You can given alias name to imported module as :

```
import<module> as <aliasname>
```

e.g.,

```
import tempConversion as tc
```

Now you can use name **tc** for the imported module *e.g.*, **tc.to_centigrade( ).**

Please note, if in a module there is another **import** statement importing an already imported module (from same origin), Python will ignore that import statement. Thus, a module once imported will not be re-imported even another **import** statement for the same module is encountered again.

4.3.2 Importing Select Objects from a Module

If you want to import some selected items, not all from a module, then you can use from **<module> import** statement as per following syntax :

```
from <module> import <objectname> [,<objectname> [...]|*
```

To Import Single Object

If you want to import a single object from the module like this so that you don't have to prefix the module's name, you can write the name of object after keyword **import.** For instance, to import just the constant ***pi*** from module **math**, you can write :

```
from math import pi
```

Now, the constant ***pi*** can be used and you need not prefix it with *module name*. That is, to print the value of ***pi***, after importing like above, you'll be writing

```
print(pi)
```

*After **'from <module> import'** command you need not qualify the name of imported item with module name like this*

Not this

```
print(math.pi)
```

Do not use module name with imported object if imported through from <module> import command

Do not use module name with imported object if imported through **from <module> import** command because now the imported object is part of your program's environment.

To Import Multiple Objects

If you want to import multiple objects from the module like this so that you don't have to prefix the module's name, you can write the comma separated list of objects after keyword **import.** For instance, to import just *two* functions *sqrt( )* and *pow( )* from math module, you'll write :

```
from math import sqrt, pow
```

To Import All Objects of a Module

If you want to import all the items from the module like this so that you don't have to prefix the module's name, you can write :

```
from <modulename> import *
```

That is, to import all the items from module **math**, you can write :

```
from math import *
```

Now you can use all the defined functions, variables etc from *math* module, without having to prefix module's name to the imported item name.

4.3.3 Python's Processing of import <module> Command

With every import command issued, Python internally does a series of steps. In this section, we are briefly discussing the same. Before we discuss the internal processing of import statements, let's first discuss namespace – an important and related concept, which plays a role in internal processing of import statement.

Namespace

A namespace, in general, is a space that holds a bunch of names. Before we go on to explain namespaces in Python terms, consider this real life example.

> In an interstate student seminar, there are students from different states having similar names. Say there are *three* **Nalinis**, one from ***Kerala***, one from ***Delhi*** and one from ***Odisha***.
>
> As long they are staying in their state's ward, there is no confusion. Since in ***Delhi***, there is one *Nalini*, calling name Nalini would automatically refer to **Delhi's** student **Nalini**. Same applies to ***Kerala*** and ***Odisha*** wards separately.
>
> But the problem arises when the students from Delhi, Kerala and Odisha states are sitting together. Now calling just Nalini would create confusion – which state's Nalini ? So, one needs to qualify the name as **Odisha's Nalini** or **Kerala's Nalini** and so on.

From the above real-life example, we can say that Kerala ward has its own namespace where there no two names as Nalini ; same holds for Delhi and Odisha.

In Python terms, namespace can be thought of as a named environment holding logical grouping of related objects. You can think of it as named list of some names.

For every module (.py file), Python creates a namespace having its name similar to that of module's name. That is, the name of ***module time's namespace is*** also **time.**

NAMESPACE

Namespace is a named logical environment holding logical grouping of related objects within a namespace, its member object is referred without any prefix.

When two namespaces come together, to resolve any kind of object-name dispute, Python asks you to qualify the names of objects as **<module-name>.<object-name>**, just like in real life example, we did by calling Delhi's Nalini or Odisha's Nalini and so on. *Within a namespace, an object is referred without any prefix.*

Processing of import <module> command

When you issue **import <module>** command, internally following things take place :

- the code of imported module is interpreted and executed[3].
- defined functions and variables created in the module are now available to the program that imported module.
- For imported module, a new ***namespace*** is setup with the same name as that of the module.

For instance, you imported module **myMod** in your program. Now all the objects of module **myMod** would be referred as **myMod.<object-name>**, *e.g.*, if **myMod** has a function defined as **checknum( )**, then it would be referred to as **myMod.checknum( )** in your program.

