Modules

A group of functions, variables and classes saved to a file, which is nothing but module.

Every Python file (.py) acts as a module.

Eg: durgamath.py

```
1)     x=888
2)
3)   def add(a,b):
4)     print("The Sum:",a+b)
5)
6)   def product(a,b):
7)     print("The Product:",a*b)
```

durgamath module contains one variable and 2 functions.

If we want to use members of module in our program then we should import that module.

import modulename

We can access members by using module name.
modulename.variable
modulename.function()

test.py:

```
1)   import durgamath
2)   print(durgamath.x)
3)   durgamath.add(10,20)
4)   durgamath.product(10,20)
5)
6)    Output
7)    888
8)   The Sum: 30
9)   The Product: 200
```

Note:

whenever we are using a module in our program, for that module compiled file will be generated and stored in the hard disk permanently.

Renaming a module at the time of import (module aliasing):

Eg:

```
import durgamath as m
```

here durgamath is original module name and m is alias name.
We can access members by using alias name m

test.py:

```
1) import durgamath as m
2) print(m.x)
3) m.add(10,20)
4) m.product(10,20)
```

from ... import:

We can import particular members of module by using from ... import .
The main advantage of this is we can access members directly without using module name.

Eg:

```
from durgamath import x,add
print(x)
add(10,20)
product(10,20)==> NameError: name 'product' is not defined
```

We can import all members of a module as follows

```
from durgamath import *
```

test.py:

```
1) from durgamath import *
2) print(x)
3) add(10,20)
4) product(10,20)
```

Various possibilties of import:

import modulename
import module1,module2,module3
import module1 as m
import module1 as m1,module2 as m2,module3
from module import member
from module import member1,member2,memebr3
from module import memeber1 as x
from module import *

member aliasing:

from durgamath import x as y,add as sum
print(y)
sum(10,20)

Once we defined as alias name,we should use alias name only and we should not use original name

Eg:
from durgamath import x as y
print(x)==>NameError: name 'x' is not defined

Reloading a Module:

By default module will be loaded only once eventhough we are importing multiple multiple times.

Demo Program for module reloading:

```
1)  import time
2)  from imp import reload
3)  import module1
4)  time.sleep(30)
5)  reload(module1)
6)  time.sleep(30)
7)  reload(module1)
8)  print("This is test file")
```

Note: In the above program, everytime updated version of module1 will be available to our program

module1.py:

```
print("This is  from module1")
```

test.py

```
import module1
import module1
import module1
import module1
print("This is test module")

Output
This is  from module1
This is test module
```

In the above program test module will be loaded only once eventhough we are importing multiple times.

The problem in this approach is after loading a module if it is updated outside then updated version of module1 is not available to our program.

We can solve this problem by reloading module explicitly based on our requirement.
We can reload by using reload() function of imp module.

```
import imp
imp.reload(module1)
```

test.py:

```
import module1
import module1
from imp import reload
reload(module1)
reload(module1)
reload(module1)
print("This is test module")
```

In the above program module1 will be loaded 4 times in that 1 time by default and 3 times explicitly. In this case output is

```
This is  from module1
This is  from module1
This is  from module1
This is  from module1
This is test module
```

The main advantage of explicit module reloading is we can ensure that updated version is always available to our program.

Finding members of module by using dir() function:

Python provides inbuilt function dir() to list out all members of current module or a specified module.

dir() ===>To list out all members of current module
dir(moduleName)==>To list out all members of specified module

Eg 1: test.py

```
1)  x=10
2)  y=20
3)  def f1():
4)      print("Hello")
5)  print(dir())    # To print all members of current module
6)
7)  Output
8)  ['__annotations__', '__builtins__', '__cached__', '__doc__', '__file__', '__loader__', '__nam
    e__', '__package__', '__spec__', 'f1', 'x', 'y']
```

Eg 2: To display members of particular module:

durgamath.py:

```
1)  x=888
2)
3)  def add(a,b):
4)    print("The Sum:",a+b)
5)
6)  def product(a,b):
7)    print("The Product:",a*b)
```

test.py:

```
1)  import durgamath
2)  print(dir(durgamath))
3)
4)  Output
5)  ['__builtins__', '__cached__', '__doc__', '__file__', '__loader__', '__name__',
6)  '__package__', '__spec__', 'add', 'product', 'x']
```

Note: For every module at the time of execution Python interpreter will add some special properties automatically for internal use.

