A Book Of

Python

For MBA (Business Analytics) : Semester - III

[Course Code 302 : Credit - 03]

CBCS Pattern

As Per New Syllabus, Effective from June 2020

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Preface ...

I take this opportunity to present this book entitled as **"Python"** to the students of Third Semester - MBA (Business Analytics). The object of this book is to present the subject matter in a most concise and simple manner. The book is written strictly according to the New Syllabus (CBCS Pattern).

The book has its own unique features. It brings out the subject in a very simple and lucid manner for easy and comprehensive understanding of the basic concepts, its intricacies, programs and practices. This book will help the readers to have a broader view on Python. The language used in this book is easy and will help students to improve their knowledge of programming and understand the matter in a better and happier way.

I sincerely thank Shri. Dineshbhai Furia and Shri. Jignesh Furia of Nirali Prakashan, for the confidence reposed in us and giving us this opportunity to reach out to the students of management studies.

I have given our best inputs for this book. Any suggestions towards the improvement of this book and sincere comments are most welcome on niralipune@pragationline.com.

Author

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Syllabus ...

1. **Introduction to Python Programming** **[7 + 2]**
   - Introduction
   - History of Python
   - Python Features
   - Applications in Various Domains
   - Introduction to IDES
   - Python Installation and Set-up
   - Python Interpreter
   - Script Execution
   - Dir and Help: Getting Help from the Python Interpreter
   - Python Basics: Variables, Keywords, Literals, Multi-Line Statements, Quotation, Comments, Line and Indentation, Input/Output Functions
   - Operators: Arithmetic, Comparison, Logical, Identity, Membership
2. **Python Data Types and Loop Structures** **[7 + 2]**
   - Mutable Vs Immutable Data Types, Data Types: Number, Strings: Creation, Manipulation, Operations, Lists and Tuples: Properties, Operations, Indexing.
   - Dictionaries: Key-value Pairs, Updating, Deleting Elements.
   - Sets: Properties, Operations, Uniqueness, Type Conversions and Casting between Data Types.
   - Flow Control: Conditional Statements - if, if-else, if-elif-else, loops - for, while.
   - Loop Control Statement: continue, break and pass, python list comprehension.
3. **Functions and Functional Programming** **[7 + 2]**
   - Introduction To Functions, Defining and Calling Functions, Arguments, Python 'Self' as Default Argument, Functions With Multiple Arguments, return values, range() function, Objects, Generators, Decorators, Scope - Global Scope, Local Scope, Nested Scope, Anonymous functions (lambda), map(), filter(), reduce(), Date and Time functions: datetime, timedelta, date, time classes
4. **File Handling and I/O Operations** **[7 + 2]**
   - Introduction to Files, Types of Files, Keyboard I/O Operations, File Handling Modes: Opening, Reading, Writing, Closing Files, Working with CSV and Excel Files using Python, Error Handling in File Operations, File and Directory-related Operations, Pickle Module.
5. **Introduction to Python Libraries for Analytics** **[7 + 2]**
   - Overview of Analytical Tasks and Role of Libraries, Introduction to the Data Analysis Workflow, NumPy: Creating Arrays, Array Operations, Pandas: Series, Data Frame Creation, Indexing and Data Manipulation, Use of Python in Basic Data Analysis Tasks.

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Chapter 1...

Introduction to Python Programming

Contents ...

- Introduction
- History of Python
- Python Features
- Applications in Various Domains
- Introduction to IDES
- Python Installation and Set-up
- Python Interpreter
- Script Execution
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- Operators: Arithmetic, Comparison, Logical, Identity, Membership

1.1 Introduction

- Python is a high-level, interpreted, interactive and object-oriented programming language. Today, Python is the trendiest programming language programming.
- Python is popular programming language because of it provides more reliability of code, clean syntax of code, advanced language features, scalability of code, portability of code, support object-oriented programming, broad standard library, easy to learn and read, support GUI mode, interactive, versatile, and interpreted, interfaces to all major commercial databases, and so on.

1.2 History of Python

- Python laid its foundation in the late 1980s. Python was developed by Guido Van Rossum at National Research Institute for Mathematics and Computer Science in Netherlands in 1990.
- Inspired by Monty Python's Flying Circus, a BBC comedy series, he named the language Python.
- Python is derived from many other languages, including ABC, Modula-3, C, C++, Algol-68, Smalltalk, and Unix shell and other scripting languages.

- Like Perl, Python source code is now available under the GNU General Public License (GPL).
- Python widely used in both industry and academia because of its simple, concise and extensive support of libraries.
- In 1994, Python 1.0 was released with new features like lambda, map, filter, and reduce.
- Python 2.0 added new features such as list comprehensions, garbage collection systems.
- Python 3.0 (which early in its development was commonly referred to as Python 3000 or py3k), a major, backwards-incompatible release, was released on 3 December 2008 after a long period of testing. Many of its major features have been back ported to the backwards-compatible Python 2.6.x and 2.7.x version series.
- The given programming languages influence Python: 1. ABC language, 2. Modula-3.
- Python is available for almost all operating systems such as Windows, Mac, Linux/Unix etc. Python can be downloading from http://www.python.org/downloads.

1.3 Features of Python

1. Easy to Learn/Code and Use:

- Python is easy to learn and use. It is developer-friendly and high-level programming language.
- Python has few keywords, simple structure, and a clearly defined syntax that makes it easily understandable for beginners.
- Python language is more expressive means that it is more understandable and readable for programmers.
- In Python programming programs are easy to write and execute as it omits some cumbersome, poorly understandable, and confusing features of other programming language such as C, C++ and Java.

2. Interpreted Language:

- Python is an interpreted language i.e., interpreter executes the code line by line at a time. This makes debugging easy and thus suitable for beginners. There are excellent, straightforward tools to work with python code, is interactive interpreter.
- In python, we need not to learn a build system, IDE, special text editor, or anything else to start using python. All we need only a command prompt and the interactive editor.
- Python provides a Python Shell (also known as Python Interactive Shell) which is used to execute a single Python command and get the result as shown in Fig. 1.1. If python is installed on the PC then to open the Python Shell on Windows, open the command prompt, write python and press enter.
- As we can see, a Python Prompt comprising of three Greater Than symbols (>>>) appear, (See Fig. 1.1).

