Introduction to Data and Programming with Python





.1 Familiarisation with Python

Learning Scope

Introduction, History of Python, Elementary concept of Python, Features of Python, Uses and advantages of Python, First step to Python (Interactive and Script Modes), Basic elements of Python Programming namely Character Set, Escape Sequences, Literals, Identifiers, Assignments, Keywords, Punctuators, Expression and Statement.

INTRODUCTION

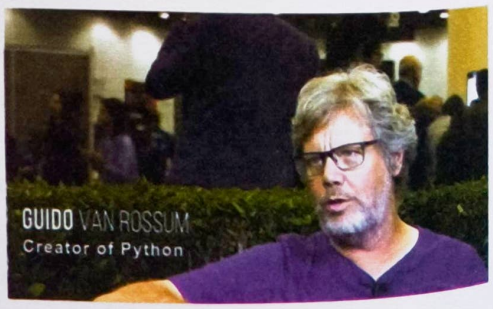
Have you heard about Python? What is the first word that comes into your mind when you hear the word "PYTHON"? The world's longest snake that wraps around its prey resulting in its death due to suffocation. Most people around us will think the same, if they are not associated with the world of computers.



In this chapter, we will take you to an interesting world of learning using a relatively new programming language called the "PYTHON".

HISTORY OF PYTHON

Guido Van Rossum (Master's degree in Mathematics and Computer Science from the University of Amsterdam, Netherland) wanted to give a mysterious name to his invention. In the year 1991, the inspiration for the name came from BBC's popular TV show (Monty Python's Flying Circus) and this is how he named his project as 'Python'. He is regarded as the creator of Python.



ELEMENTARY CONCEPT OF PYTHON

Python is a fourth-generation programming language. It is user's friendly which is one of the main reasons for it to be the fastest growing programming language. Gradually, it became the first choice for many software developers for the creation of new applications.



Python is a general-purpose interpreted, interactive high-level programming language written in C programming language. However, this language has been derived from many other languages such as the ABC, Modula-3, C++, Algol-68, etc. It uses simple English words with some punctuations marks. This is also one of the reasons for Python becoming a popular programming language among students and working professionals.

Just to Know

Interpreter is a software that is used to convert a program written in a high-level language into its equivalent machine language. It accepts instructions and generates its machine codes line-by-line or statement-by-statement.

PROCEDURE ORIENTED AND OBJECT-ORIENTED PROGRAMMING

Computer languages are broadly classified into two types namely, low-level languages and high-level languages. However, the low-level languages (machine and assembly) have certain limitations, therefore high-level languages have been developed. They provide a comfortable platform for the users to understand and design programming logic. The high-level languages are further classified into two types. They are as follows:

- Procedure Oriented Programming (POP)
- Object Oriented Programming (OOP)

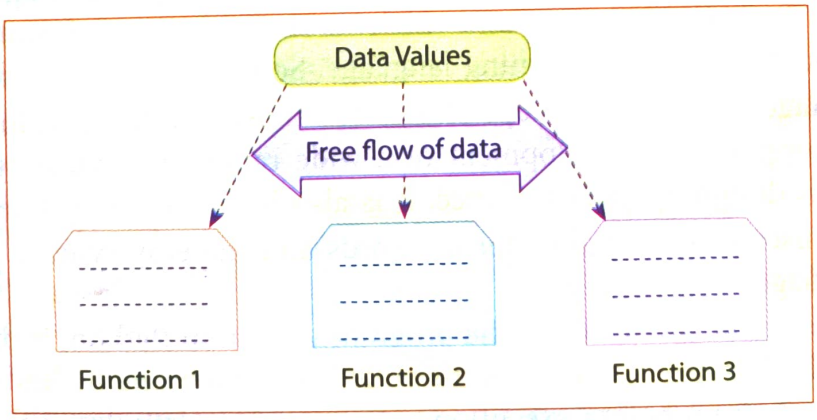
Procedure Oriented Programming (POP)

A programming language in which the emphasis is laid on the functions or procedures (actions to be taken) rather than data values is known as *Procedure Oriented Programming language*. It is a type of computer programming language that uses variables, functions, statements and conditional operators. It contains a systematic order of statements, procedures, functions and commands on the data values to complete a task. These procedures can be invoked anywhere between the program hierarchy and by other procedures as well.