Eg: __builtins__,__cached__,'__doc__,__file__, __loader__, __name__,__package__, __spec__

Based on our requirement we can access these properties also in our program.

Eg: test.py:

```
1) print(__builtins__ )
2) print(__cached__  )
3) print(__doc__)
4) print(__file__)
5) print(__loader__)
6) print(__name__)
7) print(__package__)
8) print(__spec__)
9)
10) Output
11) <module 'builtins' (built-in)>
12) None
13) None
```

test.py

```
1) <_frozen_importlib_external.SourceFileLoader object at 0x00572170>
2) __main__
3) None
4) None
```

The Special variable __name__:

For every Python program , a special variable __name__ will be added internally.
This variable stores information regarding whether the program is executed as an individual program or as a module.

If the program executed as an individual program then the value of this variable is __main__
If the program executed as a module from some other program then the value of this variable is the name of module where it is defined.

Hence by using this __name__ variable we can identify whether the program executed directly or as a module.

Demo program:

module1.py:

```
1)  def f1():
2)      if __name__=='__main__':
3)          print("The code executed as a program")
4)      else:
5)          print("The code executed as a module from some other program")
6)  f1()
```

test.py:

```
1)  import module1
2)  module1.f1()
3)
4)  D:\Python_classes>py module1.py
5)  The code executed as a program
6)
7)  D:\Python_classes>py test.py
8)  The code executed as a module from some other program
9)  The code executed as a module from some other program
```

Working with math module:

Python provides inbuilt module math.
This module defines several functions which can be used for mathematical operations.
The main important functions are

1. sqrt(x)
2. ceil(x)
3. floor(x)
4. fabs(x)
5.log(x)
6. sin(x)
7. tan(x)
....

Eg:

```
1)  from math import *
2)  print(sqrt(4))
3)  print(ceil(10.1))
4)  print(floor(10.1))
5)  print(fabs(-10.6))
6)  print(fabs(10.6))
```

```
7)
8)  Output
9)  2.0
10) 11
11) 10
12) 10.6
13) 10.6
```

Note:

We can find help for any module by using help() function

Eg:

```
import math
help(math)
```

Working with random module:

This module defines several functions to generate random numbers.
We can use these functions while developing games,in cryptography and to generate random numbers on fly for authentication.

1. random() function:

This function always generate some float value between 0 and 1 (not inclusive)

0<x<1

Eg:

```
1)  from random import *
2)  for i in range(10):
3)      print(random())
4)
5)   Output
6)   0.4572685609302056
7)  0.6584325233197768
8)  0.15444034016553587
9)  0.18351427005232201
10) 0.1330257265904884
11) 0.9291139798071045
12) 0.6586741197891783
13) 0.8901649834019002
14) 0.25540891083913053
15) 0.7290504335962871
```

2. randint() function:

To generate random integer beween two given numbers(inclusive)

Eg:

```
1)  from random import *
2)  for i in range(10):
3)      print(randint(1,100)) # generate random int value between 1 and 100(inclusive)
4)
5)  Output
6)  51
7)  44
8)  39
9)  70
10) 49
11) 74
12) 52
13) 10
14) 40
15) 8
```

3. uniform():

It returns random float values between 2 given numbers(not inclusive)

Eg:

```
1)  from random import *
2)  for i in range(10):
3)      print(uniform(1,10))
4)
5)  Output
6)  9.787695398230332
7)  6.81102218793548
8)  8.068672144377329
9)  8.567976357239834
10) 6.363511674803802
11) 2.176137584071641
12) 4.822867939432386
13) 6.0801725149678445
14) 7.508457735544763
15) 1.9982221862917555
```

random() ===>in between 0 and 1 (not inclusive)
randint(x,y) ==>in between x and y (inclusive)
uniform(x,y) ==> in between x and y (not inclusive)

4. randrange([start],stop,[step])

returns a random number from range
start<= x < stop
start argument is optional and default value is 0
step argument is optional and default value is 1

randrange(10)-->generates a number from 0 to 9
randrange(1,11)-->generates a number from 1 to 10
randrange(1,11,2)-->generates a number from 1,3,5,7,9

