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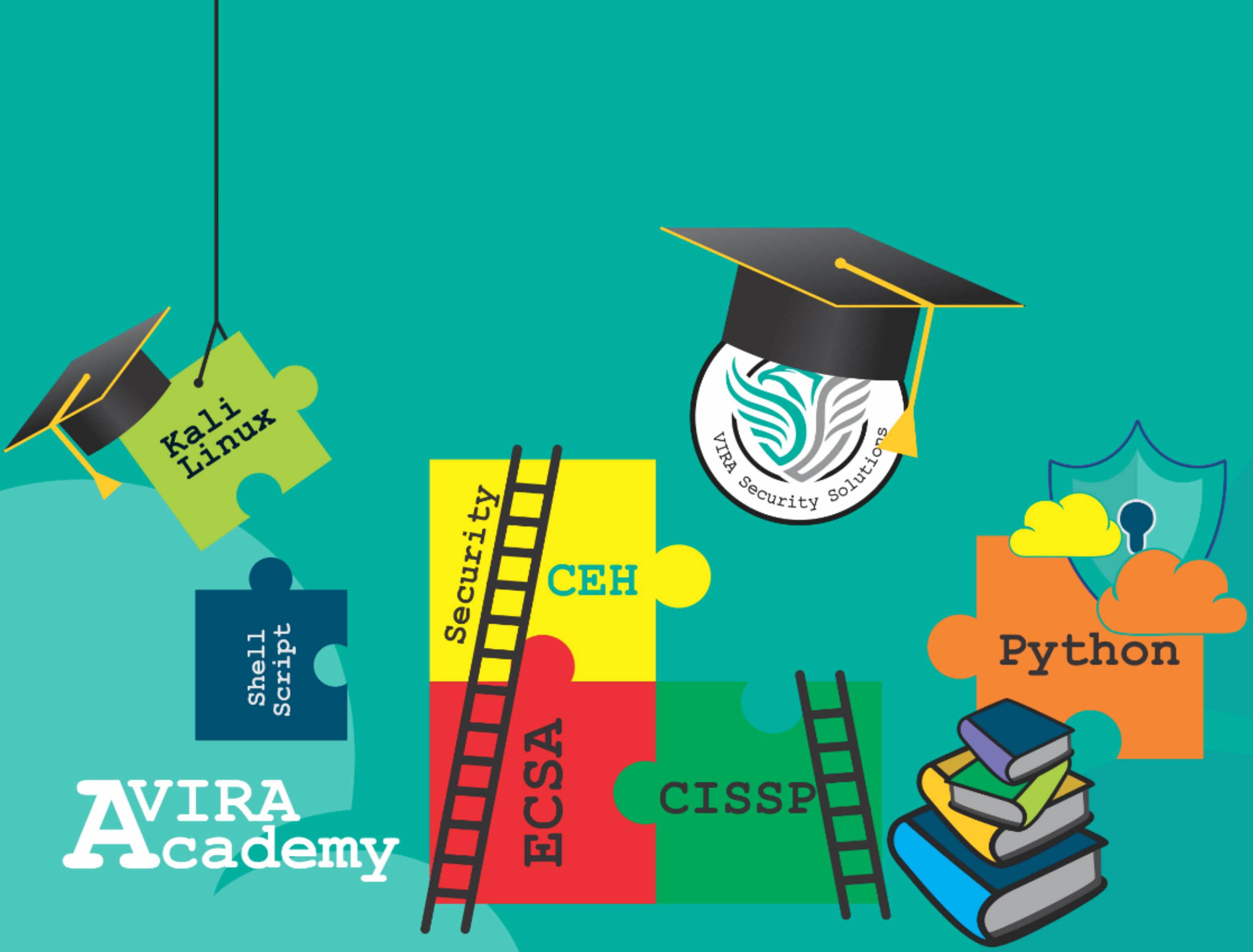
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Python

Part1

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Why to Learn Python?

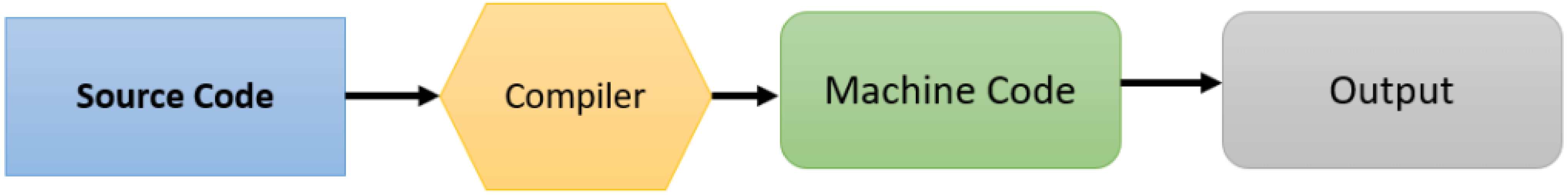
Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages.

Python is a MUST for students and working professionals to become a great Software Engineer specially when they are working in Data Science and Web Development Domain.

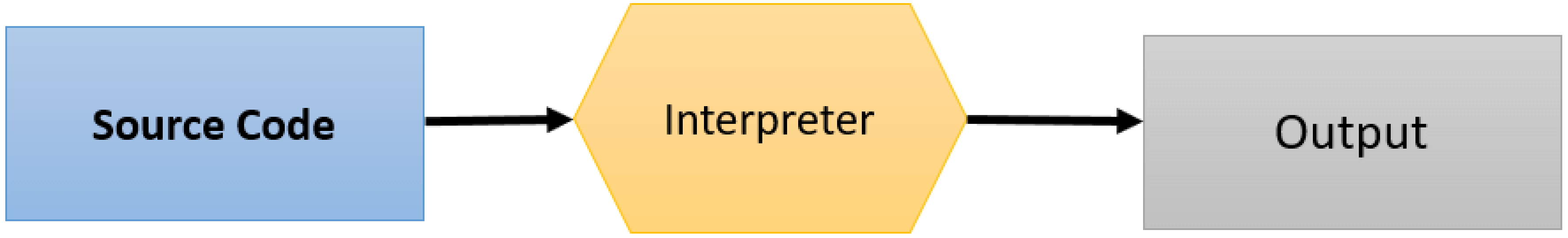
Why to Learn Python?

- **Python is Interpreted** – Python is processed at runtime by the interpreter. You do not need to compile your program before executing it. This is similar to PERL and PHP.
- **Python is Interactive** – You can actually sit at a Python prompt and interact with the interpreter directly to write your programs.
- **Python is Object-Oriented** – Python supports Object-Oriented style or technique of programming that encapsulates code within objects.
- **Python is a Beginner's Language** – Python is a great language for the beginner-level programmers and supports the development of a wide range of applications from simple text processing to WWW browsers to games.

How Compiler Works



How Interpreter Works



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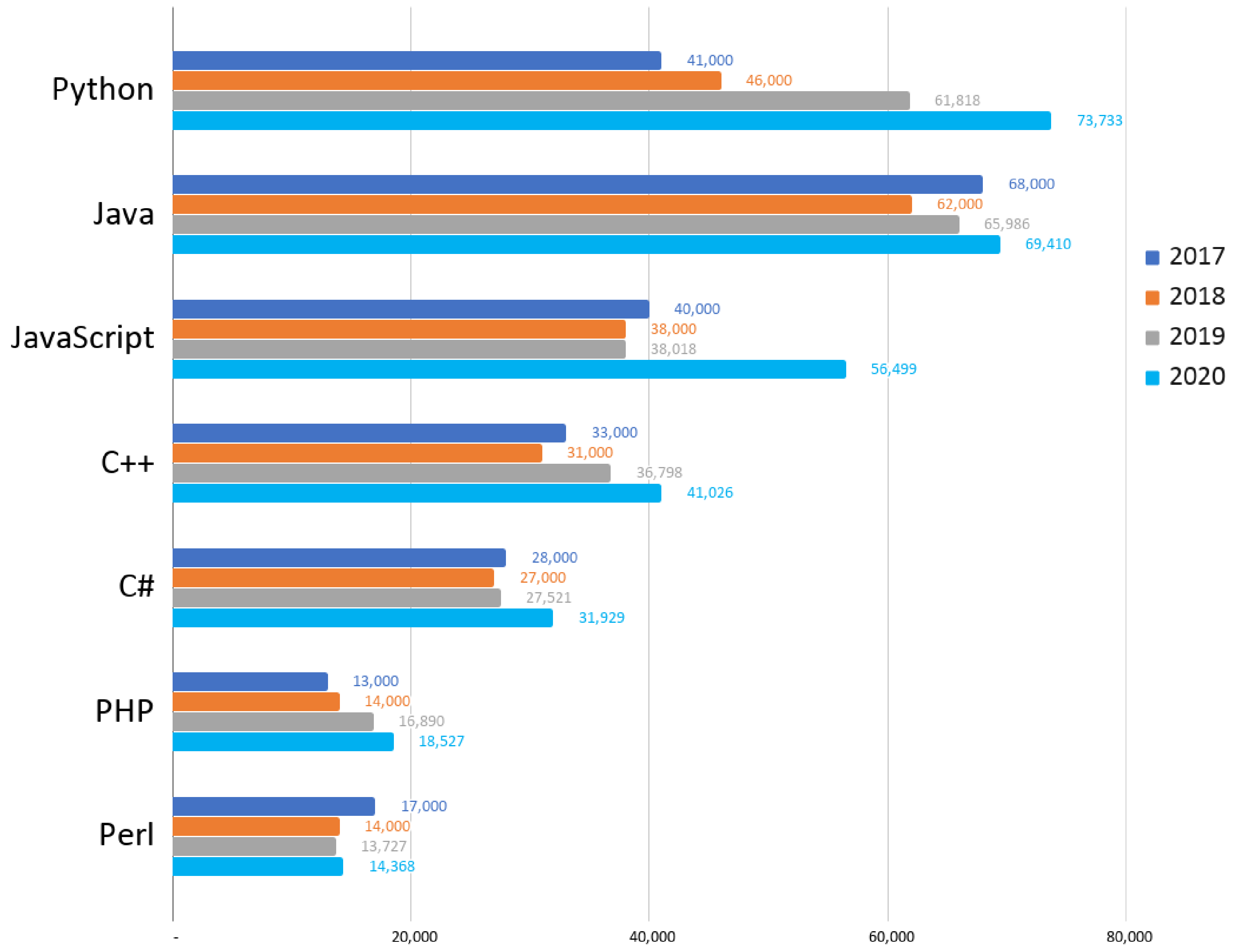