Processing of from <module> import <object> command

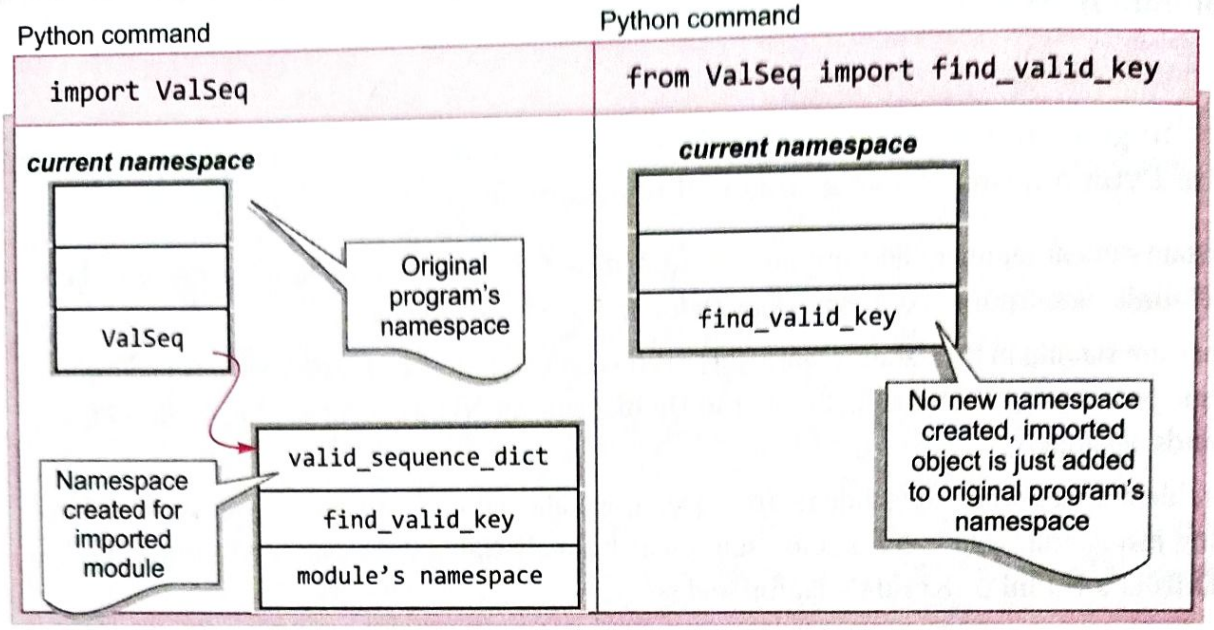
When you issue **from <module> import <object>** command, internally following things take place :

- the code of imported module is interpreted and executed[3].

[3] Refer to *Appendix A* to stop execution of module's main block while importing.

- only the asked functions and variables from the module are made available to the program.
- no new *namespace* is created, the imported definition is just added in the current *namespace*.

Figure 4.3 illustrates this difference.



To see Two ways of import in action

Scan QR Code

Figure 4.3 Difference between import <module> and from <module> import commands.

- That means if your program already has a variable with the same name as the one imported via module, then *the variable in your program* will hide imported member with same name because there cannot be two variables with the same name in one *namespace*.

Following code fragment illustrates this.

Let's consider the module given in Fig 4.2

```
from tempConversion import *

FREEZING_C = -17.5      # it will hide FREEZING_C of tempConversion module
print(FREEZING_C)
```

The above code will print `-17.5`

If you change above code to the following (we made FREEZING_C = – 17.5 as a COMMENT, see below :)

```
from tempConversion import *

# FREEZING_C = -17.5        # it is just a comment now
print(FREEZING_C)
```

Now the above code will give result as : `0.0`

as no variable from the program shares its name, hence it is not hidden.

NOTE

Avoid using the **from <module> import *** form of the import statement, it may lead to name clashes. If you use plain **import <module>**, no problems occur.

Sometimes a module is stored inside another module. Such a submodule can also be imported as :

```
from <parent module> import<submodule> [as <alias name>]
```

e.g.,

```
from products import views
from products import views as PV
```

← *this is alias name for* ***product.views*** *submodule*

PriP CREATING AND USING MODULES — Progress In Python 4.1

This Prip session is based on practice for creating and using modules.

Please check the practical component-book – Progress in Computer Science with Python and fill it there in PriP 4.1 under Chapter 4 after practically doing it on the computer.

>>>❖<<<

4.4 Using Python Standard Library's Functions and Modules

Python's standard library is very extensive that offers many built-in functions that you can use without having to import any library. Python's standard library is by default available, so you don't need to import it separately.

Python's standard library also offers, other that the built-in functions, some modules for specialized type of functionality, such as ***math*** module for mathematical functions ; ***random*** module for pseudo-random number generation ; ***urllib*** for functionality for adding and using web sites' address from within program ; etc.

In this section, we shall discuss how you can use Python's built-in functions and import and use various modules and Python's standard library.

4.4.1 Using Python' Built-in Functions

The Python interpreter has a number of functions built into it that are always available ; you need not import any module for them. In other words, the built in functions are part of current namespace of Python interpreter. So you use built-in functions of Python directly as :

```
<function-name>()
```

For example, the functions that you have worked with uptill now such as *input( ), int( ), float( ), type( ), len( )* etc. are all built in functions, that is why you never prefixed them with any module name.

4.4.1A Python's built-in Mathematical Functions

Python provides many mathematical built-in functions. You have worked with many built-in mathematical functions of Python in your previous class. Let us quickly recall those and then we shall talk about some more such functions.

Function name	Description
`len( )`	Returns the length of a sequence or iterable *e.g.*, len("abc") gives 3.
`pow( )`	Returns a^b when a and b are given as arguments, *e.g.*, pow(3, 4) gives 81.
`str( )`	Converts a number to a string, *e.g.*, str(12) will give '12' and str(12.4) will give '12.4'.
`int( )`	Converts an integer-convertible string to integer, *e.g.*, int('12') will give 12.
`float( )`	Converts a float-convertible string to integer, *e.g.*, float('12.2') will give 12.2.
`range( )`	Returns an immutable sequence type, *e.g.*, range(3) will give sequence 0, 1, 2.
`type( )`	Returns the data type of passed argument, *e.g.*, type(12) will give <class 'int'>.