Eg 1:

```
1)  from random import *
2)  for i in range(10):
3)      print(randrange(10))
4)
5)  Output
6)  9
7)  4
8)  0
9)  2
10) 9
11) 4
12) 8
13) 9
14) 5
15) 9
```

Eg 2:

```
1)  from random import *
2)  for i in range(10):
3)      print(randrange(1,11))
4)
5)  Output
6)  2
7)  2
8)  8
9)  10
10) 3
11) 5
12) 9
13) 1
14) 6
15) 3
```

Eg 3:

```
1)  from random import *
2)  for i in range(10):
3)      print(randrange(1,11,2))
4)
5)  Output
6)  1
7)  3
8)  9
9)  5
10) 7
11) 1
12) 1
13) 1
14) 7
15) 3
```

5. choice() function:

It wont return random number.
It will return a random object from the given list or tuple.

Eg:

```
1)  from random import *
2)  list=["Sunny","Bunny","Chinny","Vinny","pinny"]
3)  for i in range(10):
4)      print(choice(list))
```

Output

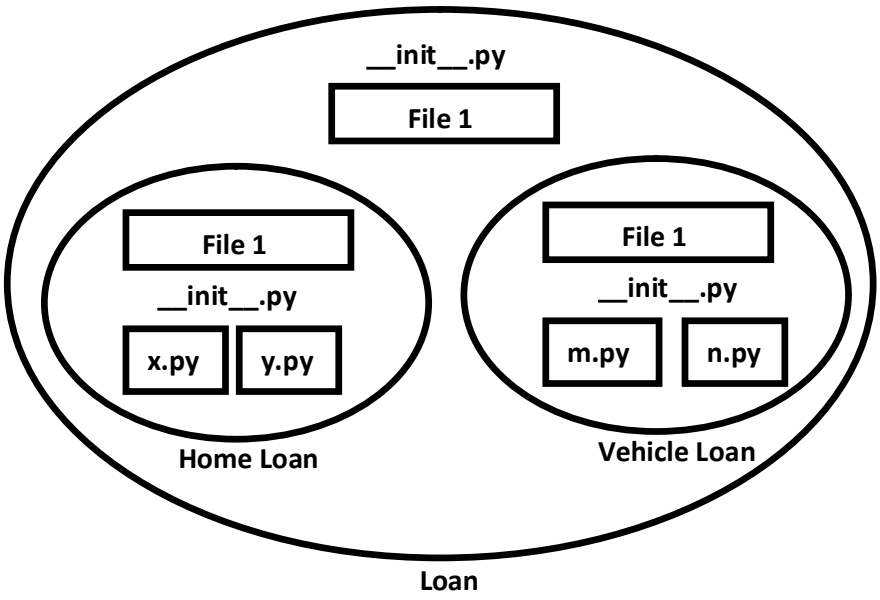
```
Bunny
pinny
Bunny
Sunny
Bunny
pinny
pinny
Vinny
Bunny
Sunny
```