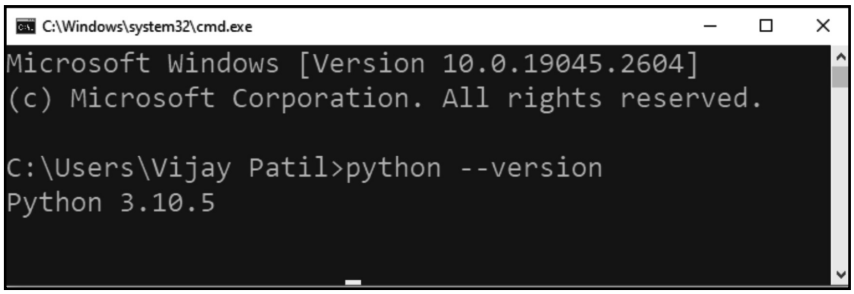


Fig. 1.1: Python prompt

3. Interactive Mode:

- Python programming language has support for interactive mode, which allows interactive testing and debugging of code. Graphical User Interfaces (GUIs) can be developed using Python.
- Python supports GUI applications that can be created and ported to many system calls, libraries and windows systems, such as Windows MFC, Macintosh and the X Window system of Unix.
- There are many free and commercial editors available for Python. Table 1.1 lists Python editors:

Table 1.1

Sr. No.	Editor	Description	Icon/Logo
1.	IDLE	IDLE is a popular Integrated Development Environment written in Python and it has been integrated with the default language. Mainly used by the beginner level developers who want to practice on Python development.	
2.	PyCharm	PyCharm is one of the widely used Python IDE which was created by Jet Brains. With PyCharm, the developers can write a neat and maintainable code. It helps to be more productive and gives smart assistance to the developers. It takes care of the routine tasks by saving time and thereby increasing profit accordingly.	
3.	Spyder	It was mainly developed for scientists and engineers to provide a powerful scientific environment for Python. It offers an advanced level of edit, debug, and data exploration feature. It is very extensible and has a good plugin system and API.	

contd. …

4.	PyDev	PyDev is an outside plugin for Eclipse. It is basically an IDE that is used for Python development. It is linear in size. It mainly focuses on the refactoring of python code, debugging in the graphical pattern, analysis of code etc. It is a strong python inter-preter.	
5.	Jupyter	The Jupyter Notebook is a browser-based graphical interface to the IPython shell. Allows us to create and share documents that contain live code, equations, visualizations and narrative text.	
6.	Anaconda	Anaconda is a distribution of the Python and R programming languages for scientific computing (data science, machine learning applications, large-scale data processing, predictive analytics, etc).	

- In this text book, IDLE is used for Python programming. IDLE (Integrated Development and Learning Environment) is an Integrated Development Environment (IDE) for Python.
- To start IDLE interactive shell, search for the IDLE icon in the start menu and double click on it and we will get the window (See Fig. 1.2).
- In Python IDLE shell not only we can execute commands one by one like in Python Command Prompt but also can create .py files and see execution of those files.

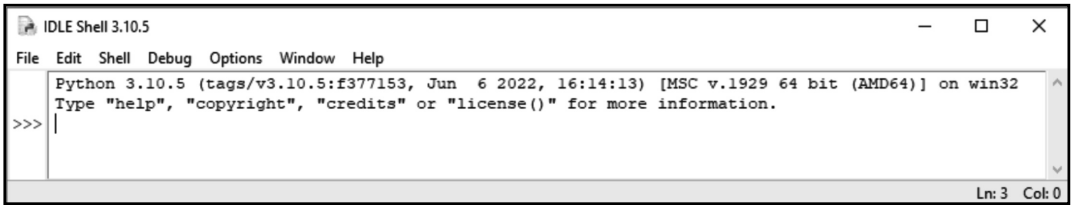


Fig. 1.2: Python Command prompt

4. Free and Open Source:

- Python programming language is developed under an OSI approved open source license making it freely available at official web address.
- Python is freely available for everyone. It is freely available on its official website www.python.org. It has a large community across the world that is dedicatedly working towards make new python modules and functions. Anyone can contribute to the Python community. The open-source means, "Anyone can download its source code without paying any penny."

- The Python software can be freely distributed and any one can use and read its source code make changes/modifications to it, and use the pieces in new free programs.

5. Platform Independence/Cross-platform Language/Portable:

- Python can run on a wide variety of hardware platforms and has the same interface on all platforms.
- Python can run equally on different platforms such as Windows, Linux, Unix and Macintosh etc. So, we can say that Python is a portable language.

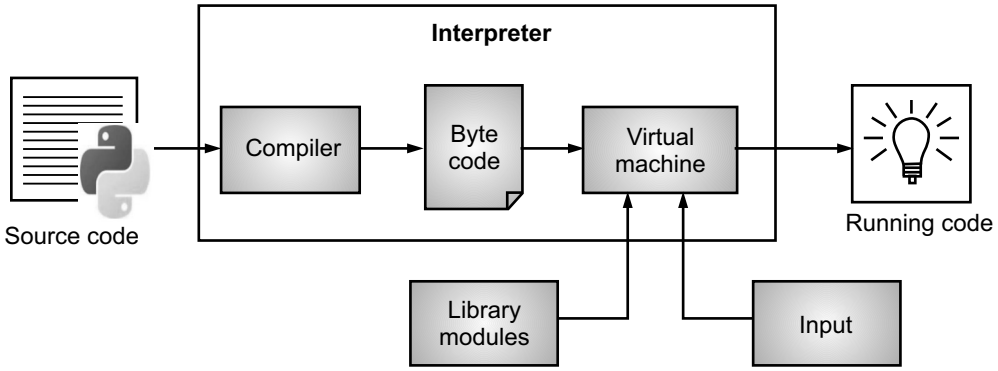


Fig. 1.3: Python Virtual machine

- Python source code goes through Compiler which compiles the source code into a format known as byte code.
- Byte code is a lower level, platform independent, efficient and intermediate representation of the source code. As soon as source code gets converted to byte code, it is fed into PVM (Python Virtual Machine).
- The PVM is the runtime engine of Python; it's always present as part of the Python system, and is the component that truly runs the scripts. Technically, it's just the last step of what is called the Python interpreter.

