Modules and packages

[Modules : Importing module, Math module, Random module, Packages, Composition, Input-Output Printing on screen, Reading data from keyboard, Opening and closing file, Reading and writing files, Functions Exception Handling Exception,

Exception Handling: Except clause, Try? finally clause, User Defined Exceptions. **]**

Modular Programming

Modular programming refers to the process of breaking a large, unwieldy programming task into separate, smaller, more manageable subtasks or modules. Individual modules can then be put together like building blocks to create a larger application.

There are several advantages to modularizing code in a large application:

- **Simplicity**: Rather than focusing on the entire problem at hand, a module typically focuses on one relatively small portion of the problem.
- **Maintainability**: Modules are typically designed so that they enforce logical boundaries between different problem domains and thereby minimize interdependency.
- **Reusability**: Functionality defined in a single module can be easily reused (through an appropriately defined interface) by other parts of the application. This eliminates the need to duplicate code.
- **Scoping**: Modules typically define a separate namespace, which helps avoid collisions between identifiers in different areas of a program.

What is module

If you quit the Python interpreter and enter it again, the definitions you have made (functions and variables) are lost. Therefore, if you want to write a somewhat longer program, you are better off using a text editor to prepare the input for the interpreter and running it with that file as input instead. This is known as creating a *script*. As your program gets longer, you may want to split it into several files

for easier maintenance. You may also want to use a handy function that you've written in several programs without copying its definition into each program.
To support this, **Python has a way to put definitions in a file and use them in a script or in an interactive instance of the interpreter. Such a file is called a *module***; definitions from a module can be *imported* into other modules or into the *main* module (the collection of variables that you have access to in a script executed at the top level and in calculator mode).
Modules in Python are simply Python files with a .py extension. The name of the module will be the name of the file. A Python module can have a set of functions, classes or variables defined and implemented

Python Modules: Overview

There are actually three different ways to define a module in Python:

- A module can be written in Python itself.
- A module can be written in C and loaded dynamically at run-time, like the re (regular expression) module.
- A built-in module is intrinsically contained in the interpreter, like the itertoolsmodule.

A module's contents are accessed the same way in all three cases: with the **import** statement.

Here, the focus will mostly be on modules that are written in Python. The cool thing about modules written in Python is that they are exceedingly straightforward to build. All you need to do is create a file that contains legitimate Python code and then give the **file** a **name with a .py extension**.

For example, suppose you have created a file called **mymod.py** containing the following:

mymod.py

```
s = "If Comrade Napoleon says it, it must be right."
a = [100, 200, 300]
def foo(arg):
    print(f'Result is = {arg}')
```

Several objects are defined in **mymod.py**:

- `s` (a string)
- `a` (a list)
- `foo()` (a function)

Assuming **mymod.py is in an appropriate location**, these objects can be accessed by importing the module as follows:

```
>>> import mymod
>>> print(mymod.s)
      If Comrade Napoleon says it, it must be right.
>>> mod.a
      [100, 200, 300]
>>> mod.foo(['quux', 'corge', 'grault'])
      Result is = ['quux', 'corge', 'grault']
>>> x = mod.Foo()
>>> x
      <mod.Foo object at 0x03C181F0>
```

The Module Search Path

When the interpreter executes the

```
>>> import mymod
```

statement, it searches for mymod.py in a list of directories assembled from the following sources:

- The **directory from which the input script was run** or the **current directory** if the interpreter is being run interactively
- The **list of directories contained in the PYTHONPATH** environment variable, if it is set. (The format for PYTHONPATH is OS-dependent but should mimic the PATH environment variable.)
- An **installation-dependent list of directories** configured at the time Python is installed

The resulting search path is accessible in the Python variable **sys.path**, which is obtained from a module named **sys**:

```
>>> import sys
>>> sys.path
        ['','/home/apurba/anaconda3/lib/python36.zip',
'/home/
apurba/anaconda3/lib/python3.6','/home/apurba/anaconda3/lib/pytho
n3.6/lib-dynload','/home/apurba/anaconda3/lib/python3.6/site-pa
ckages']
```

