# Packages (1A)

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# Package (1)

```
modules are
files containing Python statements and definitions,
like function and class definitions.

to bundle multiple modules together,
create a package.

a package is
basically a directory
with several Python files (modules)
and a special file __init__.py

inside of the Python path,
every directory contains __init__.py,
will be treated as a package by Python.
```

### Submodules in a package

packages are a way of structuring Python's module namespace by using "dotted module names".

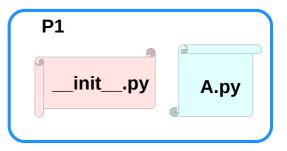
A.B stands for a submodule named B in a package named A.

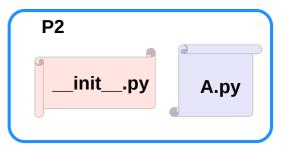
two different packages like **P1** and **P2** can both have modules with the <u>same name</u>, let's say **A**, for example.

The submodule A of the package P1 and the submodule A of the package P2 can be totally different.

P1.A P2.A

A package is imported <u>like</u> a "<u>normal</u>" module.





### Creating a package

to create a package, we need a directory.

the name of this directory will be the name of the package,

assume we want to create "simple\_package" package

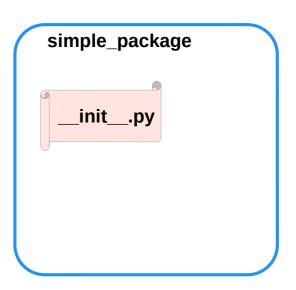
must create directory "simple\_package" and this directory needs to contain the "\_\_init\_\_.py" file

this file can be <u>empty</u>, or can contain valid Python <u>code</u>.

this code will be <u>executed</u> when a <u>package</u> is <u>imported</u>,

so it can be used to initialize a package,

e.g. to make sure that some other modules are <u>imported</u> or some values <u>set</u>.



## Examples of creating a package (1)

put all of the Python files which will be the submodules into the directory for a package.

create two simple files a.py and b.py

a.py: submodule a

def bar():
print("Hello, function 'bar' from module 'a' calling")

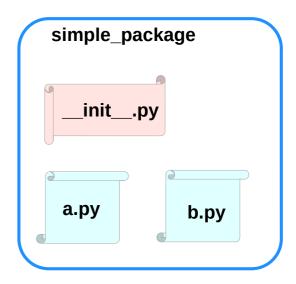
**b.py:** submodule **b** 

def foo():
print("Hello, function 'foo' from module 'b' calling")

an <u>empty file</u> with the name <u>\_\_init\_\_.py</u> inside of simple\_package directory

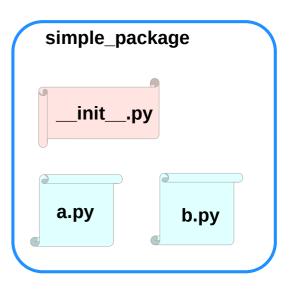
\_\_init\_\_.py:

empty file



# Examples of creating a package (2)

import simple\_package from the interactive Python shell, assuming that the directory simple\_package is either in the directory from which you call the shell or that it is contained in the search path or environment variable "PYTHONPATH" (from your operating system):



## Examples of creating a package (3)

# import simple\_package simple\_package/a

NameError Traceback (most recent call last) <ipython-input-3-347df8a711cc> in <module> ----> 1 simple package/a

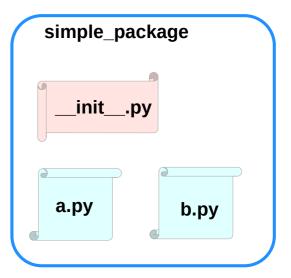
NameError: name 'a' is not defined

### simple\_package/b

NameError Traceback (most recent call last) </ri><ipython-input-4-e71d2904d2bd> in <module>

----> 1 simple package/b

NameError: name 'b' is not defined



## Examples of creating a package (4)

the package simple\_package has been <u>loaded</u> but <u>neither</u> the module "a" <u>nor</u> the module "b" has been <u>loaded</u>

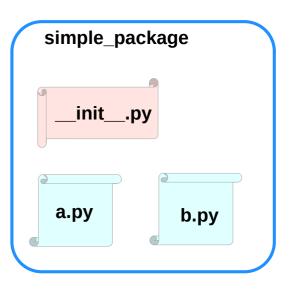
<u>can't access</u> neither "a" nor "b" by solely <u>importing</u> <u>simple\_package</u>.

must import the modules a and b as follows

### from simple\_package import a, b

a.bar()
b.foo()

Hello, function 'bar' from module 'a' calling Hello, function 'foo' from module 'b' calling



# Examples of creating a package (5)

to <u>automatically</u> <u>load</u> these <u>modules</u>.

