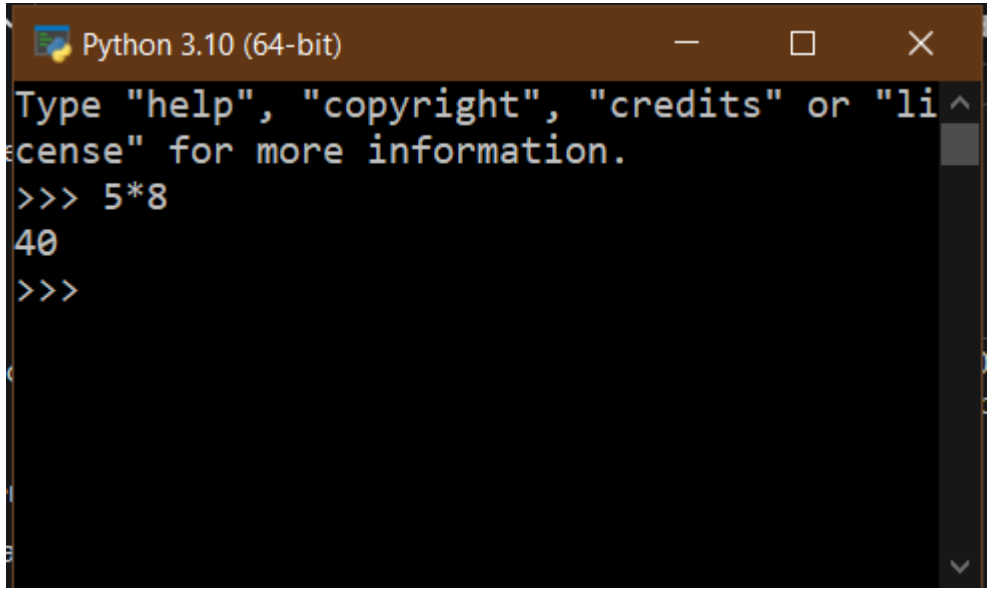



# Interactive Mode (REPL)

The >>> that you see is a prompt that indicates the interpreter is waiting for you to type a Python statement.



# Interactive Mode (REPL) …

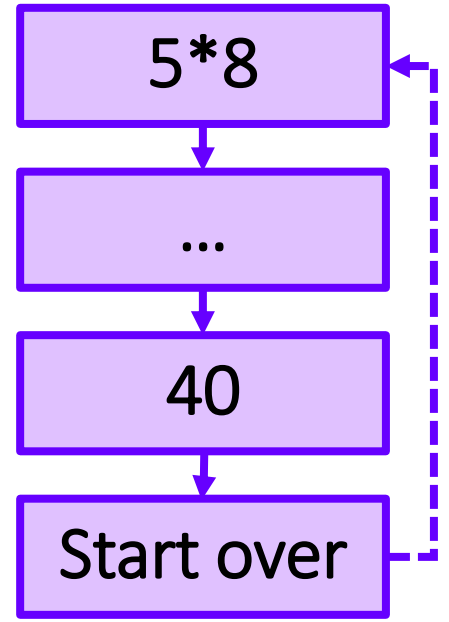



**R**ead

**E**valuate

**P**rint

**L**oop



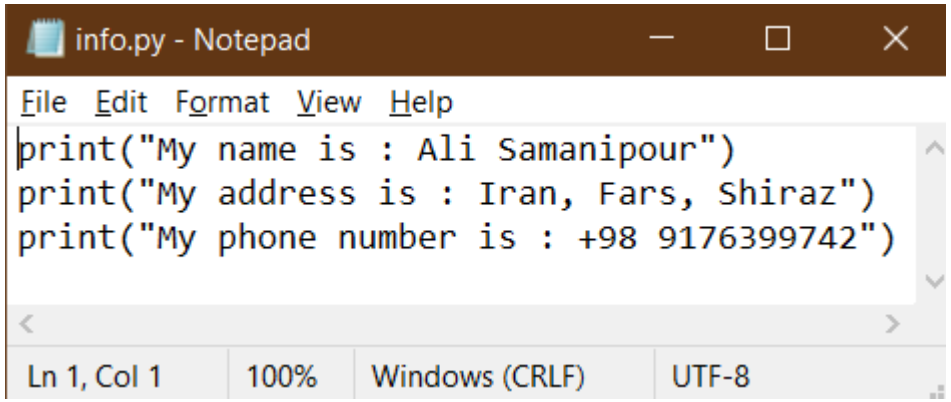

It's useful for practicing and testing. **the statements that you enter in interactive mode are not saved as a program**

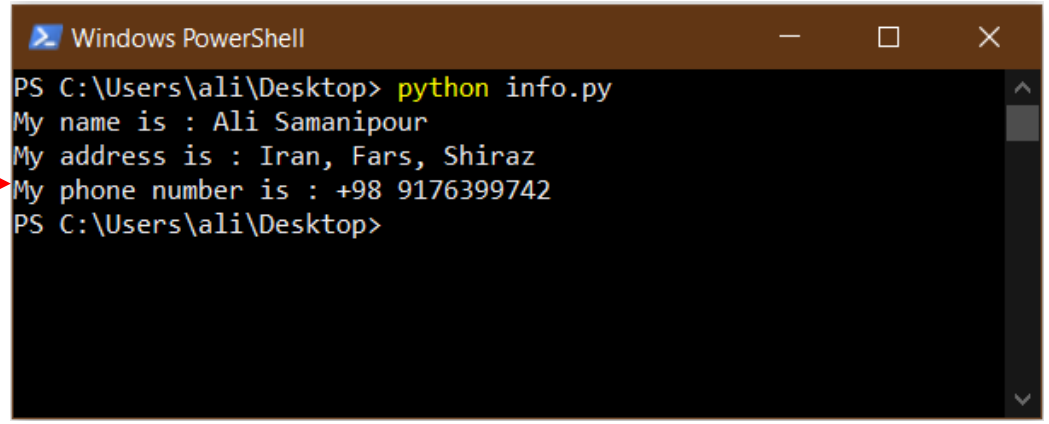
# Writing Python Programs and Running Them in Script Mode

If you want to **save a set of Python statements as a program**, **you save those statements in a file**. Then, to execute the program, you use the Python interpreter in **script mode**.