Thus, to ensure your module is found, you need to do one of the following:

- **Put mymod.py** in the **directory where the input script** is located or the **current directory**, if interactive.
- **Modify the PYTHONPATH** environment variable to contain the directory where **mymod.py** is located before starting the interpreter **or** put **mymod.py** in one of the directories already contained in the **PYTHONPATH** variable
- **Put mymod.py** in one of the **installation-dependent directories**, which you may or may not have write-access to, depending on the OS
- Put the module file in any directory of your choice and then **modify sys.path** at run-time so that it contains that directory. For example, in this case, you could put **mymod.py** in directory [**/home/apurba/PythonModule**] and then issue the following statements:

```
>>> sys.path.append('/home/apurba/PythonModule')
>>> sys.path
['','/home/apurba/anaconda3/lib/python36.zip','/home/apurba/anaconda3/lib/python3.6',
'/home/apurba/anaconda3/lib/python3.6/lib-dynload','/home/apurba/anaconda3/lib/python3
.6/site-packages', '/home/apurba/ PythonModule']
```

Once a module has been imported, you can determine the location where it was found with the module's **__file__** attribute:

```
>>> import mymod
>>> mymod.__file__
/home/apurba/PythonModule    # Output
```

The `import` Statement

Module contents are made available to the caller with the import statement. The import statement takes many different forms, shown below.

The simplest form is the one already shown above:

import <module_name>

Note that this does not make the module contents directly accessible to the caller. Each module has its own private symbol table, which serves as the global symbol table for all objects defined in the module. Thus, a module creates a separate namespace.

The statement import <module_name> only places <module_name> in the caller's symbol table. The objects that are defined in the module remain in the module's private symbol table.

From the caller, **objects in the module are only accessible when prefixed with <module_name> via dot notation**.

After the following import statement, **mymod** is placed into the local symbol table. Thus, **mymod** has meaning in the caller's local context:

```
>>> import mymod
>>> mymod
<module 'mymod' from '/home/apurba/PythonModule.py'>
```

But s and foo remain in the module's private symbol table and are not meaningful in the local context:

```
>>> s
NameError: name 's' is not defined
>>> foo('quux')
NameError: name 'foo' is not defined
```

To be accessed in the local context, names of objects defined in the module must be prefixed by mod:

```
>>> mymod.s
'If Comrade Napoleon says it, it must be right.'
>>> mymod.foo('quux')
Result is = quux
```

If required Several comma-separated modules may be specified in a single import statement:

>>> import <module_name1>[, <module_name2>[, <module_name3]..]

An alternate form of the import statement allows individual objects from the module to be imported directly into the caller's symbol table:

from <module_name> import <name(s)>

Following execution of the above statement, <name(s)> can be accessed in the caller's environment without the <module_name> prefix:

```
>>> from mymod import s, foo
>>> s
'If Comrade Napoleon says it, it must be right.'
>>> foo('quux')
Result is = quux
```

Because this form of **import places the object names directly into the caller's symbol table, any objects that already exist with the same name will be overwritten**:

```
>>> a = ['foo', 'bar', 'baz']
>>> a
['foo', 'bar', 'baz']
>>> from mymod import a
>>> a
[100, 200, 300]
```

It is even possible to indiscriminately import everything from a module at one fell swoop:

```
from <module_name> import *
```

This will place the names of all objects from <module_name> into the local symbol table, with the **exception of any that begin with the underscore (_) character**.
For example:

```
>>> from mymod import *
>>> s
'If Comrade Napoleon says it, it must be right.'
>>> a
[100, 200, 300]
>>> foo
<function foo at 0x03B449C0>
```

It is also possible to `import` individual objects but enter them into the local symbol table with alternate names:

```
from <module_name> import <name1> as <alt_name1>[,<name2> as <alt_name2> …]
```