6. Object-Oriented Language:

- A programming language that can model the real world is said to be object-oriented. It focuses on objects, and combines data and functions. Contrarily, a procedure-oriented language revolves around functions, which are code that can be reused.
- Python supports both procedure-oriented and object-oriented programming which is one of the key python features. It supports inheritance, polymorphism, and encapsulation etc. The object-oriented procedure helps to programmer to write reusable code and develop applications in less code.
- Python has a powerful but simplistic way also doing OOP, especially when compared to C++ and Java languages. Python supports object oriented language and concepts of classes and objects come into existence.

7. **Extensible:**
   - Python programming implies that other languages such as C/C++ can be used to compile the code and thus it can be used further in the python code.
   - Python has a large and broad library and provides rich set of module and functions for rapid application development.
   - Python languages bulk library is portable and cross platform compatible with Unix, Windows.
8. **Large Standard Library:**
   - Python has a large standard library which provides rich set of modules and functions.
   - Python provides a vast range of libraries for the various fields such as machine learning, web developer, and also for the scripting.
   - There are various machine learning libraries, such as Tensor flow, Pandas, Numpy, Keras, and Pytorch, etc.
   - Django, flask, pyramids are the popular framework for Python web development.
9. **GUI Programming Support:**
   - Graphical User Interface is used for the developing Desktop application. PyQT5, Tkinter, Kivy are the libraries which are used for developing the web application.
   - Python offers various toolkits, such as wxPython and JPython, which allows for GUI's easy and fast development.
10. **Embedded Language:**
    - Graphical User Interface is used for the developing Desktop application. PyQT5, Tkinter, Kivy are the libraries which are used for developing the web application.
11. **Databases:**
    - Python provides interfaces to all major commercial databases available today.

1.4 Applications of Python Programming

- Python is a general-purpose programming language that can be used for both scientific and non-scientific programming.
- Google's App Engine web development framework uses Python as an application language.
- Maya, a powerful integrated 3D modelling and animation system, provides a Python scripting API.
- Linux Weekly News, published by using a web application written in Python.
- Google makes extensive use of Python in its Web Search Systems.
- The popular YouTube video sharing service is largely written in Python programming.
- The NSA uses Python for cryptography and intelligence analysis.
- iRobot uses Python programming to develop commercial and military robotic devices.
- The Raspberry Pi single-board computer promotes Python programming as its educational language.

- Netflix and Yelp have both documented the role of Python in their software infrastructures.
- Industrial Light and Magic, Pixar and others uses Python in the production of animated movies.
- Python language is used by companies in real revenue-generating products, such as the operation of Google search engine and YouTube. Intel, Cisco, HP (Hewlett-Packard), and IBM (International Business Machines) use Python for hardware testing.
- Python is also used in Rapid Prototyping, Database applications, Game development, Web applications, System Administrations, etc.
- The general areas where Python is widely used are:
  1. Data Analysis and Processing
  2. Artificial Intelligence
  3. Games
  4. Hardware/Sensor/Robots
  5. Desktop Applications

1.5 Python Environment Setup-Installation and Working of IDE

Installing Python in Windows:

- Open any internet browser. Type http:///www.python.org/downloads/ in address bar and Enter.

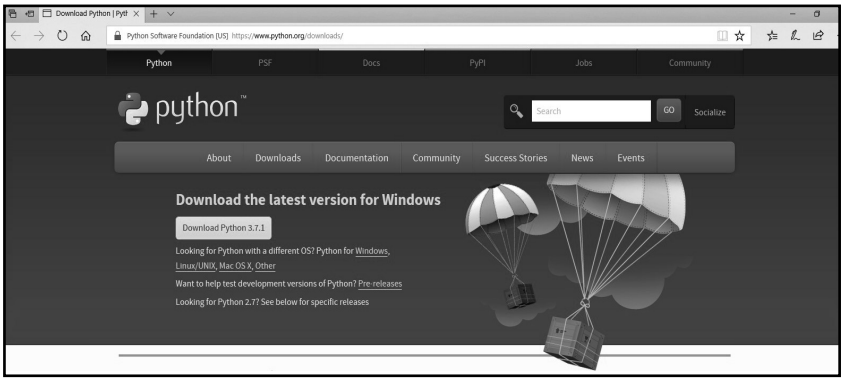


Fig. 1.4: Home Page

- Click on download the latest version for windows.

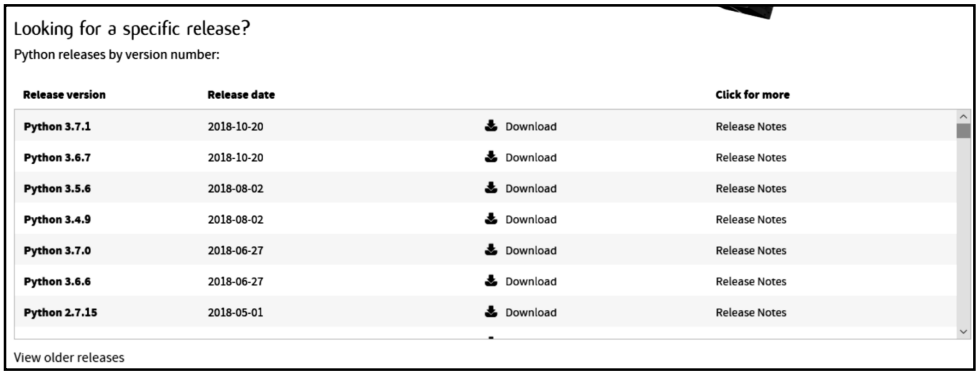


Fig. 1.5: Python release versions

- Open the python 3.7.1 or newest version pack and double click on it to start installation.