It works on the following principles:

- Problems are divided into different modules, called functions.
- The functions share global data.
- The data moves freely from function to function.

It can be understood with the help of the following illustration:

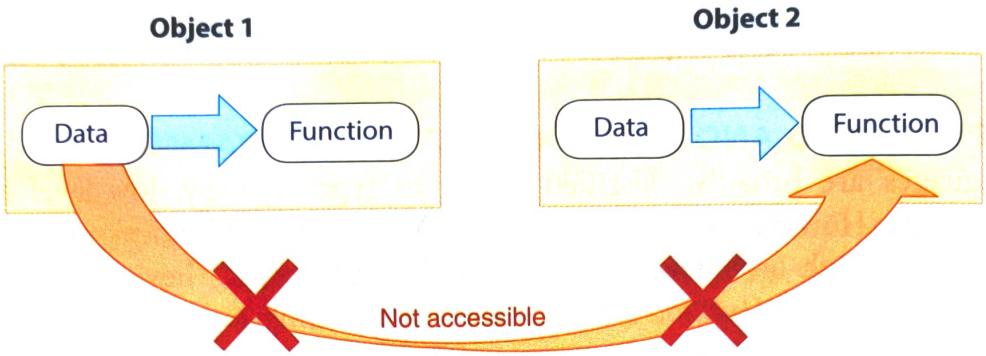


Procedure Oriented Programming Concept

The above logical structure illustrates that the data values have no restriction on their use in different functions of the program. They are independent to flow freely from one part of the program to the other. Some high-level languages such as BASIC, COBOL, FORTRAN, C, etc. are the procedure-oriented languages.

Object Oriented Programming (OOP)

To overcome the shortcomings of procedure-oriented languages, object-oriented languages have been developed. In Object Oriented Programming, the emphasis is put on the data values rather than functions. The data values are confined and used within the stipulated programming area. We can understand this concept with the help of the diagram given below:



Object Oriented Programming Concept

The above diagram illustrates that object-oriented programming allows user to split the complete program into a number of segments called *Objects*. It is done in such a way that the data values of an object can only be used within the functions of the same object. They are not directly accessible to the other objects of the program. However, the objects can communicate with each other through functions.

Thus, object-oriented programming is an approach in which the emphasis is laid on data rather than functions. The data values remain associated with the functions of a particular block of the program so as to encourage data security.

Java, C++, Small Talk, Eiffel, Python are some of the object-oriented programming languages.

FEATURES OF PYTHON

Python is a good programming language for beginners. It is highly productive as compared to other programming languages like C++ and Java (Object Oriented Programming). It is also very famous for its simple programming syntax, code readability and 'English-like' commands that make coding in Python a lot easier and efficient. There are many features of Python which make it a widely sought after programming language. Some of them are mentioned below:

- **Beginner's Language:** Python is an apt choice for those venturing into programming and development. It supports the development of a wide range of applications from simple text processing to even designing games. Hence, it is also hailed as a beginner's language.
- **Easy to Learn:** It uses simple English for keywords and the easy syntax. This allows learners to grasp the language very quickly.
- **Interpreter Based:** Unlike Java or C++, the program written in Python, is processed at runtime with the help of the interpreter and thus the code is executed line by line. It means you need not compile your program before execution.

- **Interactive Mode:** It supports an interactive mode, which allows interactive testing and debugging of the code snippets. By using a Python prompt, you can interact with the interpreter directly to execute your statements.
- **Case Sensitive:** Here, the case sensitive means differentiating between the uppercase and lowercase letters. In Python, the keywords are case sensitive. All the keywords (except True, False and None) are in lowercase and they must be written as it is. It is also case sensitive when it deals with identifiers.

  For example,

  Num and num are considered to be two different identifiers.
- **Free and Open Source:** Python is a free and open source language which means you can freely distribute the copies of the software, read the source code, make changes and use it in new programs.
- **Cross-platform Language:** Python is also known for its platform independence. It means, if Python code has been developed in Windows then its library can also run on other platforms viz. UNIX, LINUX, Windows, Macintosh, etc. Thus, it is also referred to as a cross-platform compatible language.