Characteristics of Python

Following are important characteristics of Python Programming

- It supports functional and structured programming methods as well as OOP.
- It can be used as a scripting language or can be compiled to byte-code for building large applications.
- It provides very high-level dynamic data types and supports dynamic type checking.
- It can be easily integrated with C, C++, COM, ActiveX, CORBA, and Java.

Applications of Python

- **Easy-to-learn** − Python has few keywords, simple structure, and a clearly defined syntax. This allows the student to pick up the language quickly.
- **Easy-to-read** − Python code is more clearly defined and visible to the eyes.
- **Easy-to-maintain** − Python's source code is fairly easy-to-maintain.
- **A broad standard library** − Python's bulk of the library is very portable and cross-platform compatible on UNIX, Windows, and Macintosh.
- **Interactive Mode** − Python has support for an interactive mode which allows interactive testing and debugging of snippets of code.

Applications of Python

- **Portable** – Python can run on a wide variety of hardware platforms and has the same interface on all platforms.
- **Extendable** – You can add low-level modules to the Python interpreter. These modules enable programmers to add to or customize their tools to be more efficient.
- **Databases** – Python provides interfaces to all major commercial databases.
- **GUI Programming** – 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.
- **Scalable** – Python provides a better structure and support for large programs than shell scripting.

Audience

- This **Python tutorial** is designed for software programmers who need to learn Python programming language from scratch.

Prerequisites

- You should have a basic understanding of Computer Programming terminologies. A basic understanding of any of the programming languages is a plus.

History

Python was developed by **Guido van Rossum** in the late eighties and early nineties at the National Research Institute for Mathematics and Computer Science in the Netherlands.

Python is derived from many other languages, including ABC, Modula-3, C, C++, Algol-68, SmallTalk, and Unix shell and other scripting languages.

Python is copyrighted. Like Perl, Python source code is now available under the GNU General Public License (GPL).

Python is now maintained by a core development team at the institute, although Guido van Rossum still holds a vital role in directing its progress.

Python - Environment Setup

Python Features

Python is available on a wide variety of platforms including Linux and Mac OS X.

Local Environment Setup

Open a terminal window and type "**python**" to find out if it is already installed and which version is installed.

Unix (Solaris, Linux, FreeBSD, AIX, HP/UX, SunOS, IRIX, etc.)
Win 9x/NT/2000
Macintosh (Intel, PPC, 68K)
OS/2
DOS (multiple versions)
PalmOS
Nokia mobile phones
Windows CE
Acorn/RISC OS
BeOS
Amiga
VMS/OpenVMS
QNX
VxWorks
Psion
Python has also been ported to the Java and .NET virtual machines

Getting Python

The most up-to-date and current source code, binaries, documentation, news, etc., is available on the official website of Python https://www.python.org/

You can download Python documentation from https://www.python.org/doc/. The documentation is available in HTML, PDF, and PostScript formats.

Getting Python

Windows Installation

Here are the steps to install Python on Windows machine.

- Open a Web browser and go to https://www.python.org/downloads/.
- Follow the link for the Windows installer *python-XYZ.msi* file where XYZ is the version you need to install.
- To use this installer *python-XYZ.msi*, the Windows system must support Microsoft Installer 2.0. Save the installer file to your local machine and then run it to find out if your machine supports MSI.
- Run the downloaded file. This brings up the Python install wizard, which is really easy to use. Just accept the default settings, wait until the install is finished, and you are done.

Getting Python

Unix and Linux InstallationMethod 1

Here are the simple steps to install Python on Unix/Linux machine.

- Open a Web browser and go to https://www.python.org/downloads/.
- Follow the link to download zipped source code available for Unix/Linux.
- Download and extract files.
- Editing the *Modules/Setup* file if you want to customize some options.
- run ./configure script
- make
- make install
- This installs Python at standard location */usr/local/bin* and its libraries at */usr/local/lib/pythonXX* where XX is the version of Python.

Getting Python

Unix and Linux Installation Method 2

Here are the simple steps to install Python on Unix/Linux machine.

Open a terminal and run following commands respectively:

```
yum install -y epel-release
yum update -y
yum install -y python3
yum install python-pip3
pip3 install jupyter
```

Starting jupyter notebook:

```
 # jupyter notebook
```

And open a new browser and type:

http://localhost:8888

Or use your system IP:

http://192.168.1.55:8888

Getting Python

Macintosh Installation

- Recent Macs come with Python installed, but it may be several years out of date. See http://www.python.org/download/mac/ for instructions on getting the current version along with extra tools to support development on the Mac. For older Mac OS's before Mac OS X 10.3 (released in 2003), MacPython is available.
- Jack Jansen maintains it and you can have full access to the entire documentation at his website – http://www.cwi.nl/~jack/macpython.html. You can find complete installation details for Mac OS installation.

Setting up PATH

Programs and other executable files can be in many directories, so operating systems provide a search path that lists the directories that the OS searches for executables.

The path is stored in an environment variable, which is a named string maintained by the operating system. This variable contains information available to the command shell and other programs.

The **path** variable is named as PATH in Unix or Path in Windows (Unix is case sensitive; Windows is not).

In Mac OS, the installer handles the path details. To invoke the Python interpreter from any particular directory, you must add the Python directory to your path.

Setting path at Unix/Linux

To add the Python directory to the path for a particular session in Unix −

- **In the csh shell** − type setenv PATH "$PATH:/usr/local/bin/python" and press Enter.
- **In the bash shell (Linux)** − type export PATH="$PATH:/usr/local/bin/python" and press Enter.
- **In the sh or ksh shell** − type PATH="$PATH:/usr/local/bin/python" and press Enter.
- **Note** − /usr/local/bin/python is the path of the Python directory

Setting path at Windows

- To add the Python directory to the path for a particular session in Windows −
- **At the command prompt** − type path %path%;C:\Python and press Enter.
- **Note** − C:\Python is the path of the Python directory

Python Environment Variables

Here are important environment variables, which can be recognized by Python

PYTHONPATH

- It has a role similar to PATH. This variable tells the Python interpreter where to locate the module files imported into a program. It should include the Python source library directory and the directories containing Python source code. PYTHONPATH is sometimes preset by the Python installer.

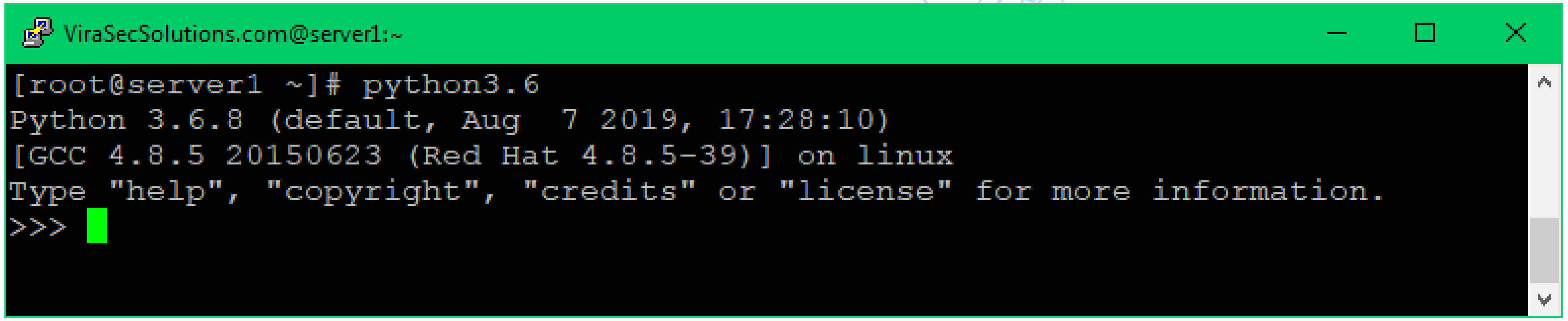
PYTHONSTARTUP

- It contains the path of an initialization file containing Python source code. It is executed every time you start the interpreter. It is named as .pythonrc.py in Unix and it contains commands that load utilities or modify PYTHONPATH.