1. Write code in plane text using text editor

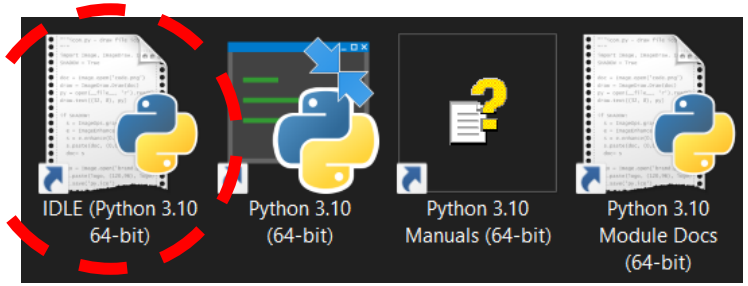
2. Open shell and execute file



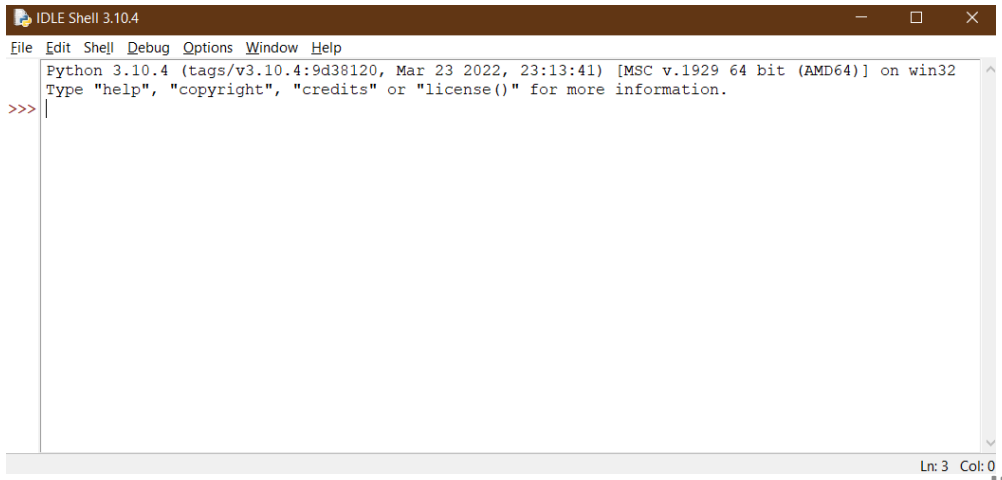



# The IDLE Programming Environment

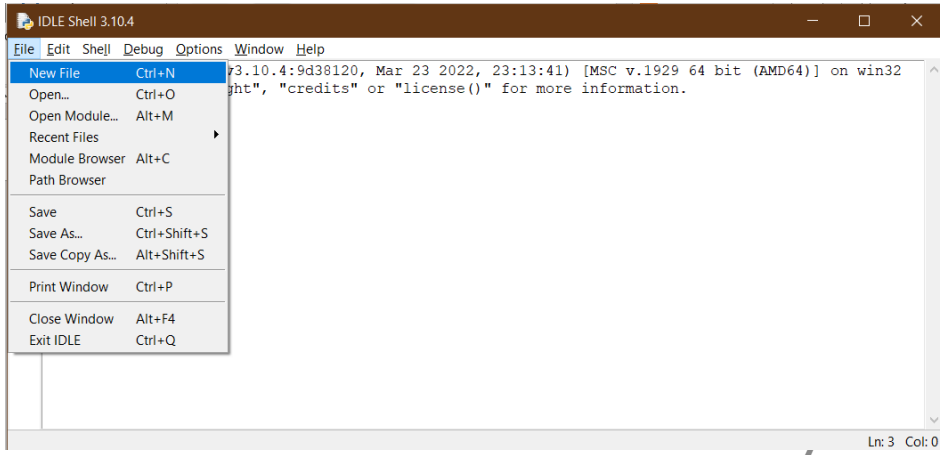
You can use an ***integrated development environment***, which is a single program that gives you all of the tools you need to write, execute, and test a program




## 1. Open IDLE




## 2. Open IDLE Editor

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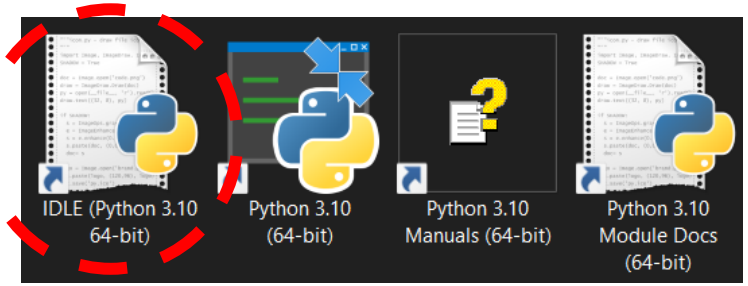
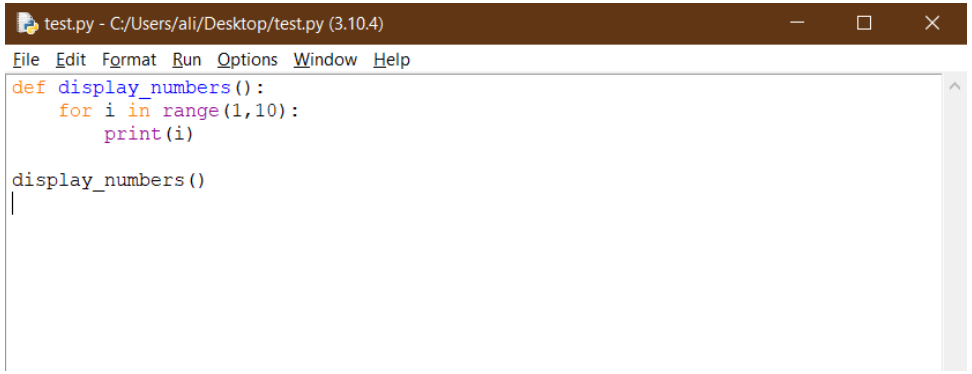
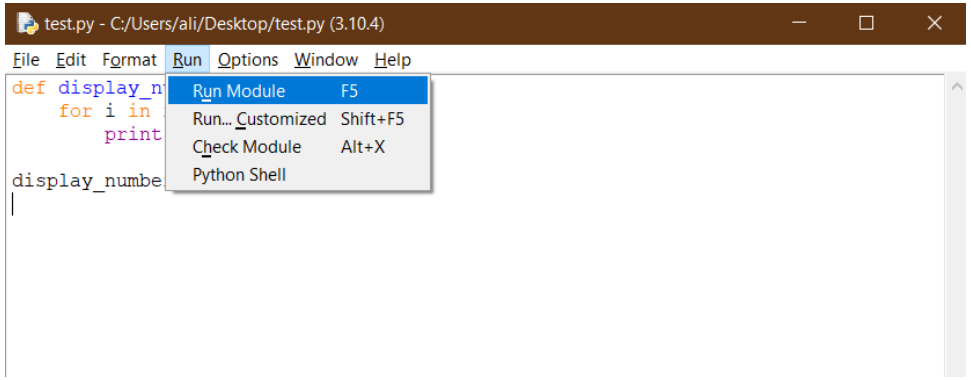



## 3. Write Code & Save Code




## 4. Run The Code



# Advanced IDEs

An ***IDE*** is a software application that helps programmers develop software code efficiently and provides them all tools they are need to develop a software, including **code editor**, **syntax highlighting**, **Intelligent code completion**, **testing and debugging** and etc. in an integrated environment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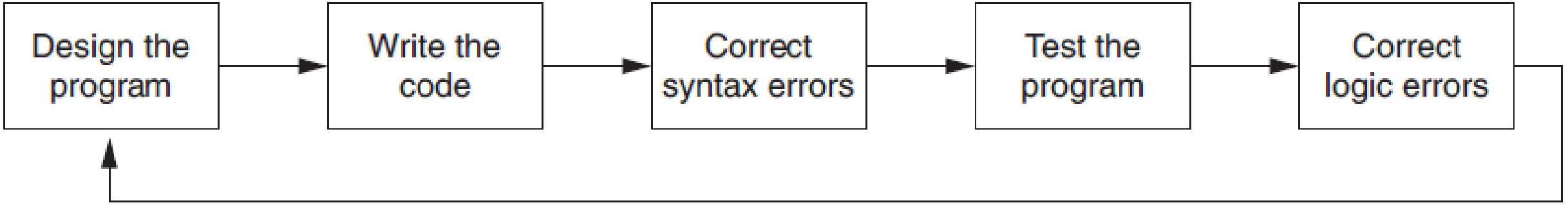
# The Program Development Cycle

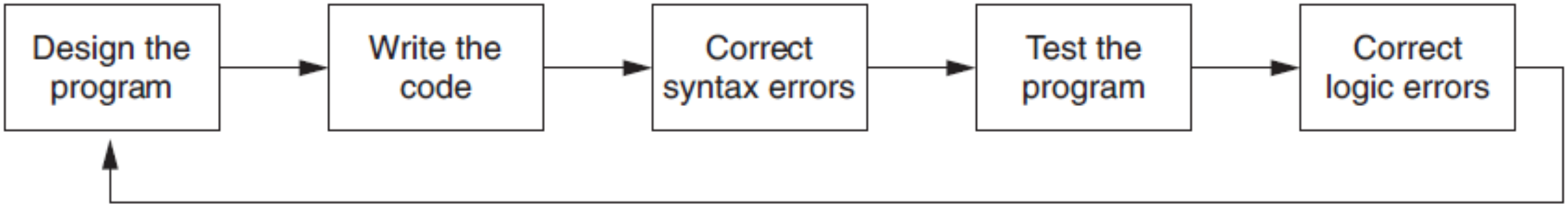
There is much **more to creating a program than writing code**.
The process of creating a program that works correctly typically requires the five phases shown bellow



# The Program Development Cycle

## CONCEPT

Programs must be carefully designed before they are written. During the design process, programmers use tools such as ***pseudocode*** and ***Flowcharts*** to ***create models of programs***.

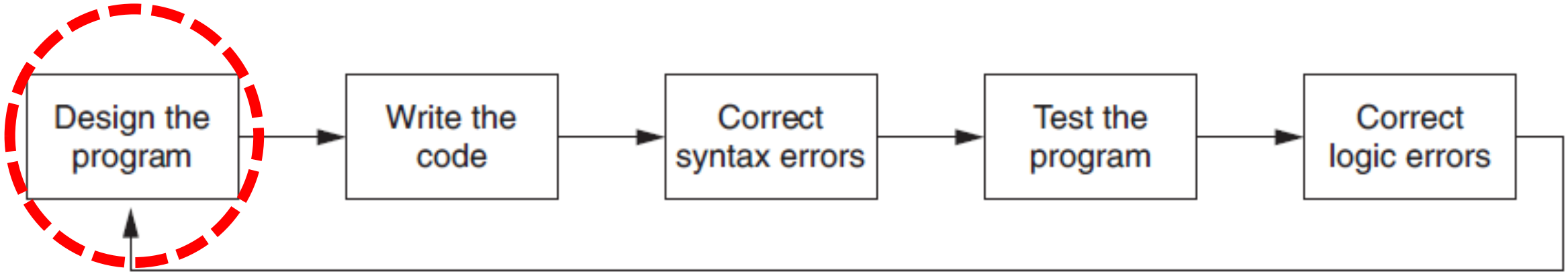


# More About the Design Process

## CONCEPT

During the **design process**, programmers use tools such as pseudocode and Flowcharts to ***create models of programs***. This process can be summarized in the following steps:

1. **Understand the task** that the program is to perform.
2. **Determine the steps** that must be taken to perform the task.