USES/APPLICATIONS OF PYTHON

In recent times, Python programming is used in almost every field of computer science, including Artificial Intelligence. It is also used for developing Graphical User Interface (GUI) applications, websites and web applications. Some of the applications of Python are mentioned below:

- **Game Development:** Like Java and C++, Python also has various modules that supports the development of video and 3D games.

  For example, PySoy is a 3D game engine which enables the users to develop interactive games. Some popular games which have been built using Python are Disney's ToonTown Online, Vega Strike, etc.



- **Web Development:** It is another important application where Python is widely used to make web-applications.
- **Artificial Intelligence:** Artificial Intelligence is the technology that makes use of machines, like computer systems or robots, to think and learn like the human mind. This can be done by developing computer system and algorithms that are capable of learning from data, reasoning, understanding natural language, perceiving their environment and adapting to new situations.
- **Audio and Video Applications:** Python is also a popular programming language, used in developing audio and video applications using Python libraries. The video and audio applications such as TimPlayer and Cplay have been developed by using Python and they provide better performance as compared to other media players.



ADVANTAGES OF PYTHON

There are many advantages of Python as a general purpose programming language. Some of them are mentioned below:

- It is known for its simplicity and readability that makes an excellent choice for both beginners and experienced programmers.
- It is an interpreter-based language which allows us for easier debugging and code development.

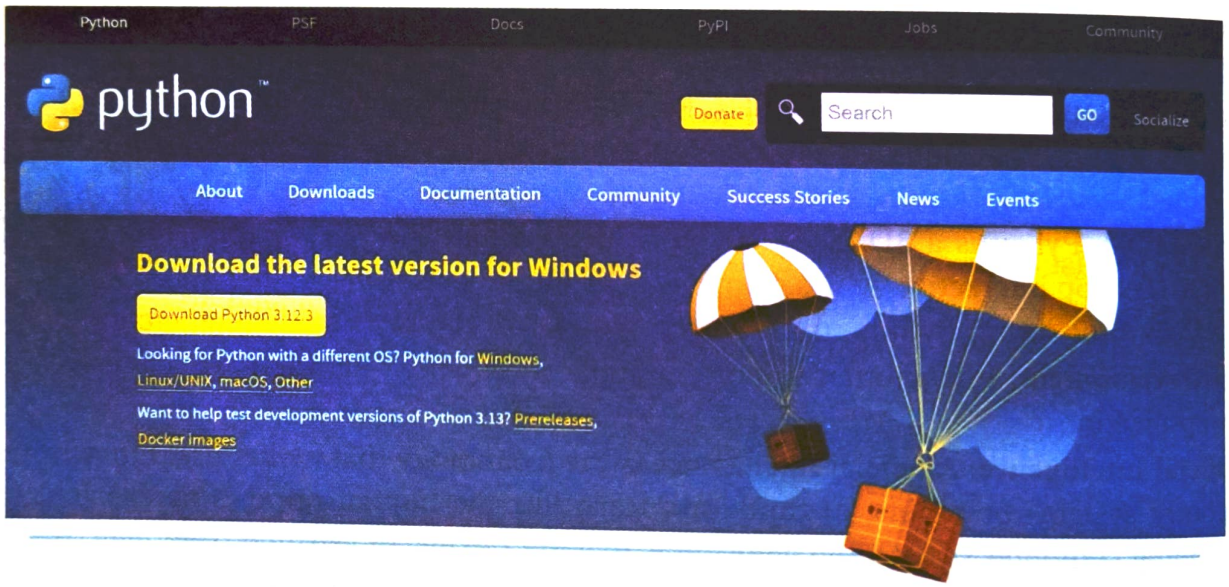
- It is dynamically typed which means you do not need to declare the data types explicitly, making it flexible and reliable.
- It is known for platform independence which makes portable across operating systems, allowing real-time code execution and testing.
- The syntax is quite concise that allows the developers to prototype applications quickly with less code.
- It supports both object-oriented and procedural programming, providing versatility in coding styles.
- It is used in IoT (Internet of Things) applications due to its simplicity and versatility.
- It privileges extensive support libraries like NumPy for numerical calculations and Pandas for data analytics, making it suitable for scientific and data-related applications.