Fig. 1.6: Python Installation prompt

- Click on next install now for installation

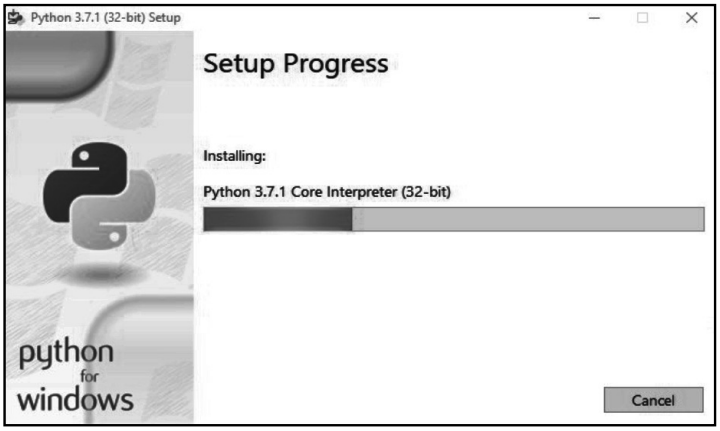


Fig. 1.7: Setup Progress

- After complete the installation close the windows

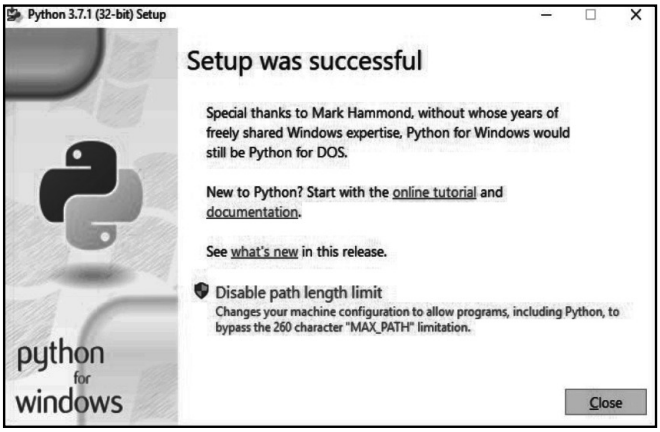


Fig. 1.8: Python Setup Completion Screen

Starting Python in different modes:

1. Starting Python (Command Line):

- Press start button.

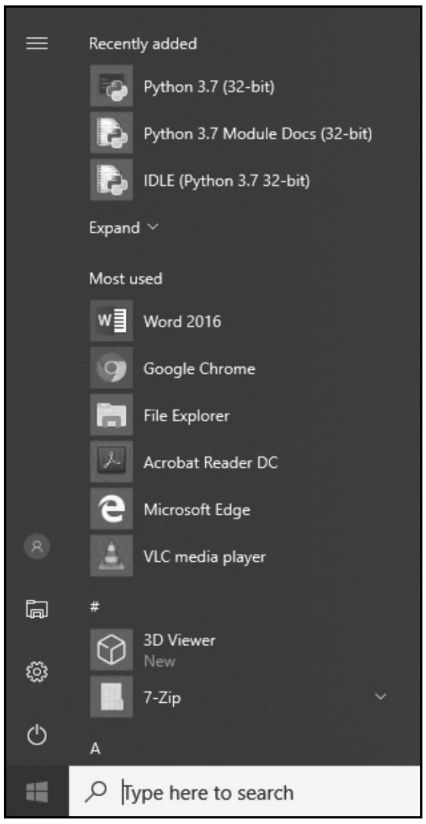


Fig. 1.9

- Click on all programs and then click on Python 3.7 (32 bit). You will see the Python interactive prompt in Python command line.



Fig. 1.10: Python command shell

- Python command prompt contains an opening message >>> called command prompt. The cursor at command prompt waits for to enter Python command. A complete command is called a statement. For example check first command to print message.

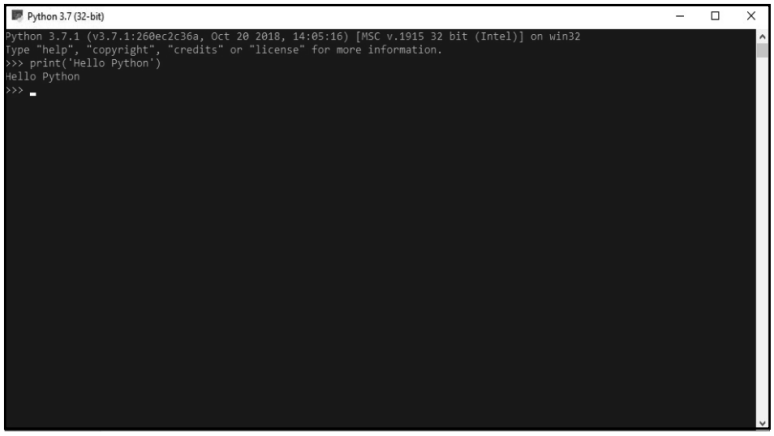


Fig. 1.11: Print message

- To exit from the command line of Python, press Ctrl+z followed by Enter or Enter exit() or quit() and Enter.

2. Starting Python IDLE:

- Press start button and click on IDLE (Python 3.7 32 bit) options.

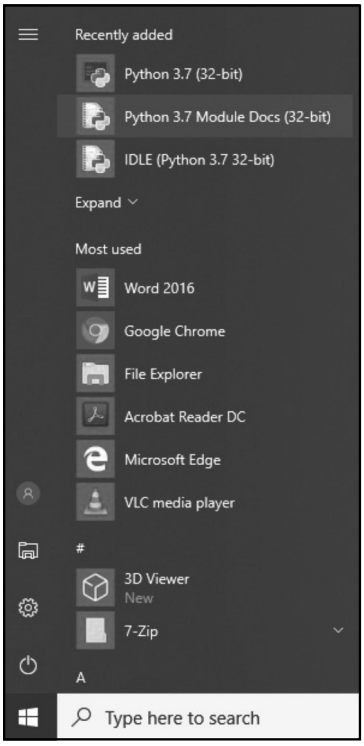


Fig. 1.12

- You will see the Python interactive prompt i.e. interactive shell.