# Understand the Task That the Program Is to Perform

**CONCEPT**

It is essential that you understand what a program is supposed to do before you can determine the steps that the program will perform. Typically, a professional programmer gains this understanding by working directly with the *customer*.

**CONCEPT**

The programmer studies the information that was gathered from the customer and creates a list of different software requirements. A software requirement is simply a single task that the program must perform in order to satisfy the customer

# Determine the Steps That Must Be Taken to Perform the Task

**CONCEPT**

Once you understand the task that the program will perform, you begin by **breaking down the task into a series of steps.**

This is similar to the way you would break down a task into a series of steps that another person can follow

# What is Algorithm?

suppose someone asks you how to boil water?

1. Pour the desired amount of water into a pot.
2. Put the pot on a stove burner.
3. Turn the burner to high.
4. Watch the water until you see large bubbles rapidly rising. When this happens, the water is boiling.

An ***algorithm*** is a **lists all of the logical steps** that must be taken by the program.

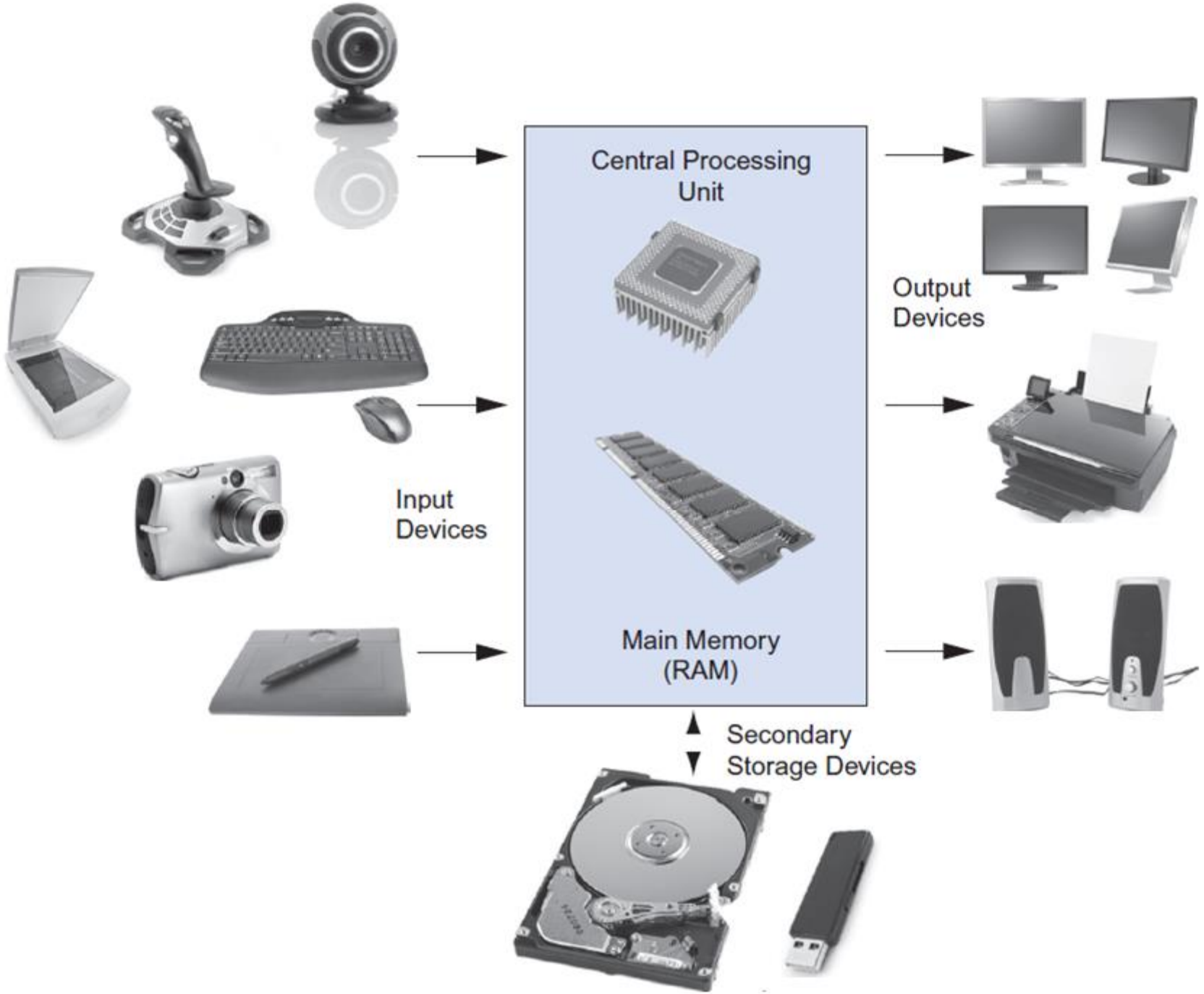
# What is Algorithm? …

**CONCEPT**

An ***algorithm*** is a set of instructions for solving a problem or accomplishing a task.

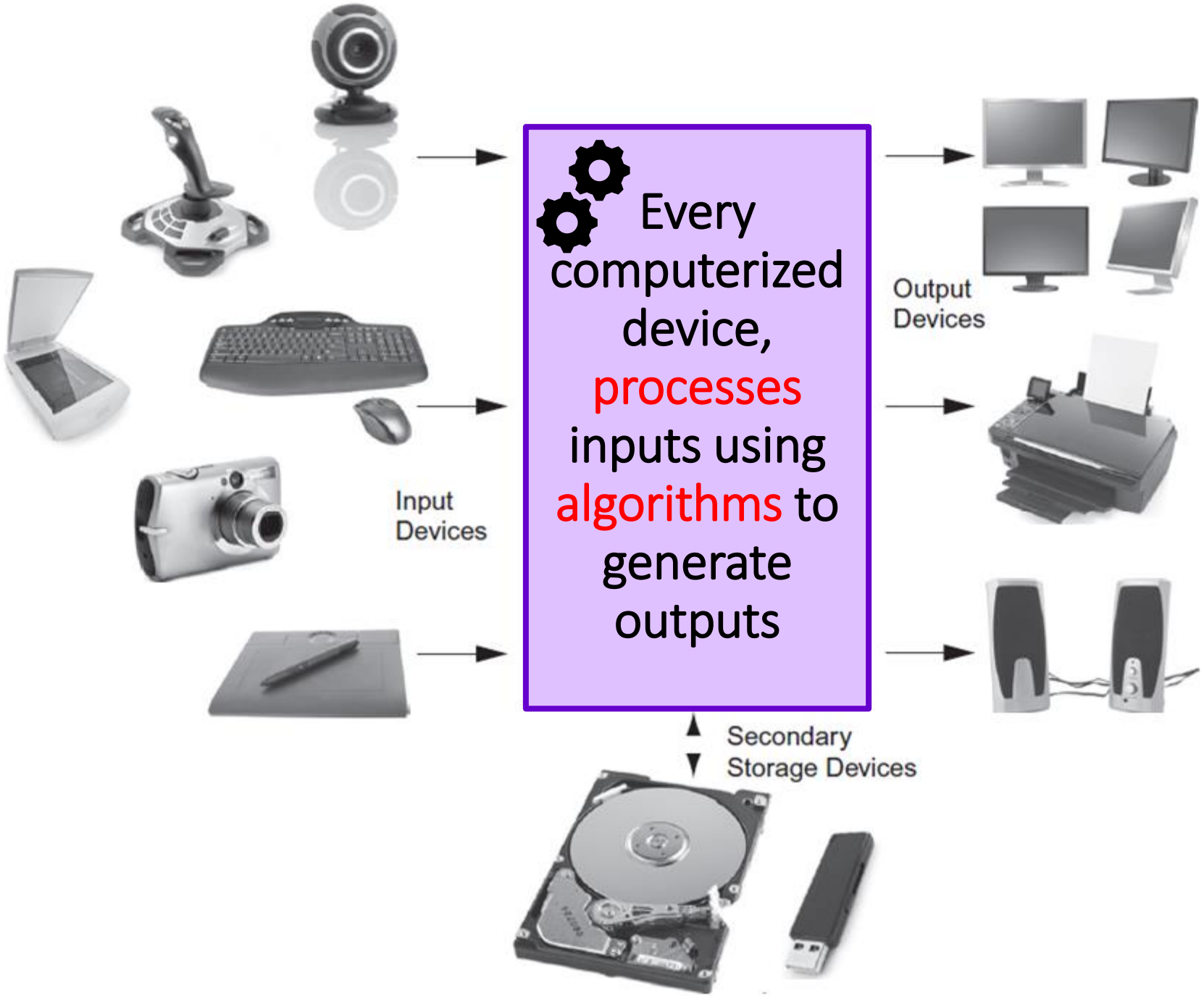
Tools that help programmers to convert steps of algorithms to executables codes

