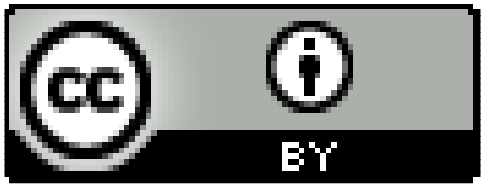
Python

Libraries



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Hierarchical organization

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A *library* does the same thing for related functions

Hierarchical organization

family	library
genus	function
species	statement

Every Python file can be used as a library

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Use `import` to load it

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```
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def threshold(signal):
  return 1.0 / sum(signal)
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def threshold(signal):
  return 1.0 / sum(signal)
```

```
# program.py
import halman
readings = [0.1, 0.4, 0.2]
print 'signal threshold is', halman.threshold(readings)
```

Every Python file can be used as a library

Use `import` to load it

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# halman.py
def threshold(signal):
  return 1.0 / sum(signal)
```

```
# program.py
import halman
readings = [0.1, 0.4, 0.2]
print 'signal threshold is', halman.threshold(readings)
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```
$ python program.py
signal threshold is 1.42857
```

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```
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is this module being loaded?
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1. Executes the statements it contains
2. Creates an object that stores references to the top-level items in that module

```
# noisy.py
print 'is this module being loaded?'
NOISE_LEVEL = 1./3.
```

```
>>> import noisy
is this module being loaded?
>>> print noisy.NOISE_LEVEL
0.33333333
```

Each module is a *namespace*

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function

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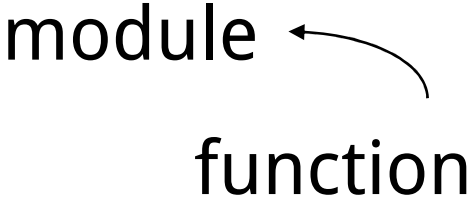

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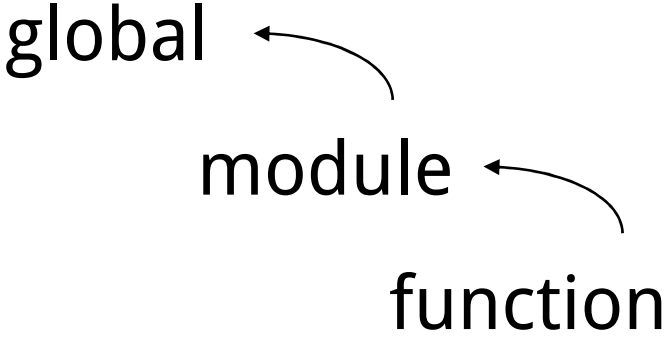

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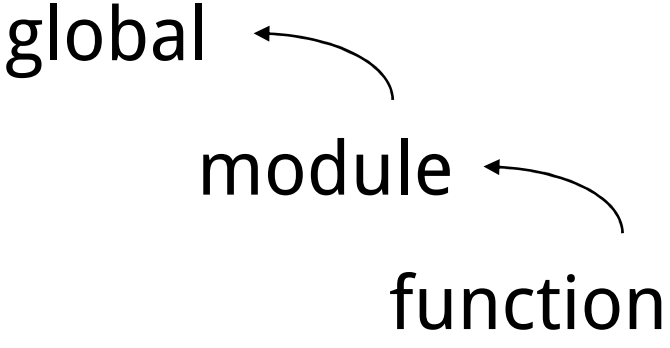
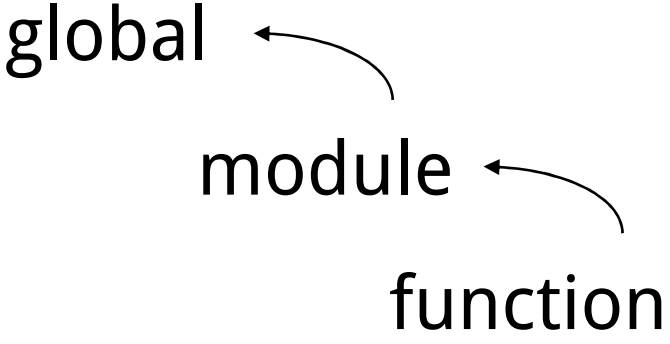



```
# module.py
NAME = 'Transylvania'

def func(arg):
  return NAME + ' ' + arg
```

Each module is a *namespace*

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# module.py
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```
>>> NAME = 'Hamunaptra'
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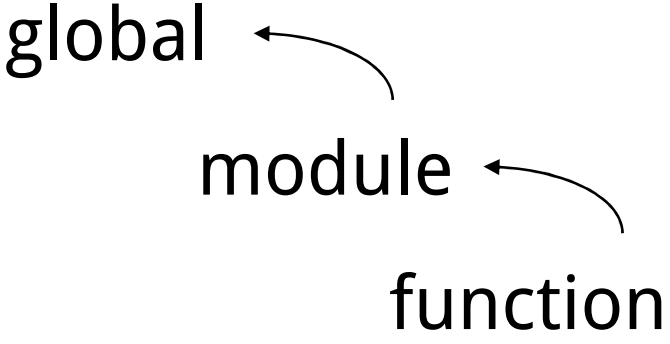


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# module.py
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def func(arg):
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```

```
>>> NAME = 'Hamunaptra'
>>> import module
```

