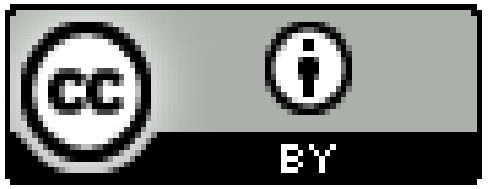
Python

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)
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```
# 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)
```

```
$ python program.py
signal threshold is 1.42857
```

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NOISE_LEVEL = 1./3.
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NOISE_LEVEL = 1./3.
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```
>>> import noisy
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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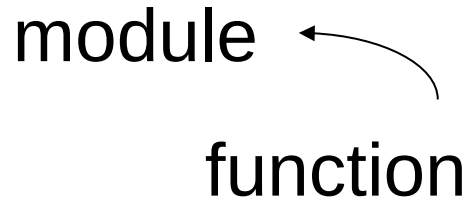
function

Each module is a *namespace*



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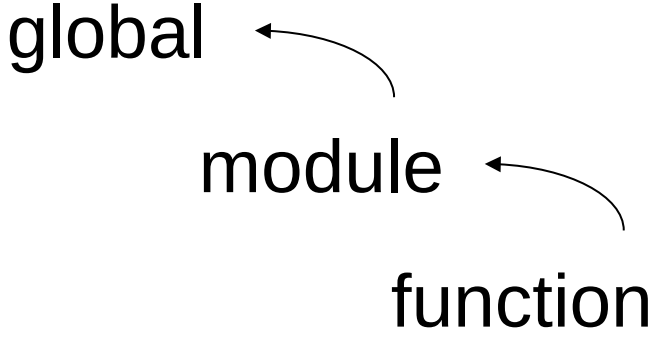

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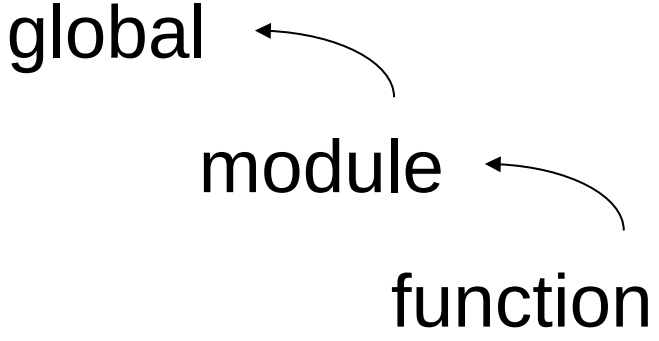
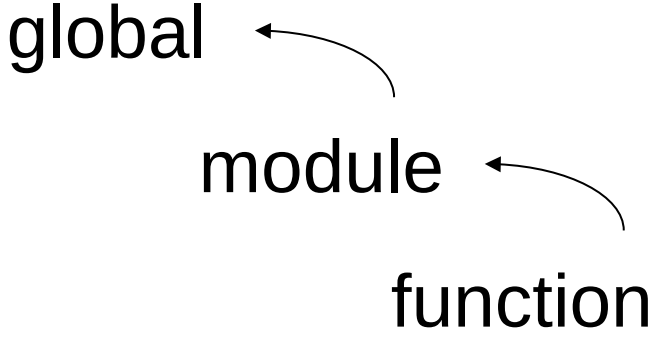



```
# module.py
NAME = 'Transylvania'

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

Each module is a *namespace*

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# module.py
NAME = 'Transylvania'

def func(arg):
  return NAME + ' ' + arg
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```
>>> NAME = 'Hamunaptra'
```

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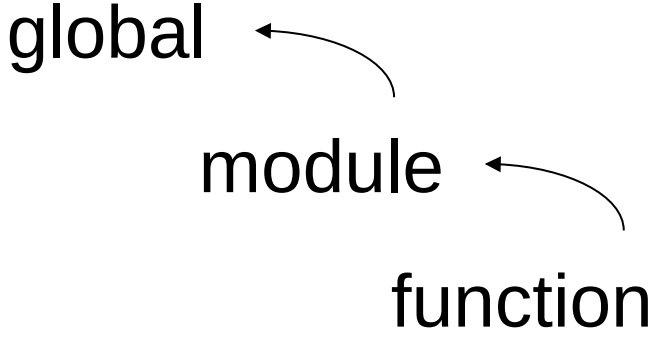


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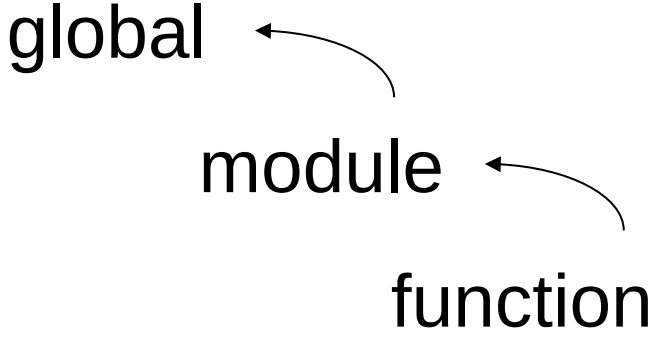
# module.py
NAME = 'Transylvania'

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

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

Each module is a *namespace*




```
# 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)
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>>> print math.sqrt(2)
1.4142135623730951
>>> 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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>>> from math import sqrt
>>> sqrt(3)
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>>> from math import *
>>> sin(pi)
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>>>
```

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Generally a bad idea

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
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>>> import sys
>>> print sys.version
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>>> 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']
```

sys.argv holds command-line arguments

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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] + " "
```

sys.argv holds command-line arguments

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# echo.py
import sys
for i in range(len(sys.argv)):
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```

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

sys.argv holds command-line arguments

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
$
```

sys.stdin is *standard input* (e.g., the keyboard)

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See the Unix shell lecture for more information

STOP HERE

```
# 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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import sys
if len(sys.argv) == 1:
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```
$ python count.py < a.txt
48
$
```

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# count.py
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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

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

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import sys

def count_lines(reader):
  '''Return number of lines in text read from reader.'''
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# adder.py
'''Addition utilities.'''

def add(a, b):
  '''Add arguments.'''
  return a+b
```

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

```
>>> import adder
>>> help(adder)
NAME
    adder - Addition utilities.
FUNCTIONS
    add(a, b)
        Add arguments.
>>>
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main program	loaded as library
'__main__'	module name

```
...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})
```

```
# 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
$
```

```
# test-stats.py
from stats import average
print 'test 4 should be None:', average(set())
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```
$ 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