This makes it possible to place names directly into the local symbol table but avoid conflicts with previously existing names:

```
>>> s = 'foo'
>>> a = ['foo', 'bar', 'baz']
>>> from mymod import s as string, a as alist
>>> s
```

```
'foo'
>>> string
'If Comrade Napoleon says it, it must be right.'
>>> a
['foo', 'bar', 'baz']
>>> alist
[100, 200, 300]
```

You can also import an entire module under an alternate name:

```
import <module_name> as <alt_name>
```

```
>>> import mymod as my_module
>>> my_module.a
[100, 200, 300]
>>> my_module.foo('qux')
Result is =  qux
```

Module contents can be imported within a function definition. In that case, the **import** does not occur until the function is called:

```
>>> def bar():
...     from mymod import foo
...     foo('corge')
...

>>> bar()
Result is = corge
```

However, Python 3 does not allow the indiscriminate import * syntax from within a function:

```
>>> def bar():
...     from mymod import *
...
SyntaxError: import * only allowed at module level
```

The `dir()` Function

The built-in function **dir()** returns a list of defined names in a namespace. Without arguments, it produces an alphabetically sorted list of names in the current local symbol table:

```
>>> dir()
['__annotations__',     '__builtins__',     '__doc__',     '__loader__',
'__name__','__package__', '__spec__']

>>> qux = [1, 2, 3, 4, 5]
```

```
>>> dir()
['__annotations__',     '__builtins__',     '__doc__',     '__loader__',
'__name__','__package__', '__spec__', 'qux']

>>> Bar=1234
['Bar',  '__annotations__',  '__builtins__',  '__doc__',  '__loader__',
'__name__','__package__', '__spec__', 'qux', 'x']
```

Note how the first call to dir() above lists several names that are automatically defined and already in the namespace when the interpreter starts. As new names are defined (qux, Bar), they appear on subsequent invocations of dir().

This can be useful for identifying what exactly has been added to the namespace by an import statement:

```
>>> dir()
['__annotations__', '__builtins__', '__doc__', '__loader__', '__name__',
'__package__', '__spec__']

>>> import mod
>>> dir()
['__annotations__', '__builtins__', '__doc__', '__loader__', '__name__',
'__package__', '__spec__', 'mod']
>>> mod.s
'If Comrade Napoleon says it, it must be right.'
>>> mod.foo([1, 2, 3])
arg = [1, 2, 3]
['__annotations__', '__builtins__', '__doc__', '__loader__', '__name__',
'__package__', '__spec__', 'mod']   # s and foo() not added
>>> from mod import a, foo
>>> dir()
['__annotations__', '__builtins__', '__doc__', '__loader__', '__name__',
'__package__', '__spec__', 'a', `foo’, 'mod']
>>> a
[100, 200, 300]
>>>foo(‘CEMK’)
CEMK

>>> from mod import s as string
>>> dir()
['Foo',  '__annotations__',  '__builtins__',  '__doc__',  '__loader__',
'__name__','__package__', '__spec__', 'a', 'mod', 'string', 'x']
>>> string
'If Comrade Napoleon says it, it must be right.'
```

When given an argument that is the name of a module, dir() lists the names defined in the module:

```
>>>
>>> import mod
>>> dir(mod)
['__builtins__',  '__cached__',  '__doc__',  '__file__',  '__loader__',
'__name__', '__package__', '__spec__', 'a', 'foo', 's']

>>>
>>> dir()
['__annotations__', '__builtins__', '__doc__', '__loader__', '__name__',
'__package__', '__spec__']
>>> from mod import *
>>> dir()
['Foo',  '__annotations__',  '__builtins__',  '__doc__',  '__loader__',
'__name__','__package__', '__spec__', 'a', 'foo', 's']
```