- **Pseudocode.**
- **Flowcharts.**




# Flash Back!

## Components of a computer system




# Flash Back!

## Components of a computer system and Algorithms

# Pseudocode

**CONCEPT**

It is an informal language that has **no syntax rules** and **is not meant to be compiled** or executed. Instead, programmers use *pseudocode* to create models, or "mock-ups," of programs.

suppose you have been asked to write a pseudocode to calculate and display the gross pay for an hourly paid employee

1. Input the hours worked
2. Input the hourly pay rate
3. Calculate gross pay as hours worked multiplied by pay rate
4. Display the gross pay

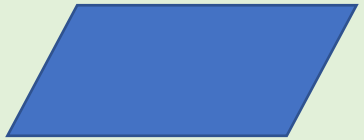
# Flowcharts

## CONCEPT

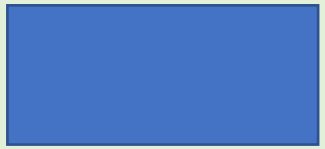
A *flowchart* is a diagram that graphically depicts the steps that take place in a program.

## Flowchart Elements

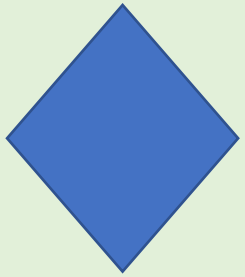
Terminal Symbols, Marks the program's starting point and the end



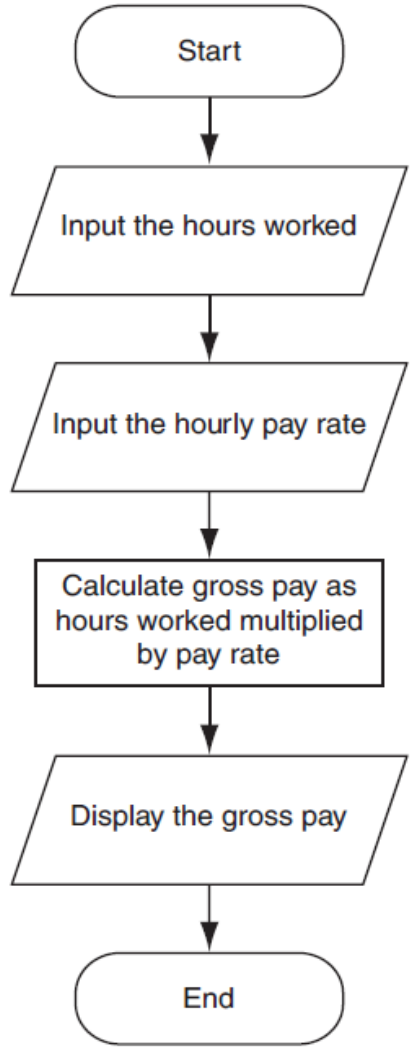
used as input symbols and output symbols. Steps in which the program reads input or displays output



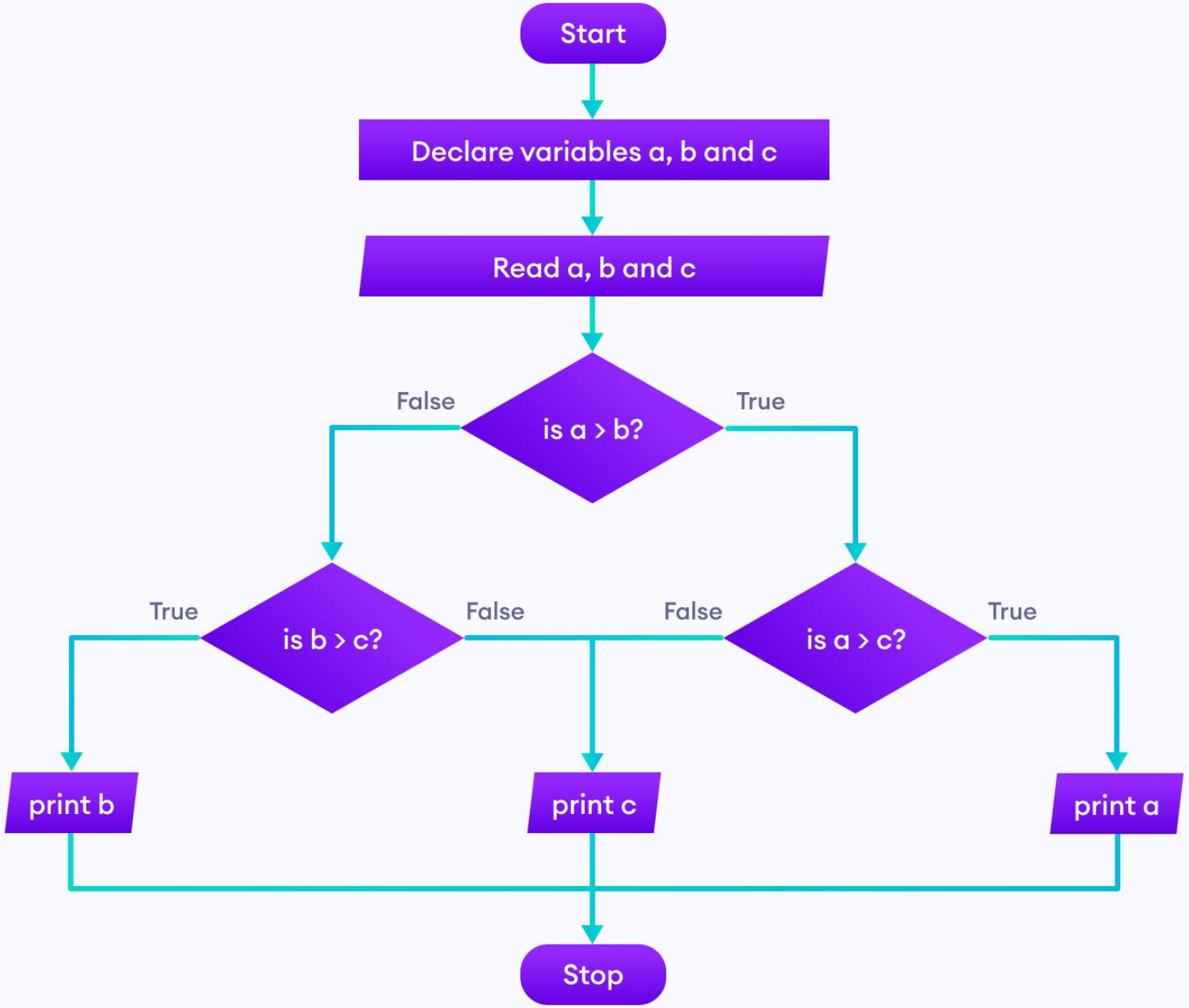
used as processing symbols. represent steps in which the program performs some process on data



used as decision symbols. represent steps in which the program make a decision based on some coditions



# A Flowchart Examples




We use **flowcharts** to visualize **algorithm** steps, it helps to understand and design algorithms better

# General Problem Solving Techniques

***Restate the Problem*** : In some cases, a problem that looks very difficult may seem easy when stated in a different way or using different terms

***Reduce the Problem:*** reduce the scope of the problem, by either adding or removing constraints, to produce a problem that you do know how to solve.

***Divide the Problem*** : Finding a way to divide a problem into steps or phases can make the problem much easier.

# General Problem Solving Techniques

***Look for Analogies:*** An analogy, for our purposes, is a similarity between a current problem and a problem already solved that can be exploited to help solve the current problem.

***Experiment:*** Sometimes the best way to make progress is to try things and observe the results

***Start with What You Know***: if you never start, you will never finish!

# Divide and Conquer Algorithms

## Step 1( Divide )

Divide the problem recursively into smaller subproblems.