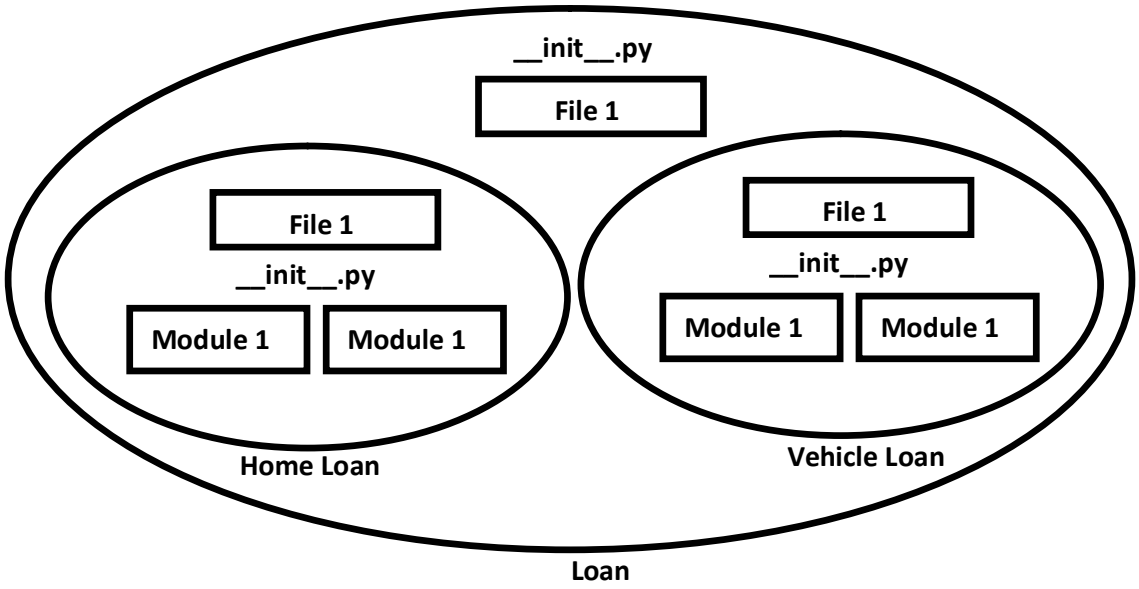
Packages

It is an encapsulation mechanism to group related modules into a single unit.
package is nothing but folder or directory which represents collection of Python modules.

Any folder or directory contains __init__.py file,is considered as a Python package.This file can be empty.

A package can contains sub packages also.





The main advantages of package statement are

1. **We can resolve naming conflicts**
2. **We can identify our components uniquely**
3. **It improves modularity of the application**

Eg 1:

```
D:\Python_classes>
    |-test.py
    |-pack1
        |-module1.py
        |-__init__.py
```

__init__.py:

empty file

module1.py:

```
def f1():
        print("Hello this is from module1 present in pack1")
```

test.py (version-1):

```
import pack1.module1
pack1.module1.f1()
```

test.py (version-2):

```
from pack1.module1 import f1
f1()
```

Eg 2:

```
D:\Python_classes>
    |-test.py
    |-com
        |-module1.py
        |-__init__.py
            |-durgasoft
                |-module2.py
                |-__init__.py
```

__init__.py:

empty file

module1.py:

```
def f1():
        print("Hello this is from module1 present in com")
```

module2.py:

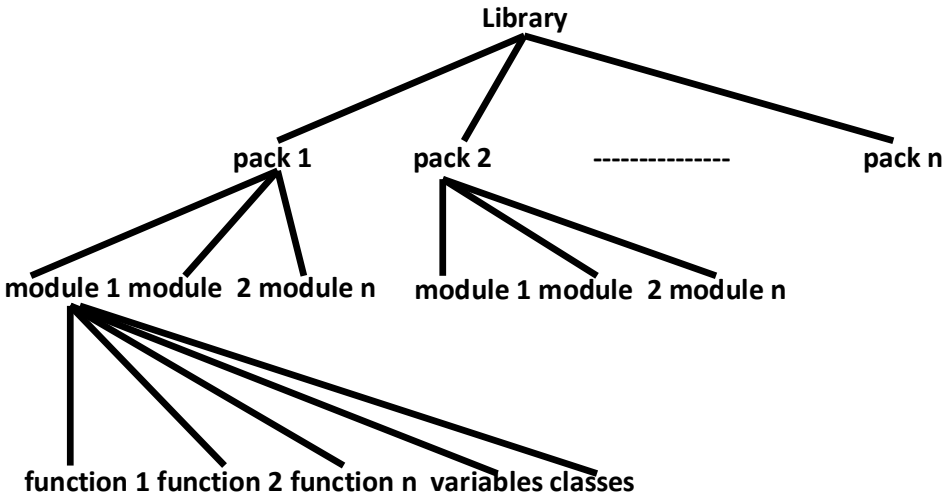
```
def f2():
        print("Hello this is from module2 present in com.durgasoft")
```

test.py:

```
from com.module1 import f1
from com.durgasoft.module2 import f2
f1()
f2()

Output
D:\Python_classes>py test.py
Hello this is from module1 present in com
Hello this is from module2 present in com.durgasoft
```

Note: Summary diagram of library,packages,modules which contains functions,classes and variables.


Library
pack 1
pack 2
----
pack n
module 1 module 2 module n
module 1 module 2 module n
function 1 function 2 function n variables classes