Table 4.1 Some useful ...

Function name	Description	Examples

`abs(x)`	Takes an integer or a floating point number as argument and returns the absolute value of a number.	`>>> abs(-12)`
		`12`
		`>>> abs(-12.4)`
		`12.4`
		`>>> abs(12.4)`
		`12.4`

`divmod(a, b)`	Takes two (non-complex) numbers as arguments and returns a pair of numbers consisting of their quotient and remainder.
	For integers, the result is the same as $(a // b, a \% b)$. For floating point numbers the result is $(q, a \% b)$
		`>>> divmod(7, 2)`
		`(3, 1)`
		Pair of quotient and remainder returned
		`>>> divmod(7.25, 2.5)`
		`(2.0, 2.25)`
		`>>>`

`sum(iterable)`
`sum(iterable,arg)`
	Returns sum of the items of an ***iterable*** from left to right and returns the total.
	With two arguments iterable and arg, it returns the sum of the items of an ***iterable*** and the ***arg's*** value.
	The ***iterable's*** items are normally numbers, and the ***arg*** value should be a number.
	(Recall that all sequence types are iterable.)
		`>>> sum([2, 3, 4])`
		`9`
		Sum of the elements of the iterable returned
		`>>> sum((2.5, 6, 4.2))`
		`12.7`
		`>>> sum([2, 3, 4], 5)`
		`14`
		Sum of the elements of the iterable along with the argument value returned
		`>>> sum([2, 3, 4], 8.3)`
		`17.3`

`max(iterable)`
`max(arg1, arg2,….)`
	Returns the largest item in an iterable / sequence or the largest of two or more arguments.
	If one positional argument is provided, it should be an iterable. The largest item in the iterable is returned.
		`>>> max(3, 5)`
		`5`
		Maximum of two integer values returned
		`>>> max([3, 5, 9,], [7])`
		`[7]`
		Maximum of two list arguments returned – list that begins with a higher value is returned
		`>>> max( (3, 5, 9, 10 ), (7,))`
		`(7,)`
		Maximum of two tuple arguments returned – tuple that begins with a higher value is returned
		`>>> max( (3, 5, 9, 10 ))`
		`10`
		Maximum of one iterable argument returned – highest element from the tuple iterable
		`>>> max([13, 15, 27, 10])`
		`27`
		Maximum of one iterable argument returned – highest element from the list iterable

Function name	Description	Examples

`min(iterable)`
`min(arg1, arg2,….)`
	Returns the smallest item in an iterable / sequence or the smallest of two or more arguments.
	If one positional argument is provided, it should be an iterable. The smallest item in the iterable is returned.
		`>>> min(3, 5)`
		`3` — *Minimum of two integer values returned*
		`>>> min([3, 5, 9, ], [7])`
		`[3, 5, 9]` — *Minimum of two list arguments returned – list that begins with a higher value is returned*
		`>>> min( (3, 5, 9, 10 ), (7,))`
		`(3, 5, 9, 10)` — *Minimum of two tuple arguments returned – tuple that begins with a higher value is returned*
		`>>> min( [13, 15, 27, 10 ])`
		`10` — *Minimum of one iterable argument returned – smallest element from the tuple iterable*
		`>>> min([13, 15, 27, 10])`
		`10` — *Minimum of one iterable argument returned – smallest element from the list iterable*

`oct(<integer>)`
`hex(<integer>)`
	returns octal string for given numbers *i.e.*, 00 + octal equivalent of number.
	returns hex string for given numbers *i.e.*, 0x + hexadecimal equivalent of number.
	Please note that *oct( ), hex( )* and *bin( )* do not return a number ; they return a string representation of converted number.
		`>>> n = 24`
		`>>> oct(n)`
		`'0o30'`
		`>>> hex(n)`
		`'0x18'`

Consider following program that uses two more built-in functions :

- **int (<number>)**[4] truncates the fractional part of given number and returns only the integer or whole part.
- **round(<number>, [<ndigits>])** returns number rounded to *ndigits* after the decimal points. If *ndigits* is not given, it returns nearest integer to its input.

4.1 ogram that inputs a real number and converts it to nearest integer using two different ions. It also displays the given number rounded off to 3 places after decimal.

Program

```
num = float(input("Enter a real number:"))
tnum = int(num)
rnum = round(num)
print("Number", num, "converted to integer in 2 ways as", tnum, "and", rnum )
rnum2 = round(num, 3)
print(num, "rounded off to 3 places after decimal is", rnum2)
```

4. The int( ) can also convert a number string into an equivalent number *e.g.*, "1235" can be converted to number 1235 using int("1235") ; works with integer strings only.

Sample run of above program is :

```
Enter a real number: 5.555682
Number 5.555682 converted to integer in 2 ways as 5 and 6
5.555682 rounded off to 3 places after decimal is 5.556
```

**The behaviour of round( ) can be surprising for floats, e.g., round(0.5) and round(–0.5) are 0, and round(1.5) is 2.

4.4.1B Python's built-in String Functions

Let us now use some string functions. Although you have worked with many string functions in your previous class, let us use three new string based functions. These are :

- **<Str>.join(<string iterable>)** – joins a string or character (*i.e.*, <str>) after each member of the *string iterator i.e., a string based sequence.*
- **<Str>.split(<string /char>)** – splits a string (*i.e.*, <str>) based on given string or character (*i.e.*, <string/char>) and returns a list containing split strings as members.
- **<Str>.replace(<word to be replaced>, <replace word>)** – replaces a word or part of the string with another in the given string <str>.