Running Python

There are three different ways to start Python

- Interactive Interpreter
- You can start Python from Unix, DOS, or any other system that provides you a command-line interpreter or shell window.
- Enter **python** the command line.
- Start coding right away in the interactive interpreter.



```
[root@server1 ~]# python3.6
Python 3.6.8 (default, Aug  7 2019, 17:28:10)
[GCC 4.8.5 20150623 (Red Hat 4.8.5-39)] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

Python - Basic Syntax

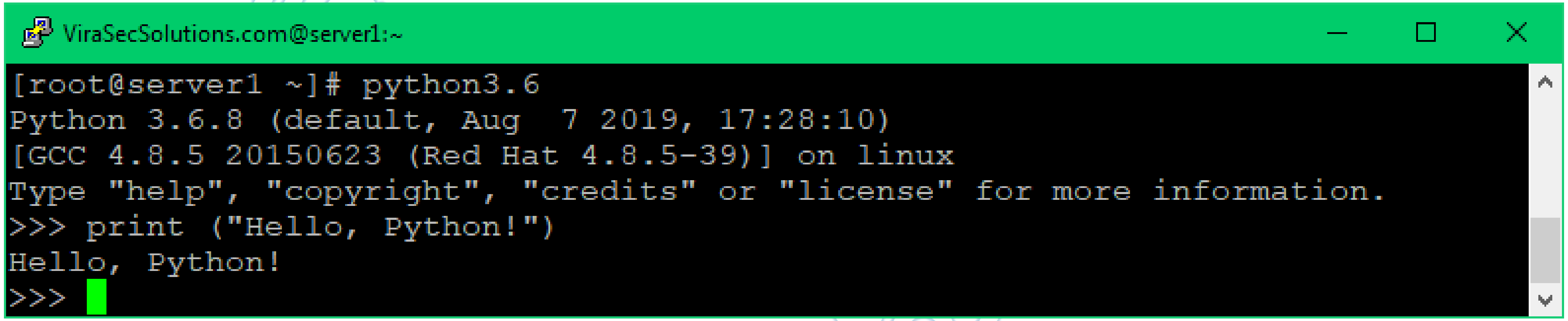
The Python language has many similarities to Perl, C, and Java. However, there are some definite differences between the languages.

First Python Program

- Let us execute programs in different modes of programming.
- Interactive Mode Programming
- Invoking the interpreter without passing a script file as a parameter brings up the following prompt

Python - Basic Syntax

First Python Program



```
[root@server1 ~]# python3.6
Python 3.6.8 (default, Aug  7 2019, 17:28:10)
[GCC 4.8.5 20150623 (Red Hat 4.8.5-39)] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> print ("Hello, Python!")
Hello, Python!
>>>
```

If you are running new version of Python, then you would need to use print(statement with parenthesis as in in **print ("Hello, Python!");**. However in Python version 3.6.8, this produces the following result

Python - Basic Syntax

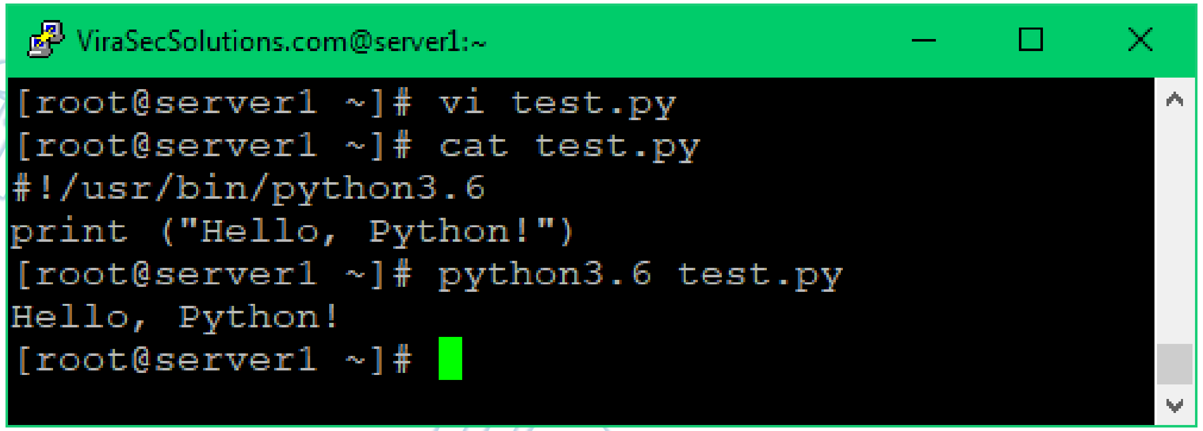
First Python Program

Script Mode Programming

For this module you can write a small script like test.py

```
#!/usr/bin/python3.6
print ("Hello, Python!")
```

and then run with following command:
Python3.6 test.py



```
[root@server1 ~]# vi test.py
[root@server1 ~]# cat test.py
#!/usr/bin/python3.6
print ("Hello, Python!")
[root@server1 ~]# python3.6 test.py
Hello, Python!
[root@server1 ~]#
```

Python - Basic Syntax

First Python Program

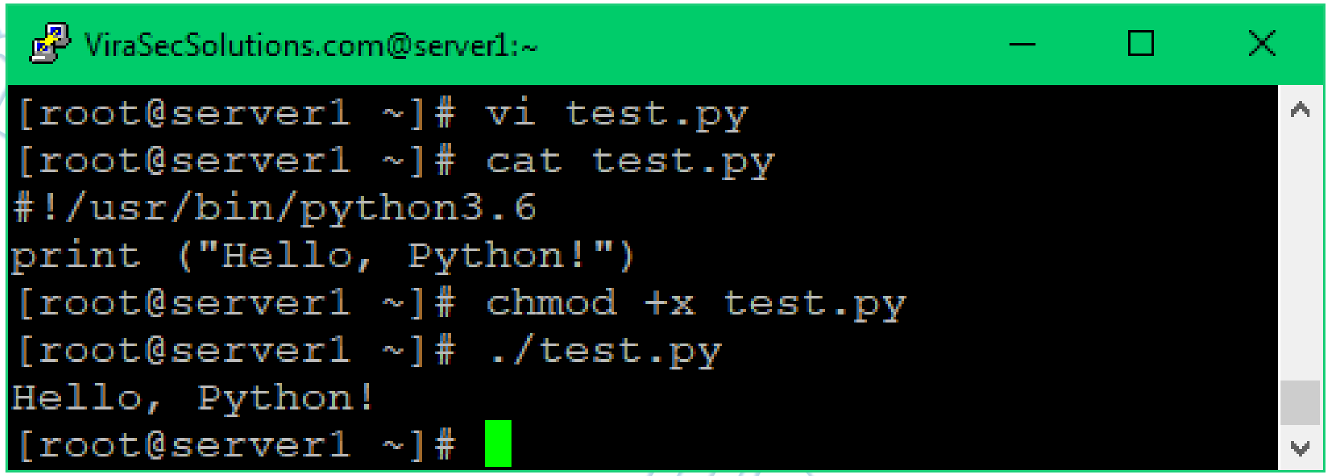
Script Mode Programming

For this module you can write a small script like test.py

```
#!/usr/bin/python3.6
print("Hello, Python!")
```

and then run with following command:

```
chmod +x  test.py
./test.py
```



```
[root@server1 ~]# vi test.py
[root@server1 ~]# cat test.py
#!/usr/bin/python3.6
print ("Hello, Python!")
[root@server1 ~]# chmod +x test.py
[root@server1 ~]# ./test.py
Hello, Python!
[root@server1 ~]#
```

Python Identifiers

A Python identifier is a name used to identify a variable, function, class, module or other object. An identifier starts with a letter A to Z or a to z or an underscore (_) followed by zero or more letters, underscores and digits (0 to 9).

Python does not allow punctuation characters such as @, $, and % within identifiers. Python is a case sensitive programming language.
Thus, **Manpower** and **manpower** are two different identifiers in Python.

Here are naming conventions for Python identifiers –

- Class names start with an uppercase letter. All other identifiers start with a lowercase letter.
- Starting an identifier with a single leading underscore indicates that the identifier is private.
- Starting an identifier with two leading underscores indicates a strongly private identifier.
- If the identifier also ends with two trailing underscores, the identifier is a language-defined special name.

Reserved Words

The following list shows the Python keywords. These are reserved words and you cannot use them as constant or variable or any other identifier names. All the Python keywords contain lowercase letters only.

and	exec	not
assert	finally	or
break	for	pass
class	from	print(
continue	global	raise
def	if	return
del	import	try
elif	in	while
else	is	with
except	lambda	yield

Lines and Indentation

Python provides no braces to indicate blocks of code for class and function definitions or flow control. Blocks of code are denoted by line indentation, which is rigidly enforced.

The number of spaces in the indentation is variable, but all statements within the block must be indented the same amount. For example −

```
if True:
   print( "True“)
else:
   print( "False“)
```

However, the following block generates an error −

```
if True:
print( "Answer“)
print( "True“)
else:
print( "Answer“)
print( "False“)
```

Lines and Indentation

- Thus, in Python all the continuous lines indented with same number of spaces would form a block. The following example has various statement blocks −
- **Note** − Do not try to understand the logic at this point of time. Just make sure you understood various blocks even if they are without braces.