FIRST STEP TO PYTHON

Before starting to work in Python, you need to download and install Python in your computer system which is available for free on the following website:

https://www.python.org

Click on the link and follow the instructions to download Python for Windows. Once it is downloaded, install Python in your system.



However, it is always suggested to install the latest version, so that you may use a wide variety of functions. In this book, we will discuss and work on Python i.e., Python 3.12.3 version.

Just to Know

Different Versions of Python:

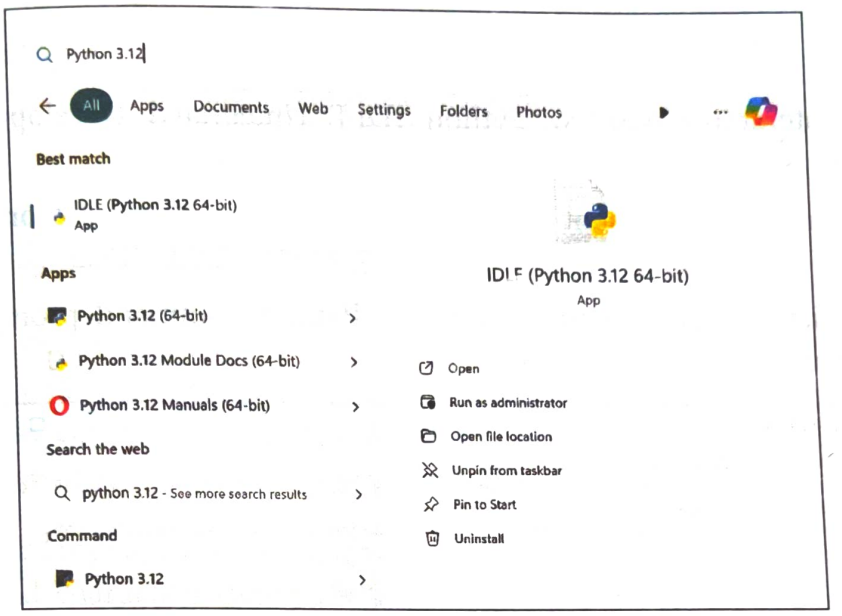
Python 3.12.3 : released on 9 April 2024
Python 3.11.3 : released on 5 April 2023
Python 3.10.1 : released on 6 December 2021
Python 3.9.1 : released on 8 December 2020
Python 3.8.0 : released on 14 October 2019
Python 3.7.0 : released on 27 June 2018
Python 3.5.0 : released on 13 September 2015
Python 3.4.0 : released on 16 March 2014
Python 3.3.0 : released on 29 September 2012
Python 3.2 : released on 20 February 2011
Python 3.1 : released on 27 June 2009
Python 3.0 : released on 3 December 2008
Python 2.0 : released on 16 October 2000

Once Python is downloaded, you will notice that Python is available in the computer system. It can be viewed by taking the following steps:

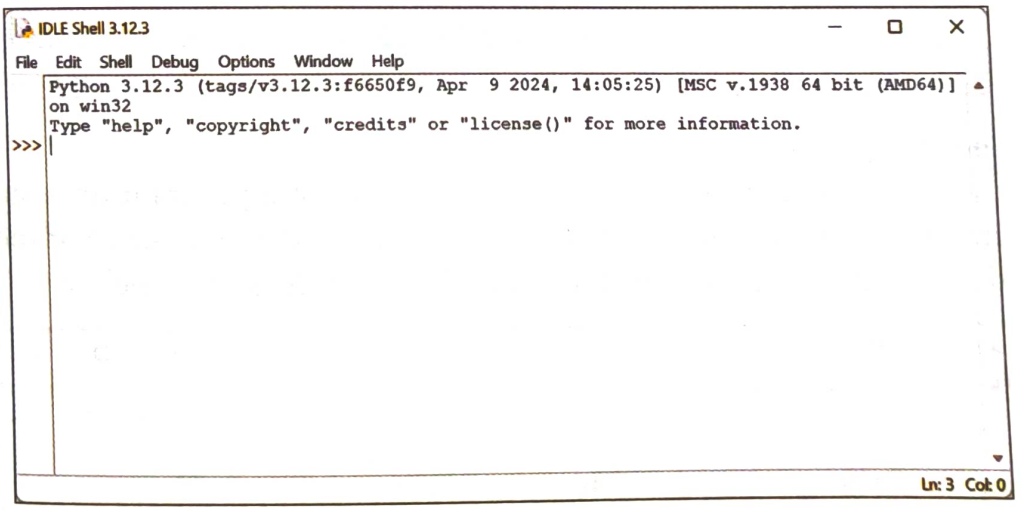
Step 1: Click on Start button, located at the extreme left-side of the taskbar.