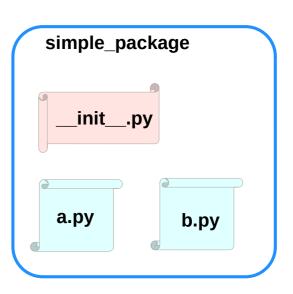
add the following lines to the file \_\_init\_\_.py:

```
import simple_package.a
import simple_package.b
```

### Then

```
import simple_package
simple_package.a.bar()
simple_package.b.foo()
```

Hello, function 'bar' from module 'a' calling Hello, function 'foo' from module 'b' calling



### Package Examples (1)

```
sound
I-- effects
  |-- init .py
  I-- echo.py
  -- reverse.py
   `-- surround.py
-- filters
  |-- init .py
  I-- equalizer.py
  |-- karaoke.py
   `-- vocoder.pv
 -- formats
  |-- init__.py
  |-- aiffread.py
  |-- aiffwrite.py
  |-- auread.py
  |-- auwrite.py
  |-- wavread.py
   `-- wavwrite.py
   init .py
```

```
sound
  _init___.py
   effects
                                     filters
     _init__.py
                                      __init__.py
    echo.py
                                       equalizer.py
                                       karaoke.py
    reverse.py
                                       vocoder.py
    surround.py
   formats
      _init___.py
    aiffread.py
                 aurwrite.py
    aifwrite.py
                 wavred.py
    auread.py
                 wavwrite.py
```

```
sound1
 __init__.py
     effects
                                                            filters
       __init__.py
                                                              __init__.py
        echo.py
                                                              equalizer.py
       reverse.py
                                                              karaoke.py
                                                              vocoder.py
        surround.py
     formats
                                                              import sound1
                                                              print(sound1)
                                                                                    ... OK
        __init__.py
                                                              print(sound1.effects)
                                                                                    ... Error
        aiffread.py
                            aurwrite.py
        aifwrite.py
                            wavred.py
        auread.py
                            wavwrite.py
```

```
sound2
 __init___.py
              import sound2.effects
     effects
                                                             filters
       __init__.py
                                                               __init__.py
        echo.py
                                                               equalizer.py
                                                               karaoke.py
        reverse.py
                                                               vocoder.py
        surround.py
     formats
                                                                import sound1
                                                                print(sound1)
                                                                                      ... OK
        __init__.py
                                                                print(sound1.effects)
                                                                                      ... Error
        aiffread.py
                            aurwrite.py
        aifwrite.py
                            wavred.py
        auread.py
                            wavwrite.py
```

```
sound2
 __init___.py
              from . import effects
     effects
                                                             filters
       __init__.py
                                                               __init__.py
        echo.py
                                                               equalizer.py
                                                               karaoke.py
        reverse.py
                                                               vocoder.py
        surround.py
     formats
                                                                import sound1
                                                                print(sound1)
                                                                                      ... OK
        __init__.py
                                                                print(sound1.effects)
                                                                                      ... Error
        aiffread.py
                            aurwrite.py
        aifwrite.py
                            wavred.py
        auread.py
                            wavwrite.py
```

```
sound2
 __init___.py
              from . import effects
     effects
                                                              filters
        __init__.py
                                                                __init__.py
                        from .. import formats
        echo.py
                                                                equalizer.py
                                                                karaoke.py
        reverse.py
                                                                vocoder.py
        surround.py
     formats
                                                                 import sound1
                                                                 print(sound1)
                                                                                       ... OK
        __init__.py
                                                                 print(sound1.effects)
                                                                                       ... Error
        aiffread.py
                             aurwrite.py
        aifwrite.py
                             wavred.py
        auread.py
                             wavwrite.py
```