Let us understand and use these string functions practically. Carefully go through the examples of these as given below :

<str>.join( )

(*i*) If the string **based** iterator is a string then the <str> is inserted after every character of the string, *e.g.,*

```
>>>"*".join("Hello")
'H*e*l*l*o'
```

See, a character is joined with each member of the given string to form the new string

```
>>>"***".join("TRIAL")
'T***R***I***A***L'
```

*See, a string("***" here) is joined with each member of the given string to form the new string*

(*ii*) If the string based iterator is a *list* or *tuple* of strings then, the given string/character is joined with each member of the list or tuple, BUT the tuple or list must have all member as strings otherwise Python will raise an error.

```
>>>"$$".join(["trial", "hello"])
Out[7]: 'trial$$hello'
```

Given string ("$$") joined between the individual items of a string based list

```
>>>"###".join(("trial", "hello", "new"))
Out[8]: 'trial###hello###new'
```

Given string ("$$") joined between the individual items of a string based tuple

```
>>>"###".join((123, "hello", "new"))
Traceback (most recent call last):

  File "<ipython-input-11-a0be3b94faec>", line 1, in <module>
    "###".join((123, "hello", "new"))

TypeError: sequence item 0: expected str instance, int found
```

The sequence must contain all strings, else Python will raise an error.

<str>.split( )

(i) If you do not provide any argument to split then by default it will split the given string considering whitespace as a separator, *e.g.*,

```
>>>"I Love Python".split()
['I', 'Love', 'Python']

>>>"I Love Python".split(" ")
['I', 'Love', 'Python']
```

With or without whitespace, the output is just the same i.e., the list containing individual words

(ii) If you provide a string or a character as an argument to split( ), then the given string is divided into parts considering the given string/character as separator and separator character is not included in the split strings *e.g.*,

```
>>>"I Love Python".split("o")
['I L', 've Pyth', 'n']
```

The given string is divided from positions containing "o"

NOTE

You can use **split( )** with a line of text to split it in words. It will be quite handy for you in some file based programs.

<str>.replace( )

```
>>>"I Love Python".replace("Python", "Programming")
'I Love Programming'
```

Word 'Python' has been replaced with 'Programming' in given string

Program 4.2 Write a program that inputs a main string and then creates an encrypted string by embedding a short symbol based string after each character. The program should also be able to produce the decrypted string from encrypted string.

```
def encrypt(sttr, enkey):
    return enkey.join(sttr)
def decrypt(sttr, enkey):
    return sttr.split(enkey)
#-main-
mainString = input("Enter main string :")
encryptStr = input("Enter encryption key :")
enStr = encrypt(mainString, encryptStr)
deLst = decrypt(enStr, encryptStr)
# deLst is in the form of a list, converting it to string below
deStr="".join(deLst)
print("The encrypted string is", enStr)
print("String after decryption is :", deStr)
```

The sample run of the above program is as shown below :

```
Enter main string : My main string
Enter encryption key : @$
The encrypted string is M@$y@$ @$m@$a@$i@$n@$ @$s@$t@$r@$i@$n@$g
String after decryption is :  My main string
```

You have already learnt to use math module in previous class. First chapter's section 1.8.5 also revises the same. So let us use some other useful modules of Python (as recommended by practical suggestions of the syllabus).

4.4.2 Working with Some Standard Library Modulus

Other than built-in functions, standard library also provides some modules having functionality for specialized actions. Let us learn to use some such modules. In the following lines we shall talk about how to use some useful functions of *random* and *string* modules[5] of Python's standard library.

4.4.2A Using Random Module

Python has a module namely **random** that provides random-number[6] generators. A random number in simple words means – *a number generated by chance, i.e.,* randomly.

To use random number generators in your Python program, you first need to import module ***random*** using any import command, *e.g.,*

```
import random
```

Some most common random number generator functions in ***random module*** are :

random( )	it returns a random floating point number *N* in the range [0.0, 1.0), *i.e.,* $0.0 \le N < 1.0$. Notice that the number generated with *random( )* will always be less than 1.0. (only lower range-limit is inclusive). Remember, it generates a floating point number.
randint(*a, b*)	it returns a random integer *N* in the range (*a, b*), *i.e.,* $a \le N \le b$ (both range-limits are inclusive). Remember, it generates an integer.
random.uniform(*a, b*)	it returns a random floating point number *N* such that a <= N <= b for a <= b and b <= N <= a for b < a.
random.randrange(stop) random.randrange(start, stop[, step])	it returns a randomly selected element from range(start, stop, step).

Let us consider some examples. In the following lines we are giving some sample codes along with their output.

1. To generate a random floating-point number between 0.0 to 1.0, simply use **random( )**:

```
>>> import random
>>> print(random.random())
0.022353193431
```

The output generated is between range [0.0, 1.0)

2. To generate a random floating-point number between range ***lower to upper*** using **random( )**:
   (*a*) multiply **random( )** with difference of upper limit with lower limit, *i.e.,* (upper – lower)
   (*b*) add to it lower limit

5. Please note that learning how to use modules is important for learning how to use libraries.
6. In fact, pseudo-random numbers because it is generated via some algorithm or procedure and hence deterministic somewhere.