Executing modules as scripts

Any **.py** file that contains a module is essentially also a Python script, and there isn't any reason it can't be executed like one.
Here again mymod.py is define as earlier:

mymod.py

```
s = "If Comrade Napoleon says it, it must be right."
a = [100, 200, 300]
def foo(arg):
     print(f'arg = {arg}')

class Foo:
   pass
```

This can be run as a script:

```
$ python mymod.py
$ [ No output ]
```

There are no errors, so it apparently worked. Granted, it's not very interesting. As it is written, it only defines objects. It doesn't do anything with them, and it doesn't generate any output.
Let's **modify the above Python module so it does generate some output** when run as a script:

mymod.py

```
s = "If Comrade Napoleon says it, it must be right."
a = [100, 200, 300]

def foo(arg):
    print(f'Result is = {arg}')

print(s)
print(a)
foo('quux')
```

Now if you run the script

```
$ python mymod.py
  If Comrade Napoleon says it, it must be right.
  [100, 200, 300]
  Result is = quux
```

Unfortunately, now it also generates output when imported as a module:

```
>>> import mymod
If Comrade Napoleon says it, it must be right.
[100, 200, 300]
arg = quux
```

This is probably not what you want. It isn't usual for a module to generate output when it is imported.
Wouldn't it be nice if you could **distinguish between when the file is loaded as a module and when it is run as a standalone script**?

When a **.py** file is **imported as a module**, Python sets the special variable **__name__** to the **name of the module**. However, if a **file is run as a standalone script, __name__ is** (creatively) set to the string '**__main__**'. Using this fact, you can differentiate which is the case at run-time and alter behavior accordingly:

mymod.py

```
s = "If Comrade Napoleon says it, it must be right."
a = [100, 200, 300]

def foo(arg):
    print(f'arg = {arg}')

if (__name__ == '__main__'):
    print('Executing as standalone script')
    print(s)
    print(a)
    foo('quux')
```

Now, if you run as a script, you get output:

```
$ python mod.py
Executing as standalone script
If Comrade Napoleon says it, it must be right.
[100, 200, 300]
arg = quux
```

But if you import as a module, you don't:

```
>>>
>>> import mymod
>>> mymod.foo('Success')
Result is = Success
```

Modules are often designed with the capability to run as a standalone script for purposes of testing the functionality that is contained within the module. This is referred to as unit testing. For example, suppose you have created a module `fact.py` containing a factorial function, as follows:

```
fact.py
def fact(n):
    return 1 if n == 1 else n * fact(n-1)

if (__name__ == '__main__'):
    import sys
    if len(sys.argv) > 1:
        print(fact(int(sys.argv[1])))
```

The file can be treated as a module, and the fact() function imported:

```
>>>
>>> from fact import fact
>>> fact(6)
720
```

But it can also be run as a standalone by passing an integer argument on the command-line for testing:

```
$ python fact.py 6
720
```

Reloading a Module

For reasons of efficiency, a module is only loaded once per interpreter session. That is fine for function and class definitions, which typically make up the bulk of a module's contents. But a module can contain executable statements as well, usually for initialization. Be aware that these statements will only be executed the *first time* a module is imported.

Consider the following file my`mod.py`:

mymod.py

```
a = [100, 200, 300]
print('a =', a)
```

```
>>> import mymod
a = [100, 200, 300]
>>> import mymod
```

```
>>> mymod.a
[100, 200, 300]
```

The print() statement is not executed on subsequent imports. (For that matter, neither is the assignment statement, but as the final display of the value of mod.a shows, that doesn't matter. Once the assignment is made, it sticks.)

If you make a change to a module and need to reload it, you need to either restart the interpreter or use a function called reload() from module importlib:

```
>>> import mymod
a = [100, 200, 300]

>>> import mymod

>>> import importlib
>>> importlib.reload(mymod)
a = [100, 200, 300]
<module 'mymod' from '/home/apurba/MyPython/mymod.py'>
```

Python Packages

Suppose you have developed a very large application that includes many modules each one developed by a separate programmer. **As the number of modules grows, it becomes difficult to keep track of them all if they are dumped into one location**. This is particularly so if they have similar names or functionality. You might wish for a means of grouping and organizing them.