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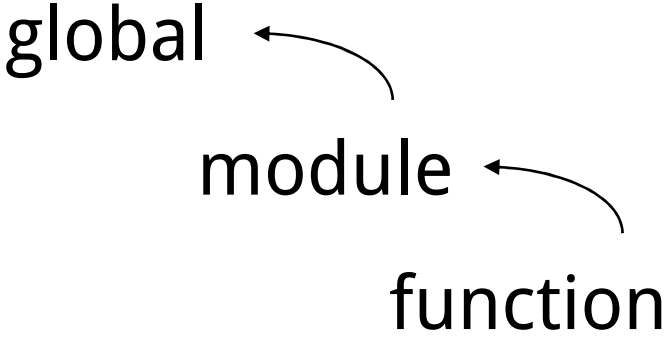


```
# module.py
NAME = 'Transylvania'

def func(arg):
  return NAME + ' ' + arg
```

```
>>> NAME = 'Hamunaptra'
>>> import module
>>> print module.func('!!!')
Transylvania !!!
```

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```
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>>> print math.sqrt(2)
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>>> print math.hypot(2, 3)  # sqrt(x**2 + y**2)
3.6055512754639891
>>> print math.e, math.pi   # as accurate as possible
2.7182818284590451 3.1415926535897931
```

Python also provides a `help` function

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```
>>> import math
>>> help(math)
Help on module math:
NAME
    math
FILE
    /usr/lib/python2.5/lib-dynload/math.so
MODULE DOCS
    http://www.python.org/doc/current/lib/module-math.html
DESCRIPTION
    This module is always available.  It provides access to the
    mathematical functions defined by the C standard.
FUNCTIONS
    acos(...)
        acos(x)
        Return the arc cosine (measured in radians) of x.
⋮
```

And some nicer ways to do imports

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Generally a bad idea

Someone could add to the library after you start using it

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```
>>> import sys
>>> print sys.version
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[MSC v.1500 32 bit (Intel)]
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Almost every program uses the `sys` library

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[MSC v.1500 32 bit (Intel)]
>>> print sys.platform
win32
>>> print sys.maxint
2147483647
>>> print sys.path
['',
  'C:\\WINDOWS\\system32\\python27.zip',
  'C:\\Python27\\DLLs', 'C:\\Python27\\lib',
  'C:\\Python27\\lib\\plat-win',
  'C:\\Python27', 'C:\\Python27\\lib\\site-packages']
```

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Script name is `sys.argv[0]`

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```
# echo.py
import sys
for i in range(len(sys.argv)):
  print i, '"' + sys.argv[i] + '"'
```

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# echo.py
import sys
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  print i, '"' + sys.argv[i] + '"'
```

```
$ python echo.py
0 "echo.py"
$
```

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Script name is `sys.argv[0]`

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# echo.py
import sys
for i in range(len(sys.argv)):
  print i, '"' + sys.argv[i] + '"'
```

```
$ python echo.py
0 echo.py
$ python echo.py first second
0 echo.py
1 first
2 second
$
```

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See the Unix shell lecture for more information

```
# count.py
import sys
if len(sys.argv) == 1:
  count_lines(sys.stdin)
else:
  rd = open(sys.argv[1], 'r')
  count_lines(rd)
  rd.close()
```

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if len(sys.argv) == 1:
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else:
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if len(sys.argv) == 1:
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  count_lines(rd)
  rd.close()
```

```
$ python count.py < a.txt
48
$
```

```
# count.py
import sys
if len(sys.argv) == 1:
  count_lines(sys.stdin)
else:
  rd = open(sys.argv[1], 'r')
  count_lines(rd)
  rd.close()
```

```
$ python count.py < a.txt
48
$ python count.py b.txt
227
$
```

The more polite way

```
'''Count lines in files.  If no filename arguments given,
read from standard input.'''

import sys

def count_lines(reader):
  '''Return number of lines in text read from reader.'''
  return len(reader.readlines())

if __name__ == '__main__':
  ...as before...
```

The more polite way

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'''Count lines in files.  If no filename arguments given,
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Used for online (and offline) help

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# adder.py
'''Addition utilities.'''

def add(a, b):
  '''Add arguments.'''
  return a+b
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# adder.py
'''Addition utilities.'''

def add(a, b):
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  return a+b
```

```
>>> import adder
>>> help(adder)
NAME
    adder - Addition utilities.
FUNCTIONS
    add(a, b)
        Add arguments.
>>>
```

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# adder.py
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def add(a, b):
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FUNCTIONS
    add(a, b)
        Add arguments.
>>> help(adder.add)
add(a, b)
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```

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main program

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if __name__ == '__main__':
  ...run as main program...
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main program	loaded as library
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```
...module definitions...

if __name__ == '__main__':
  ...run as main program...
```

← Always executed

← Only executed when file run directly

```
# stats.py
'''Useful statistical tools.'''

def average(values):
  '''Return average of values or None if no data.'''
  if values:
    return sum(values) / len(values)
  else:
    return None

if __name__ == '__main__':
  print 'test 1 should be None:', average([])
  print 'test 2 should be 1:', average([1])
  print 'test 3 should be 2:', average([1, 2, 3])
```

```
# test-stats.py
from stats import average
print 'test 4 should be None:', average(set())
print 'test 5 should be -1:', average({0, -1, -2})
```

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from stats import average
print 'test 4 should be None:', average(set())
print 'test 5 should be -1:', average({0, -1, -2})
```

```
$ python stats.py
test 1 should be None: None
test 2 should be 1: 1
test 3 should be 2: 2
$
```

```
# test-stats.py
from stats import average
print 'test 4 should be None:', average(set())
print 'test 5 should be -1:', average({0, -1, -2})
```

```
$ python stats.py
test 1 should be None: None
test 2 should be 1: 1
test 3 should be 2: 2
$ python test-stats.py
test 4 should be None: None
test 5 should be -1: -1
$
```

created by

Greg Wilson

October 2010