```
#!/usr/bin/python

import sys

try:
  # open file stream
  file = open(file_name, "w")
except IOError:
  print( "There was an error writing to", file_name
  sys.exit()
print( "Enter '", file_finish,
print( "' When finished"
while file_text != file_finish:
  file_text = raw_input("Enter text: ")
  if file_text == file_finish:
    # close the file
    file.close
    break
  file.write(file_text)
  file.write("\n")
file.close()
file_name = raw_input("Enter filename: ")
if len(file_name) == 0:
  print( "Next time please enter something"
  sys.exit()
try:
  file = open(file_name, "r")
except IOError:
  print( "There was an error reading file"
  sys.exit()
file_text = file.read()
file.close()
print( file_text
```

Multi-Line Statements

Statements in Python typically end with a new line. Python does, however, allow the use of the line continuation character (\) to denote that the line should continue. For example

```
total = item_one + \
        item_two + \
        item_three
```

Statements contained within the [], {}, or () brackets do not need to use the line continuation character. For example

```
days = ['Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday']
```

Quotation in Python

Python accepts single ('), double (") and triple (''' or """) quotes to denote string literals, as long as the same type of quote starts and ends the string.

The triple quotes are used to span the string across multiple lines. For example, all the following are legal

```
word = 'word'
sentence = "This is a sentence."
paragraph = """This is a paragraph. It is
made up of multiple lines and sentences."""
```

Comments in Python

A hash sign (#) that is not inside a string literal begins a comment. All characters after the # and up to the end of the physical line are part of the comment and the Python interpreter ignores them.

```
#!/usr/bin/python

# First comment
print ("Hello, Python!“)    # second comment
```

This produces the following result

```
Hello, Python!
```

Using Blank Lines

A line containing only whitespace, possibly with a comment, is known as a blank line and Python totally ignores it.

In an interactive interpreter session, you must enter an empty physical line to terminate a multiline statement.

Waiting for the User

The following line of the program displays the prompt, the statement saying "Press the enter key to exit", and waits for the user to take action

```
#!/usr/bin/python
raw_input("\n\nPress the enter key to exit.")
Or
input("\n\nPress the enter key to exit.")
```

Here, "\n\n" is used to create two new lines before displaying the actual line. Once the user presses the key, the program ends. This is a nice trick to keep a console window open until the user is done with an application.

Multiple Statements on a Single Line

The semicolon (;) allows multiple statements on the single line given that neither statement starts a new code block. Here is a sample snip using the semicolon

```
#!/usr/bin/python
import sys; x = ‘Vira'; sys.stdout.write(x + '\n')
```

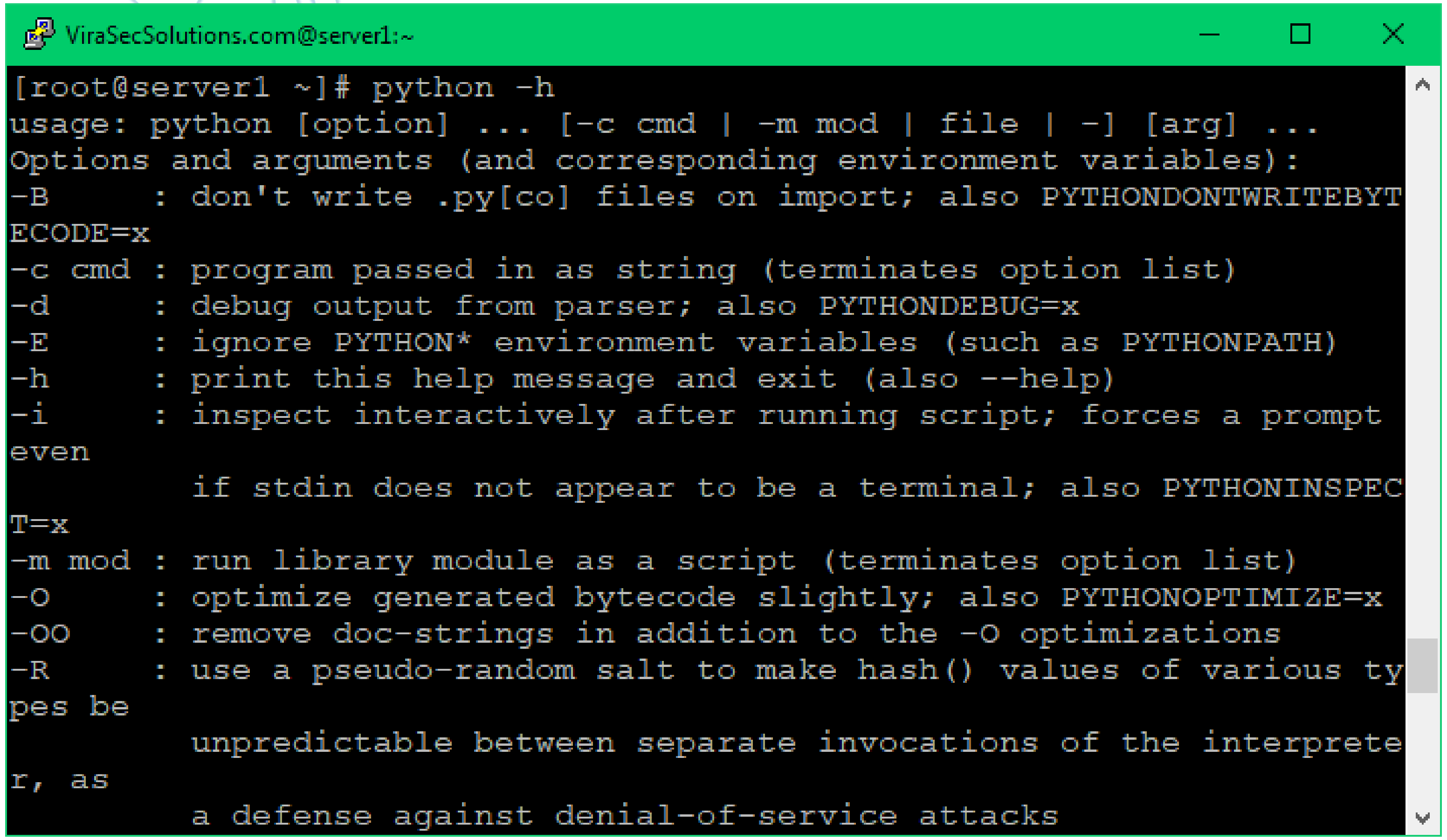
Multiple Statement Groups as Suites

A group of individual statements, which make a single code block are called **suites** in Python. Compound or complex statements, such as if, while, def, and class require a header line and a suite.
Header lines begin the statement (with the keyword) and terminate with a colon (:) and are followed by one or more lines which make up the suite. For example

```
if expression :
   suite
elif expression :
   suite
else :
   suite
```

Command Line Arguments

Many programs can be run to provide you with some basic information about how they should be run. Python enables you to do this with -h



ViraSecSolutions.com@server1:~

```
[root@server1 ~]# python -h
usage: python [option] ... [-c cmd | -m mod | file | -] [arg] ...
Options and arguments (and corresponding environment variables):
-B     : don't write .py[co] files on import; also PYTHONDONTWRITEBYT
ECODE=x
-c cmd : program passed in as string (terminates option list)
-d     : debug output from parser; also PYTHONDEBUG=x
-E     : ignore PYTHON* environment variables (such as PYTHONPATH)
-h     : print this help message and exit (also --help)
-i     : inspect interactively after running script; forces a prompt
even
         if stdin does not appear to be a terminal; also PYTHONINSPEC
T=x
-m mod : run library module as a script (terminates option list)
-O     : optimize generated bytecode slightly; also PYTHONOPTIMIZE=x
-OO    : remove doc-strings in addition to the -O optimizations
-R     : use a pseudo-random salt to make hash() values of various ty
pes be
         unpredictable between separate invocations of the interprete
r, as
         a defense against denial-of-service attacks
```

Python - Variable Types

Variables

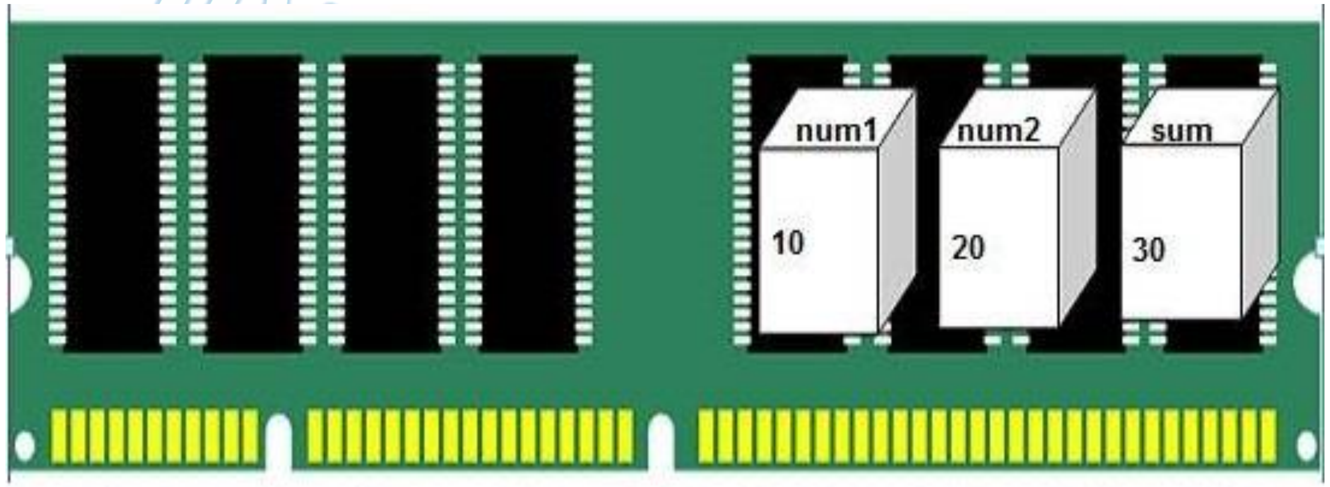
Variables are nothing but reserved memory locations to store values. This means that when you create a variable you reserve some space in memory.
Based on the data type of a variable, the interpreter allocates memory and decides what can be stored in the reserved memory. Therefore, by assigning different data types to variables, you can store integers, decimals or characters in these variables.

X = 10

Ch = 'A'

Str = ' this is a string'

num1 = 10 , num2 = 20 , num3 = 30



Graphical Representation of Three Variables with values in memory-RAM

Assigning Values to Variables

Python variables do not need explicit declaration to reserve memory space. The declaration happens automatically when you assign a value to a variable. The equal sign (=) is used to assign values to variables.
The operand to the left of the = operator is the name of the variable and the operand to the right of the = operator is the value stored in the variable. For example:

```
#!/usr/bin/python
counter = 100          # An integer assignment
fvar   = 1000.0       # A floating point
name     = “Vira"       # A string
print( (counter)
print( (fvar)
print( (name)
```

Here, 100, 1000.0 and “Vira" are the values assigned to counter, fvar, and name variables, respectively. This produces the following result −

```
100
1000.0
Vira
```

Multiple Assignment

Python allows you to assign a single value to several variables simultaneously. For example −

```
a = b = c = 1
```

Here, an integer object is created with the value **1**, and all three variables are assigned to the same memory location. You can also assign multiple objects to multiple variables. For example −

```
a,b,c = 1,2,“Vira“
```

Here, two integer objects with values **1** and **2** are assigned to variables a and b respectively, and one string object with the value “**Vira**" is assigned to the variable c.

Standard Data Types

The data stored in memory can be of many types. For example, a person's age is stored as a numeric value and his or her address is stored as alphanumeric characters. Python has various standard data types that are used to define the operations possible on them and the storage method for each of them.
Python has five standard data types –

- ✓ **Numbers**
- ✓ **String**
- ✓ **List**
- ✓ **Tuple**
- ✓ **Dictionary**

Python Numbers

Number data types store numeric values. Number objects are created when you assign a value to them. For example –

```
var1 = 1
var2 = 10
```

You can also delete the reference to a number object by using the del statement. The syntax of the del statement is –

```
del var1[,var2[,var3[....,varN]]]]
```

You can delete a single object or multiple objects by using the del statement. For example –

```
del var
del var_a, var_b
```

Python supports four different numerical types –

- **int (signed integers)**
- **long (long integers, they can also be represented in octal and hexadecimal)**
- **float (floating point real values)**
- **complex (complex numbers)**

Python Numbers

Examples

Here are some examples of numbers –

int	long	float	complex
10	51924361L	0.0	3.14j
100	-0x19323L	15.20	45.j
-786	0122L	-21.9	9.322e-36j
080	0xDEFABCECBD AECBFBAEl	32.3+e18	.876j
-0490	535633629843L	-90.	-.6545+0J
-0x260	-052318172735L	-32.54e100	3e+26J
0x69	-4721885298529L	70.2-E12	4.53e-7j

•Python allows you to use a lowercase l with long, but it is recommended that you use only an uppercase L to avoid confusion with the number 1. Python displays long integers with an uppercase L.

•A complex number consists of an ordered pair of real floating-point numbers denoted by x + yj, where x and y are the real numbers and j is the imaginary unit.

Python Strings

Strings in Python are identified as a contiguous set of characters represented in the quotation marks. Python allows for either pairs of single or double quotes. Subsets of strings can be taken using the slice operator ([ ] and [:]) with indexes starting at 0 in the beginning of the string and working their way from -1 at the end.

The plus (+) sign is the string concatenation operator and the asterisk (*) is the repetition operator. For example:

```
#!/usr/bin/python
str = 'Hello World!'
print( (str))          # print(s complete string
print( (str[0]))       # print(s first character of the string
print( (str[2:5]))     # print(s characters starting from 3rd to 5th
print( (str[2:]))      # print(s string starting from 3rd character
print( (str * 2))      # print(s string two times
print( (str + "TEST“)) # print(s concatenated string
```

This will produce the following result:

```
Hello World!
H
llo
llo World!
Hello World!Hello World!
Hello World!TEST
```

Python Strings

Lists are the most versatile of Python's compound data types. A list contains items separated by commas and enclosed within square brackets ([]). To some extent, lists are similar to arrays in C. One difference between them is that all the items belonging to a list can be of different data type.
The values stored in a list can be accessed using the slice operator ([ ] and [:]) with indexes starting at 0 in the beginning of the list and working their way to end -1. The plus (+) sign is the list concatenation operator, and the asterisk (*) is the repetition operator. For example

```
#!/usr/bin/python

list = [ 'abcd', 786 , 2.23, 'Vira', 70.2 ]
tinylist = [123, 'Vira']

print( (list) )        # print(s complete list
print( (list[0]))       # print(s first element of the list
print( (list[1:3]))      # print(s elements starting from 2nd till 3rd
print( (list[2:]))      # print(s elements starting from 3rd
element
print( (tinylist * 2))  # print(s list two times
print( (list + tinylist)) # print(s concatenated lists
```

This produce the following result

```
['abcd', 786, 2.23, 'Vira', 70.2]
abcd
[786, 2.23]
[2.23, 'Vira', 70.2]
[123, 'Vira', 123, 'Vira']
['abcd', 786, 2.23, 'Vira', 70.2, 123, 'Vira']
```

Python Tuples

A tuple is another sequence data type that is similar to the list. A tuple consists of a number of values separated by commas. Unlike lists, however, tuples are enclosed within parentheses.
The main differences between lists and tuples are: Lists are enclosed in brackets ([ ]) and their elements and size can be changed, while tuples are enclosed in parentheses (( )) and cannot be updated. Tuples can be thought of as **read-only** lists. For example

```
#!/usr/bin/python

tuple = ( 'abcd', 786 , 2.23, 'Vira', 70.2  )
tinytuple = (123, 'Vira')

print( (tuple) )          # print(s complete list
print( (tuple[0]))        # print(s first element of the list
print( (tuple[1:3]))      # print(s elements starting from 2nd till 3rd
print( (tuple[2:]))       # print(s elements starting from 3rd element
print( (tinytuple * 2))   # print(s list two times
print( (tuple + tinytuple)) # print(s concatenated lists
```

This produce the following result

```
('abcd', 786, 2.23, 'Vira', 70.2)
abcd
(786, 2.23)
(2.23, 'Vira', 70.2)
(123, 'Vira', 123, 'Vira')
('abcd', 786, 2.23, 'Vira', 70.2, 123, 'Vira')
```

Python Tuples

The following code is invalid with tuple, because we attempted to update a tuple, which is not allowed. Similar case is possible with lists

```
#!/usr/bin/python

tuple = ( 'abcd', 786 , 2.23, 'Vira', 70.2  )
list = [ 'abcd', 786 , 2.23, 'Vira', 70.2  ]
tuple[2] = 1000    # Invalid syntax with tuple
list[2] = 1000     # Valid syntax with list
```

Python Dictionary

Python's dictionaries are kind of hash table type. They work like associative arrays or hashes found in Perl and consist of key-value pairs. A dictionary key can be almost any Python type, but are usually numbers or strings. Values, on the other hand, can be any arbitrary Python object.
Dictionaries are enclosed by curly braces ({ }) and values can be assigned and accessed using square braces ([]). For example

```
#!/usr/bin/python

dict = {}
dict['one'] = "This is one"
dict[2]     = "This is two"
tinydict = {'name': 'Vira','code':6734, 'dept': 'sales'}
print( dict['one'])       # print(s value for 'one' key
print( dict[2] )          # print(s value for 2 key
print( tinydict )         # print(s complete dictionary
print( tinydict.keys())   # print(s all the keys
print( tinydict.values()) # print(s all the values
```

This produce the following result