For example, to generate between 15 to 35 , you may write :

```
>>> import random        # need not re-write this command, if random
                         # module already imported
>>> print(random.random()* (35 -15 ) + 15)
28.3071872734
```

The output generated is floating point number between range 15 to 35

3. To generate a random integer number in range 15 to 35 using *randint( )*, write :

```
>>> print(random.randint(15, 35))
16
```

The output generated is integer between range 15 to 35

4. To generate a floating point random number in the ranges 11...55 or 111...55, after importing random module using import statement, you may write :

```
>>> random.uniform(11, 55)
41.34518981317353
>>> random.uniform(111, 55)
60.03906551659219
```

5. To generate a random integer in the ranges 23..47 with a step 3 or 0..235, after importing random module using import statement, you may write :

```
>>> random.randrange(23, 47, 3)
38
>>> random.randrange(235)
126
```

EXAMPLE 4.1 *Given the following Python code, which is repeated four times. What could be the possible set of outputs out of given four sets (dddd represent any combination of digits) ?*

```
import random
print(15 + random.random() * 5)
```

(*i*) 17.dddd, 19.dddd, 20.dddd, 15.dddd
(*ii*) 15.dddd, 17.dddd. 19.dddd, 18.dddd
(*iii*) 14.dddd, 16.dddd, 18.dddd, 20.dddd
(*iv*) 15.dddd, 15.dddd, 15.dddd, 15.dddd

Solution. Option (*ii*) and (*iv*) are the correct possible outputs because :

(*a*) *random( )* generates number N between range $0.0 <= N < 1.0$.
(*b*) when it is multiplied with 5, the range becomes 0.0 to < 5
(*c*) when 15 is added to it, the range becomes 15 to < 20

Only option (*ii*) and (*iv*) fulfill the condition of range 15 to < 20.

EXAMPLE 4.2 *What could be the minimum possible and maximum possible numbers by following code ?*

```
import random
print(random.randint(3, 10) - 3)
```

Solution. minimum possible number = 0
maximum possible number = 7

Because,

- randint(3, 10) would generate a random integer in the range 3 to 10
- subtracting 3 from it would change the range to 0 to 7 (because if ***randint(3,10)*** generates then –3 would make it 7 ; similarly, for lowest generated value 3, it will make it 0)

EXAMPLE 4.3 *In a school fest, three randomly chosen students out of 100 students (having roll numbers 1-1 have to present bouquets to the guests. Help the school authorities choose three students randomly.*

Solution.

```
import random
student1 = random.randint(1, 100)
student2 = random.randint(1, 100)
student3 = random.randint(1, 100)
print("3 chosen students are",)
print(student1, student2, student3)
```

4.4.2B Using String Module

Python has a module by the name **string** that comes with many constants and classes. It al offers a utility function **capwords( )**. Let us talk about some useful constants defined in th string module.

Please note that like other modules, before you can use any of the constants/functions define in the **string** module, you must import it using an import statement :

```
import string
```

Some useful **constants** defined in the string module are being listed below :

string.ascii_letters	it returns a string containing all the collection of ASCII letters.
string.ascii_lowercase	it returns a string containing all the lowercase ASCII letters, *i.e.*, 'abcdefghijklmnopqrstuvwxyz'.
string.ascii_uppercase	it returns all the uppercase ASCII letters, *i.e.*, 'ABCDEFGHIJKLMNOPQRSTUVWXYZ'.
string.digits	it returns a string containing all the digits Python allows, *i.e.*, the string '0123456789'.
string.hexdigits	it returns a string containing all the hexadecimal digits Python allows, *i.e.*, the string '0123456789abcdefABCDEF'.
string.octdigits	it returns a string containing all the octal digits Python allows, *i.e.*, the string '01234567'.
string.punctuation	it returns a string of ASCII characters which are considered punctuation characters, *i.e.*, the string '!"#$%&'()*+,-./:;?@[\]^_'{|}~'

The string module also offers a utility function capwords( ) :

capwords(<str>, [sep=None])	it splits the specified string <*Str*> into words using <*Str*>.*split( )*. Then it capitalizes each word using <*Str*>.*capitalize( )* function. Finally, it joins the capitalized words using <*Str*>.*join( )*. If the optional second argument *sep* is absent or is *None*, it will remove leading and trailing whitespaces and all inside whitespace characters are replaced by a single space.

You can obtain the value of the constants defined in **string** module by simply giving their name with the string module name after importing string module, *e.g.*,

```
>>> import string
>>> string.ascii_letters
'abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ'
>>> string.digits
'0123456789'
>>> string.ascii_uppercase
'ABCDEFGHIJKLMNOPQRSTUVWXYZ'
>>> string.punctuation
'!"#$%&\'()*+,-./:;?@[\\]^_'{|}~'
```

You can use ***capwords( )*** using the string module name and passing the string name as its argument, *e.g.*,

```
>>> import string
>>> line = "this is a simple line\n New line"
>>> string.capwords(line)
'This Is A Simple Line New Line'
```

See it has capitalized each word separately and all leading, trailing whitespaces have been removed and inside whitespace characters (eg '\n' and spaces) have been replaced with a single space.