### Package sound1 (1)

```
init__.py
                                                 filters/__init__.py
print("sound1 package is getting imported!")
                                                 print("filters package is getting imported!")
                                                  filters/equalizer.pv
                                                 def func1():
                                                    print("Function func1 has been called!")
effects/__init__.py
                                                 print("Module equalizer.py has been loaded!")
print("effects package is getting imported!")
                                                 filters/karaoke.py
effects/echo.pv
def func1():
                                                  def func1():
  print("Function func1 has been called!")
                                                    print("Function func1 has been called!")
print("Module echo.py has been loaded!")
                                                  print("Module karaoke.py has been loaded!")
                                                 filters/vocoder.py
effects/reverse.py
def func1():
                                                  def func1():
  print("Function func1 has been called!")
                                                    print("Function func1 has been called!")
print("Module reverse.py has been loaded!")
                                                 print("Module vocoder.py has been loaded!")
effects/surround.pv
                                                  If we import the package sound1
def func1():
                                                  by using the statement import sound1.
  print("Function func1 has been called!")
                                                  Only the package sound1 is imported
                                                  but none of the subpackages
                                                  will be imported
                                                  effects, filters and formats
sound
I-- effects
                                                  because the file init .py
I-- filters
                                                  doesn't contain any code
I-- formats
                                                 for importing subpackages:
|-- init .py
                                                  import sound1
                                                  print(sound1)
```

```
formats/ init .pv
print("formats package is getting imported!")
formats/aiffread.pv
def func1():
  print("Function func1 has been called!")
print("Module aiffread.py has been loaded!")
formats/aiffwrite.pv
def func1():
  print("Function func1 has been called!")
print("Module aiffwrite.py has been loaded!")
formats/auread.py
def func1():
  print("Function func1 has been called!")
print("Module auread.py has been loaded!")
formats/auwrite.py
def func1():
  print("Function func1 has been called!")
print("Module auwrite.py has been loaded!")
formats/wavread.pv
def func1():
  print("Function func1 has been called!")
print("Module wavread.py has been loaded!")
formats/wavwrite.py
```

print("Function func1 has been called!")

print("Module wavwrite.py has been loaded!")

def func1():

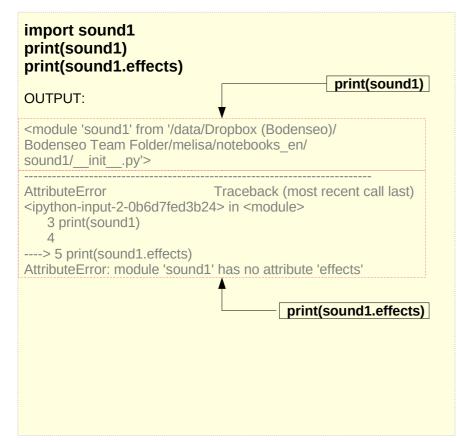
https://python-course.eu/python-tutorial/packages.php

print(sound1.effects)

... OK

... Error

# Package sound1 (2)



If you also want to use the package effects, you have to import it explicitly with import sound.effects:

import sound1.effects
print(sound1.effects)

<module 'sound1.effects' from '/data/Dropbox (Bodenseo)/
Bodenseo Team Folder/melisa/notebooks\_en/
sound1/effects/\_\_init\_\_.py'>

It is possible to have the submodule importing done automatically when importing the sound1 module.

We will change now to sound2 to demonstrate how to do this.

We use the same files as in sound1, but we will add the code line import sound2.effects into the file \_\_init\_\_.py of the directory sound2.

"""An empty sound package
This is the sound package, providing hardly anything!"""