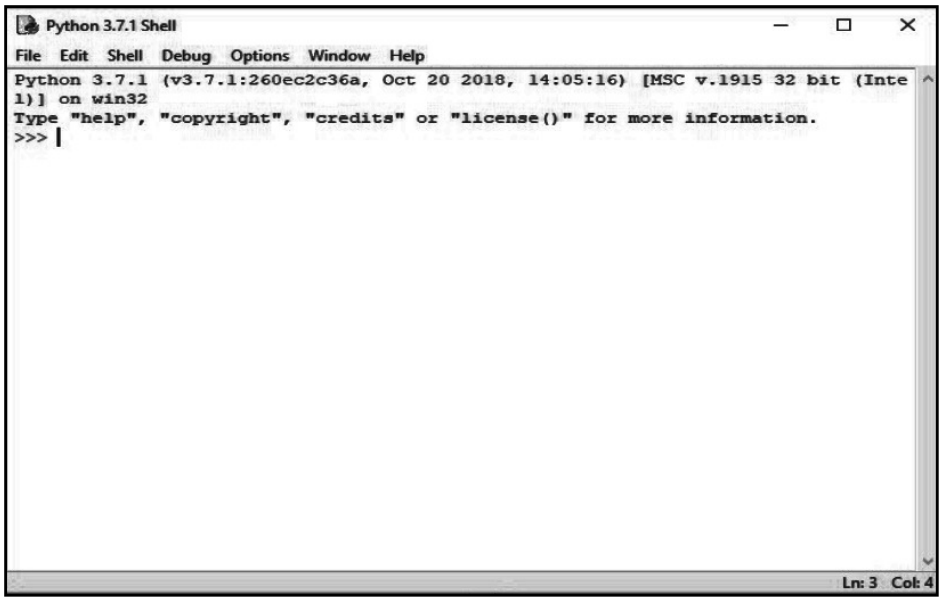


Fig. 1.13: Python Interactive Shell

- Python interactive shell prompt contains opening message >>>, called shell prompt. A cursor is waiting for the command. A complete command is called a statement. When you write a command and press enter, the python interpreter will immediately display the result.

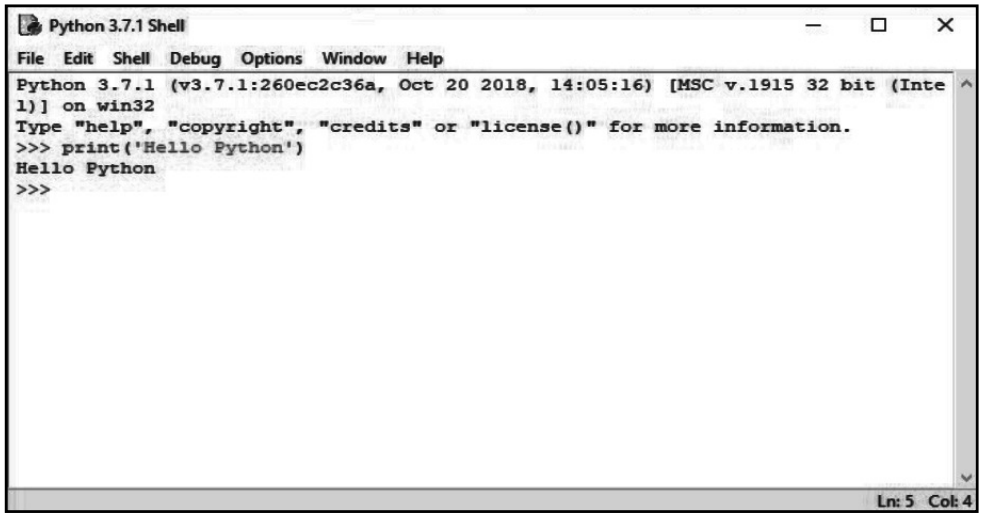


Fig. 1.14: Print Message

Executing Python Programs:

- In Python IDLEs-shell window, click on **File**, and the on **New File** or click **Ctrl+N**.

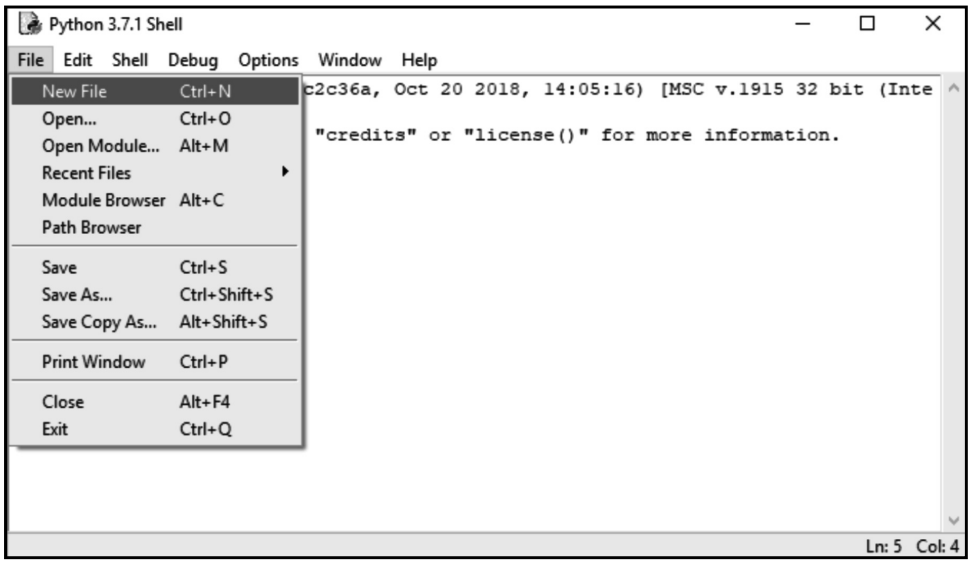


Fig. 1.15

- As soon as you click on New File, the window appears as:

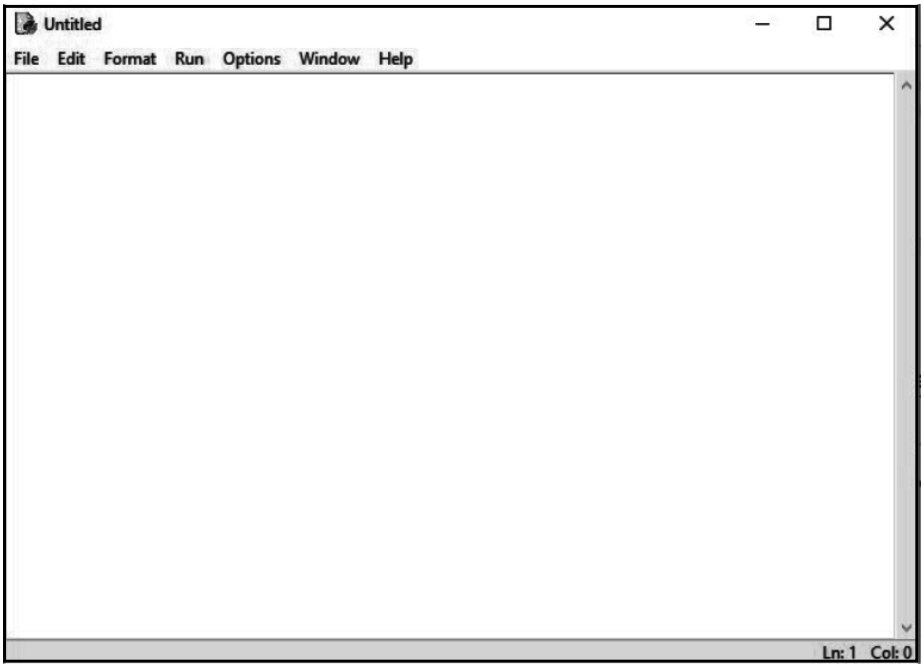


Fig. 1.16

- Write python program in script mode.