```
This is one
This is two
{'dept': 'sales', 'code': 6734, 'name': 'Vira'}
['dept', 'code', 'name']
['sales', 6734, 'Vira']
```

Dictionaries have no concept of order among elements. It is incorrect to say that the elements are "out of order"; they are simply unordered.

Data Type Conversion

Sometimes, you may need to perform conversions between the built-in types. To convert between types, you simply use the type name as a function.
There are several built-in functions to perform conversion from one data type to another. These functions return a new object representing the converted value.

Sr.No.	Function & Description
1	**int(x [,base])** Converts x to an integer. base specifies the base if x is a string.
2	**long(x [,base])** Converts x to a long integer. base specifies the base if x is a string.
3	**float(x)** Converts x to a floating-point number.
4	**complex(real [,imag])** Creates a complex number.
5	**str(x)** Converts object x to a string representation.
6	**repr(x)** Converts object x to an expression string.

Data Type Conversion

Sometimes, you may need to perform conversions between the built-in types. To convert between types, you simply use the type name as a function.
There are several built-in functions to perform conversion from one data type to another.
These functions return a new object representing the converted value.

Sr.No.	Function & Description
7	**eval(str)** Evaluates a string and returns an object.
8	**tuple(s)** Converts s to a tuple.
9	**list(s)** Converts s to a list.
10	**set(s)** Converts s to a set.
11	**dict(d)** Creates a dictionary. d must be a sequence of (key,value) tuples.
12	**frozenset(s)** Converts s to a frozen set.

Data Type Conversion

Sometimes, you may need to perform conversions between the built-in types. To convert between types, you simply use the type name as a function.
There are several built-in functions to perform conversion from one data type to another. These functions return a new object representing the converted value.

Sr.No.	Function & Description
13	**chr(x)** Converts an integer to a character.
14	**unichr(x)** Converts an integer to a Unicode character.
15	**ord(x)** Converts a single character to its integer value.
16	**hex(x)** Converts an integer to a hexadecimal string.
17	**oct(x)** Converts an integer to an octal string.

Python - Basic Operators

Basic Operators

Operators are the constructs which can manipulate the value of operands.
Consider the expression 4 + 5 = 9. Here, 4 and 5 are called operands and + is called operator.

Types of Operator

Python language supports the following types of operators.

- ❖ Arithmetic Operators
- ❖ Comparison (Relational) Operators
- ❖ Assignment Operators
- ❖ Logical Operators
- ❖ Bitwise Operators
- ❖ Membership Operators
- ❖ Identity Operators

Python Arithmetic Operators

Assume variable a holds 10 and variable b holds 20, then

Operator	Description	Example
+ Addition	Adds values on either side of the operator.	a + b = 30
- Subtraction	Subtracts right hand operand from left hand operand.	a – b = -10
* Multiplication	Multiplies values on either side of the operator	a * b = 200
/ Division	Divides left hand operand by right hand operand	b / a = 2
% Modulus	Divides left hand operand by right hand operand and returns remainder	b % a = 0
** Exponent	Performs exponential (power) calculation on operators	a**b =10 to the power 20
//	Floor Division - The division of operands where the result is the quotient in which the digits after the decimal point are removed. But if one of the operands is negative, the result is floored, i.e., rounded away from zero (towards negative infinity) –	9//2 = 4 and 9.0//2.0 = 4.0, -11//3 = -4, -11.0//3 = -4.0

Python Arithmetic Operators

Assume variable a holds 10 and variable b holds 20, then

```
#!/usr/bin/python

a = 21
b = 10
c = 0

c = a + b
print( "Line 1 - Value of c is ", c)

c = a - b
print( "Line 2 - Value of c is ", c)

c = a * b
print( "Line 3 - Value of c is ", c)

c = a / b
print( "Line 4 - Value of c is ", c)

c = a % b
print( "Line 5 - Value of c is ", c)

a = 2
b = 3
c = a**b
print( "Line 6 - Value of c is ", c)

a = 10
b = 5
c = a//b
print( "Line 7 - Value of c is ", c)
```

When you execute the above program, it produces the following result

```
Line 1 - Value of c is 31
Line 2 - Value of c is 11
Line 3 - Value of c is 210
Line 4 - Value of c is 2
Line 5 - Value of c is 1
Line 6 - Value of c is 8
Line 7 - Value of c is 2
```

Python Comparison Operators

These operators compare the values on either sides of them and decide the relation among them. They are also called Relational operators. Assume variable a holds 10 and variable b holds 20, then

Operator	Description	Example
==	If the values of two operands are equal, then the condition becomes true.	(a == b) is not true.
!=	If values of two operands are not equal, then condition becomes true.	(a != b) is true.
<>	If values of two operands are not equal, then condition becomes true.	(a <> b) is true. This is similar to != operator.
>	If the value of left operand is greater than the value of right operand, then condition becomes true.	(a > b) is not true.
<	If the value of left operand is less than the value of right operand, then condition becomes true.	(a < b) is true.
>=	If the value of left operand is greater than or equal to the value of right operand, then condition becomes true.	(a >= b) is not true.
<=	If the value of left operand is less than or equal to the value of right operand, then condition becomes true.	(a <= b) is true.

Python Comparison Operators

Assume variable a holds 10 and variable b holds 20, then

```
#!/usr/bin/python
a = 21
b = 10
c = 0
if ( a == b ):
   print( "Line 1 - a is equal to b“)
else:
   print( "Line 1 - a is not equal to b“)
if ( a != b ):
   print( "Line 2 - a is not equal to b“)
else:
   print( "Line 2 - a is equal to b“)
if ( a <> b ):
   print( "Line 3 - a is not equal to b“)
else:
   print( "Line 3 - a is equal to b“)
if ( a < b ):
   print( "Line 4 - a is less than b“)
else:
   print( "Line 4 - a is not less than b“)
if ( a > b ):
   print( "Line 5 - a is greater than b“)
else:
   print( "Line 5 - a is not greater than b“)
```

```
a = 5;
b = 20;
if ( a <= b ):
   print( "Line 6 - a is either less)
than or equal to  b"
else:
   print( "Line 6 - a is neither less
than nor equal to  b“)

if ( b >= a ):
   print( "Line 7 - b is either greater
than  or equal to b“)
else:
   print( "Line 7 - b is neither
greater than  nor equal to b“)
```

When you execute the above program, it produces the following result

```
Line 1 - a is not equal to b
Line 2 - a is not equal to b
Line 3 - a is not equal to b
Line 4 - a is not less than b
Line 5 - a is greater than b
Line 6 - a is either less than or equal to b
Line 7 - b is either greater than or equal to b
```

Python Assignment Operators

Assume variable a holds 10 and variable b holds 20, then:

Operator	Description	Example
=	Assigns values from right side operands to left side operand	c = a + b assigns value of a + b into c
+= Add AND	It adds right operand to the left operand and assign the result to left operand	c += a is equivalent to c = c + a
-= Subtract AND	It subtracts right operand from the left operand and assign the result to left operand	c -= a is equivalent to c = c - a
*= Multiply AND	It multiplies right operand with the left operand and assign the result to left operand	c *= a is equivalent to c = c * a
/= Divide AND	It divides left operand with the right operand and assign the result to left operand	c /= a is equivalent to c = c / a
%= Modulus AND	It takes modulus using two operands and assign the result to left operand	c %= a is equivalent to c = c % a
**= Exponent AND	Performs exponential (power) calculation on operators and assign value to the left operand	c **= a is equivalent to c = c ** a
//= Floor Division	It performs floor division on operators and assign value to the left operand	c //= a is equivalent to c = c // a

Python Assignment Operators

Assume variable a holds 10 and variable b holds 20, then

```
#!/usr/bin/python
a = 21
b = 10
c = 0
c = a + b
print( "Line 1 - Value of c is ", c)
c += a
print( "Line 2 - Value of c is ", c)
c *= a
print( "Line 3 - Value of c is ", c)
c /= a
print( "Line 4 - Value of c is ", c)

c  = 2
c %= a
print( "Line 5 - Value of c is ", c)

c **= a
print( "Line 6 - Value of c is ", c)

c //= a
print( "Line 7 - Value of c is ", c)
```

When you execute the above program, it produces the following result

```
Line 1 - Value of c is 31
Line 2 - Value of c is 52
Line 3 - Value of c is 1092
Line 4 - Value of c is 52
Line 5 - Value of c is 2
Line 6 - Value of c is 2097152
Line 7 - Value of c is 99864
```

Python Bitwise Operators

Bitwise operator works on bits and performs bit by bit operation. Assume if a = 60; and b = 13; Now in the binary format their values will be 0011 1100 and 0000 1101 respectively. Following table lists out the bitwise operators supported by Python language with an example each in those, we use the above two variables (a and b) as operands:

a = 0011 1100
b = 0000 1101
----
a&b = 0000 1100
a|b = 0011 1101
a^b = 0011 0001
~a = 1100 0011

There are following Bitwise operators supported by Python language

Python Bitwise Operators

There are following Bitwise operators supported by Python language

Operator	Description	Example
& Binary AND	Operator copies a bit to the result if it exists in both operands	(a & b) (means 0000 1100)
| Binary OR	It copies a bit if it exists in either operand.	(a | b) = 61 (means 0011 1101)
^ Binary XOR	It copies the bit if it is set in one operand but not both.	(a ^ b) = 49 (means 0011 0001)
~ Binary Ones Complement	It is unary and has the effect of 'flipping' bits.	(~a) = -61 (means 1100 0011 in 2's complement form due to a signed binary number.
<< Binary Left Shift	The left operands value is moved left by the number of bits specified by the right operand.	a << 2 = 240 (means 1111 0000)
>> Binary Right Shift	The left operands value is moved right by the number of bits specified by the right operand.	a >> 2 = 15 (means 0000 1111)

Python Bitwise Operators

Assume variable a holds 10 and variable b holds 20, then