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import sound2.effects

print("sound2.effects package is getting imported!")

```
init__.py
print("sound2 package is getting imported!")
import sound2.effects
effects/__init__.py
print("effects package is getting imported!")
effects/echo.py
def func1():
  print("Function func1 has been called!")
print("Module echo.py has been loaded!")
effects/reverse.py
def func1():
  print("Function func1 has been called!")
print("Module reverse.py has been loaded!")
effects/surround.pv
def func1():
  print("Function func1 has been called!")
sound
I-- effects
I-- filters
-- formats
|-- init .py
```

```
filters/__init__.py
print("filters package is getting imported!")
filters/equalizer.pv
def func1():
  print("Function func1 has been called!")
print("Module equalizer.py has been loaded!")
filters/karaoke.py
def func1():
  print("Function func1 has been called!")
print("Module karaoke.py has been loaded!")
filters/vocoder.py
def func1():
  print("Function func1 has been called!")
print("Module vocoder.py has been loaded!")
import sound2.effects
in __init__.py of the package sound2
when the package sound2 is imported,
the subpackage effects will also
be automatically loaded:
import sound2
```

```
formats/__init__.py
print("formats package is getting imported!")
formats/aiffread.pv
def func1():
  print("Function func1 has been called!")
print("Module aiffread.py has been loaded!")
formats/aiffwrite.py
def func1():
  print("Function func1 has been called!")
print("Module aiffwrite.py has been loaded!")
formats/auread.py
def func1():
  print("Function func1 has been called!")
print("Module auread.py has been loaded!")
formats/auwrite.py
def func1():
  print("Function func1 has been called!")
print("Module auwrite.py has been loaded!")
formats/wavread.py
def func1():
  print("Function func1 has been called!")
print("Module wavread.py has been loaded!")
formats/wavwrite.py
def func1():
```

print("Function func1 has been called!")
print("Module wavwrite.py has been loaded!")

https://python-course.eu/python-tutorial/packages.php

sound2 package is getting imported!

effects package is getting imported!

```
init__.py
print("sound3 package is getting imported!")
from . import effects
effects/__init__.py
print("effects package is getting imported!")
effects/echo.py
def func1():
  print("Function func1 has been called!")
print("Module echo.py has been loaded!")
effects/reverse.py
def func1():
  print("Function func1 has been called!")
print("Module reverse.py has been loaded!")
effects/surround.pv
def func1():
  print("Function func1 has been called!")
sound
I-- effects
I-- filters
-- formats
|-- init .py
```

```
filters/__init__ .py
print("filters package is getting imported!")
filters/equalizer.pv
def func1():
  print("Function func1 has been called!")
print("Module equalizer.py has been loaded!")
filters/karaoke.py
def func1():
  print("Function func1 has been called!")
print("Module karaoke.py has been loaded!")
filters/vocoder.py
def func1():
  print("Function func1 has been called!")
print("Module vocoder.py has been loaded!")
Instead of using an absolute path we
could have imported the effects package
relative to the sound2 package.
import sound2.effects # absolute path
from . import effects
                           # relative path
```

```
formats/__init__.py
print("formats package is getting imported!")
formats/aiffread.pv
def func1():
  print("Function func1 has been called!")
print("Module aiffread.py has been loaded!")
formats/aiffwrite.py
def func1():
  print("Function func1 has been called!")
print("Module aiffwrite.py has been loaded!")
formats/auread.py
def func1():
  print("Function func1 has been called!")
print("Module auread.py has been loaded!")
formats/auwrite.py
def func1():
  print("Function func1 has been called!")
print("Module auwrite.py has been loaded!")
formats/wavread.py
def func1():
  print("Function func1 has been called!")
print("Module wavread.py has been loaded!")
formats/wavwrite.py
def func1():
  print("Function func1 has been called!")
```

print("Module wavwrite.py has been loaded!")

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import sound3

sound3 package is getting imported!

effects package is getting imported!

```
init__.py
print("sound4 package is getting imported!")
from . import effects
effects/__init__.py
print("effects package is getting imported!")
from .. import formats
effects/__init__.py
print("effects package is getting imported!")
effects/echo.py
def func1():
  print("Function func1 has been called!")
print("Module echo.py has been loaded!")
effects/reverse.py
def func1():
  print("Function func1 has been called!")
print("Module reverse.py has been loaded!")
effects/surround.pv
def func1():
  print("Function func1 has been called!")
sound
I-- effects
I-- filters
-- formats
-- init .pv
```

```
filters/_init__.py
print("filters package is getting imported!")

filters/equalizer.py
def func1():
    print("Function func1 has been called!")
print("Module equalizer.py has been loaded!")

filters/karaoke.py
def func1():
    print("Function func1 has been called!")
print("Module karaoke.py has been loaded!")

filters/vocoder.py
def func1():
    print("Function func1 has been called!")
print("Function func1 has been called!")
print("Module vocoder.py has been loaded!")
```