Packages allow for a hierarchical structuring of the module namespace using dot notation. In the same way that modules help avoid collisions between global variable names, packages help avoid collisions between module names.

Creating a package is quite straightforward, since it makes use of the operating system's inherent hierarchical file structure. Consider the following arrangement:

Here, there is a **directory named pkg** that contains two modules, **mod1.py and mod2.py**. The contents of the modules are:

mod1.py

```
def foo():
   print('[mod1] foo()')
```

mod2.py

```
def bar():
   print('[mod2] bar()')
```

Accessing module within package

Given this structure, if the **pkg directory resides in a proper location** where it can be found (in one of the directories contained in sys.path), you can **refer** to the **two modules with dot notation(pkg.mod1, pkg.mod2) and import them** with the syntax you are already familiar with:

```
import <module_name>[, <module_name> ...]
```

```
>>> import pkg.mod1, pkg.mod2
>>> pkg.mod1.foo()
[mod1] foo()
```

```
>>> pkg.mod2.bar()
[mod2] bar()
```

Alternatively

```
from <module_name> import <name(s)>

>>> from pkg.mod1 import foo
>>> foo()
[mod1] foo()
```

Or

```
from <module_name> import <name> as <alt_name>


>>> from pkg.mod2 import bar as pmod
>>> pmod()     #
[mod2] bar()
```

You can import modules with these statements as well:

```
from <package_name> import <modules_name>[, <module_name> ...]
from <package_name> import <module_name> as <alt_name>

>>> from pkg import mod1
>>> mod1.foo()
[mod1] foo()

>>> from pkg import mod2 as quux
>>> quux.bar()
[mod2] bar()
```

You can technically import the package as well:

```
>>>
>>> import pkg
>>> pkg
<module 'pkg' (namespace)>
```

But this is of little avail. Though this is, strictly speaking, a syntactically correct Python statement, it doesn't do much of anything useful. In particular, it does not place any of the modules in pkg into the local namespace:

```
>>> pkg.mod1
Traceback (most recent call last):
File "<pyshell#34>", line 1, in <module>
pkg.mod1
AttributeError: module 'pkg' has no attribute 'mod1'
>>> pkg.mod1.foo()
Traceback (most recent call last):
 File "<pyshell#35>", line 1, in <module>
pkg.mod1.foo()
```

To actually import the modules or their contents, you need to use one of the forms shown above.

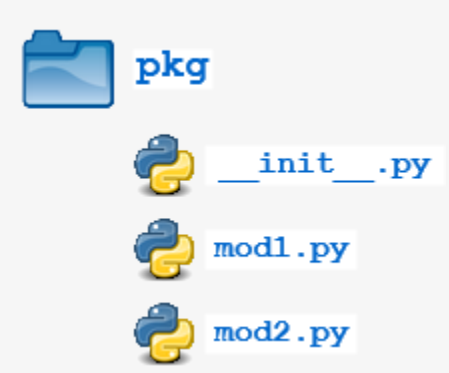
Package Initialization

If a file named **__init__.py** is present in a package directory, **it is invoked when the package or a module in the package is imported**. This can be used for execution of package initialization code, such as initialization of package-level data.
For example, consider the following **__init__.py** file:

__init__.py

```
print(f'Invoking __init__.py for {__name__}')
A = ['quux', 'corge', 'grault']
```

Let's add this file to the pkg directory from the above example:



Now when the package is imported, the global list A is initialized:

```
>>>
>>> import pkg
Invoking __init__.py for pkg
>>> pkg.A
['quux', 'corge', 'grault']
```

A module in the package can access the global variable by importing it in turn:

mod1.py

```
def foo():
    from pkg import A
    print('[mod1] foo() / A = ', A)

>>> from pkg import mod1
Invoking __init__.py for pkg
>>> mod1.foo()
[mod1] foo() / A =  ['quux', 'corge', 'grault']
```