## Step 2(Solve)

Subproblems are solved independently.

## Step 3(Combine)

Combine subproblem solutions in order to deduce the answer to the original large problem.

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# Input, Processing, and Output

**CONCEPT**

Input is data that the program receives. When a program receives data, it usually processes it by performing some operation with it. The result of the operation is sent out of the program as output.

Computer programs typically perform the following three-step process:

1. **Input is received.**
2. **Some process is performed on the input.**
3. **Output is produced.**

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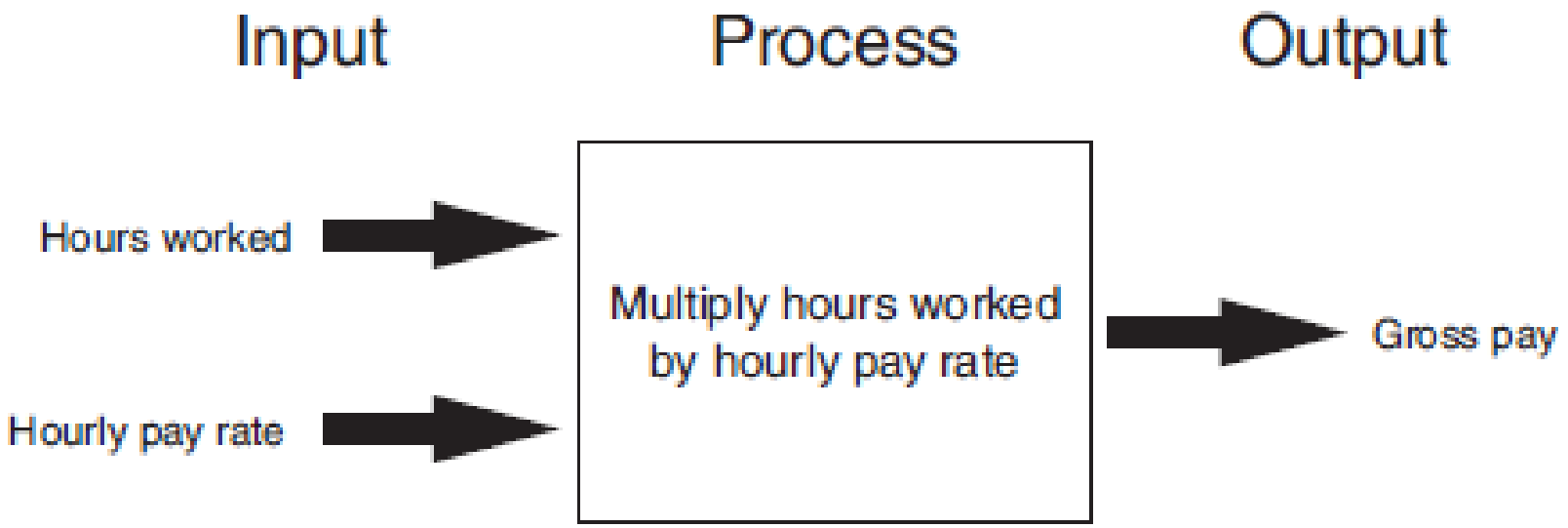


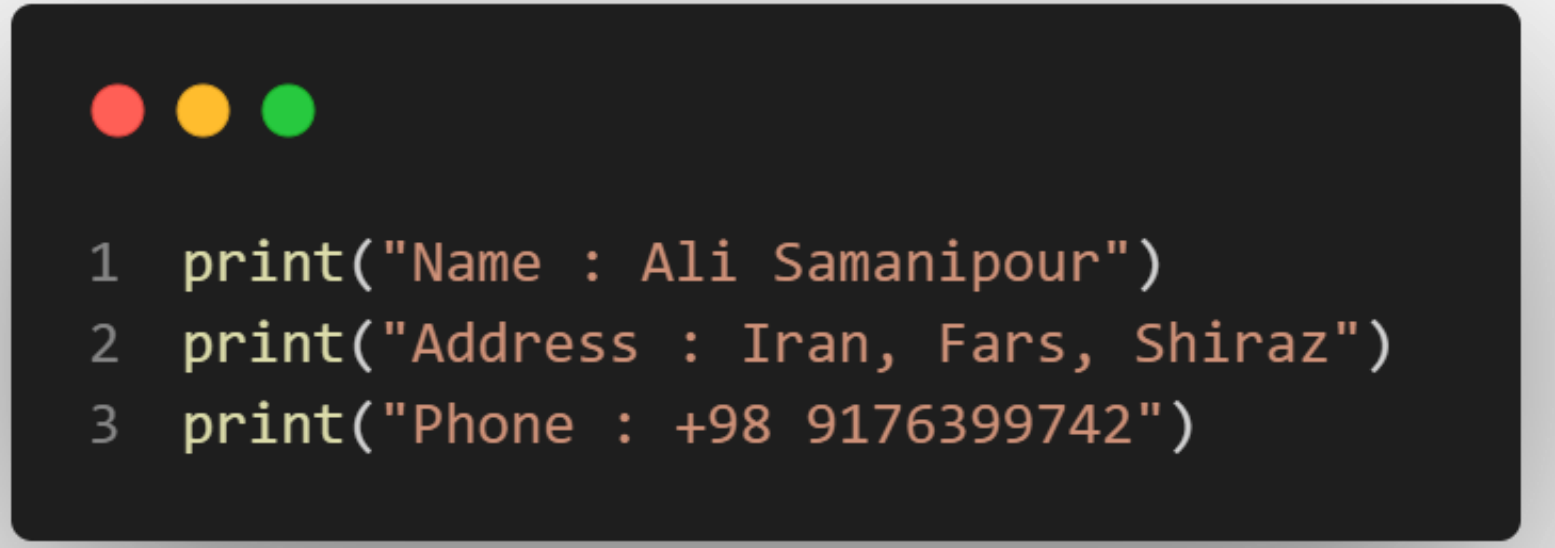
# Displaying Output

**CONCEPT**

A ***function*** is a piece of prewritten code that performs an operation. Python has numerous *built-in* functions that perform various operations.

You use the **print** function to display output in textual interfaces (like PowerShell or bash )in a Python program.

# Displaying Output print() Function



```
1  print("Name : Ali Samanipour")
2  print("Address : Iran, Fars, Shiraz")
3  print("Phone : +98 9176399742")
```

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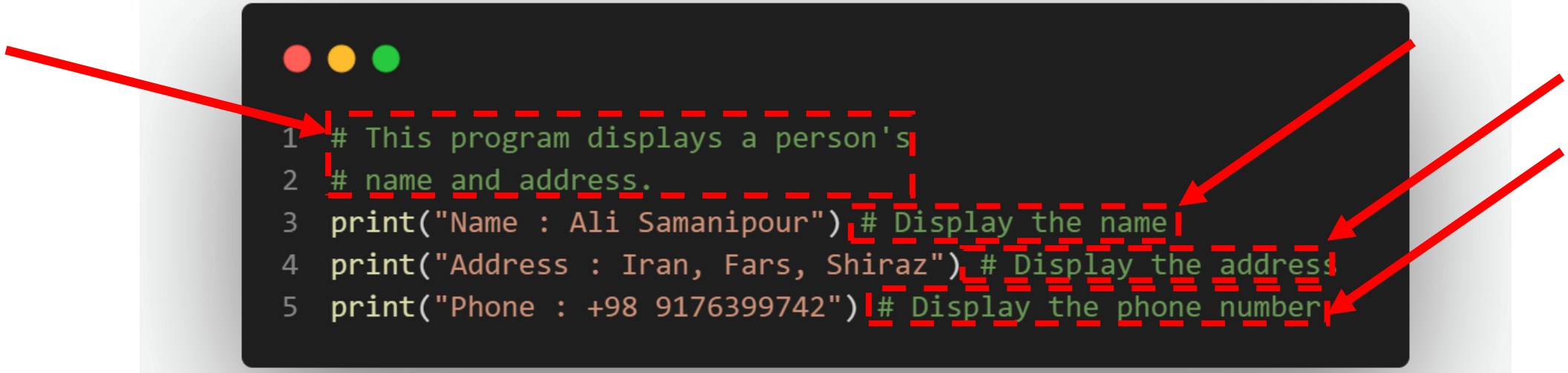
# Comment

**CONCEPT**

Comments are notes of **explanation** that document lines or sections of a program.

Comments are part of the program, but the **Python interpreter ignores them**.



# Variables

**CONCEPT**

A variable is a name that **represents a storage location** in the computer's memory.