PriP WORKING WITH math AND random MODULES — Progress In Python 4.2

This PriP session is based on using Python Standard Library Modules – *math* and *random*.

⋮

Please check the practical component-book – Progress in Computer Science with Python and fill it there in PriP 4.2 under Chapter 4 after practically doing it on the computer.

>>>❖<<<

4.5 Creating a Python Library

Other than standard library, there are numerous libraries available which you can install and use in your programs. Some such libraries are *NumPy, SciPy, tkinter* etc.

One of these libraries, *NumPy*, has been covered briefly in chapter 8. **Appendix B** discusses another Python library – **tkinter**. You can also create your own libraries.

You have been using terms *modules* and *libraries* so far. Let us talk about a related word, **package**. In fact, most of the times **library** and **package** terms are used interchangeably.

A **package** is collection of Python modules under a common namespace, created by placing different modules on a single directory along with some special files (such as __init__.py)

In a directory structure, in order for a folder (containing different modules *i.e.*, .py files) to be recognized as a package, a special file namely *__init__.py* must also be stored in the folder, even if the file __init__.py is empty.

A ***library*** can have one or more packages and *subpackages*.

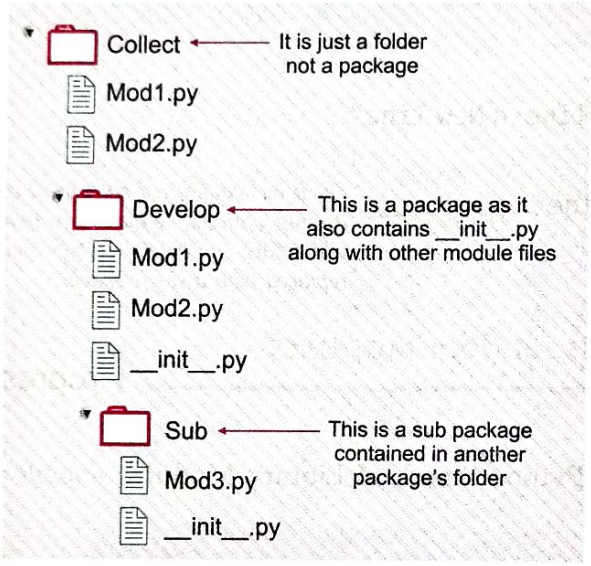
Let us now learn how you can create your own library in Python.

Now on, we shall be using word *package* as we shall be creating simple libraries that can be called **package** interchangeably.

4.5.1 Structure of a Package

As you know that *Python packages* are basically collections of modules under common namespace. This common namespace is created via a directory that contains all related modules. But here you should know one thing that NOT ALL folders having multiple .py files (*i.e.*, modules) are packages. In order for a folder containing Python files to be recognized as a package, an **__init__.py** file (even if empty) must be part of the folder.

Following figure (Fig 4.4) explains it.



NOTE

The file __init__.py in a folder, indicates it is an importable Python package, Without __init__.py, a folder is not considered a Python package.

You can even add an empty file having name as __init__.py in a folder to make it a Python package.

Figure 4.4 A package *vs.* folder.

4.5.2 Procedure For Creating Packages

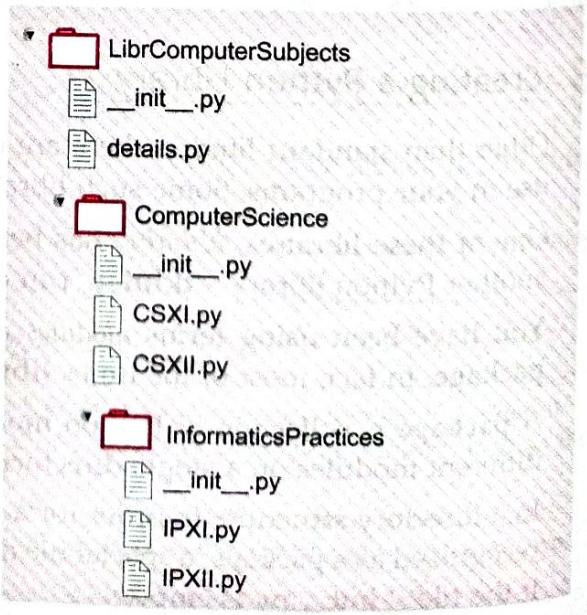
In order to create a package, you need to follow a certain procedure as discussed below.

Major steps to create a package are :

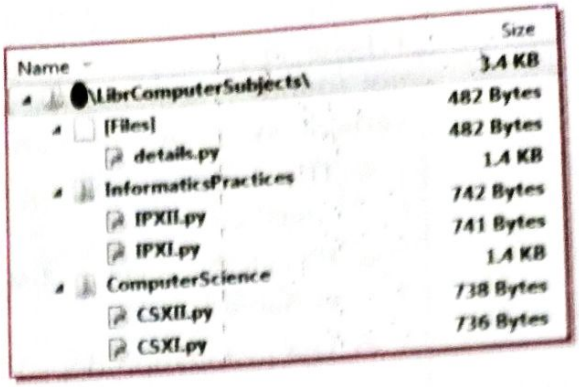
1. ***Decide about the basic structure of your package.*** It means that you should have a clear idea about what will be your package's name (*i.e.*, a directory/folder with that name will be created) and what all modules and subfolders (to serve as sub packages) will be part of it.