Step 2: Type Python 3.12 in the Search box (as shown).

Step 3: Click on IDLE (Python 3.12 64 bit), available in the Best match.



Thus, IDLE Shell 3.12.3 window will be available on the screen (as shown).



Further, it is important to know that Python works in two different modes:

- Interactive Mode
- Script Mode

These modes are used as per the need of the user while performing the tasks.

Interactive Mode

Interactive mode refers to the mode where the user can instantly obtain the output, for the input given. The moment a statement or a command is typed in the Python command prompt (>>>) and the 'Enter' key is pressed, the output will appear on the next line of the interactive screen.

To work in the interactive mode, click IDLE (Python 3.12 64-bit) icon which is available on the Start pop-up screen.

Or,

Click shortcut icon, if available on the desktop.

Or,

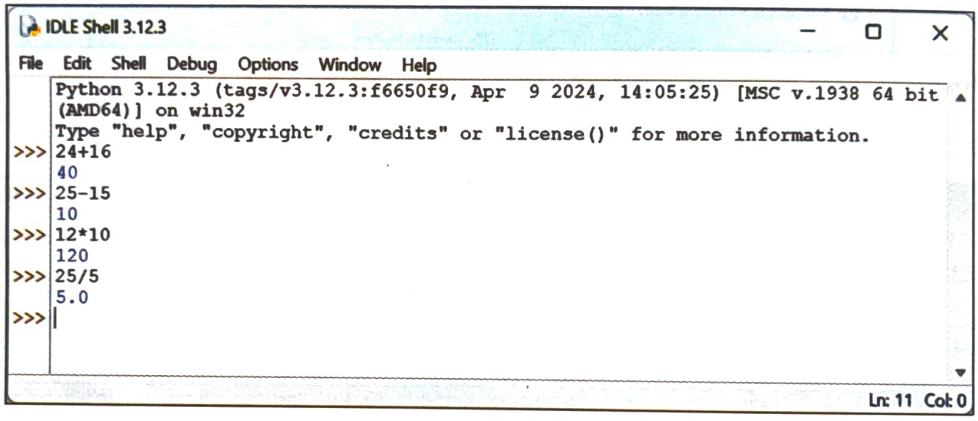
Click shortcut icon, if pinned to taskbar.



It will open the interactive window Python IDLE (Integrated Development and Learning Environment) Shell as shown below.

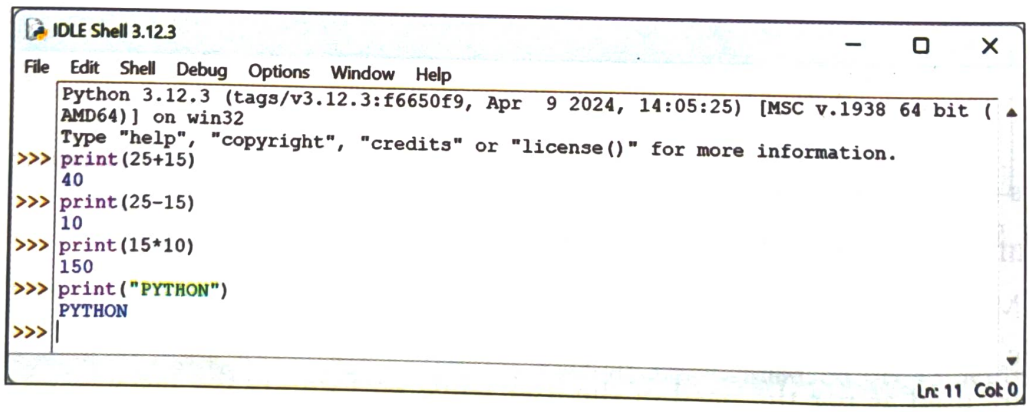
Now, type the command or statement in front of the Python command prompt and press 'Enter' key.