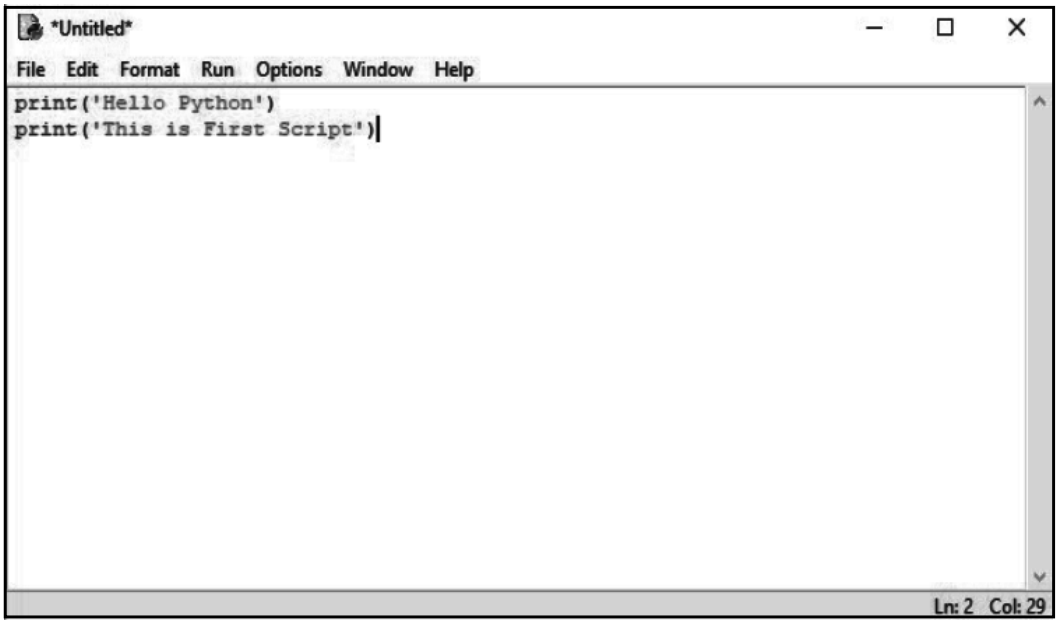


Fig. 1.17: Python Script mode

- Save the above code with filename. By default, python interpreter will save it using the filename.py. Here we save the script with file name test.py.

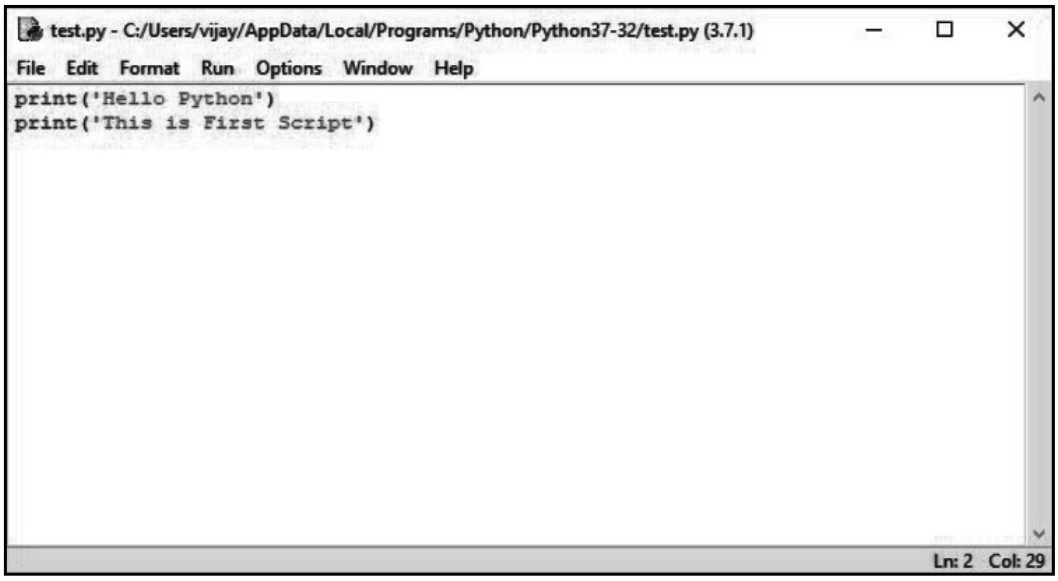


Fig. 1.18

- To run the python program, click on **Run** and then **Run Module** option or you can press **Ctrl+F5**.

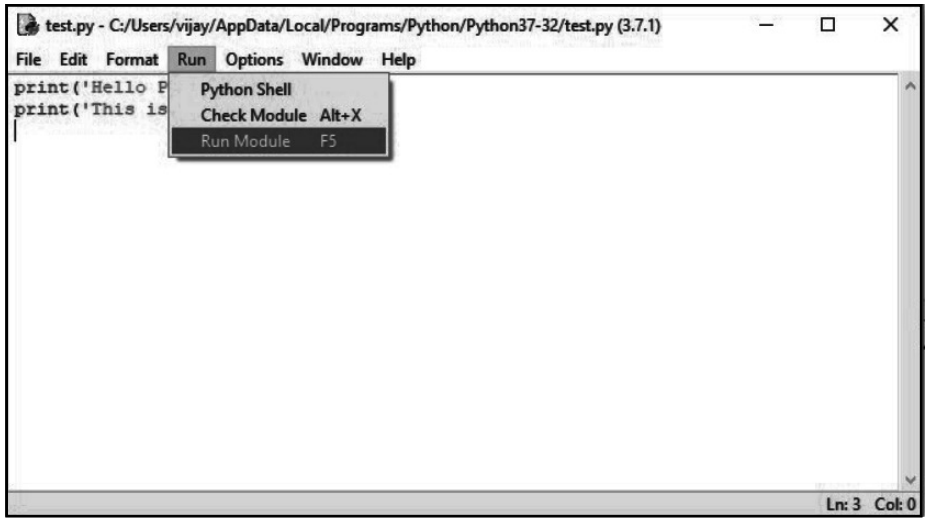


Fig. 1.19: Python Run module

- After clicking Run Module, you will get the output of program.