When a variable represents a value in the computer's memory, we say that the variable ***references*** the value

# Creating Variables

**CONCEPT**

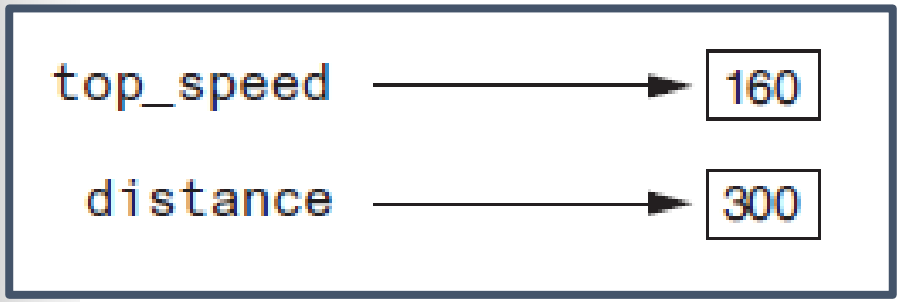
You use an **assignment statement** to create a variable and make it reference a piece of data

*variable = expression*

```
1  age = 25
```

# Creating Variables …

```
1  # Create two variables: top_speed and distance.
2  top_speed = 160
3  distance = 300
4  # Display the values referenced by the variables.
5  print('The top speed is')
6  print(top_speed)
7  print('The distance traveled is')
8  print(distance)
```



# Variable Naming Rules

You **cannot use one of Python's keywords** as a variable name.

A variable name **cannot contain spaces**

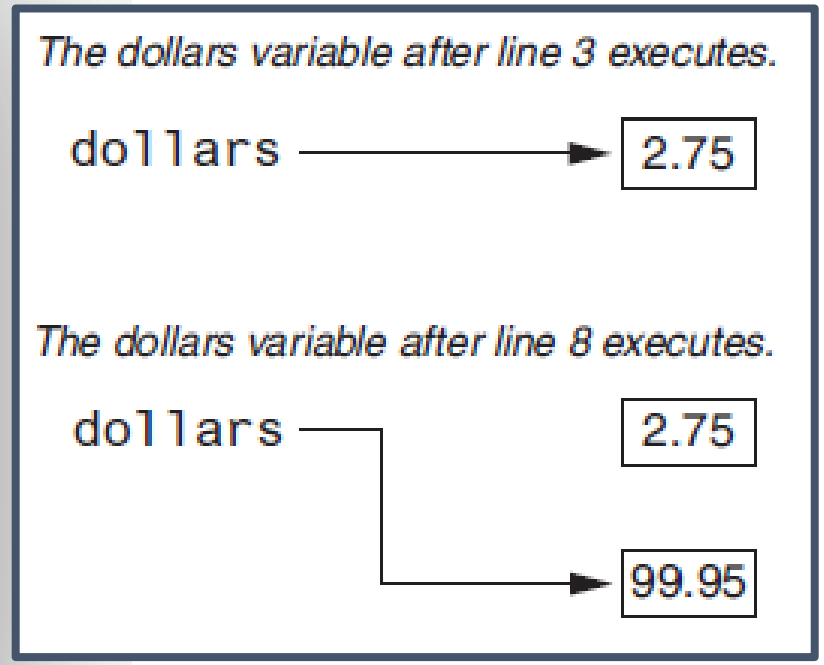
**Uppercase** and **lowercase** characters are distinct

After the first character you may use the letters a through z or A through Z, the digits 0 through 9, or underscores

The first character must be one of the letters a through z, A through Z, or an underscore character (_).

# Variable Reassignment

```
1  # This program demonstrates variable reassignment.
2  # Assign a value to the dollars variable.
3  dollars = 2.75
4  print('I have', dollars, 'in my account.')
5
6  # Reassign dollars so it references
7  # a different value.
8  dollars = 99.95
9  print('But now I have', dollars, 'in my account!')
```



# Primitive Datatypes

| | | | | | |
|---|---|---|---|---|---|
| -5 | -4.97 | True | False | ‘Ali’ | ‘Number is:’ |
| 2 | 1.97 | | | | |
| Integer | Floats | | | | |
| Numbers | | Boolean | | String | |

Complex Data Types(Dictionaries, Classes, … )

# Numbers

| Integer | |
|---|---|
| -5 | 4 |
| As big(small) as supported by memory and OS | |
| cast other type to integer with int() | |

| Float | |
|---|---|
| 1.58 | -0.8559 |
| As big(small) as supported by memory and OS | |
| cast other type to integer with float() | |

Write numbers with more readability: 100_258_012.587

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# Reading Input from the Keyboard

**CONCEPT**

Programs commonly need to read ***input*** **typed by the** ***user*** **on the keyboard**

*variable = input(prompt)*

```
1  # Get the user's first name.
2  first_name = input('Enter your first name: ')
3
4  # Get the user's last name.
5  last_name = input('Enter your last name: ')
6
7  # Print a greeting to the user.
8  print('Hello', first_name, last_name)
```

# Reading Numbers with the input Function

```
1  # Get the user's name, age, and income.
2  name = input('What is your name? ')
3  age = int(input('What is your age? '))
4  income = float(input('What is your income? '))
5
6  # Display the data.
7  print('Here is the data you entered:')
8  print('Name:', name)
9  print('Age:', age)
10 print('Income:', income)
```

# Python *Mathematical* Operators

| CONCEPT | | | |
|---|---|---|---|
| Python has numerous ***operators*** that can be used to perform mathematical calculations. | + | **Addition**: Adds two numbers | 9 + 5 ➔ 14 |
| | - | **Subtraction**: Subtracts one number from another | 9 – 5 ➔ 4 |
| | * | **Multiplication**: Multiplies one number by another | 9 * 5 ➔ 45 |
| | / | **Division Divides**: one number by another and gives the result as a floating-point number | 9 / 5 ➔ 1.8 |
| | // | **Integer division:** Divides one number by another and gives the result as a whole number | 9 // 5 ➔ 1 |
| | ** | **Exponent:** Raises a number to a power | 9 ** 5 ➔ 59049 |
| | % | **Remainder:** Divides one number by another and gives the remainder | 9 % 5 ➔ 4 |

# Operator Precedence

**The precedence of the math operators, from highest to lowest, are:**

1. Exponentiation: **
2. Multiplication, division, and remainder: * / // %
3. Addition and subtraction: + –

Operations that are **enclosed in parentheses** are performed first. Then, when two operators share an operand, the operator with the higher ***precedence*** is applied first

# Example: Time Converter Program

```python
# Get a number of seconds from the user.
total_seconds = float(input('Enter a number of seconds: '))

# Get the number of hours.
hours = total_seconds // 3600

# Get the number of remaining minutes.
minutes = (total_seconds // 60) % 60

# Get the number of remaining seconds.
seconds = total_seconds % 60

# Display the results.
print('Here is the time in hours, minutes, and seconds:')
print('Hours:', hours)
print('Minutes:', minutes)
print('Seconds:', seconds)
```

# Example: Future Value Program (Question)

Suppose you want to deposit a certain amount of money into a savings account and leave it alone to draw interest for the next 10 years. At the end of 10 years, you would like to have $10,000 in the account. How much do you need to deposit today to make that happen? You can use the following formula to find out:

$$P = \frac{F}{(1+r)^n}$$

The terms in the formula are as follows:

- P is the present value, or the amount that you need to deposit today.
- F is the future value that you want in the account. (In this case, F is $10,000.)
- r is the annual interest rate.
- n is the number of years that you plan to let the money sit in the account.

# Example: Future Value Program (Algorithm – pseudocode)

*1. Get the desired future value.*
*2. Get the annual interest rate.*
*3. Get the number of years that the money will sit in the account.*
*4. Calculate the amount that will have to be deposited.*
*5. Display the result of the calculation in step 4.*

# Example: Future Value Program (Source Code)

```
1  # Get the desired future value.
2  future_value = float(input('Enter the desired future value: '))
3
4  # Get the annual interest rate.
5  rate = float(input('Enter the annual interest rate: '))
6
7  # Get the number of years that the money will appreciate.
8  years = int(input(
   'Enter the number of years the money will grow: '))
9
10 # Calculate the amount needed to deposit.
11 present_value = future_value / (1.0 + rate)**years
12
13 # Display the amount needed to deposit.
14 print('You will need to deposit this amount:', present_value)
```

# Mixed-Type Expressions and Data Type Conversion

**CONCEPT**

When you perform a math operation on two operands, the data type of the result will depend on the data type of the operands

```python
# This program shows how python follows these rules when evaluating mathematical expressions
int_var1 = 5
int_var2 = -8
float_var1 = 2.138
float_var2 = -0.257

# When an operation is performed on two int values, the result will be an int.
print("Summing tow int :", int_var1 + int_var2)

# When an operation is performed on two float values, the result will be a float.
print("Summing tow float :", float_var1 + float_var2)

# When an operation is performed on an int and a float, the int value will be
print("Summing one int and float :", int_var1 + float_var2)
```

# Module Roadmap

1. Using Python
2. Designing a Program & Problem Solving
3. Input, Processing and Output
4. Variables & Data Types
5. Working with Inputs & Performing Calculation
6. Working with Numbers & Strings

# Strings and Literals

**CONCEPT**

In programming terms, **a sequence of characters** that is used as data is called a string. When a string appears in the actual code of a program, it is called a ***string literal***.

| | | |
|---|---|---|
| “single line text” | ‘single line text’ | “””multiple line text””” |

# String Concatenation

String concatenation is the appending of one string to the end of another.