```
#!/usr/bin/python
a = 60            # 60 = 0011 1100
b = 13            # 13 = 0000 1101
c = 0
c = a & b;        # 12 = 0000 1100
print( "Line 1 - Value of c is ", c)

c = a | b;        # 61 = 0011 1101
print( "Line 2 - Value of c is ", c)

c = a ^ b;        # 49 = 0011 0001
print( "Line 3 - Value of c is ", c)

c = ~a;           # -61 = 1100 0011
print( "Line 4 - Value of c is ", c)

c = a << 2;       # 240 = 1111 0000
print( "Line 5 - Value of c is ", c)

c = a >> 2;       # 15 = 0000 1111
print( "Line 6 - Value of c is ", c)
```

When you execute the above program, it produces the following result

```
Line 1 - Value of c is 12
Line 2 - Value of c is 61
Line 3 - Value of c is 49
Line 4 - Value of c is -61
Line 5 - Value of c is 240
Line 6 - Value of c is 15
```

Python Logical Operators

There are following logical operators supported by Python language. Assume variable a holds 10 and variable b holds 20 then

Operator	Description	Example
and Logical AND	If both the operands are true then condition becomes true.	(a and b) is true.
or Logical OR	If any of the two operands are non-zero then condition becomes true.	(a or b) is true.
not Logical NOT	Used to reverse the logical state of its operand.	Not(a and b) is false.

Python Membership Operators

Python's membership operators test for membership in a sequence, such as strings, lists, or tuples. There are two membership operators as explained below:

Operator	Description	Example
in	Evaluates to true if it finds a variable in the specified sequence and false otherwise.	x in y, here in results in a 1 if x is a member of sequence y.
not in	Evaluates to true if it does not finds a variable in the specified sequence and false otherwise.	x not in y, here not in results in a 1 if x is not a member of sequence y.

Python Membership Operators

Assume variable a holds 10 and variable b holds 20, then

```
#!/usr/bin/python
a = 10
b = 20
list = [1, 2, 3, 4, 5 ];
if ( a in list ):
   print( "Line 1 - a is available in the given list ")
else:
   print( "Line 1 - a is not available in the given list ")
if ( b not in list ):
   print( "Line 2 - b is not available in the given list ")
else:
   print( "Line 2 - b is available in the given list ")
a = 2
if ( a in list ):
   print( "Line 3 - a is available in the given list ")
else:
   print( "Line 3 - a is not available in the given list ")
```

When you execute the above program, it produces the following result

```
Line 1 - a is not available in the given list
Line 2 - b is not available in the given list
Line 3 - a is available in the given list
```

Python Identity Operators

Identity operators compare the memory locations of two objects. There are two Identity operators explained below:

Operator	Description	Example
is	Evaluates to true if the variables on either side of the operator point to the same object and false otherwise.	x is y, here **is** results in 1 if id(x) equals id(y).
is not	Evaluates to false if the variables on either side of the operator point to the same object and true otherwise.	x is not y, here **is not** results in 1 if id(x) is not equal to id(y).

Python Identity Operators

Assume variable a holds 10 and variable b holds 20, then

```
#!/usr/bin/python
a = 20
b = 20
if ( a is b ):
   print( "Line 1 - a and b have same identity ")
else:
   print( "Line 1 - a and b do not have same identity ")

if ( id(a) == id(b) ):
   print( "Line 2 - a and b have same identity ")
else:
   print( "Line 2 - a and b do not have same identity ")
b = 30
if ( a is b ):
   print( "Line 3 - a and b have same identity ")
else:
   print( "Line 3 - a and b do not have same identity ")

if ( a is not b ):
   print( "Line 4 - a and b do not have same identity ")
else:
   print( "Line 4 - a and b have same identity ")
```

When you execute the above program, it produces the following result

```
Line 1 - a and b have same identity
Line 2 - a and b have same identity
Line 3 - a and b do not have same identity
Line 4 - a and b do not have same identity
```

Python Operators Precedence

The following table lists all operators from highest precedence to lowest.

Sr.No.	Operator & Description
1	****** Exponentiation (raise to the power)
2	**~ + -** Complement, unary plus and minus (method names for the last two are +@ and -@)
3	*** / % //** Multiply, divide, modulo and floor division
4	**+ -** Addition and subtraction
5	**>> <<** Right and left bitwise shift
6	**&** Bitwise 'AND'
7	**^ |** Bitwise exclusive `OR' and regular `OR'
8	**<= < > >=** Comparison operators
9	**<> == !=** Equality operators
10	**= %= /= //= -= += *= **=** Assignment operators
11	**is is not** Identity operators
12	**in not in** Membership operators
13	**not or and** Logical operators

Python Operators Precedence

Assume variable a holds 10 and variable b holds 20, then

```
#!/usr/bin/python

a = 20
b = 10
c = 15
d = 5
e = 0
e = (a + b) * c / d       #( 30 * 15 ) / 5
print( "Value of (a + b) * c / d is ",  e)

e = ((a + b) * c) / d     # (30 * 15 ) / 5
print( "Value of ((a + b) * c) / d is ",  e)

e = (a + b) * (c / d);    # (30) * (15/5)
print( "Value of (a + b) * (c / d) is ",  e)

e = a + (b * c) / d;      #  20 + (150/5)
print( "Value of a + (b * c) / d is ",  e)
```

When you execute the above program, it produces the following result

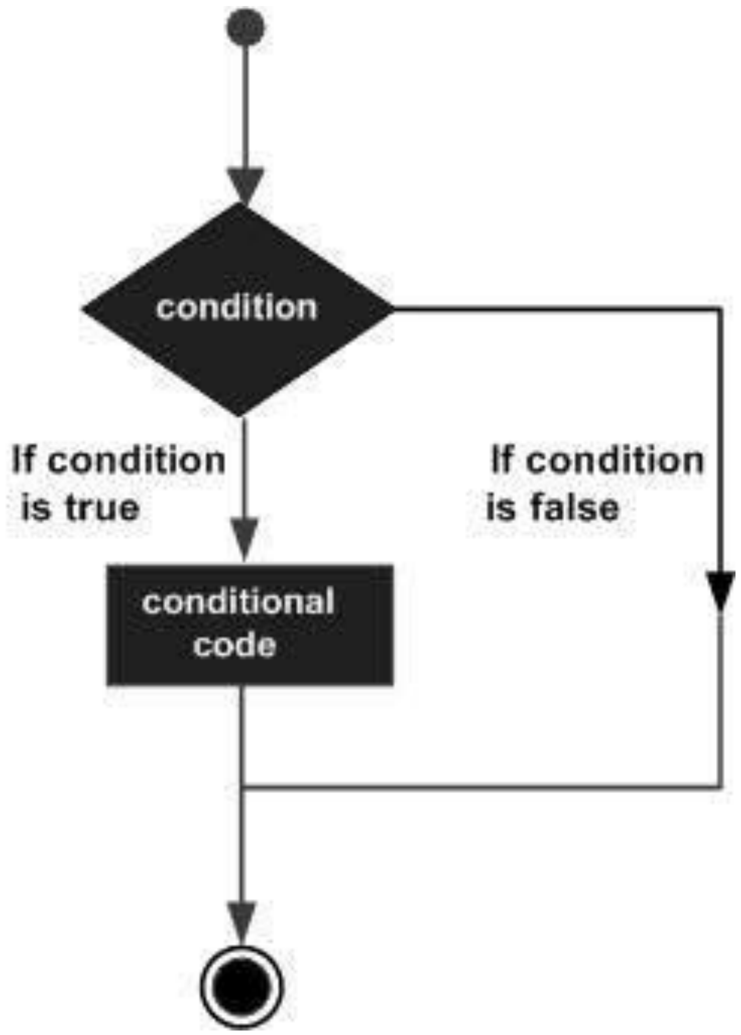
```
Value of (a + b) * c / d is 90
Value of ((a + b) * c) / d is 90
Value of (a + b) * (c / d) is 90
Value of a + (b * c) / d is 50
```

Python - Decision Making

Python - Decision Making

Decision making is anticipation of conditions occurring while execution of the program and specifying actions taken according to the conditions.
Decision structures evaluate multiple expressions which produce TRUE or FALSE as outcome. You need to determine which action to take and which statements to execute if outcome is TRUE or FALSE otherwise.

Following is the general form of a typical decision making structure found in most of the programming languages



Python - Decision Making

Python programming language assumes any **non-zero** and **non-null** values as TRUE, and if it is either **zero** or **null**, then it is assumed as FALSE value.
Python programming language provides following types of decision making statements. Click the following links to check their detail.

if statements
An if statement consists of a Boolean expression followed by one or more statements.

if...else statements
An if statement can be followed by an optional else statement, which executes when the Boolean expression is FALSE.

nested if statements
You can use one if or else if statement inside another if or else if statement(s).

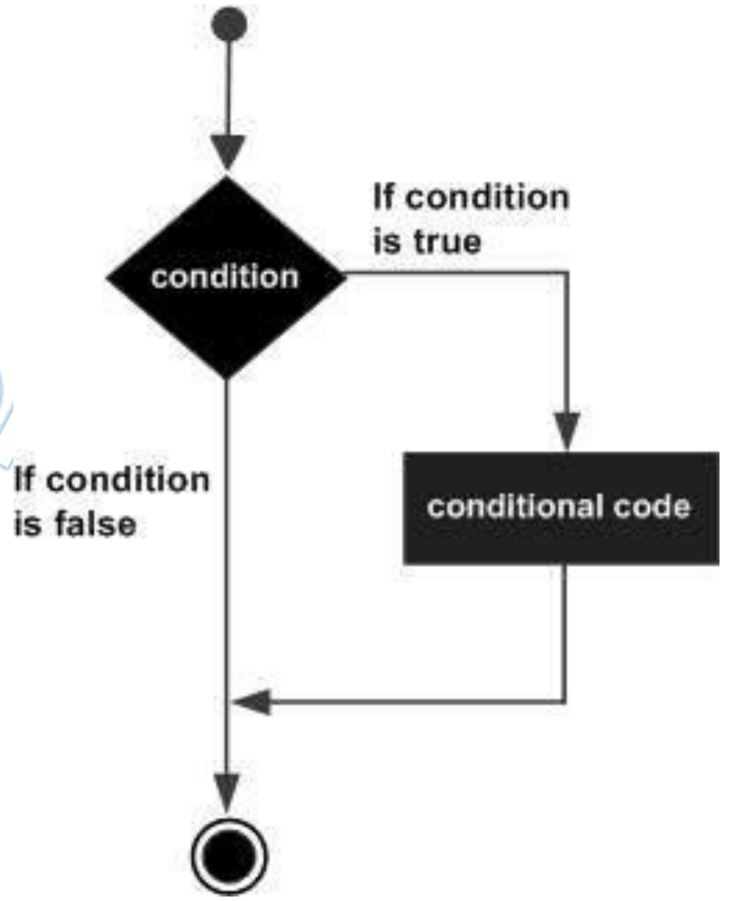
Python - IF Statement

It is similar to that of other languages. The **if** statement contains a logical expression using which data is compared and a decision is made based on the result of the comparison.

Syntax