__init__.py can also be used to effect automatic importing of modules from a package. For example, earlier you saw that the statement import pkg only places the name pkg in the caller's local symbol table and doesn't import any modules. But if **__init__.py in the pkg directory contains the following**:

__init__.py

```
print(f'Invoking __init__.py for {__name__}')
import pkg.mod1, pkg.mod2
```

then when you execute **import pkg**, **modules mod1 and mod2 are imported automatically**:

```
>>> import pkg
Invoking __init__.py for pkg
>>> pkg.mod1.foo()
[mod1] foo()
>>> pkg.mod2.bar()
[mod2] bar()
```

Note: *Much of the Python documentation states that an **__init__.py** file must be present in the package directory when creating a package. This was once true. It used to be that the very presence of __init__.py signified to Python that a package was being defined. The file could contain initialization code or even be empty, but it had to be present.*

*Starting with **Python 3.3**, Implicit Namespace Packages were introduced. These allow for the creation of a package without any __init__.py file. Of course, it can still be present if package initialization is needed. But it is no longer required.*

Importing * From a Package

For the purposes of the following discussion, the previously defined package is expanded to contain some additional modules:

There are now four modules defined in the pkg directory. Their contents are as shown below:

mod1.py

```
def foo():
    print('[mod1] foo()')
```

mod2.py

```
def bar():
    print('[mod2] bar()')
```

mod3.py

```
def baz():
    print('[mod3] baz()')
```

mod4.py

```
def qux():
    print('[mod4] qux()')
```

You have already seen that when **import * is used for a module**, all objects from the module are imported into the local symbol table, except those whose names begin with an underscore, as always:

```
>>>
>>> dir()
['__annotations__', '__builtins__', '__doc__', '__loader__', '__name__',
'__package__', '__spec__']

>>> from pkg.mod3 import *

>>> dir()
['Baz',  '__annotations__',  '__builtins__',  '__doc__',  '__loader__',
'__name__',
'__package__', '__spec__', 'baz']
>>> baz()
[mod3] baz()
```

The analogous statement for a package is this:

```
from <package_name> import *
```

What does that do?

```
>>> dir()
['__annotations__', '__builtins__', '__doc__', '__loader__', '__name__',
'__package__', '__spec__']
```

```
>>> from pkg import *

>>> dir()
['__annotations__', '__builtins__', '__doc__', '__loader__', '__name__',
'__package__', '__spec__']
```

As you can see, by default python does not bring all the modules in the local namespace. Instead, Python follows this convention: if the **__init__.py** file in the package directory contains a list named **__all__**, it is taken to be a list of modules that should be imported when the statement

`from <package_name> import *` **is encountered.**

For the present example, suppose you create an **__init__.py** in the pkg directory like this:

```
pkg/__init__.py
     __all__ = [
                'mod1',
               'mod2',
                'mod3',
                'mod4'
                 ]
```

Now

```
from MyPython import *
```

imports all four modules:

```
>>>
>>> dir()
['__annotations__', '__builtins__', '__doc__', '__loader__', '__name__',
'__package__', '__spec__']

>>> from pkg import *

>>> dir()
['__annotations__', '__builtins__', '__doc__', '__loader__', '__name__',
'__package__', '__spec__', 'mod1', 'mod2', 'mod3', 'mod4']

>>> mod2.bar()
[mod2] bar()
```

Using **import** * still isn't considered terrific form, any more for packages than for modules. But this facility at least gives the creator of the package some control over what happens when **import** * is specified. (In fact, it provides the capability to disallow it entirely. As you have seen, the default behavior for packages is to import nothing.)