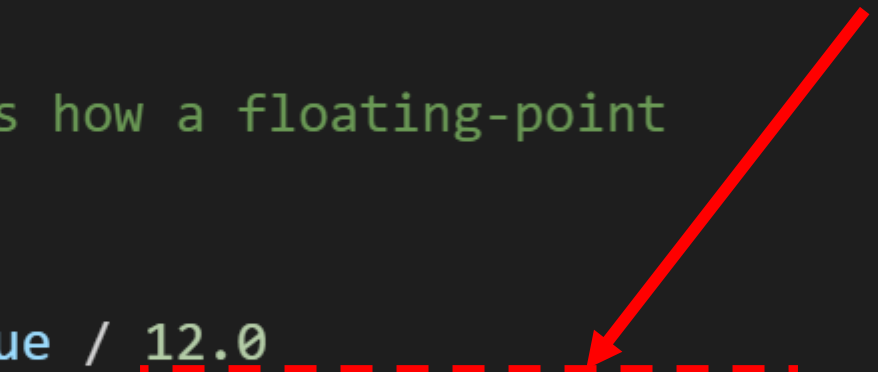
```
1  # This program demonstrates string concatenation.
2  first_name = input('Enter your first name: ')
3  last_name = input('Enter your last name: ')
4
5  # Combine the names with a space between them.
6  full_name = first_name + ' ' + last_name
7
8  # Display the user's full name.
9  print('Your full name is ' + full_name)
```

# Displaying Formatted Output with F-strings

**CONCEPT**

***F-strings*** are a special type of string literal that allow you to format Values in a variety of ways

```
1  # This program demonstrates how a floating-point
2  # number can be rounded.
3  amount_due = 5000.0
4  monthly_payment = amount_due / 12.0
5  print(f'The monthly payment is {monthly_payment:.2f}.')
```



# Displaying Formatted Output with F-strings

```
1  # This program demonstrates how to align strings.
2  string_var1 = 'left align string'
3  string_var2 = 'center align string'
4  string_var3 = 'right align string'
5
6  # Display the texts.
7
8  # < Designator Left-aligns the value
9  print(f'***{string_var1:<50}***')
10 # ^ Designator Center-aligns the value
11 print(f'***{string_var2:^50}***')
12 # > Designator Right-aligns the value
13 print(f'***{string_var3:>50}***')
```

# Escape Characters

**CONCEPT**

An ***escape character*** is a special character that is preceded with a backslash (\), appearing inside a string literal.

When a string literal that contains escape characters is printed, the escape characters are treated as special commands that are embedded in the string.

# Using Escape Characters

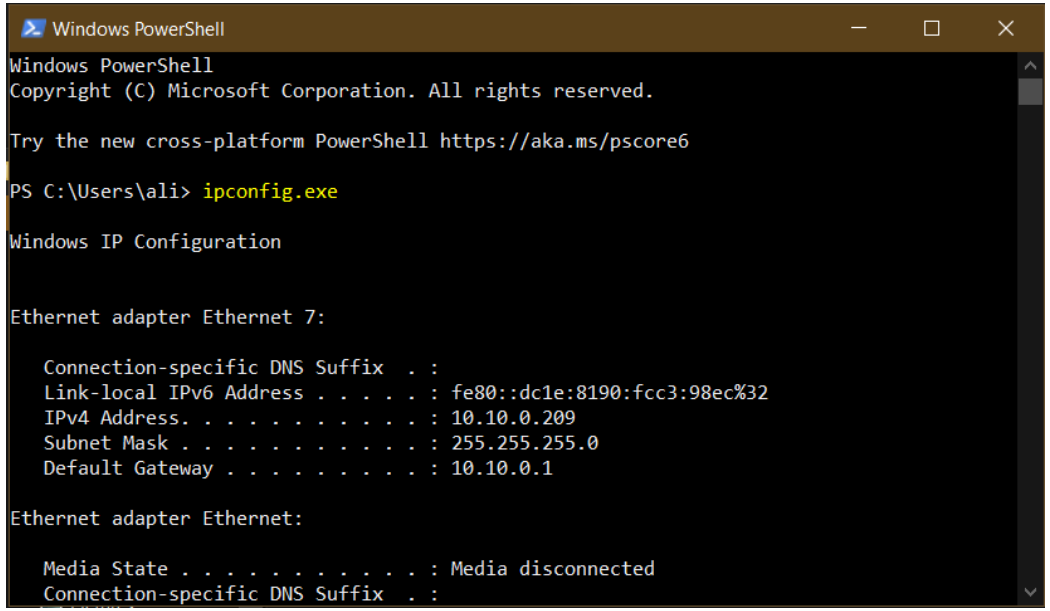
```
1  #this program illustrate functions of escape characters
2
3  # \n Causes output to be advanced to the next line.
4  print("First line \n Second line \n Third line")
5
6  # \t Causes output to skip over to the next horizontal tab position
7  print('Sat\tSun\tMon\tTues\tWed\tThur')
8
9  # \' and \" escape characters to display quotation marks
10 print("Your assignment is to read \"Hafez\" by tomorrow.")
11 print('I\'m ready to begin.')
12
13 # \\ Causes a backslash character to be printed
14 print('The path is C:\\temp\\data.')
```

# GUI vs CLI

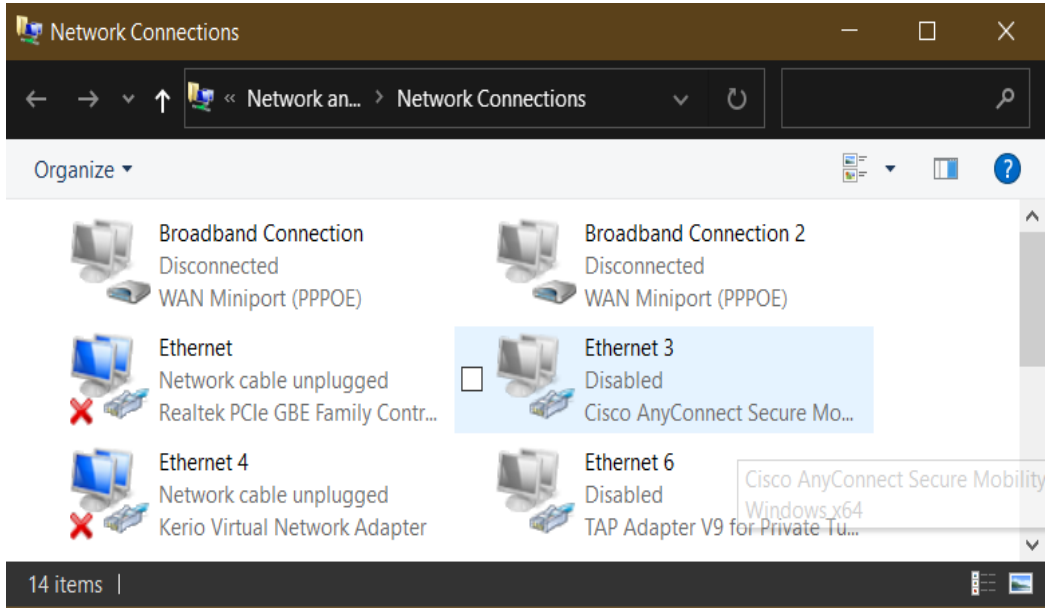
## CONCEPT

***GUI*** lets a user interact with the device/system with the help of graphical elements, like windows, menus, icons, etc. The ***CLI***, on the other hand, lets a user interact with their device/system with the help of various commands

## CLI




## GUI



# Named Constants

**CONCEPT**

A ***named constant*** is a name that represents a special value, such as a magic number.

