MODULES

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- A group of functions, variables and classes saved to a file, which is nothing but module.
- Every Python file (.py) acts as a 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)
```

- 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)
```

Output

```
888
The Sum: 30
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.

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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.

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

1) import modulename
2) import module1,module2,module3
3) import module1 as m
4) import module1 as m1,module2 as m2,module3
5) from module import member
6) from module import member1,member2,memebr3
7) from module import memeber1 as x
8) from module import *

Member Aliasing:

```
1) from durgamath import x as y,add as sum
2) print(y)
3) sum(10,20)
```

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

```
1) from durgamath import x as y
2) 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.

module1.py:

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

test.py

```
1) import module1
2) import module1
3) import module1
4) import module1
5) 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.**

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


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test.py:

```
1) import module1
2) import module1
3) from imp import reload
4) reload(module1)
5) reload(module1)
6) reload(module1)
7) 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

```
1) This is  from module1
2) This is  from module1
3) This is  from module1
4) This is  from module1
5) 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
```

Output

```
['__annotations__', '__builtins__', '__cached__', '__doc__', '__file__', '__loader__', '__name__', '__package__', '__spec__', 'f1', 'x', 'y']
```


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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))
```

Output

['__builtins__', '__cached__', '__doc__', '__file__', '__loader__', '__name__', '__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__)
```

Output

```
<module 'builtins' (built-in)>
None
None
```


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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()
```

```
D:\Python_classes>py module1.py
The code executed as a program

D:\Python_classes>py test.py
The code executed as a module from some other program
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)
    8) ....

```
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))
```

Output

```
2.0
11
10
10.6
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)

$0<x<1$

```
1) from random import *
2) for i in range(10):
3)     print(random())
```

Output

```
0.4572685609302056
0.6584325233197768
0.15444034016553587
0.18351427005232201
0.1330257265904884
0.9291139798071045
0.6586741197891783
0.8901649834019002
0.25540891083913053
0.7290504335962871
```

2) randint() Function:

To generate random integer beween two given numbers(inclusive)

```
1) from random import *
2) for i in range(10):
3)     print(randint(1,100)) # generate random int value between 1 and 100(inclusive)
```

Output

```
51
44
39
70
49
74
52
10
40
8
```

3) uniform() Function:

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

```
1) from random import *
2) for i in range(10):
3)     print(uniform(1,10))
```


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Output

```
9.787695398230332
6.81102218793548
8.068672144377329
8.567976357239834
6.363511674803802
2.176137584071641
4.822867939432386
6.0801725149678445
7.508457735544763
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

```
1) from random import *
2) for i in range(10):
3)     print(randrange(10))
```

Output:

```
9
4
0
2
9
4
8
9
5
9
```

```
1) from random import *
2) for i in range(10):
3)     print(randrange(1,11))
```

Output: 2
2
8
10
3
5
9
1
6
3

```
1)  from random import *
2)  for i in range(10):
3)      print(randrange(1,11,2))
```

Output: 1
3
9
5
7
1
1
1
7
3

5) choice() Function:

- It won't return random number.
- It will return a random object from the given list or tuple.

```
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

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PACKAGES

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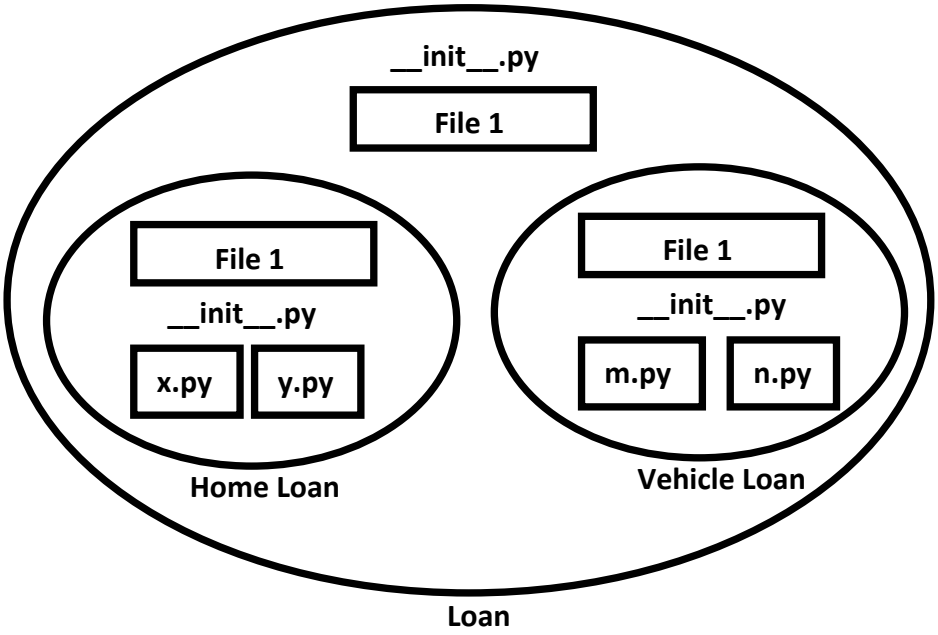
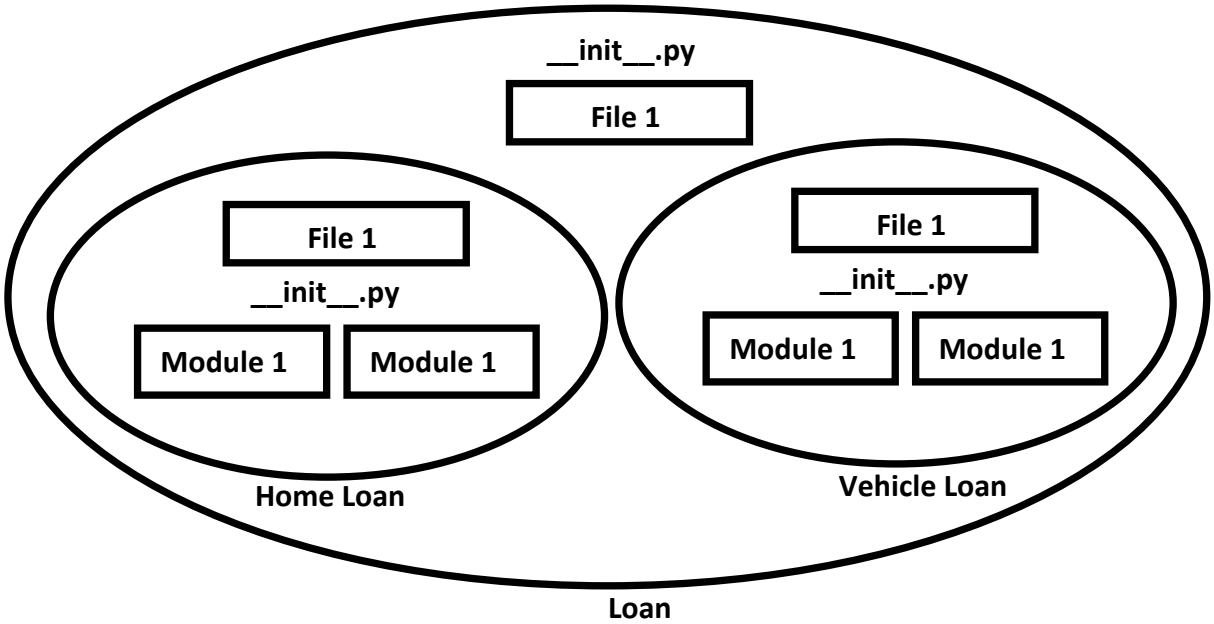
- It is an encapsulation mechanism to group related modules into a single unit.
- package is nothing but folder or directory which represents collection of Python modules.
- Any folder or directory contains __init__.py file,is considered as a Python package.This file can be empty.
- A package can contains 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

```
1) from com.module1 import f1
2) from com.durgasoft.module2 import f2
3) f1()
4) 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.