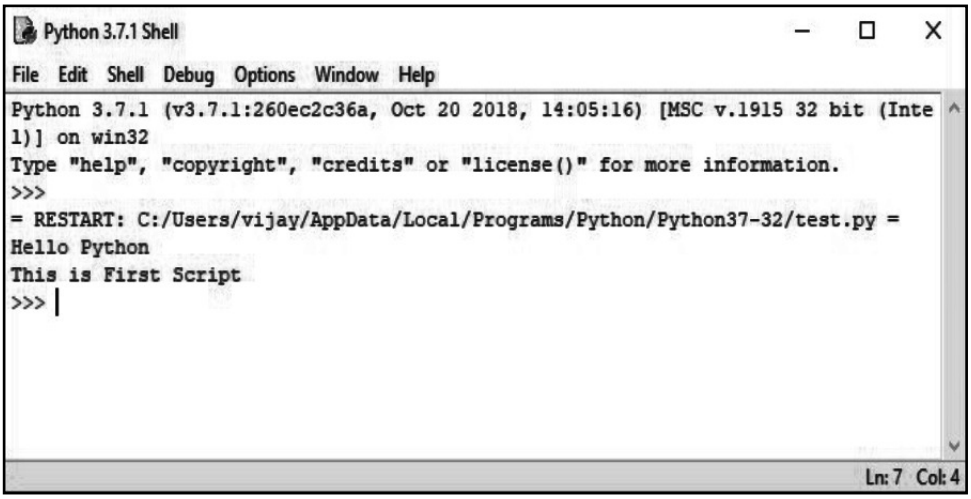
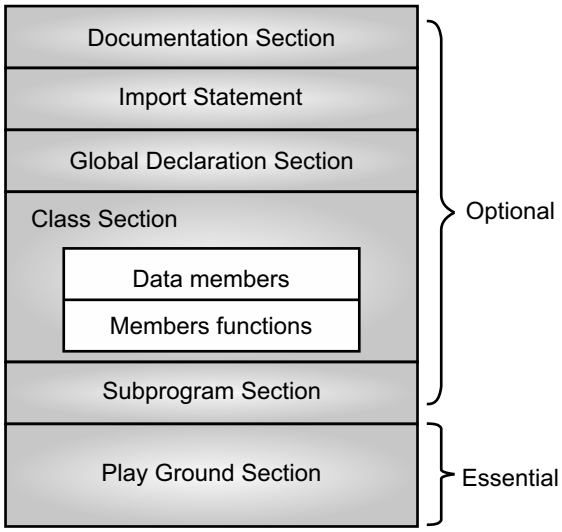


Fig. 1.20

1.6 Structure of Python

- Fig. 1.21 shows a typical program structure Python programming.
- Python programming programs are structured as a sequence as statements. A Python statement is smallest program unit. Statements are the instructions that are written in a program to perform a specific task.
- A Python statement is a complete instruction executed by the Python interpreter. A Python program may consist as more than one statement.
- By default, the Python interpreter execute all statements sequentially, but we can change order of execution using control statements.




```
#Python program to calculate area of
Circle
# Documentation Section
import math
#import statement
radius=5
#global declaration Section
class Circle():
#class section
    def getArea(self):
        return math.pi*radius*radius
    def showradius():
#sub Program section
        print("Radius =",radius)
showradius()
#Playground Section
c=Circle()
c.showradius()
print("Area =",c.getArea())
```

Output:

```
Radius = 5
Area = 78.53981633974483
```

Fig. 1.21: Typical Program Structure of Python Programming with Example

- Program structure of Python programming contains following sections:
  1. **Documentation Section** includes the comments that specify the purpose of the program. A comments that is a non-executable statement which is ignored by the compiler while program execution. Python comments are written anywhere in the program.
  2. **Import Section** is used includes different built in or user defined modules.
  3. **Global Declaration Section** is used to define the global variables for the programs.
  4. **Classification** describe the information about the user defined classes in the program. A class is a collection of data members and member functions called method, that operation data members.
  5. **Sub program Section** includes user defined functions. The functions include the set of statements that need to be executed when the function is called form anywhere.
  6. **Pay Ground Section** is the main section of Python program and the main section starts where the function calling.

1.7 Running Python Scripts

- Python has two basic modes namely, script and interactive.
- The normal mode is the mode where the scripted and finished .py files are run in the Python interpreter.
- The interactive mode is a command line shell which gives immediate feedback for each statement, while running previously fed statements in active memory.
- As new lines are fed into the interpreter, the fed program is evaluated both in part and in whole.

1. Interactive Mode:

- Interactive mode is great for quickly and conveniently running single lines or blocks of code. Here's an example using the python shell that comes with a basic python installation.
- The ">>>" indicates that the shell is ready to accept interactive commands. So for example if we want to print the statement "this is interactive mode", simply type the appropriate code and hit enter.