By the way, **__all__** can be defined in a module as well and serves the same purpose: to control what is imported with import *. For example, modify **mod1.py** as follows:

```
pkg/mod1.py
__all__ = ['foo']

def foo():
    print('[mod1] foo()')

def loo():
    print('[mod1] foo()')
```

Now an **import * statement from pkg.mod1** will only import what is contained in **__all__**:

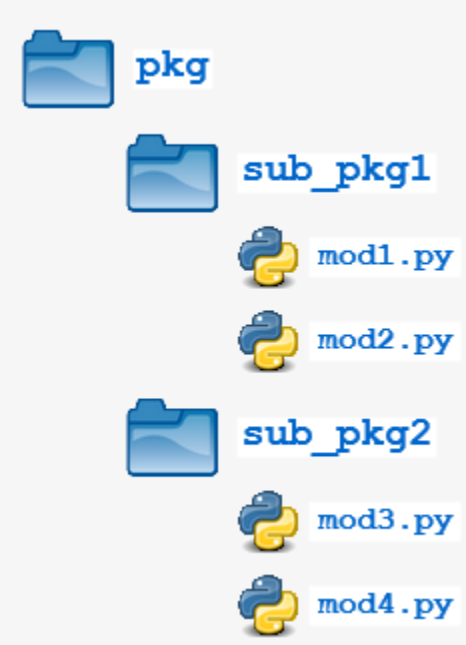
```
>>> dir()
['__annotations__', '__builtins__', '__doc__', '__loader__', '__name__',
'__package__', '__spec__']

>>> from pkg.mod1 import *
>>> dir()
['__annotations__', '__builtins__', '__doc__', '__loader__', '__name__',
'__package__', '__spec__', 'foo']   # loo() is not loaded


>>> foo()
[mod1] foo()
>>> loo()
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
NameError: name 'loo' is not defined
```

foo() (the function) is now defined in the local namespace, but loo() is not, because the latter is not in __all__.
In summary, __all__ is used by both packages and modules to control what is imported when import * is specified. But the default behavior differs:

- **For a package, when __all__ is not defined, import * does not import anything.**
- **For a module, when __all__ is not defined, import * imports everything (except—you guessed it—names starting with an underscore).**

Subpackages

Packages can contain nested subpackages to arbitrary depth. For example, let's make one more modification to the example package directory as follows:



The four modules (mod1.py, mod2.py, mod3.py and mod4.py) are defined as previously. But now, **instead of** being lumped together **into the pkg directory, they are split out into two subpackage directories, sub_pkg1 and sub_pkg2**.
Importing still works the same as shown previously. Syntax is similar, but additional dot notation is used to separate package name from subpackage name:

```
>>>
>>> import pkg.sub_pkg1.mod1
>>> pkg.sub_pkg1.mod1.foo()
[mod1] foo()

>>> from pkg.sub_pkg1 import mod2
>>> mod2.bar()
[mod2] bar()

>>> from pkg.sub_pkg2.mod3 import baz
>>> baz()
[mod3] baz()

>>> from pkg.sub_pkg2.mod4 import qux as grault
>>> grault()
[mod4] qux()
```

In addition, a module in **one subpackage can reference objects in a sibling subpackage** (in the event that the sibling contains some functionality that you need). For example, suppose you want to import and execute function **foo() (defined in module mod1) within module mod3**. You can either use an absolute import:

```
pkg/sub__pkg2/mod3.py

def baz():
    print('[mod3] baz()')

from pkg.sub_pkg1.mod1 import foo
foo()


>>> from pkg.sub_pkg2 import mod3
>>> mod3.foo()
[mod1] foo()
```

Or you can use a relative import, where .. refers to the package one level up. From within mod3.py, which is in subpackage sub_pkg2,
.. evaluates to the parent package (pkg), and
..sub_pkg1 evaluates to subpackage sub_pkg1 of the parent package.

```
pkg/sub__pkg2/mod3.py

def baz():
    print('[mod3] baz()')

from .. import sub_pkg1
print(sub_pkg1)

from ..sub_pkg1.mod1 import foo
foo()


>>> from pkg.sub_pkg2 import mod3
<module 'pkg.sub_pkg1' (namespace)>
[mod1] foo()
```