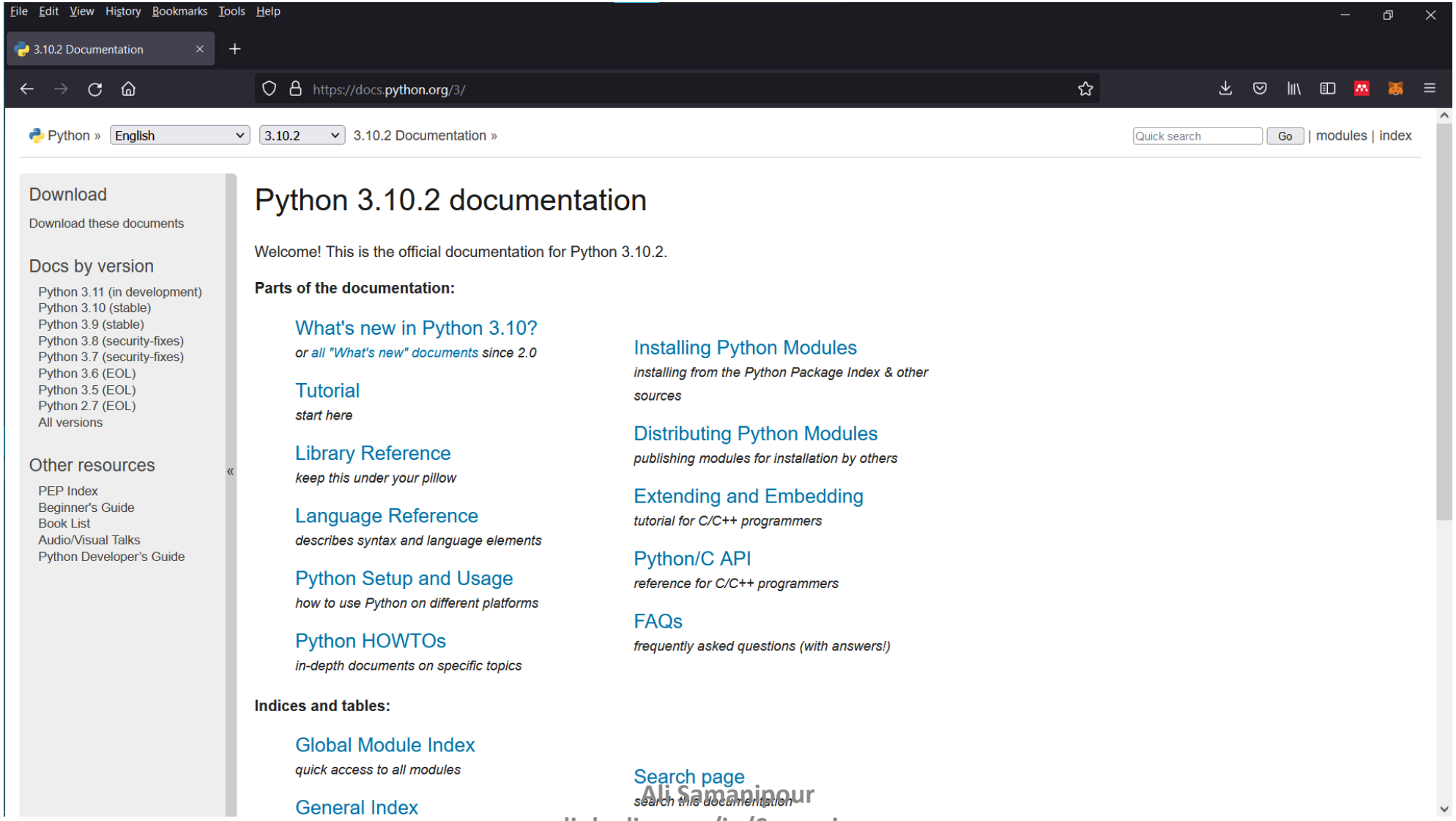
named constant is written in all **uppercase** letters. This is a standard practice in most programming languages because it makes named constants easily distinguishable from regular variables.

# Benefit of Using Named Constants

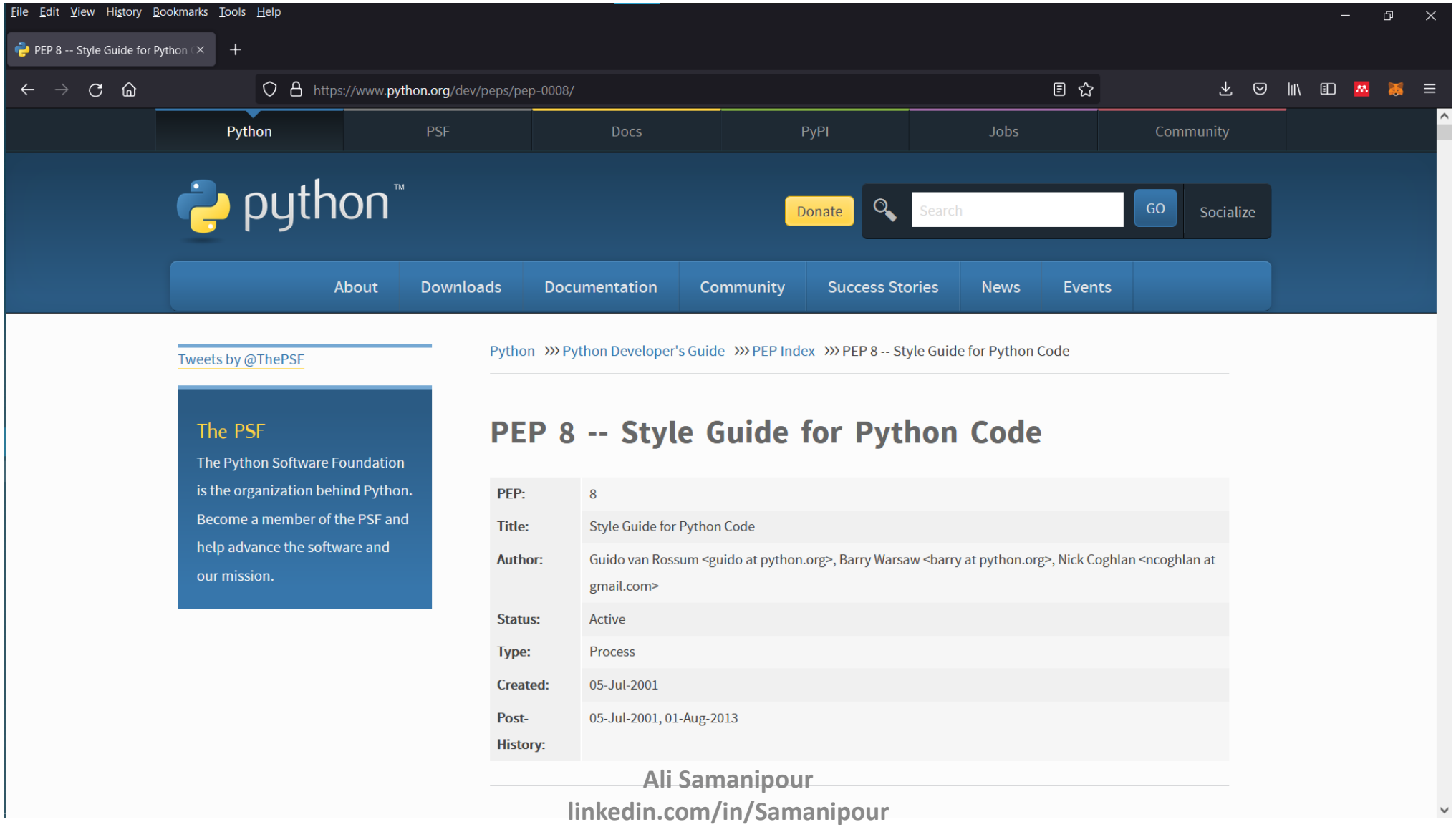
```python
radius = float(input("please input circle radius "))
circle_area = 3.14 * (radius**2)
print(f'Circle area is : {circle_area:.3f}')
```

```python
PI_VALUE = 3.14
radius = float(input("please input circle radius "))
circle_area = PI_VALUE * (radius**2)
print(f'Circle area is : {circle_area:.3f}')
```

# Appendix: Python Documentation



# Appendix: Python Coding style



# Accessing Resources (Codes, Slides, etc.)

**github.com/Samanipour**

**t.me/SamaniGroup**

# References


- **Automate The Boring Stuff With Python, 2nd Edition: Practical Programming For Total Beginners**
- **Python Crash Course, 2nd Edition: A Hands-On, Project-Based Introduction To Programming**
- **Supercharged Python: Take Your Code to the Next Level**
- **Python Tricks: A Buffet of Awesome Python Features**
- **Learn Python the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code**
- **Starting Out with Python, Tony Gaddis, Global Edition**