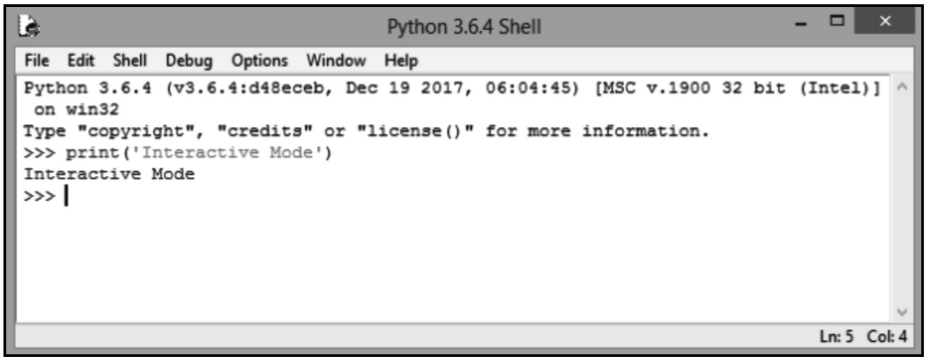
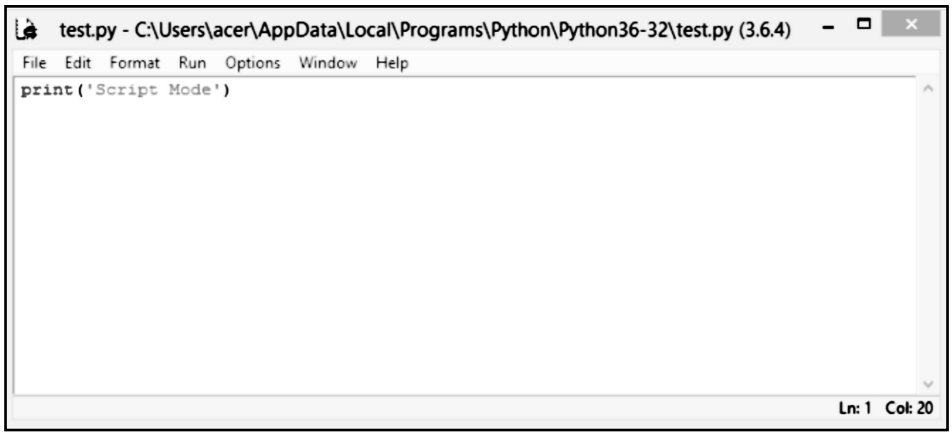


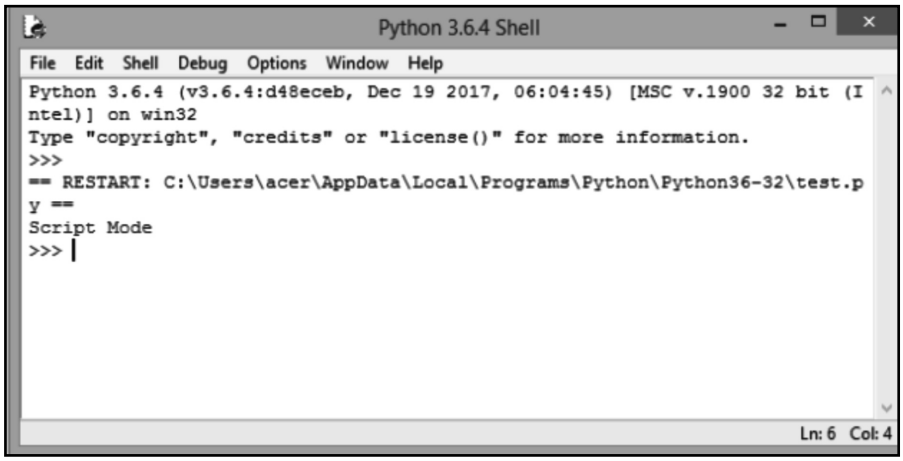
Fig. 1.22: Interactive mode

2. Script Mode:

- In the standard Python shell we can go to "File" → "New File" (or just hit Ctrl + N) to pull up a blank script in which to put the code. Then save the script with a ".py" extension.
- We can save it anywhere we want for now, though we may want to make a folder somewhere to store the code as we test Python out. To run the script, either select "Run" → "Run Module" or press F5.
- We should see something like shown in Fig. 1.23.



(a)



(b)

Fig. 1.23

1.8 Internal Working of Python

- Python is an object oriented programming language like C++ and Java. Python is called an interpreted language means Python programs are executed by the interpreter. Python uses code modules that are interchangeable instead of a single long list of instructions that was standard for functional programming languages.
- The standard implementation of python is called "CPython". It is the default and widely used implementation of the Python.
- Python does not convert its code into machine code. It actually converts code into byte code. So within python, compilation happens, but it's just not into a machine language.
- It is into byte code and this byte code cannot be understood by CPU. So we need actually an interpreter called the Python Virtual Machine (PVM). The python virtual machine executes the byte codes.

- When a programmer tries to run a Python code as instructions in an interactive manner in a Python shell, then Python performs various operations internally.
- All such internal operations can be broken down into a series of steps as shown in Fig. 1.24.

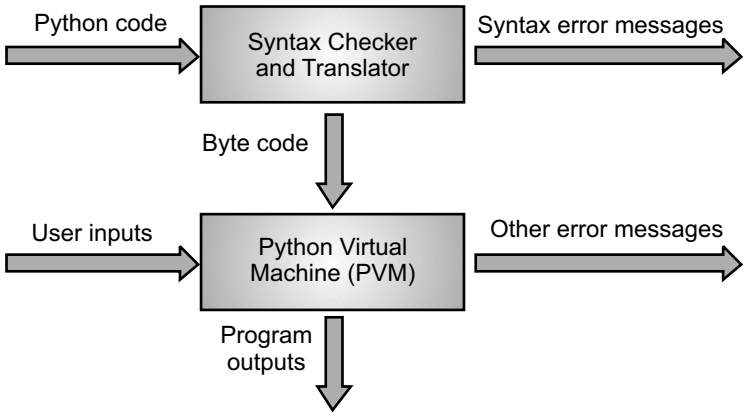


Fig. 1.24: Internal Working of Python

- The Python interpreter performs following tasks to execute a Python program:
  1. The interpreter reads a Python expression or statement, also called the source code, and verifies that it is well formed. In this step, as soon as the interpreter encounters such an error, it halts translation with an error message.
  2. If a Python expression is well formed, the interpreter then translates it to an equivalent form in a low-level language called byte code. When the interpreter runs a script, it completely translates it to byte code.
  3. This byte code is next sent to another software component, called the Python Virtual Machine (PVM), where it is executed. If another error occurs during this step, execution also halts with an error message.

Python Building Blocks:

- Keywords, identifiers, variables etc., are the basic building blocks of Python programming. Python uses the character sets as the building block to form the basic program elements such as variables, keywords, constants, etc

1.9 Python Basics

1.9.1 Character Set

- The character set is a set of alphabets, letters, symbols and some special characters that are valid in Python programming language.
- Python uses the following character sets. These characters are submitted to the Python interpreter; they are interpreted or uniquely identified in various contexts, such as characters, identifiers, names or constants.
  1. **Alphabets:** All Capital Letters (A-Z) and Small Letters (a-z).