# import sound4 sound4 package is getting imported! effects package is getting imported! formats package is getting imported! in the \_\_init\_\_.py file of sound4 directory from . import formats import formats

```
formats/__init__.py
print("formats package is getting imported!")
formats/aiffread.pv
def func1():
  print("Function func1 has been called!")
print("Module aiffread.py has been loaded!")
formats/aiffwrite.py
def func1():
  print("Function func1 has been called!")
print("Module aiffwrite.py has been loaded!")
formats/auread.py
def func1():
  print("Function func1 has been called!")
print("Module auread.py has been loaded!")
formats/auwrite.py
def func1():
  print("Function func1 has been called!")
print("Module auwrite.py has been loaded!")
```

print("Function func1 has been called!")
print("Module wavread.py has been loaded!")
formats/wavwrite.py

formats/wavread.py

def func1():

formats/wavwrite.py
def func1():
 print("Function func1 has been called!")
print("Module wavwrite.py has been loaded!")

```
init__.py
print("sound5 package is getting imported!")
from . import effects
effects/__init__.py
print("effects package is getting imported!")
from .. import formats
effects/__init__.py
print("effects package is getting imported!")
effects/echo.py
def func1():
  print("Function func1 has been called!")
print("Module echo.py has been loaded!")
effects/reverse.py
def func1():
  print("Function func1 has been called!")
print("Module reverse.py has been loaded!")
effects/surround.pv
def func1():
  print("Function func1 has been called!")
sound
I-- effects
I-- filters
-- formats
-- init .pv
```

```
filters/_init_.py
print("filters package is getting imported!")
filters/equalizer.py
def func1():
    print("Function func1 has been called!")
print("Module equalizer.py has been loaded!")
filters/karaoke.py
def func1():
    print("Function func1 has been called!")
print("Module karaoke.py has been loaded!")
filters/vocoder.py
def func1():
```

import karaoke module from filters package when we import the effects package.

from ..filters import karaoke into the \_\_init\_\_.py file of formats directory

print("Function func1 has been called!")

print("Module vocoder.py has been loaded!")

can access the functions of karaoke:

sound5.filters.karaoke.func1()

Function func1 has been called!

```
formats/__init__.py
print("formats package is getting imported!")
from ..filters import karaoke
```

formats/aiffread.py
def func1():
 print("Function func1 has been called!")
print("Module aiffread.py has been loaded!")

formats/aiffwrite.py
def func1():
 print("Function func1 has been called!")
print("Module aiffwrite.py has been loaded!")

formats/auread.py
def func1():
 print("Function func1 has been called!")
print("Module auread.py has been loaded!")

formats/auwrite.py
def func1():
 print("Function func1 has been called!")
print("Module auwrite.py has been loaded!")

formats/wavread.py
def func1():
 print("Function func1 has been called!")
print("Module wavread.py has been loaded!")

formats/wavwrite.py
def func1():
 print("Function func1 has been called!")
print("Module wavwrite.py has been loaded!")

```
init__.py
print("sound5 package is getting imported!")
from . import effects
effects/__init__.py
print("effects package is getting imported!")
from .. import formats
effects/__init__.py
print("effects package is getting imported!")
effects/echo.py
def func1():
  print("Function func1 has been called!")
print("Module echo.py has been loaded!")
effects/reverse.py
def func1():
  print("Function func1 has been called!")
print("Module reverse.py has been loaded!")
effects/surround.pv
def func1():
  print("Function func1 has been called!")
sound
I-- effects
I-- filters
-- formats
-- init .pv
```

```
filters/_init__.py
print("filters package is getting imported!")

filters/equalizer.py
def func1():
    print("Function func1 has been called!")
print("Module equalizer.py has been loaded!")

filters/karaoke.py
def func1():
    print("Function func1 has been called!")
print("Module karaoke.py has been loaded!")
```