Python will immediately give you the result and Python command prompt will reappear to accept another instruction from the user.



Output Statement in Python: print( )

In Python, the print( ) function is used to view the output of a program on a standard output device (i.e., monitor), when executed. It may be a value, a variable, a message or the combination of message and variables written within the round brackets. It is show below:



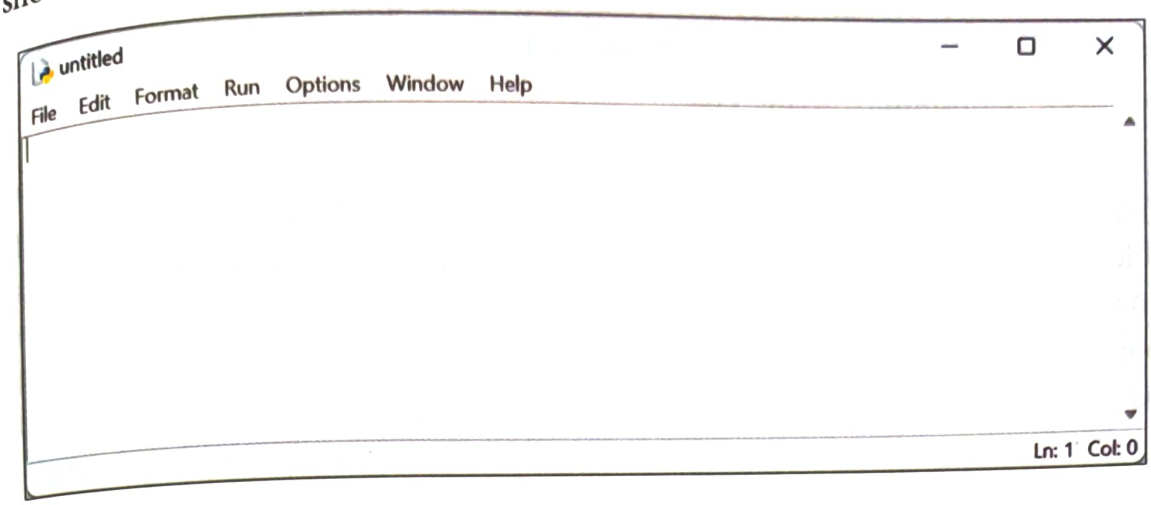
Script Mode (Python IDLE)

Script mode is used only when the user needs to create a program file. In this mode, you can save complete set of instructions in a program file. To do so, you need to follow these steps:

Step 1: Click shortcut icon of IDLE Shell (Python 3.12 64-bit)

Step 2: Click 'File' and select 'New File' from the dropdown menu.

An untitled window will appear. This window provides a platform for the user to write programs on it (as shown).



Basic Elements of Python Programming

Each programming language requires some basic elements which are essentially needed to write the code. Python also consists of such elements which are mentioned below:

Character Sets

Python is a computer language that enables the users to communicate with the computer system, using the set of valid characters that a language can recognise which is similar to alphabet of English language. It may be any letter, digit or any other symbol. The different character sets used in Python are shown below:

Character Sets	Explanation
Letters	All the letters of English alphabet (A-Z and a-z) are used in Python.
Digits	The digits (0 – 9) can be used in Python.
Arithmetical Operators	All arithmetical operators like +, -, *, /, % are applicable in Python codes.
Logical operators	In Python *and*, *or* and *not* are used as logical operators.
Relational operators	The Python language uses relational operators as <, <=, >, >=, == and !=.
Special Characters	The characters such as space, backslash, underscore, (_), ! , : , ; , @, parenthesis viz. ( ), { },[ ] are used as special characters.
White Spaces	Blank space, Tab key, Enter Key, Newline are some keys used for white spaces.