(*Just keep in mind that while naming the folders/subfolders, keep the words in the name underscore-separated; don't use any other word separators, at all (not even hyphens)*)

For instance, we are going to create the package shown on the right.



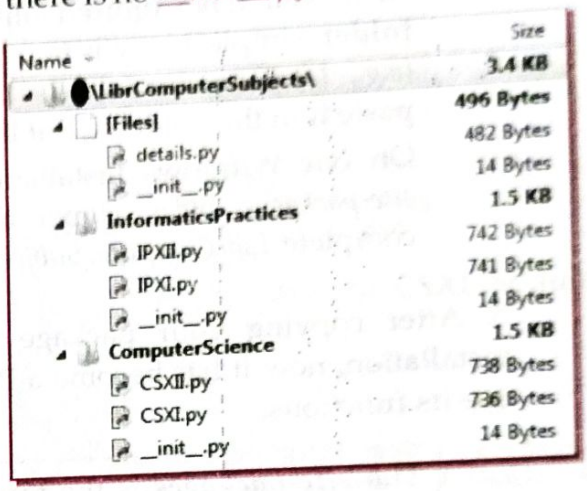
2. ***Create the directory structure having folders with names of package and subpackages.*** In our example shown above, we created a folder by the name **LibrComputerSubjects**.



Inside this folder, we created files/modules, *i.e.*, the .py files and subfolders with their own .py files. Now our topmost folder has the package name as per above figure and subfolders have names as the subpackages (as per adjacent figure).

But this is not yet eligible to be a package in Python as there is no *__init__.py* file in the folder(s).

3. ***Create __init__.py files in package and subpackage folders.*** We created an empty file and saved it as "__init__.py" and then copied this empty *__init__.py* file to the package and subpackage folders.



Now our directory structure looked like the one shown here.

Without the __init__.py file, Python will not look for submodules inside that directory, so attempts to import the module will fail.

4. ***Associate it with Python installation.*** Once you have your package directory ready, you can associate it with Python by attaching it to Python's **site-packages** folder of current Python distribution in your computer. You can import a library and package in Python only if it is attached to its **site-packages** folder.

(*i*) In order to check the path of the site-packages folder of Python, on the Python prompt, type the following two commands, one after another and try to locate the path of site-packages folder :

```
import sys
print (sys.path)
```

```
In [11]: import sys

In [12]: print(sys.path)
['', 'C:\\ProgramData\\Anaconda3\\python36.zip',
\Anaconda3\\DLLs', 'C:\\ProgramData\\Anaconda3\\lib', 'C:\\ProgramData\
\Anaconda3',
'C:\\ProgramData\\Anaconda3\\lib\\site-packages', 'C:\
\ProgramData\\Anaconda3\\lib\\site-packages\\win32', 'C:\\ProgramData\
\Anaconda3\\lib\\site-packages\\win32\\lib', 'C:\\ProgramData\\Anaconda3\
\lib\\site-packages\\Pythonwin', 'C:\\ProgramData\\Anaconda3\\lib\\site-
packages\\IPython\\extensions', 'C:\\Users\\Edup\\.ipython']
```

This is the path of site-packages folder on your computer

The **sys.path** attribute gives an important information about **PYTHONPATH**, which specifies the directories that the Python interpreter will look in when importing modules.

If you carefully look at above result of **print(sys.path)** command, you will find that the first entry in PYTHONPATH is ' '. It means that the Python interpreter will first look in the current directory when trying to do an import. If the asked module/package is not found in current directory, then it check the directory listed in PYTHONPATH.

Whenever we import a module, say ***info***, the interpreter searches a built-in version. If not found, it searches for a file named ***info.py*** under a list of directories given by variable **sys.path**. This variable is initialized from the following locations :

- The directory holding the input script (or the current directory, in case no file is specified).
- PYTHONPATH (a list of directory names, with the same syntax as the shell variable PATH).
- The installation-dependent default.

(*ii*) Once you have figured out the path of **site-packages folder**, simplest way is to copy your own package-folder (*e.g., LibrComputerSubjects* that we created above) and paste it in this folder. (*But this is not the standard way.)

On our Windows installation, we simply opened the *site-packages folder* as per above path and pasted the complete *LibrComputerSubjects* folder there.

NOTE

The standard way of attaching a libray/package to site-packages folder uses a command like python setup.py install, BUT we are not going in details of that as we are keeping this discussion as simple as possible).

5. After copying your package folder in **site-packages** folder of your current Python installation, now it has become a Python library so that now you can import its modules and use its functions.

The ***site-packages*** is the target directory in which all installed Python packages are placed by default.

4.5.3 Using/Importing Python Libraries

Once you have created your own package (and subpackages) and attached it to **site-packages** folder of current Python installation on your computer, you can use them just as the way you use other Python libraries.

To use an installed Python library you need to do the following :

1. Import the library using import command :
   `import <full name of library>`
2. Use the functions, attributes etc. defined in the library by giving their full name.