# filters/vocoder.py def func1(): print("Function func1 has been called!") print("Module vocoder.py has been loaded!")

import karaoke module from filters package when we import the effects package.

from ..filters import karaoke into the \_\_init\_\_.py file of formats directory

can access the functions of karaoke:

sound5.filters.karaoke.func1()

Function func1 has been called!

```
formats/__init__.py
print("formats package is getting imported!")
from ..filters import karaoke
```

```
formats/aiffread.py
def func1():
    print("Function func1 has been called!")
print("Module aiffread.py has been loaded!")
```

```
formats/aiffwrite.py
def func1():
    print("Function func1 has been called!")
print("Module aiffwrite.py has been loaded!")
```

```
formats/auread.py
def func1():
    print("Function func1 has been called!")
print("Module auread.py has been loaded!")
```

```
formats/auwrite.py
def func1():
    print("Function func1 has been called!")
print("Module auwrite.py has been loaded!")
```

```
formats/wavread.py
def func1():
    print("Function func1 has been called!")
print("Module wavread.py has been loaded!")
```

```
formats/wavwrite.py
def func1():
    print("Function func1 has been called!")
print("Module wavwrite.py has been loaded!")
```

# Package sound6 (1)

add a module (file) **foobar** (filename: **foobar.py**) to the **sound** directory.

might expect to import this way all the submodules and subpackages of the package.

### from sound6 import \*

sound package is getting imported!

Yet, if we check with the **dir** function, we see that neither the module **foobar** nor the subpackages **effects**, **filters** and **formats** have been imported:

for mod in ['foobar', 'effects', 'filters', 'formats']:
 print(mod, mod in dir())

foobar False effects False filters False formats False

# Package sound7 (1)

to give an explicit index of the **subpackages** and **modules** of a packages, which should be imported.

can define a list named \_\_all\_\_.
as the <u>list</u> of **module** and **package names** to be imported when **from package import** \* is encountered.

\_\_all\_\_ = ["formats", "filters", "effects", "foobar"]

to the **\_\_init\_\_.py** file of the **sound** directory.

### from sound7 import \*

sound package is getting imported! formats package is getting imported! filters package is getting imported! effects package is getting imported! foobar module is getting imported

Even though it is already apparent that all the modules have been imported, we can check with **dir** again:

for mod in ['foobar', 'effects', 'filters', 'formats']:
 print(mod, mod in dir())

foobar True effects True filters True formats True

if we use \* in a subpackage:

### from sound.effects import \*

sound package is getting imported! effects package is getting imported!

### dir()

```
['__builtins__', '__doc__', '__loader__', '__name__', '__package__', '__spec__']
```

Like expected the modules inside of effects have <u>not</u> been imported automatically.

# Package sound8 (1)

So we can add the following \_\_all\_\_ list into the \_\_init\_\_ file of the package effects:

We have to add to the \_\_init\_\_.py files of the directories **filters**, **formats** and **effects** corrrespondingly the following lines of code:

```
__all__ = ["equalizer", "__init__", "karaoke", "vocoder"]
__all__ = ["aiffread", "aiffwrite", "auread", "auwrite",
"wavread", "wavwrite"]
__all__ = ["echo", "surround", "reverse"]
```

Now we get the intended result:

### from sound8 import \*

sound package is getting imported! formats package is getting imported! filters package is getting imported! effects package is getting imported! foobar module is getting imported

### from sound8.effects import \*

Module echo.py has been loaded! Module surround.py has been loaded! Module reverse.py has been loaded! from sound8.filters import \*

Module equalizer.py has been loaded! Module karaoke.py has been loaded! Module vocoder.py has been loaded!

### from sound8.formats import \*

Module aiffread.py has been loaded! Module aiffwrite.py has been loaded! Module auread.py has been loaded! Module auwrite.py has been loaded! Module wavread.py has been loaded! Module wavwrite.py has been loaded!

Although certain modules are designed to export only names that follow certain patterns when you use import, it is still considered bad practice. The recommended way is to import specific modules from a package instead of using

# Package sound6 (3)