```
if expression:
   statement(s)
```

Flow Diagram



If the boolean expression evaluates to TRUE, then the block of statement(s) inside the if statement is executed. If boolean expression evaluates to FALSE, then the first set of code after the end of the if statement(s) is executed.

Python - IF Statement

```
#!/usr/bin/python

var1 = 100
if var1:
   print("1 - Got a true expression value ")
   print(var1)

var2 = 0
if var2:
   print("2 - Got a true expression value ")
   print(var2)
print(“Good bye! ")
```

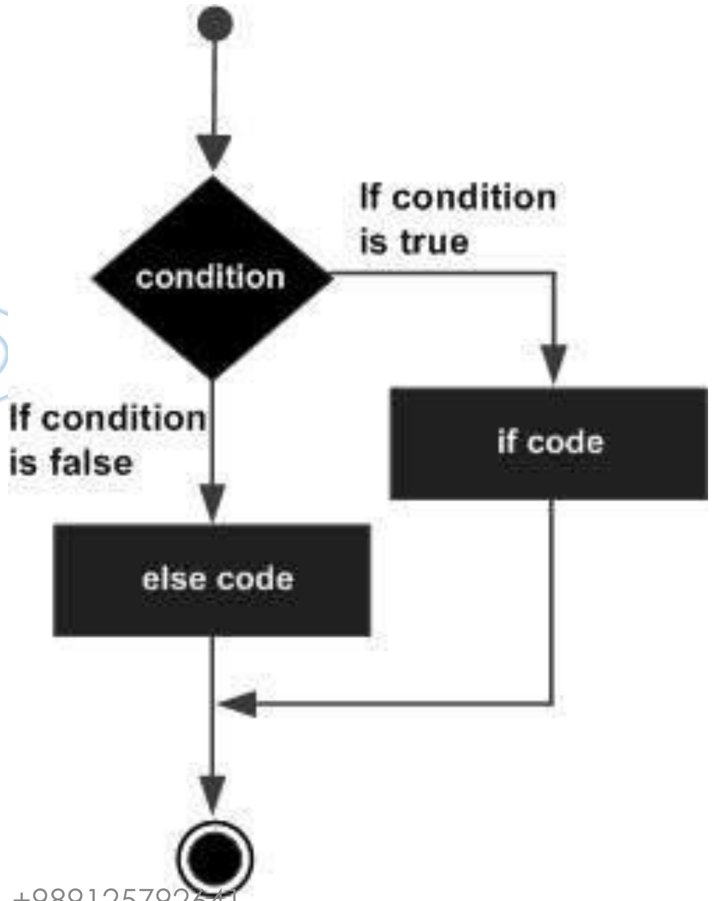
When the above code is executed, it produces the following result –

```
1 - Got a true expression value
100
Good bye!
```

Python IF...ELIF...ELSE Statements

An **else** statement can be combined with an **if** statement. An **else** statement contains the block of code that executes if the conditional expression in the if statement resolves to 0 or a FALSE value.
The *else* statement is an optional statement and there could be at most only one **else** statement following **if**.

Flow Diagram



Syntax

```
if expression:
   statement(s)
else:
   statement(s)
```

Python IF...ELIF...ELSE Statements

```
#!/usr/bin/python
var1 = 100
if var1:
   print("1 - Got a true expression value ")
   print(var1)
else:
   print( "1 - Got a false expression value ")
   print(var1)
var2 = 0
if var2:
   print( "2 - Got a true expression value ")
   print(var2)
else:
   print( "2 - Got a false expression value ")
   print(var2)

print( "Good bye ")
```

When the above code is executed, it produces the following result −

```
1 - Got a true expression value
100
2 - Got a false expression value
0
Good bye!
```

Python nested IF statements

There may be a situation when you want to check for another condition after a condition resolves to true. In such a situation, you can use the nested **if** construct.
In a nested **if** construct, you can have an **if...elif...else** construct inside another **if...elif...else** construct.

Syntax

```
if expression1:
  statement(s)
  if expression2:
    statement(s)
  elif
expression3:
    statement(s)
  elif
expression4:
    statement(s)
  else:
    statement(s)
else:
  statement(s)
```

Python nested IF statements

```
#!/usr/bin/python

var = 100
if var < 200:
  print( "Expression value is less than 200 ")
  if var == 150:
    print( "Which is 150 ")
  elif var == 100:
    print( "Which is 100 ")
  elif var == 50:
    print( "Which is 50 ")
  elif var < 50:
    print( "Expression value is less than 50 ")
else:
  print( "Could not find true expression ")
print( "Good bye ")
```

When the above code is executed, it produces the following result −

```
Expression value is less than 200
Which is 100
Good bye!
```

Python Single Statement Suites

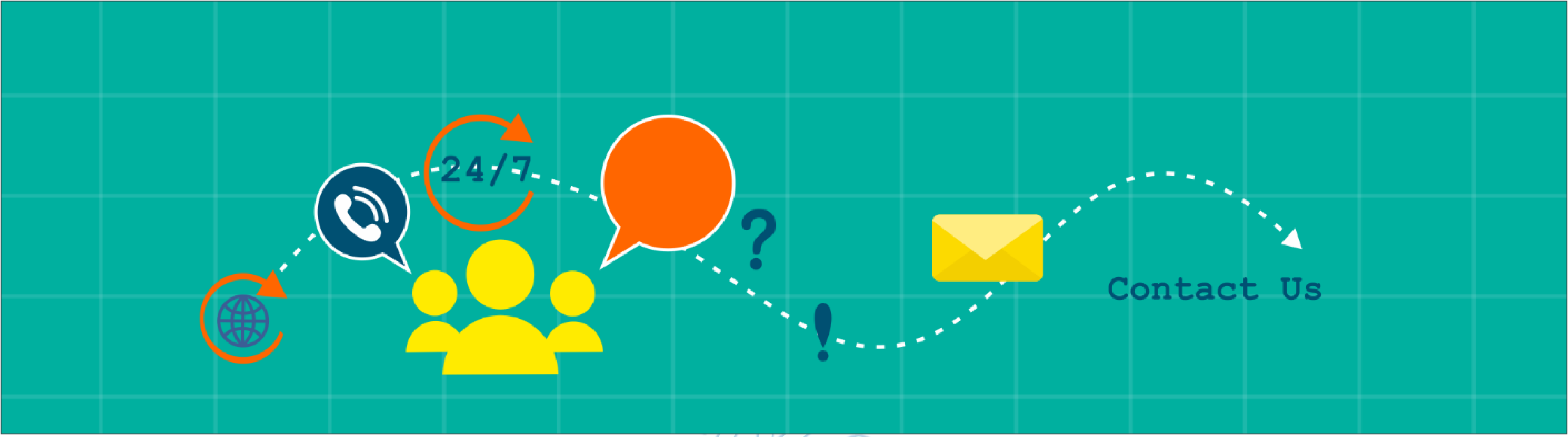
If the suite of an **if** clause consists only of a single line, it may go on the same line as the header statement.
Here is an example of a **one-line if** clause

```
#!/usr/bin/python

var = 100
if ( var == 100 ) : print( ("Value of expression is
100")
print( ("Good bye! ")
```

When the above code is executed, it produces the following result −

```
Value of expression is 100
Good bye!
```



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