For instance, to use package *LibrComputerPackages's* two module files, which are shown here, you can import them and then use them as shown below :

```
#details.py
"""Details about computer subjects in CBSE"""
def SubjectsList( ) :
    print("There are two computer subjects in CBSE")
    print("'Computer Science' and 'Informatics Practices'")
                :
```

```
#CSXI.py
"""Details about CBSE CS XI"""
def Syllabus() :
    print("Unit 1 : Programming and Computational Thinking-1")
    print("       : Pythom basics, basic sorting techniques etc.")
    print("Unit 2 : Computer Systems and Organisation")
    print("       : Computer organisation, execution, cloud computing etc.")
    print("Unit 3 : Data Management - 1")
    print("       : SQL, basics of NoSQL databases etc.")
    print("Unit 4 : Society, Law and ethics - 1")
    print("       : Cyber Safety, safe data communication etc.")
    print("Unit 5 : Practical Unit")
def About( ) :
    print("Computer Science XI")
    print("Contains 4 units and a Practical unit")
```

As you can see that the **details** module has a function namely ***SubjectsList( )*** and **CSXI** module has *two* functions namely ***Syllabus( )*** and ***About( )***.

(*i*) To import module ***details***, you can write import command as :

```
import LibrComputerSubjects.details
```

*As **details** module is inside package folder **LibraComputerDetails**, its full name is as shown here*

and use its function(s) by giving its full name *i.e.*,

LibrComputerSubjects.details.<function>( )

```
In [13]: import LibrComputerSubjects.details

In [14]: LibrComputerSubjects.details.SubjectsList()
There are two computer subjects in CBSE
'Computer Science' and 'Informatics Practices'
```

See how function **SubjectsList()** of **details** module in **LibrComputerSubjects** package is being invoked

(*ii*) To import module *CSXI*, you can write import command as :

```
import LibrComputerSubjects.ComputerScience.CSXI
```

*As **CSXI** module is inside **ComputerScience** subfolder of package **LibraComputerDetails**, its full name is as shown here*

and use its function(s) by giving its full name *i.e.*,

LibrComputerSubjects.ComputerScience.CSXI.<function>( )

```
In [15]: import LibrComputerSubjects.ComputerScience.CSXI

In [16]: LibrComputerSubjects.ComputerScience.CSXI.Syllabus()
Unit 1 : Programming and Computational Thinking-1
       : Pythom basics, basic sorting techniques etc.
Unit 2 : Computer Systems and Organisation
       : Computer organisation, execution, cloud computing etc.
Unit 3 : Data Management - 1
       : SQL, basics of NoSQL databases etc.
Unit 4 : Society, Law and ethics - 1
       : Cyber Safety, safe data communication etc.
Unit 5 : Practical Unit
```

See how function **Syllabus()** of CSXI module in subfolder **ComputerScience** of package folder **LibrComputerSubjects** is being invoked

We have kept this discussion very simple and basic. You can even create installable libraries in Python. The installable libraries also have a *setup.py* file. But we are not going into those details as this is beyond the scope of this book.

However, we shall recommend one thing: While naming a library, try to use all lowercase letters although we used capital letters in above example (LibrComputerSubjects). We did this to make it more readable so that you could understand it easily. But if you are creating an actual library and you want it to be used by any python user then try to give it a unique name (*i.e.*, check in PyPI[7] – *Python Package Index* if your library name is unique) all in lowercase so that everyone can use it without bothering about the case of the letters.

Appendix B. '**Working with some useful Python Libraries – tkinter**' briefly talks about how you can use a useful Python Library : *tkinter* (your suggested practical exercises expect you to use this library alongwith *NumPy* and *SciPy*. *NumPy* is covered in chapter 8)

Check Point

1. Which operator is used in Python to import all modules from packages?
   (*a*) . operator
   (*b*) * operator
   (*c*) -> symbol
   (*d*) , operator
2. Which file must be part of the folder containing Python module files to make it importable python package?
   (*a*) init.py
   (*b*) __ setup__.py
   (*c*) __init__.py
   (*d*) setup.py
3. In python which is the correct method to load a module math?
   (*a*) include math
   (*b*) import math
   (*c*) #include<math.h>
   (*d*) using math
4. Which is the correct command to load just the tempc method from a module called usable?
   (*a*) import usable, tempc
   (*b*) import tempc from usable
   (*c*) from usable import tempc
   (*d*) import tempc
5. What is the extension of Python library modules?
   (*a*) .mod (*b*) .lib (*c*) .code (*d*) .py

CREATING AND USING PACKAGES — Progress In Python 4.3

This PriP session is based on practice questions for creating and using Python packages.

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With this, we have come to the end of this chapter. Let us quickly revise what we have covered in this chapter.

LET US REVISE

- *A library refers to a collection of modules that together cater to specific type of needs or applications.*
- *A module is a separately saved unit whose functionality can be reused at will.*
- *A function is a named block of statements that can be invoked by its name.*
- *Python can have three types of functions : built-in functions, functions in modules and user-defined functions.*
- *A Python module can contain objects like docstrings, variables, constants, classes, objects, statements, functions.*
- *A Python module has the .py extension.*
- *The docstrings are useful for documentation purposes.*
- *A Python module can be imported in a program using import statement.*

7. The *Python Package Index* (PyPI) is a repository of software for the Python programming language. PyPI helps you find and install software developed and shared by the Python community. Package authors use PyPI to distribute their software.