Escape Sequences

There are some non-graphic characters, which are used as commands to direct the cursor while printing. These characters are frequently used in Python codes and are referred to as Escape Sequences. An escape sequence character begins with a backslash (\) and it is followed by one or more characters.

Escape Sequences	Description
\t	Horizontal tab
\\	Backslash
\'	Single quote
\"	Double quote
\b	Backspace
\n	New line feed

Literals (Constants)

When you write a code, you may come across some quantities which remain fixed (i.e., do not change) throughout the execution of the program. Such quantities are termed as Constants. These constants include integer, string and boolean.

For example, 345, "Computer", True, etc.

Identifiers

An identifier is a component of a programming statement (token) defined with a name to identify a block (*i.e.*, a set of indented statements). Moreover, a function name, a class name or a variable name also refer to as an identifier.

For example, $n = 25$

Where, n is a variable name which refers to a specific identifier.

Assignments

Assigning means to store values in variables using a token '=' which acts as an assignment operator. The operand to the left of '=' operator is the variable name and the operand to the right of '=' operator is the value to be stored.

For example, $n = 15$

It means that the numeric constant 15 is stored in the variable n.

Keywords

Keywords are the reserved words which are preserved by the system and carry special meaning for the language translator (interpreter). These words cannot be used as variable names in the program. Some keywords are given in the table (alongside).

false	class	else	return
none	continue	for	not
true	def	if	or
and	del	import	pass
break	elif	is	while

Punctuators

Punctuators are the special signs used as special characters in Python to organise the structure as well as to put emphasis on the expressions of the sentences.

For example,

Comma (,), colon (:), semicolon (;), [ ], { }, ( ), #, are some of the punctuators commonly used in Python coding.

Expression and Statement

When a set of values, variables, and operators used together to obtain a meaningful result, is known as an Expression. It must be noted that the evaluation of an expression produces a value. That is why expressions appear on the left-hand side of an assignment statement. If you ask Python to print an expression, the interpreter evaluates the expressions to produce the result. Few examples of expressions are as follows:

(i) x + y

(ii) m – 15

(iii) a*a + 2*a*b + b*b

(iv) a*a + b*b + c*c + 2*a*b*c

When the values are assigned to these variables, they produce the result.

Whereas, the statements are the set of instructions written by users or programmers that the Python interpreter can execute. They are used in programs to obtain the desired output.

For example,

```
m = 15
n = 25
sum = m + n
print(sum)
```

← Python statements

Most of the cases, we come across with the assignment statement. Some other kinds of statements include if statements, import statements, for statements, etc. However, it is important to know that every programming language has its own way of writing statements to give the instructions to the system.



Chapter at a Glance

- High-level languages are classified into two categories viz. Procedure Oriented and Object-Oriented languages.
- Procedure Oriented languages are COBOL, BASIC, etc.
- Object Oriented languages are C++, Java, Python, etc.
- In Procedure Oriented programming, there is no restriction of data values and hence, they flow freely throughout the program.
- In Object Oriented programming, the data values are more secured.
- Python is a fourth-generation programming language.
- Guido van Rossum is best known as the creator Python language.
- The name Python has come from BBC's popular TV show Monty Python's Flying Circus.
- This language has been derived from many other languages such as the ABC, Modula-3, C, C++, etc.
- Python can be downloaded free from the website https://www.python.org.
- This language is commonly used for developing desktop GUI applications.
- Python programming is used in almost every field of computer science, including Artificial Intelligence.
- Python works in two different modes viz. Interactive mode, Script mode.
- Some of the basic elements of Python language includes character sets, escape sequences, identifiers, keywords, etc.
- Python is an interpreter-based language which allows us for easier debugging and code development.
- Python supports both object-oriented and procedural programming, providing versatility in coding styles.
- Escape sequences are some non-graphic characters which are used as commands to direct the cursor while printing.
- Keywords are the reserved words which are preserved by the system and carry special meaning for the language translator.
- The quantities which remain fixed throughout the execution of the program, are known as constants.